The Career Benefits and Missed Parenthood–Penalty of Obtaining Independent Post-doc Funding *

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Abstract

Obtaining independent post-doc funding is a crucial step in pursuing an academic career. Receiving it coincides with a period where other important life events like parenthood are timely. Studying 2005–2009 Research Council of Finland post-doc applications, the main form of pursuing an independent academic career in Finland, we find that obtaining post-doc funding that allows independent research i) improves academic outcomes and income; ii) childless men and women with children pay a missed parenthood penalty through a (starkly) reduced probability of getting a child; iii) academic outcomes improve only for men without children and income for men without children and women with children.
NONE OF THE AUTHORS HAS ANY CONFLICTS OF INTEREST REGARDING THIS RESEARCH.

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1 Introduction

For those that obtain a PhD, an academic career is a potentially enticing opportunity. However, the career structure in academia has a steep "up or out" - structure where individuals need to compete for a smaller and smaller number of positions as they climb up the academic career ladder. In many if not most countries and fields of science, a post-doc position with independent funding is the first step towards establishing oneself as an independent researcher. Given that a PhD is usually obtained in the late 20s or early 30s, such funding is received in a period in one's life when other important potential life events, like parenthood, are timely. This may be one reason why women are still underrepresented at the top levels of academia (e.g. Kim and Moser 2022). Our objective in this paper is to shed light on the gender-specific effects of the chance to pursue an academic career obtained through an independent prestigious post-doc grant and to study the causal impact of obtaining such a grant on both career and parenthood outcomes.

There is extensive evidence that women are still underrepresented at the top of the scientific community (e.g. Kim and Moser 2022) and that women publish less than men (e.g. Huang et al. 2020; Iaria et al. 2022). One potential explanation for these observed differences is the unequal career burden imposed by parenthood. The so-called child penalty is by now well established: Mothers worldwide experience a sharp and permanent decline in income after parenthood (Kleven et al. 2023; see also Ganguli et al. 2014). Regarding scientists, Kim and Moser (2022) show that mothers in science experience a decline in the publication productivity in their early 30s - the age when other researchers are at their most productive. One would expect that women and men of the same (child-bearing) age who have, through a post-doc grant, obtained an option to advance a intensive, interesting and time-consuming career, will react differently to such a career option if (when) the cost of parenthood is asymmetric.

We construct a data set comprising all individuals applying for Research Council of Finland (former Academy of Finland) post-doc grants 2005-2009. Our data include information on the year of application, grades the applications received, the panel and committee (see section 2 below) handling the application and whether or not the applicant was awarded a grant. In Finland, these grants are the most prestigious independent funding available to young researchers who want to take the first step in their careers as independent researchers. Typically, such a grant forms the stepping stone to one's own research group in the lab sciences, and the possibility to boost one's research in social sciences unencumbered by the financing challenges that less fortunate early stage colleagues face. Similar grants are widely used in other developed countries. We collect publication information of these individuals and use (pseudonymized) individual identifiers to match publication and application data to registry data containing information on biological children and income in particular.

For our main results, we use a restricted sample of accepted and rejected applicants with the same or almost the same grade. Given that the subsamples then consist of not too many individuals, we repeat the analysis with a larger but invariably more heterogenous sample of applicants. As we document below, our results hold in the larger sample, giving us confidence that they are not statistical flukes of the smaller sample.

A growing literature studies the causal impact of research funding on academic output. Results vary from no effects (e.g. Jacob and Lefgren 2011 who study NIH grants) to positive (e.g. Oliboni et al. 2023 who study Norwegian Research Council grants) and heterogenous (e.g. Ghirelli et al. 2023, studying ERC grants, find positive output effects in chemistry, universe and earth sciences, institutions and

behaviours, human mind studies and medicine).[1] We complement the existing literature by adding to the body of results on the effects of funding on academic output. We extend this literature by studying the effect of post-doc grants on income, and find, using difference-in-difference where the control group consists of applicants with grades at or just below the acceptance threshold, that in the 8 years following the application, grantees publish over 40% more but with no change in number of citations per article, and have 20% higher income due to the grant. Our event-study results are somewhat noisy, but suggest that the publication effects arrive after the grant has expired, i.e., with quite some lag, whereas the wage effects are immediate. These grants thus seem to be a career-changer for the successful applicants.

Our work is also directly related to the research on the gender gap in science (Huang et al. 2020; Iaria et al. 2022) and the work of Kim and Moser (2022) on the impact of motherhood on scientific output and careers. We add to this literature by being to our knowledge the first to study the causal effect of independent post-doc funding on parenthood outcomes. The publication effects materialize after the grant period whereas the income effects are immediate and long-lasting (i.e., they last beyond the funding period). Using a regression discontinuity design, comparing applicants at the threshold (or very close to it), we find that obtaining a post-doc grant has heterogenous effects on the probability of getting a child after receiving a grant: Women with children and especially men without children are less likely to get a (further) child. The estimated effects are, at -17 (women with children) and -35 (men without children) percentage points, large both in absolute and in relative terms. In contrast, the probability of childless women and men with children getting a (further) child is not affected; for the latter group we obtain a large positive but noisily estimated treatment effect. Thus childless men and women with children bear a cost in terms of family building as a result of obtaining a post-doc grant. We call this the *missed parenthood*–penalty of obtaining an independent post-doc grant.

We then revisit our career outcome regressions by conditioning the treatment effect on gender and parenthood at the time of application. We find that men who did not have children at the time of application are the main beneficiaries career-wise: They publish more (>70%) and earn more (50%). The estimated publication and citation effects for women with children - the other group paying the parenthood penalty - are noisy, but the estimated wage impact is large at 20% and statistically significant. They thus seem to pay the parenthood penalty without other career benefits but an increase in income. The extant literature has not, as far as we can tell, conditioned the causal effects of grant funding on academic outcomes on gender or parenthood.

The fact that we work with the population of applicants over our observation period unfortunately does not result in a large data set. This becomes an issue especially when we split the applicants by gender and parenthood into subgroups. We conduct robustness tests to gauge how sensitive our parenthood results are for the group of successful applicants that seems to be the most affected - childless men. (NEED TO CONDUCT AND REPORT THESE TESTS). While the fact that our data is small necessarily should affect the interpretation of our results, we note first, that having a dichotomous outcome variable (getting a child) and dichotomous key explanatory variables means that outliers are not generating our results and two, that small as the data is, the results do suggest that further inquiry into the heterogenous effects of obtaining post-doc grants is warranted in order for policy makers to be able to design a system that enables different types of researchers to benefit from the funding that is made available.

[1] Ganguli (2017) studies grants to Soviet scientists by the International Science Foundation. Though much smaller in absolute terms (500$), these were still relatively substantial in relative terms (1.6 times average annual Soviet wage). Ganguli (2017) finds large and long-lasting effects of these grants.

Our results suggest that also childless men starting an academic career seem to suffer a parenthood penalty though not through the child penalty: Instead of hurting their career through parenthood, they sacrifice parenthood to make the most out of a (large) career opportunity. While childless men pay the missed parenthood penalty, childless women benefit less from the same career opportunity because they do not delay parenthood. We can only speculate what the reason behind this gender difference in behavior is: A potential explanation is that most of the applicants are individuals in an age where parenthood decisions are made, and women are more cognizant of the fact that the probability of parenthood (i.e., probability of getting the first child) declines quickly with age. It could be that childless men overestimate the probability of being able to delay parenthood. The decline in the probability of parenthood as a function of age is large for both sexes. To illustrate, using registry data on all individuals in Finland for 2011-2019 who were 30 or 40 in 2011 and have an MSc degree by 2011, i.e., individuals who are quite comparable to the applicants in our data (three quarters of the both male and female applicants in our main estimation sample are younger than 42 at time of application and less than 10% are younger than 30), we find that women who were childless at age 30 in 2011 will become parents by 2019 with 67% probability and similar men with 65% probability. The probability to become a parent by 2019 for those women who are otherwise similar, but childless at age 40 in 2011, is only 11%, a decrease of 56 percentage points or 84% and for the respective men 26%, a decrease of 39 percentage points or 60%. According to the survey results of Miettinen and Rotkirch (2008) (Table 21), 16% of childless Finnish men aged 35-44 plan to have a child within 5 years. The respective per cent of childless women in the same age group is 8.1. From our registry data we calculate that for individuals who were 35-44 old and childless in 2011, the probability of parenthood in the following 5 years is 19% for women and 25% for men, suggesting that both childless women and men under- rather than overestimate their probability of parenthood and men less so.[2]

We describe the institutional setting in Section 2. In Section 3 we detail our data, explain our sample constructions and provide a descriptive analysis. Section 4 is devoted our econometric models whereas in Section 5 we present and discuss our results. We offer our conclusions in Section 6.

2 Institutional setting

We describe the institutional setting as it was during 20005–2009, the years during which the applications we use were made.[3] We focus on two types of grants of the Research Council of Finland (RCF) (formerly Academy of Finland) for individual researchers: 1) Postdoctoral Researcher; and 2) Academy Research Fellow. The RCF explicitly states that *"The funding supports the Academy Research Fellow so that they can increase their competencies and make significant career progress towards more demanding research positions and achieve an established position in the national and international research community"*.

Eligibility. To be eligible, the researcher must be affiliated with a Finnish research institute or university. In addition, she must have obtained the doctoral degree no more than four or nine years ago, for respectively the Postdoctoral Researcher and the Academy Research Fellow grant. Although

[2]If we follow the individuals who were 35-44 years old and childless in 2011 all the way to 2019, the probability on parenthood for women is 21% and for men 28%. According to Statistics Finland, the fertility rate of Finnish women aged 25-29 was 117 (117 births / 1000 women) and that of women aged 30-34 120 in 2010, whereas those of women aged 35-39 and 40-44 were 57 and 12 respectively. Paavilainen et al. (2016) report that in Finland in the period 2005–2009, 4.8% of first-time fathers were aged 40-44 and only 1.7% 45 or more.

[3]The details of the structure have changed since the period from which our data emanates.

the grants target a different audience, with the Postdoctoral Researcher grant focused on more junior (i.e., less experienced) researchers, the objectives and responsibilities are comparable.[4]

The application process is similar to that employed by corresponding national funding organizations in other countries; we visualize it in online appendix figure OA-1. The administrative structure handling the applications at the RCF had two tiers during 2005–2009: A *panel*, consisting of international academics with relevant substance knowledge. Each panel reports to a *council*, consisting of (Finnish) representatives of those fields of science that the council covers. During our observation period there were 4 councils: Scientific Council for Biological and the Environmental Sciences, Scientific Council for Health Sciences, Scientific Council for Culture and Society and Scientific Council for Sciences and Technology. Each application is reviewed by a panel of (international) experts, focusing on four criteria: Quality, impact, renewal and multidisciplinary, phenomenon-based and internationally-oriented research. The panel reads and evaluates all applications within its field of expertise and agrees on one report and one grade for each application. This grade is an integer on a Likert scale 0–6 that represents the quality of the application, with 6 being the best grade.[5] Based on the panels' reports, the councils make the final funding decisions. The amount of available funding dictates how many applications receive funding from a given council and there is thus no predetermined cutoff grade. We therefore identify the cutoff grade for every council-year combination.[6]

The site of research must be a research organization in Finland, though international (visiting) mobility is encouraged during the funding period (with extra funding provided for this). The RCF requires that the institution provides *"all necessary basic facilities"*, which vary according to the field of study. The 5-year funding is generous and provides a salary that is roughly commensurate with what an assistant professor in Finland would earn plus compulsory social security payments and similar.[7] Besides salary, the funding covers setting up a research team, research costs, costs of international collaboration and mobility and other research costs.

Use of the grant. The successful applicants are quite free to use the funding as they see fit; the most binding constraints relate to shifting funding from one year to another. The money is also moveable in that if a successful applicant moves from one research institution to another, the funding follows.

In the Finnish context, the RCF post-doc funding is both prestigious and generous. The alternative for individuals eligible for the RCF's post-doc funding is often to resort to smaller and shorter grants from private foundations, or to work as a post-doc for a more senior researcher.

3 Data and descriptive analysis

3.1 Data sources

We have three main data sources: Research Council of Finland (RCF), Web of Science (WoS) and Statistics Finland (SF).

Research Council of Finland (RCF). The RCF data contain information on all Postdoctoral and Academy Research Fellow applications 2005–2009. For each application we know the applicant's name,

[4]For special reasons, applicants with more than years since the doctorate may apply. Special reasons include: Completing a medical speciality, maternity, paternity, parental or childcare leave, military service or nonmilitary service and long-term illness.

[5]In 2005 and 2006, a scale of 0 to 5 was used, with 5 being the highest grade.

[6]We provide a schematic overview of the application process in Figure OA-1.

[7]The length of the funding period has changed and is currently 4 years.

gender, year of birth, affiliation, the panel reviewing the application, the final grade and the funding decision of the committee. These data include a personal identifier which allows Statistics Finland to link the application data to registry data.[8]

Web of Science (WoS). We collected publication information from WoS for all applicants that were close to the cut-off grade in the particular application round they participated in. We searched for publications using the applicants' first and last names.[9] We manually check whether the downloaded publication is correctly assigned by comparing the WOS data against the applicant's CV, the publication list at the website of the research institution the applicant is affiliated with and the applicant's profile at researchgate.net. The cleaned publication list is then linked to the application information from RCF using information on the first and last name of the applicant as well as the research institution the applicant is affiliated with. The key variables for us are the number of publications (at individual-year level) and the number of citations those publications have received.

Statistics Finland (SF). We use the following so-called FOLK modules of SF:[10] *Basic data* (standard individual level information such as sex, age, level and field of education, location at birth, nationality, municipality of residence, marital status, socio-economic group etc); *Child-parent* (link between children and biological parents), *Family* (number of children in the household) and *Income* (income subject to state taxation and capital income total in state taxation). All these data are available at individual-year level for us until and including 2019. These data all contain an individual identifier which allows us to link them to each other, and to the RCF data.

3.2 Sample construction and outcome variables

Career outcomes - sample and outcome variables. For career outcomes, a (RDD-) difference-in-difference approach is natural. We follow all applicants from before they apply to well after their application. In practice, we limit the time window to $k \in \{-3, 8\}$, where $k = 0$ is the year of application (see online appendix figure OA-2). A strength of our setting is that we have a natural control group for each year's successful applicants: The unsuccessful applicants from the same year (with the (almost) same grade).

We measure career outcomes using the following variables: Number of publications by individual i in year t; citations to the publications of an individual i published in year t; and finally, taxable income of individual i in year t.[11] The first two are by now standard in the literature whereas the the third is to our knowledge new to the literature.

An issue we face regarding both publications and citations is that the data contain many zeros. We approach this by following the advice of Chen and Roth (2023) and estimate Poisson models for the number of publications and the number of citations. We use the widely used (natural) log transformation for income as there are very few individuals in our data that ever have zero income.

For career outcomes, we work with two estimation samples. The construction of our main estimation sample for career outcomes proceeds as follows: First, we keep those successful and unsuccessful

[8] The merged data at Statistics Finland are pseudonymized.

[9] Since the manual downloading and cleaning of the publication list is a very time-consuming process, we drop 46 applicants whose name string returns more than 500 publications. The motivation for this is that it is highly unlikely that relatively junior researchers would have that many publications and much more likely that the name search results in a large number of false matches.

[10] The SF research data catalogue Taika lists these and all other ready-made data modules available to researchers at SF.

[11] As an alternative income measure, we add capital income to taxable income. This makes no appreciable difference to our results.

applicants who obtained the marginal grade.[12] Second, we follow the outcomes of these individuals 3 years backwards and 8 years forward from the year of application. This process results in an individual-year level panel data which we label the "**RDD Sample**". As an alternative sample we keep all applicants in the sample; we label this sample the "**Full sample**". This allows us to increase sample size at the cost of introducing more heterogeneity into the estimation sample.

Parenthood outcomes - sample and outcome variable. In the parenthood analysis the outcome variable is a dummy indicating whether individual i gets a child in the eight years following the application. As it is well-known that the decision to obtain a second (further) child is different from the first (e.g. Andersson et al. 2006; Jones et al. 2023), the difference-in-difference approach is inappropriate. Instead, we use a regression discontinuity (RD) approach. To form our main estimation sample, we again keep the successful applicants and those unsuccessful applicants with (almost) the same grade as the successful applicants (with the lowest grade conditional on being successful). The data is thus a cross-section of our career outcomes sample, where applicant characteristics are measured at the time of the application. Just as with career outcomes, we first restrict the sample to those applicants who obtained the marginal grade and for the alternative sample include all applicants.

3.3 Descriptive analysis

We start with descriptive statistics on the applicants, displayed in Table 1. The RDD sample consists of 240, the Full sample of 323 applicants, yielding respectively 2628 and 3558 applicant-year observations. Not quite half of the applicants are women; the average age at application is 37; and three quarters of applicants have at least one child at the time of application. 12% of applicants are childless women, 15% childless men. The Scientific Council for Culture and Society receives the largest share of applications (35%). Two out of five applications are funded.

PLACE TABLE 1 HERE

Turning to career outcomes - publications, citations and income - in Table 2, we find that the number of publications per year increases for both funded and unfunded applicants. The number of citations on the other hand shows no such progression for either type of applicants; if anything, citations decrease for funded applicants. Income on the other hand inreases substantially for both groups, from a pre-application average of somewhat over 30 thousand euro / year to about 50 thousand euro / year in the post-application period. The RDD and Full samples display very similar features.

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We then turn to descriptive statistics conditioned on the type of the applicant in Table 3. Looking first at the top panel (RDD sample), the number of publications per year in the pre-period is lowest for funded men without children (0.54) and highest for unfunded men with children (1.21). Notice that we do not condition on the Scientific Council In the post-period, number of publications per year increase for all applicant types irrespective of the funding decisions. Women with children have the lowest post-period publication output (1.04) whereas the other groups are at quite similar levels on average.

PLACE TABLE 3 HERE

[12] By the marginal grade we mean the minimum grade of the successful and the maximum grade of the unsuccessful applicants. There are no cases in the same committee-year sample of an unsuccessful applicant having a higher grade than the lowest graded successful applicants. This approach does not remove any successful applicants.

There are differences in citations per publication, with funded women without a child having the highest level in the pre-period and women with children the lowest. Moving from the pre- to the post-period we record an increase in citations for men without children, but a drop for female applicants. Incomes are quite even across applicant types before the application year with childless (funded) men having the lowest average income. Incomes increase substantially moving to the post-period with men with children recording the highest average incomes.

Finally, the probability of getting a child in the 8 years post application is the highest for women who were childless at the time of application - they have a 50% probability of getting a child. Women with children at the time of application who obtain funding have the lowest probability of getting another child. Generally, the probability of getting a child in the post-period is lower for funded than unfunded applicants, women without child at the time of application excepted.

When we compare the RDD sample descriptive statistics to those for the Full sample, we find them to be mostly in the same ball park. Pre-period publications are mostly higher in the RDD than in the Full sample (men with children being the exception). In terms of pre-period citations the one group with a difference across the samples is funded men without a child at the time of application. This same group also has a higher probability of getting a child in the Full than in the RDD sample.

4 Econometric models

4.1 Pooled Career Outcomes

For the career outcomes, our estimation equation takes the following form:

$$y_{ik} = \delta D_{ik} + \alpha_i + \alpha_k + \alpha_t + \epsilon_{ik} \tag{1}$$

In equation (1), the outcome variables are the number of publications by individual i in treatment (as opposed to calendar) year k, the citations to those publications, and the log of taxable income. We follow e.g. Jäger and Heining (2019) and link treatment time k with calendar time t through $k = t - d$ where t is the calendar year of the observation and d is the calendar year of the application to RCF. Thus, $k = 0$ is the year of application. D_{ik} is an indicator variable taking value one for individual i if the individual by that year has obtained a grant that year or earlier, i.e., it is our treatment dummy. D_{ik} thus takes value 1 from year $k = 0$ onwards, and is zero for $k < 0$. We assume a constant treatment effect: δ is hence the average treatment effect on the treated. We however vary the length of the post-period and operate with two lengths: 4 and 8 years. 4 years is the funding period and 8 years is dictated by our observation period relative to the point in time we collected our data. We control for individual (α_i), treatment year (α_k) and calendar year (α_t) fixed effects. Because we include individual fixed effects we do not need to control for grades as would be the norm in a regression discontinuity setting.

Given that different individuals apply for and are denied or given a grant in different years, our set-up is staggered. The literature on the econometrics of staggered difference-in-difference settings has taken great strides recently (e.g. Goodman-Bacon 2021; De Chaisemartin and d'Haultfœuille 2023; Callaway et al. 2022). Our setting deviates from the standard one in that literature in that we can assign treatment time also for the individuals in the control group, i.e., the unsuccessful applicants. We follow e.g. Jäger and Heining (2019) and use this feature of our data to deal with the staggered take-up of treatment. A further motivation for this approach is that we are interested in heterogenous, group-

specific, treatment effects and modeling them with this approach is straight forward (see subsection 4.3).

As is common in difference-in-difference settings, our key identifying assumption is that in the counterfactual case of no treatment, the trends in the outcome variable would have been same in the treatment group as they are in the control group, conditional on the controls.

4.2 Parenthood Outcomes

For the parenthood outcomes we employ the following RDD specification:

$$y_i = \beta_0 + \gamma_D D_i + \gamma_{DG} D_i G_i + \gamma_{DP} D_i P_i + \gamma_{DGP} D_i G_i P_i + \boldsymbol{\beta X_i} + g(Gr_i) + \omega_i \tag{2}$$

The outcome variable y_i in equation (2) is a dummy taking value one if individual i gets a child in the first 8 years after receiving a post-doc grant and is zero otherwise. The most interesting variables on the right hand side are D_i and its interactions with G_i and P_i. In this triple interaction, D_i is the treatment dummy taking value one if individual i obtained a post-doc grant and value zero otherwise; G_i is a gender dummy taking value one for women; and P_i is a dummy taking value one for those individuals who are parents at the time of submitting the application. The γ_m's ($m \in \{D,\ DG,\ DP,\ DGP\}$) are the average treatment effect parameters associated with a particular combination of these dummies. Our base category of individuals is a male applicant who is childless by the time of submitting the application. We include into equation (2) a vector $\boldsymbol{X_i}$ of control variables whose effects are captured by the coefficient vector $\boldsymbol{\beta}$. In particular, $\boldsymbol{X_i}$ contains a full set of G_i-P_i interactions. We control for grades with the function $g(Gr_i)$, where Gr_i is the normalized grade of individual i. Following the advice of Gelman and Imbens (2019) (see Ghirelli et al. 2023 for an application that is relevant for us), we approximate the unknown function $g(Gr_i)$ with a second order polynomial where the coefficients are allowed to differ above and below the cutoff grade. Finally, the error term ω_i completes the specification.

4.3 Conditional Career Outcomes

Our econometric specification for the career outcomes where we condition on gender and parenthood is essentially an amalgam of equations (1) and (2), in that we employ the same difference-in-difference approach that we use for the pooled data (equation (1)), but we introduce that G_i-P_i interactions and the triple-interactions of them and the D_{ik} treatment dummy (from equation (2)), yielding equation 3:

$$y_{ik} = \theta_D D_i + \theta_{DG} D_i G_i + \theta_{DP} D_i P_i + \theta_{DGP} D_i G_i P_i + \mu_i + \mu_k + \mu_t + v_{ik} \tag{3}$$

where, following the discussion above, θ_m are the (elements of) conditional average treatment effects, i.e., the parameters of interest, the μ_j are the calendar and treatment year fixed effects as well as the individual fixed effect, and v_{ik} is the individual-treatment year - specific error term.

5 Estimation results

5.1 Pooled Career Outcomes

We report the difference-in-difference estimation results of career outcomes for the RDD and Full samples, pooling all applicant types, in Table 4. Starting with the top panel where results using the RDD

sample are reported, we find, looking at the coefficient of the *Post* variable, that 1) the number of publications increases; 2) citations decrease; and 3) incomes increase for the applicants in the control group after the application. Turning to the average treatment effects reported in row *Post* $\times$ *Grant*, we find (columns (1) and (2)) that there is no statistically significant impact on the number of publications in the short run (4 years post application), but a sizeable positive average treatment effect of roughly 40% in the long (8 year) run. Thus, getting a prestigious post-doc grant does boost a researcher's career in terms of the number of publications, but the gains see to come mostly only after the funding period has ended. This is not necessarily a huge surprise given the time it takes to establish a research group and/or to navigate the refereeing process. In contrast to this positive results, coefficients in columns (3) and (4) suggest imprecisely measured but negative treatment effects on the number of citations. We thus find no evidence of an increase in quality due to receiving a grant. Finally, turning to the financial implications of getting a grant, we find in column (5) that succesful applicants experience a sizeable, over 20%, gain in income already during the grant and that this effect continues after the grant for at least another 4 years (column (6)).

The control group effects do not change much when we switch to the Full sample, nor do the average treatment effects regarding the number and quality of publications. The effects on income weaken however. This is due to the estimated coefficient decreasing some 40% with the estimated standard errors being only slightly smaller than with the RDD sample.

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5.2 Parenthood Outcomes

Main parenthood results. We now turn to the question of whether getting a post-doc grant has an impact on the probability of getting (another) child. We show results using the RDD sample in Table 5 and results using the Full sample in Table 6. We first estimate the average treatment effect for all applicants, and then condition the treatment effect on the gender and parenthood status of the applicant.

In column (1) Tables 5 and 6 we report the average treatment effect when we do not condition on applicant type. We find negative coefficients of roughly -0.08, with the coefficient using the Full sample obtaining statistical significance at the 5% level. There is thus some evidence that obtaining a post-doc grant decreases the probability of getting a child. We condition on parenthood in column (2). The coefficient of the *Grant*-variable decreases now in absolute value, especially in the Full sample, and the coefficient on the $\times$*Parent*-interaction carries a negative albeit statistically imprecise coefficient.

In column (3) we display the results from the model with a full set of interactions between *Grant*, *Parent* and *Female*. The *Grant* coefficient is -0.35 and highly significant in the RDD sample and -0.21 but somewhat more imprecisely measured in the Full sample. These results suggest that applicants in our base group, childless men, experience a decrease in their probability of becoming a parent in response to getting a post-doc grant. The interaction *Grant* $\times$ *Female* obtains a coefficient of 0.56 in the RDD sample and 0.37 in the Full sample; both are statistically significant at conventional levels. The average treatment effect on women who do not have children at the time of application is the sum of the *Grant* and *Grant* $\times$ *Female* coefficients. We report this treatment effect and its statistical significance in Treatment effect panel of the table, row "Women without children at application". The average treatment effect is positive at roughly 0.2, but statistically insignificant. Childless male and female grantees thus behave differently, with the former decreasing their likelihood of getting a child in response to obtaining a grant, the latter, if anything, increasing the likelihood.

Turning to those applicants with children at time of application, we find that the interaction *Grant* × *Parent* carries a positive coefficient of 0.32 in the RDD sample and 0.15 in the Full sample; only the former is statistically significant at conventional levels. This coefficient allows us to calculate the treatment effect on successful male applicants with children at application - this is given by the sum of the *Grant* and *Grant* × *Parent* coefficients and reported in the row "Men with children at application". We estimate the average treatment effect to be either close to zero or a relatively modest negative number for such applicants, with neither sample producing estimates approaching statistical significance. We conclude that our data does not support concluding that obtaining a post-doc grant affects the decision to get another child for male applicants who had children at the time of application.

The conclusion is different for women with children at the time of application, as now we add to the treatment effect both the (positive) *Grant* × *Female* and the (large in absolute value) negative *Grant* × *Female* × *Parent* coefficients to obtain an estimate of the average treatment effect of -0.17 using the RDD and -0.14 using the Full sample. Both are statistically significant. Our results thus suggest that successful childless male applicants and female applicants with children pay a missed parenthood penalty due to receiving a post-doctoral grant from RCF.

PLACE TABLES 5 AND 6 HERE

Robustness tests.

Some of the most intriguing results are obtained when we condition on both gender and parenthood. The challenge we face is that the subgroups become small even though we work with the full population of all applicants over our sample period (see Table 3). We are particularly worried about our parenthood results and therefore concentrate on them in what follows. Regarding the parenthood results it is helpful that the outcome variable is dichotomous, as are the independent variables - these facts rule out the possibility that individual outliers would generate our results.

To gauge the robustness of our parenthood results, we engage in the following two exercises: First, we start adding placebo observations into the treatment group of childless men (for whom our treatment effect is the largest) and assign them to **get a child**, i.e., we assign the value 1 for their outcome variable. We then investigate how many such "placebo fathers" we can accommodate before we lose the statisticaly significance of our estimated treatment effect.

As a second robustness check, we engage in the opposite exercise, i.e., we remove, one by one, successful childless male applicants from the data that do not get a child after obtaining a post-doc grant. We then investigate how many such treated individuals we can lose before our estimated treatment effect for this group become statistically insignificant.

TO BE FINALIZED

5.3 Conditional Career Outcomes

Given the above parenthood outcomes it is important to return to the career outcomes to see whether they also differ by gender and parenthood. For that purpose, we rerun our difference-in-difference regressions for career outcomes, but now condition the treatment effect on gender and parenthood at time of application. We display the results in Tables 7 (RDD sample) and **??** (full sample). The top part of the table displays the important coefficients, the bottom part the group-specific treatment effects (and their standard errors).

PLACE TABLES 7 AND **??** HERE

Inspecting the RDD sample results first, and starting with the number of publications, we find that when we condition on gender only (column 1), our results suggest that it is successful male applicants who increase their number of publications: the point estimate for males is close to 0.4 and statistically significnat, whereas the point estimate for treated females is 0.006, with a relatively speaking large standard error. Results in column 2 show that conditioning on parenthood yields only statistically insignificant coefficients. Finally, in column 3 we condition on both gender and parenthood. These results strongly suggest that the career benefits, in terms of an increase in the number of publications, go to men, and in particular, men without children at the time of application: The treatment effect for childless men is 0.7 whereas that for fathers is somewhat less than half of this. The point estimates for women are either negative (childless women) or small and positive (mothers), both noisily estimated.

Turning then to the number of citations per publication, the only statistically significant coefficients in columns 4-6 are for the interaction with being a parent (-0.86) and being female and a parent (1.16). When we combine the different coefficients to get the group-specific treatment effects, we find all of these to be noisily estimated, in line with our grouped results (see Table 4).

Finally, in columns 7 - 9 the outcome variable is (log) income. Column 7 reveals that conditioning on gender results in insignificant treatment coefficients; column 8 instead shows that when we condition on parenthood we obtain a large and statistically significant coefficient of 0.298 for the *Grant* $\times$ *Post* interaction, but a negative and insignificant coefficient for the interaction *Grant* $\times$ *Post* $\times$ *has children at application*. The bottom part of the table reveals that the treatment effect for parents is 0.142 which is statistically significant at 10% level. These results suggest that the treatment effect on income is twice as large for those successful applicants who are childless at application than for those who are parents. Column 8 contains the results from the model with the full set of interactions. Now the the coefficient of *Grant* $\times$ *Post* is 0.502, significant at the 10% level. The individual interaction terms' coefficients are not statistically significant. As one can see from the bottom part of the table, the only groups for which we obtain a statistically significant treatment effect are childless men and mothers. Both groups experience a very large increases in income: For childless men, the point estimate is over 50%, for mothers it is over 20%. The point estimates for fathers and childless women are positive, smaller in magnitude, and noisily estimated.

6 Conclusions

Using a difference-in-difference framework of marginally accepted and rejected applicants for prestigious Research Council of Finland post-doc grants 2005–2009, we first establish that obtaining independent post-doc funding has a large impact both on academic output and income on average. The number of publications increases, though the increase takes place after the funding period. We find no effect on the quality of publications, but large wage increases that start during the funding period, but continue well past it.

We then study parenthood outcomes using a regression discontinuity design and find that men without children react to a grant by reducing the probability of parenthood by over 30 percentage points, but find no such effect for women without children. Looking at applicants who already have at least one child at the time of application, the gender-specific results are reversed albeit the negative effect on mothers is smaller than that on childless men. The results suggest that men without children and women who already have children pay a missed parenthood penalty in that they get fewer children than they would in the counterfactual case of not receiving the grant or, in the case of childless male

applicants, even forego parenthood entirely.

When we condition career outcomes on gender and parenthood, we find that it is childless men and women with children who reap the career benefits: The former increase their publication output and experience large income increases, the latter do not improve their academic output, but experience a substantial increase in their income.

Given the limitations of our data, we caution against drawing too strong (policy) conclusions. Having said that, our results strongly suggest that more research is needed on the heterogenous effects of research funding on the careers and lives of academic researchers. Without such information we are at risk of losing potentially promising researchers through no fault of theirs.

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Figures and Tables

Table 1: Descriptive statistics: Applicants

	Full Sample		RDD Sample	
	mean	sd	mean	sd
Female	0.49	0.50	0.48	0.50
Has children at application	0.73	0.45	0.75	0.44
Woman, no children	0.12	0.32	0.12	0.32
Woman, children	0.37	0.48	0.36	0.48
Man, no children	0.15	0.36	0.14	0.35
Woman, children	0.36	0.48	0.38	0.49
Age at application	37.00	6.35	37.11	6.49
Biological and environmental sci.	0.21	0.41	0.18	0.38
Culture and society	0.35	0.48	0.37	0.48
Health sciences	0.16	0.37	0.17	0.38
Sciences and technology	0.28	0.45	0.28	0.45
Funded	0.39	0.49	0.41	0.49
Normalized application score	-0.15	0.78	0.17	0.42
Applicant-years	3558		2628	
Applicants	323		240	

Notes: Normalized application score is calculated as ZZZ.

Table 2: Descriptive statistics: Outcomes, pooled sample

	Full sample		RDD sample	
	Unfunded mean	Funded mean	Unfunded mean	Funded mean
Publications Pre	0.99	0.88	0.93	0.89
Publications Post	1.48	1.51	1.43	1.51
Citations Pre	33.91	32.11	31.16	33.06
Citations Post	32.09	27.00	29.39	27.68
Income Pre	31.62	30.71	32.19	31.35
Income Post	49.82	51.34	49.56	52.45
Applicant-years	2140	1418	1527	1101
Applicants	196	127	141	99

Notes: Publications are measures as the number of publications per year in the pre-period $\tau = -4, .., 0$ and the post-period $\tau = 1, ..., 8$. Citations are the citations per article in XXXX. Income is measured in year 20XX thousands of Euro.

Table 3: Descriptive statistics: Outcomes, conditional on applicant type

	Woman No Child		Woman Child		Man No Child		Man Child	
	Unfunded mean	Funded mean	Unfunded mean	Funded mean	Unfunded mean	Funded mean	Unfunded mean	Funded mean
RDD Sample								
Publications Pre	0.81	0.89	0.73	0.84	0.79	0.54	1.21	1.06
Publications Post	1.66	1.61	1.04	1.16	1.67	1.58	1.67	1.77
Citations Pre	32.81	45.51	30.36	36.90	34.40	12.19	30.40	32.17
Citations Post	19.81	31.74	22.34	24.31	42.48	27.06	33.94	29.43
Income Pre	31.02	30.77	30.07	28.54	29.27	24.94	35.55	36.27
Income Post	46.85	50.72	48.55	50.38	45.06	51.99	52.93	55.10
Birth Post	0.50	0.50	0.26	0.09	0.35	0.23	0.41	0.39
Applicant-years	145	149	600	390	170	131	612	431
Applicants	14	14	53	34	20	13	54	38
Full Sample								
Publications Pre	1.09	0.72	0.84	0.83	0.96	0.85	1.14	0.99
Publications Post	1.89	1.53	1.14	1.13	1.77	1.61	1.62	1.80
Citations Pre	37.51	35.50	32.15	36.22	38.84	23.16	32.68	30.76
Citations Post	26.58	27.63	26.53	23.49	49.25	25.56	32.19	30.40
Income Pre	29.74	27.32	30.84	30.11	27.93	25.53	34.66	34.63
Income Post	47.06	48.66	48.67	49.88	45.61	49.68	53.87	54.27
Birth Post	0.50	0.56	0.27	0.14	0.35	0.37	0.40	0.33
Applicant-years	217	195	870	481	279	200	774	542
Applicants	20	18	77	42	31	19	68	48

Notes: "No Child" and "Child" refer to whether the individual has a child at the time of grant application. Publications are measures as the number of publications per year in the pre-period $\tau = -4, .., 0$ and the post-period $\tau = 1, ..., 8$. Citations are the citations per article in XXXX. Income is measured in year 20XX thousands of Euro. Birth is an indicator variable taking value 1 if the individual got a(n additional) biological child and 0 otherwise.

Table 4: Career outcomes

RDD Sample

	Publications		Citations/publ		Income	
	(1) Short	(2) Long	(3) Short	(4) Long	(5) Short	(6) Long
Post	0.424***	0.544***	-0.322**	-0.893***	0.502***	0.630***
	(0.111)	(0.139)	(0.156)	(0.115)	(0.052)	(0.066)
Post x Grant	0.193	0.389**	-0.324	-0.261	0.238**	0.240**
	(0.170)	(0.166)	(0.217)	(0.239)	(0.106)	(0.120)
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	394	386	230	244	444	436
Individuals	197	193	115	122	222	218
(Pseudo) R-Squared	0.429	0.492	0.834	0.851	0.720	0.699

Full Sample

	Publications		Citations/publ		Income	
	(1) Short	(2) Long	(3) Short	(4) Long	(5) Short	(6) Long
Post	0.439***	0.583***	-0.437***	-0.915***	0.541***	0.676***
	(0.089)	(0.104)	(0.114)	(0.108)	(0.044)	(0.058)
Post x Grant	0.107	0.308**	-0.210	-0.180	0.150*	0.149
	(0.140)	(0.140)	(0.169)	(0.210)	(0.085)	(0.098)
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	532	520	312	316	604	590
Individuals	266	260	156	158	302	295
(Pseudo) R-Squared	0.461	0.512	0.845	0.846	0.714	0.695

Notes: Short = post-period 4 years; *Long* = post-period 8 years.

Table 5: Parenthood outcomes: RDD sample

	Child in post-grant period		
	(1)	(2)	(3)
Grant	-0.075	-0.040	-0.347**
	(0.061)	(0.140)	(0.154)
Grant × Female			0.561***
			(0.171)
Grant × Has children at application		-0.045	0.322*
		(0.163)	(0.183)
Grant × Female × Has children at application			-0.700***
			(0.191)
Gender	Yes	Yes	Yes
Children at application	Yes	Yes	Yes
Grant Committee FE	Yes	Yes	Yes
Age bins	Yes	Yes	Yes
Gender by age bins	Yes	Yes	Yes
Observations	240	240	240
R-Squared	0.220	0.220	0.261
Treatment effects and s.e.			
Men without children at application	-0.075 (0.061)	-0.040 (0.140)	-0.347** (0.154)
Men with children at application	-0.076 (0.053)	-0.085 (0.074)	-0.031 (0.100)
Women without children at application	-0.076 (0.053)	-0.040 (0.140)	0.215 (0.155)
Women with children at application	-0.076 (0.053)	-0.085 (0.074)	-0.168* (0.090)

Notes:

Table 6: Parenthood outcomes: Full sample

	Child in post-grant period		
	(1)	(2)	(3)
Grant	-0.081	-0.019	-0.210
	(0.044)	(0.098)	(0.121)
Grant × Female			0.369
			(0.148)
Grant × Has children at application		-0.066	0.146
		(0.120)	(0.143)
Grant × Female × Has children at application			-0.443
			(0.152)
Constant	0.533	0.552	0.544
	(0.117)	(0.117)	(0.120)
Gender	Yes	Yes	Yes
Children at application	Yes	Yes	Yes
Grant Committee FE	Yes	Yes	Yes
Age bins	Yes	Yes	Yes
Gender by age bins	Yes	Yes	Yes
Score	Yes		Yes
Observations	323	323	323
R-Squared	0.206	0.203	0.225
Treatment effects			
Men without children at application			
Men with children at application			
Women without children at application			
Women with children at application			

Notes:

Table 7: Career outcomes: RDD sample

	(1) ,Publications	(2)	(3)	(4) Citations/publication	(5)	(6)	(7) ln(Income)	(8)	(9)
Grant × Post	0.371**	0.224	0.734*	-0.257	0.109	0.476	0.183	0.298*	0.502*
	(0.153)	(0.334)	(0.420)	(0.237)	(0.211)	(0.368)	(0.116)	(0.167)	(0.278)
Grant × Post × Female	-0.365		-0.923	0.391		-0.566	-0.003		-0.389
	(0.257)		(0.617)	(0.337)		(0.478)	(0.150)		(0.332)
Grant × Post × Has children at application		-0.020	-0.435		-0.236	-0.855**		-0.156	-0.411
		(0.372)	(0.461)		(0.297)	(0.419)		(0.171)	(0.277)
Grant × Post × Female × Has children at application			0.684			1.165*			0.503
			(0.672)			(0.657)			(0.346)
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age bins	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2601	2601	2601	1362	1362	1362	2628	2628	2628
Individuals	237	237	237	204	204	204	240	240	240
Within R-Squared							0.502	0.501	0.508
Treatment Effects									
Men without children at application	0.371** (0.153)	0.224 (0.334)	0.734* (0.42)	-0.257 (0.222)	0.109 (0.225)	0.476 (0.361)	0.183 (0.116)	0.298* (0.167)	0.502* (0.278)
Men with children at application	0.371** (0.153)	0.204 (0.142)	0.299* (0.172)	-0.257 (0.222)	-0.127 (0.201)	-0.379 (0.239)	0.183 (0.116)	0.142* (0.075)	0.090 (0.106)
Women without children at application	0.006 (0.210)	0.224 (0.334)	-0.189 (0.450)	0.134 (0.238)	0.109 (0.225)	-0.090 (0.301)	0.180* (0.092)	0.298* (0.167)	0.113 (0.167)
Women with children at application	0.006 (0.210)	0.204 (0.142)	0.061 (0.227)	0.134 (0.238)	-0.127 (0.201)	0.220 (0.332)	0.180* (0.092)	0.142* (0.075)	0.205* (0.107)

Notes:

Online Appendix: Not for Publication

OA-1 Institutional setting

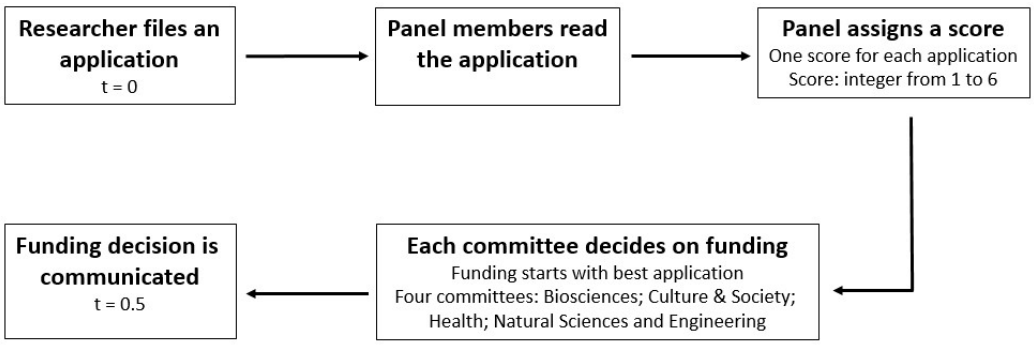


Figure OA-1: The Decision-making process

OA-2 Data

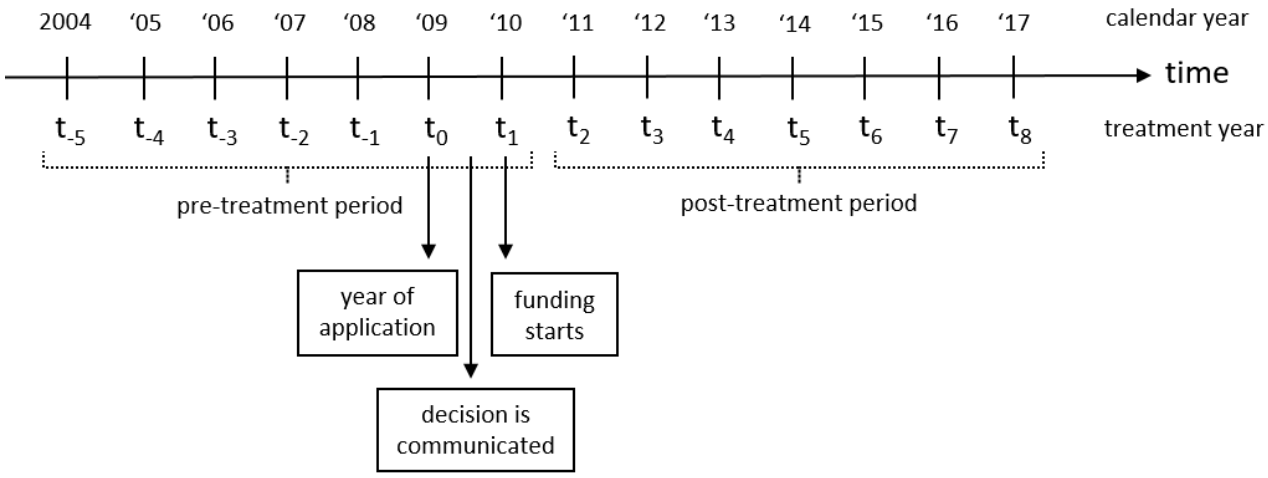


Figure OA-2: Timeline

OA-3 Robustness tests