Gender, Ethnicity and Funding of Early Career Researchers: Evidence from the UK's Medical Research Council

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Abstract

We investigate the effect of public funding on early career researchers, defined as those applying to secure their first grant as Principal Investigators. Using data from both successful and unsuccessful candidates, who applied to the UK's Medical Research Council between 2006 and 2016, we explore the impact of funding on research grants and publication outcomes in the years that follow their submission. Applying propensity score weighting, our results provide evidence that successful candidates accumulate more external funding post submission than those who were not successful. In terms of publications, receiving an award does not increase the volume of publications and citations. Yet, when the analysis is done by gender, we find that successful female applicants are better cited in their field and produce more senior author publications. When looking into ethnicity, successful applicants from Black, Asian and Ethnic Minority background produce publications with higher outreach than white researchers. This is the first counterfactual study on this topic that goes beyond scientific productivity and provides evidence of a gender and ethnicity effect of funding in scientific influence of young researchers.

1. Introduction

Securing funding in early stages of one's research career is crucial. Not only it determines whether a researcher can develop their own project and build their own team, but it can define their career choices and whether they stay in academia or secure a permanent job. Funding bodies around the world have established early career schemes aiming to support post-doctoral researchers to pursue their own research agenda and make the transition to research independence. In the US, the National Institutes for Health (NIH) have established the Pathway to Independence Awards (NIH 2022) that provide a combination of mentored and independent support to promising postdoctoral scientists preparing them for the very competitive Research Project Grant Program (R01). In the UK, ECRs in health and medical sciences can apply for a fellowship or award from the Medical Research Council (MRC), the Wellcome Trust or the National Institute for Health and Care Research (NIHR) while the European Research Council offers Starting Grants for scholars across Europe (European Research Council 2017).

Yet, empirical evidence of the effect that early career schemes have on individual researchers is scarce. Two studies on the topic, provide conflicting results. Bol *et al* (2018) provide empirical evidence supporting the Matthew effect hypothesis; previous successes positively affect successes in the future. Applying a regression-discontinuity analysis on data from The Netherlands, they show that early winners just above the winning threshold accumulate twice as much funding in the years following the grant application that those who scored just below. They find that the two groups do not differ in terms of publications, citations or H-index and argue that the accumulation of more income for successful applicants is due to the non-successful candidates being less likely to submit more applications. Almost the opposite results are shown in a study published in the US using NIH data. Wang et al (2019) use similar regression-discontinuity techniques and show that near misses are more likely to win grants in the future, arguing this is down to a perseverance mechanism; near misses are more likely to apply for more grants. The studies find no difference between male and female applicants or other subgroup analyses.

In this paper we are exploring the impact that funding of early career researchers (ECRs), defined as those applying to secure their first grant as Principal Investigators, has on researchers' subsequent academic performance. We go beyond research income and scientific productivity and also look at scientific influence, including metrics such as the Relative Citation Ratio (RCR), the Field Citation Ratio (FCR), and the Altmetrics score (iCite et al 2019). We conduct a number of subgroup analyses to take a closer look at specific groups for whom the impact may be different, including female applicants, those of Black, Asian & Minority Ethnic background (BAME) background, those from elite institutions and clinical academics. We use data from both successful and unsuccessful candidates that applied for an ECR scheme from the Medical Research Council (MRC) in the UK, in what is the first time an analysis of this kind in the UK.

2. Empirical Context of the study: the MRC's early career schemes

The MRC is the largest public funding body of medical research in the UK and one of the largest funders of medical research in the world (Viergever and Hendriks, 2016). Since 2019, it is one of the nine councils that form the UK Research and Innovation (UKRI), funded through the science budget of the UK's Department for Business, Energy and Industrial Strategy (BEIS).

MRC's annual investment in support for early career researchers, is approximately £30 million (four per cent of the portfolio, supporting 40 researchers per year). The MRC's ECR schemes include two fellowship schemes, namely the Career Development Award (CDA) and Clinician Scientist Fellowships

(CSF) and one grant scheme that is aimed for early career researchers only: the New Investigator Research Grant (NIRG).

Applications for an early career fellowship or award are open to researchers who have not received previously income as a PI. Applicants are asked to submit a research proposal and letter of support from a UK institution that is willing to host the researcher if they are successful. The applications are then peer-reviewed and given a score which determines whether their application will be considered at a board level. The panel board decides on which applicants will be funded.

3. Data and Methods

3.1. Sample

Our sample consists of every individual researcher who applied for an MRC early career fellowship (CDA or CSF) or award (NIRG) between 2006 and 2016. This allowed at least 5 years from submission to 2021, the year we got data on income and publications. For the purposes of the main analysis, we focus only on those applicants who reached the board. Furthermore, to make the control group of unsuccessful applicants comparable to the successful group, we excluded researchers who are no longer in academia as these are not applying for grants and are less likely to publish in peer review journals, as well as those applicants who appear as unsuccessful in our dataset, but secured an early career award from another funding body.

3.2. Datasets and Variables

Data sources include: the MRC's own records for key baseline characteristics; Dimensions, a database compiling research information of individual researchers, on research outcomes for research income and publication outcomes; and LinkedIn and Google for career progression (Appendix Table A1).

More specifically, the MRC holds information on the applicants' characteristics at the time of submission. These include gender (female or male), ethnicity (white or BAME), age (in years) and hosting research organisation. The research organisations were classified into two categories: those belonging to the elite Universities in London, Oxford or Cambridge and those outside that region. For each applicant we also know the year of submission, the scheme they applied for, whether clinical or non-clinical academics, the panel that considered their application, whether they were successful or not as well as the amount they were awarded.

Data on external funding and publications were obtained from Dimensions, a database compiling research information of individual researchers on research outcomes. For each individual in our sample, Dimensions provided data on grants that researchers secured per calendar year, which can be split into

total income and income as PI. On the basis of these variables, we calculated the cumulative income secured by each applicant over the years.

For publication outcomes, using Dimensions we were able to calculate both measures of scientific productivity and scientific influence. For scientific productivity we have information on the total number of publications and citations each applicant had prior to submission of their application to the MRC and for each year post submission. We were able to measure the number of publications individuals published as senior (last) authors each year post submission. In addition, we had information for scientific influence. For every paper we know the Relative Citation Ratio (RCR), a weighted measure of the number of citations a paper receives in comparison to other papers in the same field (Hutchins et al 2016), their Field Citation Ratio (FCR), which divides the total number of times a paper has been cited by the average number received by documents published in the same year in the same field (iCite et al 2019), and the Altmetrics score, a weighted count of the attention an article has received (iCite et al 2019. Based on these citations metrics, we calculate the average RCR, average FCR and average Altmetrics score each individual received for the papers they published after submission of an application to the MRC. Dimensions also provide information on the field of research each paper is published in. For each individual we could identify the field they most frequently publish in.

Finally, from Dimensions, we could identify the research institute each applicant is currently in, using the affiliation they have in their latest publication. For those applicants, for whom we could not find this information, we searched LinkedIn and Google to identify their current employment. Doing so, we could create the following variables concerning their career progression: 'whether still in academia', 'whether still in the UK', 'whether in the same institution'. As mentioned earlier, one possible noise in our data is the fact that some candidates that appear as unsuccessful in our data may have received an ECR fellowship or award from another funding body. Therefore, we searched all the unsuccessful candidates who appeared as PIs in our database and identified those who had received an ECR award from another body by looking into their personal websites or LinkedIn. We excluded these candidates from our analysis.

3.3. Empirical strategy

We used propensity score weighting (PSW) for our analysis (Rosenbaum and Rubin 1983). By conditioning on the probability of receiving an award on observed covariates (propensity score), we estimate the average treatment effect that the award has on publication outcomes and income generation.

$$ATE = E[Y^T - Y^C | T] * P(T) + E[Y^T - Y^C | C] * P(C) \qquad (1)$$

where, Y^T is the outcome for the treated group T (successful applicants) and Y^C is the outcome for the control group C (unsuccessful applicants).

We use an inverse probability score (ipw), meaning that applicants who received an award get a weight of 1, and those unsuccessful get a weight of $p/(1-p)$, where p refers to an individual's probability of receiving the award. This weighting allows the two groups, successful and unsuccessful candidates, to be similar across a number of observed characteristics at the baseline, namely the time of submission of an application to the MRC. Hence the differences post submissions will be attributed to the effect of the award.

To compare the characteristics of the two groups at the baseline, we took into consideration a number of issues. To allow for differences in citation and publications cultures in different schemes, we calculated the z-scores of these variables for each applicant within their own field. Prior to submission, it is likely that a number of the applicants may not have received any income as these are early career schemes, hence we created a binary variable on whether they have received any income or not. We also compared the two groups over a number of other variables at baseline, including gender, age, BAME background, whether they had received income in the past and whether they had applied again for an MRC fellowship or award.

We run subgroup analysis by gender, BAME background, institution (whether they are in the London, Oxford, Cambridge triangle), and whether they had received a clinical or a non-clinical fellowship. Finally, we run balanced diagnostics to examine whether the propensity score model is appropriately specified

Data analysis was performed using STATA 17.

3.4. Ethical approval

The study received ethical approval from City, University of London.

4. Results

4.1 Descriptive statistics

Their main characteristics of the full sample of 2,191 who applied for an ECR scheme at the MRC between 2006-2016 can be found on Table 1. Success seems to support retention of early career researchers in academia; only 3% (12/424) of successful applicants had left academia in 2021 in comparison to 38% (670/1,767) of unsuccessful applicants. Successful applicants are also much more likely to stay in the UK than those who did not get an award or fellowship (92% vs 59%).

[Insert Table 1 here]

Of the full sample, 1,283 applicants were declined at triage and 908 arrived at the board. From those arriving at the board, 484 were unsuccessful and 424 received an award (Table 2). Our analysis focuses only on those applicants who have reached the board. We further excluded researchers who are no longer in academia (n=158) and those applicants who were unsuccessful from the MRC, but secured an early career award from another funding body (n=36). That leaves a clean sample of 724 applicants for our analysis of whom 410 were successful.

[Insert Table 2 here]

4.2 Baseline comparisons

First, we compare the two groups of successful and unsuccessful applicants in terms of their main observable characteristics at the baseline. Results show that the two groups are not significantly different at submission in terms of gender (χ^2<0.001, p=0.996), BAME background (χ^2=2.1927, p=0.139) or research institution they come from (χ^2=1.04, p=0.308). They do not differ in terms of publications (t=-0.3437, p=0.3656) or Altmetrics (t=-0.0155, p=0.4938). However, they significantly differ in terms of age (t=6.4697, p<0.001); citations (t=-1.7070, p=0.0442); relative citation ratio before submission (t=-2.2529, p=0.0123); field citation ratio before submission (t=-0.1517, p=0.0237) and whether they had secured funding prior to the application (χ^2=7.7977, p=0.005).

[Insert Table 3 here]

4.2 Overall impact of award on publication outcomes and research income

Table 4 presents the effect of the award on a number of publication outcomes; number of publications per year, number of publications as last author per year, citations per year, average RCR, average FCR and Altmetrics score. It also presents the effect of the award on generating additional research income post submission. We find no significant difference between the successful and unsuccessful candidates in terms of volume of publications and citations and no effect on any of the citation ratios or Altmetrics. Instead, there is a very strong, significant effect of the award on research income, both in terms of total annual income (ate=2.995, p<0.001) and income as PI (ate=6.783, p<0.001).

[Insert Table 4 here]

4.3 Subgroup analysis

We conducted a number of analyses on the basis of gender (male or female), BAME (BAME background or white), institution (whether at London/Oxford/Cambridge or not) and clinical fellowship (clinical or not).

Table 5 presents the results on the effect on publications and citations. There is a clear gender effect; while for male applicants the results are similar to the overall sample, when the analysis is done on the female group only, successful applicants publish significantly higher number of publications as last/senior author (0.193, $p<0.01$), are cited more (0.155, $p<0.05$) and have a higher field citation ratio (0.219, $p<0.05$). There is also a significant effect on BAME applicants with successful applicants receiving a higher average Altmetrics score than unsuccessful applicants (0.865, $p<0.05$). There are no significant differences in terms of institution and clinical background.

[Insert Table 5 here]

When focusing on research income generated post submission, there is a significant positive effect of the award on all groups, both in terms of total income as well as income as PI (Table 6).

[Insert Table 6 here]

4.5 Robustness checks

TBA

5. Discussion and conclusions

Our findings contribute to a limited literature on the effect of science funding on early career researchers. In addition to exploring the effect on income generation, the novelty of our analysis lies in that it considers more than productivity metrics and includes measures of citation outreach and scientific influence within a researcher's field and conducting a number of subgroup analyses.

In the overall sample, we find evidence of a Matthew effect similar to that of Bol *et al* (2018); receiving a grant, results in further research income being generated post submission, but no other differences in academic outputs. Yet, we find strong evidence that successful female researchers improve their citation outreach and influence in their field more than those females who did not win an award.

Our findings on publications are consistent with previous evidence that securing a research grant does not necessarily improve scientific productivity as captured by academic publications. Using data from researchers in different career stages applying for NIH research grants, Jacob and Lefgren (2011) showed that receipt of a research grant (worth roughly $1.7 million) led to only one additional publication over the next five years. Yet, this is the first analysis on early career researchers that includes publications metrics that go beyond productivity, i.e. number of publications and citations, but also

variables that reflect the candidate's relative performance in comparison to others in the field. This is important as new research suggest that moving towards scientific influence may be more important than scientific productivity (Heyard and Hottenrott 2021) and this is particularly important for early career researchers who are trying to establish a reputation of an independent researcher in their field.

Prior literature on gender and research grant success has focus on disparities in grant submission and success rates, showing fewer women apply for grants and receive smaller grants than men (Burns et al 2019; Ginther 2022; Witteman et al 2019). Our study found no significant difference between female and male candidates in receiving an award or fellowship, but we find clear evidence that women who win an award increase their research outreach and impact in comparison to women who do not.

Our study is not without limitations. We had limited information on the scores received by applicants at the board, with a big proportion of scores missing. Available scores had different scales in different years, hence the funding threshold was not the same across panels, making comparisons difficult. The lack of precise information on scores meant we could not apply other types of analysis such as a regression discontinuity.

Despite its limitations, our study is the first in the area of public funding of early career researchers that provides evidence of a positive effect on female applicants, and to a less extent to BAME applicants. The effect is mostly on scientific influence and academic outreach and has significant implications for these groups that often face more challenges in academic progression.

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Table 1: Descriptive characteristics of full sample

		UNSUCCESSFUL	SUCCESSFUL	TOTAL
Scheme				
	CDA	733	111	844
	CSF	287	86	373
	NIRG	747	227	974
Gender				
	Female	749	159	908
	Male	988	263	1251
BAME				
	White	1,378	355	1,733
	BAME	296	54	350
Institution in London/Oxbridge				
	No	914	209	1,123
	Yes	853	215	1,068
Average age		36.71	36.21	36.62
Still in the UK in 2021				
	No	605	30	635
	Yes	1,043	394	1,437
Still in academia in 2021				
	No	670	12	682
	Yes	976	412	1,388
TOTAL		1,767	424	2,191

Table 2: Selection process

	Declined at triage	Arrived at board	Total
Unsuccessful	1,283	484	1,767
Successful	0	424	424
Total	1,283	908	2,191

Table 3: T-tests of pre submission indicators (at board)

	Successful	Unsuccessful	Difference	t-test	p-value
Age	36.1650	38.3029	2.1379	6.4697	**<0.001**
Publications (standardised)	0.0119	-0.0154	-0.0054	-0.3437	0.3656
Citations (standardised)	0.0587	-0.0762	-0.1349	-1.7070	**0.0442**
RCR (standardised)	0.0752	-0.0982	-0.0268	-2.2529	**0.0123**
FCR (standardised)	0.0658	-0.0859	-0.0146	-0.1517	**0.0237**
Altmetrics (standardised)	0.0005	-0.0007	-0.0004	-0.0155	0.4938
				Chi2	p-value
Gender				<0.001	0.996
Clinical				9.9858	**0.002**
Institution in London/Oxbridge				1.04	0.308
BAME				2.1927	0.139
Past applications (binary)				7.7977	**0.005**
Previous Income (binary)				18.0344	**<0.001**
Applicants	777				

Table 4: Effect of award on publications, citations and research income (full sample)

	Publications		Citations				Research Income	
	Total per year (b/se)	**Last authorship per year** (b/se)	**Citations per year** b/se	**Average RCR** b/se	**Average FCR** b/se	**Average Altmetrics** b/se	**Total per year** b/se	**PI income per year** b/se
ATE								
Success	-0.033	-0.01	0.043	0.063	0.057	0.075	2.995***	6.783***
	-0.07	-0.07	-0.06	-0.07	-0.07	-0.07	-0.47	-0.39
POM								
No	0.031	-0.083	-0.037	-0.06	-0.06	-0.06	7.695***	5.621***
	-0.06	-0.05	-0.04	-0.06	-0.05	-0.05	-0.41	-0.39

* p<0.05, ** p<0.01, *** p<0.001

ATE: Average treatment effects

POM: Potential-outcome means

Table 5: Subgroup analysis of effect of award on publications and citations

	Publications		Citations			
	Total per year b/se	**Last authorship per year** b/se	**Citations per year** b/se	**Average RCR** b/se	**Average FCR** b/se	**Average Altmetrics** b/se
FEMALE ONLY						
ATE						
Success	-0.001	0.193**	0.155*	0.185	0.219*	0.209
	-0.13	-0.07	-0.06	-0.11	-0.09	-0.13
POM						
No	-0.115	-0.276***	-0.257***	-0.200*	-0.24***	-0.171
	-0.13	-0.04	-0.04	-0.09	-0.07	-0.09
MALE ONLY						
ATE						
Success	-0.092	-0.15	-0.028	0.019	-0.007	0.037
	-0.1	-0.1	-0.1	-0.1	-0.1	-0.08
POM						
No	0.141	0.039	0.09	0.013	0.035	-0.011
	-0.08	-0.08	-0.07	-0.06	-0.07	-0.05
BAME ONLY						
ATE						
Success	-0.015	-0.183	0.033	0.054	0.076	0.865*
	-0.16	-0.17	-0.11	-0.11	-0.1	-0.42
POM						
No	0.117	-0.04	-0.05	-0.118	-0.119	-0.183***
	-0.09	-0.14	-0.07	-0.09	-0.07	-0.05
WHITE ONLY						
ATE						

Success	-0.047	0.015	0.054	0.068	0.061	-0.003
	-0.08	-0.07	-0.07	-0.09	-0.08	-0.07
POM						
No	0.012	-0.09	-0.042	-0.052	-0.056	-0.04
	-0.06	-0.06	-0.05	-0.07	-0.06	-0.06
INSTITUTION IN LONDON/OXBRIDGE						
ATE						
Success	-0.028	-0.134	0.149	0.139	0.162	0.146
	-0.12	-0.12	-0.11	-0.1	-0.1	-0.08
POM						
No	0.202*	0.097	0.077	0.021	0.004	-0.047
	-0.1	-0.1	-0.06	-0.06	-0.05	-0.05
INSTITUTION NOT IN LONDON/OXBRIDGE						
ATE						
Success	-0.054	0.086	-0.071	-0.025	-0.054	-0.016
	-0.07	-0.06	-0.06	-0.11	-0.1	-0.12
POM						
No	-0.11	-0.230***	-0.127*	-0.115	-0.106	-0.046
	-0.06	-0.04	-0.05	-0.1	-0.09	-0.1
CLINICAL FELLOWSHIP						
ATE						
Success	0.191	-0.134	0.149	0.139	0.162	0.146
	-0.17	-0.12	-0.11	-0.1	-0.1	-0.08
POM						
No	0.102	0.097	0.077	0.021	0.004	-0.047
	-0.09	-0.1	-0.06	-0.06	-0.05	-0.05
NON-CLINICAL FELLOWSHIP						
ATE						
Success	-0.061	0.086	-0.071	-0.025	-0.054	-0.016
	-0.08	-0.06	-0.06	-0.11	-0.1	-0.12
POM						
No	-0.012	-0.230***	-0.127*	-0.115	-0.106	-0.046
	-0.07	-0.04	-0.05	-0.1	-0.09	-0.1

* p<0.05, ** p<0.01, *** p<0.001
ATE: Average treatment effects

POM: Potential-outcome means

Table 6: Subgroup analysis of effect of award on research income

	Research Income	
	Total per year	**PI income per year**
	b/se	b/se
FEMALE ONLY		
ATE		
Success	3.754***	7.445***
	-0.75	-0.58
POM		
No	6.829***	4.907***
	-0.66	-0.58
MALE ONLY		
ATE		
Success	2.890***	6.655***
	-0.65	-0.55
POM		
No	7.873***	5.783***
	-0.56	-0.55
BAME ONLY		
ATE		
Success	2.444*	5.574***
	-1.04	-0.87
POM		
No	8.327***	6.792***
	-0.84	-0.88
WHITE ONLY		
ATE		
Success	3.144***	7.038***
	-0.51	-0.43
POM		
No	7.576***	5.371***
	-0.45	-0.42
INSTITUTION IN LONDON/OXBRIDGE		
ATE		
Success	2.731***	6.610***
	-0.7	-0.6
POM		
No	7.899***	5.900***
	-0.6	-0.59
INSTITUTION NOT IN LONDON/OXBRIDGE		
ATE		

Success	3.163***	6.891***
	-0.63	-0.51
POM		
No	7.572***	5.418***
	-0.55	-0.51
CLINICAL FELLOWSHIP		
ATE		
Success	3.974***	8.228***
	-0.86	-0.68
POM		
No	6.410***	4.574***
	-0.72	-0.68
NON-CLINICAL FELLOWSHIP		
ATE		
Success	2.431***	6.194***
	-0.55	-0.5
POM		
No	8.455***	6.118***
	-0.49	-0.49

* p<0.05, ** p<0.01, *** p<0.001

ATE: Average treatment effects

POM: Potential-outcome means

Appendix

Table A1. Description of variables and data sources

Variable	Description	Source
At baseline		
Gender	Applicant's gender (female or male)	SIEBEL
BAME	Applicant is from Black, Asian & Minority Ethnic background	SIEBEL
Age	Applicant's age at submission in years	SIEBEL
Hosting institution	Hosting institution in the London/Oxford/Cambridge area	SIEBEL
Scheme	ECR scheme (e.g. Career Development Award, Clinician Scientist Fellow or New Investigator Research Grant)	SIEBEL
Submission year	Year of applying for an ECR scheme	SIEBEL
Board meeting	Board meeting that made the final decision	SIEBEL
Success	Whether the applicant was successful or not	SIEBEL
Publications	z-score of total publications prior to submission by field	Dimensions
Citation variables	z-score of ln 1 + total of citations prior to submission by scheme and year. 'relative citation ratio (RCR)', 'relative field ratio (RFR)', 'Altmetrics'.	Dimensions
Research income – pre submission	Total income secured prior to submission, standardised using inverse hyperbolic sine transformation	Dimensions
Field of Research	Field of research level 1 (for1)	Dimensions
Post submission		
Publications	z-score of total publications per year after submission by field	Dimensions
Citations	z-score of ln 1 + total of citations per year after submission by field	Dimensions
Other publication outcomes	Post submission: average relative citation ratio (RCR), average relative field ratio (RFR), average Altmetrics	Dimensions
Research income – post submission	Post submission: 'income secured per year', 'income secured as PI'	Dimensions
Destinations	'applicant still in academia', 'applicant still in the UK'	Various