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Abstract

We examine whether competitive research grants generate independent research by the funded investigator. We distinguish first- and last-author publications—indicating leading contribution in biomedical research—from total output. Using data on Czech medical research grants awarded between 2015 and 2019, we combine a regression discontinuity (RD) design around the funding cutoff with augmented inverse probability weighting (AIPW) that estimates average effects across a broader applicant sample. RD estimates show that grants increase total publications by 3.1 papers (22%). First- and last-author publications increase by 59% and 41% respectively—substantially exceeding the total effect. These gains extend to high-tier journals and to citations. AIPW estimates are qualitatively consistent but smaller in magnitude. Within AIPW, first- and last-author effects are larger for funded projects closer to the cutoff, supporting heterogeneity in returns to funding. Exploratory subgroup estimates suggest comparatively large local effects for female and less-senior investigators, although the smaller subgroup samples and differing AIPW patterns mean that these results should be interpreted cautiously.

JEL: O38, O30, I23

Keywords: Regression discontinuity design, research funding, scientific productivity

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1 Introduction

Do competitive research grants generate new scientific output? A growing body of work uses regression discontinuity designs to answer this question by comparing principal investigators (PIs) who scored just above versus just below funding thresholds (Jacob & Lefgren, 2011; Benavente *et al.*, 2012; Gerritsen *et al.*, 2013; Ganguli, 2017; Bol *et al.*, 2018; Wang *et al.*, 2019; Baruffaldi *et al.*, 2020; Ghirelli *et al.*, 2023). The results are mixed: some studies find sizable publication gains, while others report small or null effects even for prestigious awards. Two distinctions may help explain these mixed findings. First, effects at the funding margin need not coincide with average effects across the broader applicant pool. Second, outcome measures such as total publications and citations typically do not distinguish between research in which the PI plays a leading role and participation in large collaborative projects.

We address both issues by studying project grants from the Czech Agency for Health Research (AZV), which funds applied medical research. Between 2015 and 2019, AZV received 2,529 applications and funded about 22% of them, allocating a total of roughly EUR 240 million, with an average grant size of approximately EUR 430 thousand. To distinguish effects at the funding margin from average effects across a broader applicant sample, we combine two complementary approaches. First, we use a sharp regression discontinuity (RD) design (Thistlethwaite & Campbell, 1960; Lee & Lemieux, 2010) that compares projects just above and just below the funding cutoff within evaluation panels, thereby identifying a local causal effect at the funding margin. Second, we report Augmented Inverse Probability Weighting (AIPW) estimates of average effects across a broader sample of applicants under a selection-on-observables assumption. To improve overlap and make the two approaches more comparable, the main AIPW analysis restricts the comparison group to applications that are not too far below the funding cutoff.

To distinguish PI-led research from broader collaborative participation, we separately measure all publications and publications in which the PI is the first or last author. In biomedical research, first authorship commonly indicates the researcher who performed the core work, while last authorship is associated with the senior investigator responsible for scientific direction and team supervision (Neufeld, 2016; Perneger, 2023; Larivière *et al.*, 2016; Sauermann & Haeussler, 2017).¹ An increase in total publications could therefore reflect either additional PI-led research or expanded participation in projects organized by others. Throughout the paper, we use the terms “independent” and “PI-led” interchangeably to refer to publications in which the PI occupies a first- or last-author position. These terms describe observable authorship roles and do not imply

¹Note that, while alphabetical order of authors is the standard practice in economics, it is rarely used in most scientific fields, including biomedical research.

sole authorship, the absence of collaboration, or direct observation of the PI’s individual intellectual effort.

We find that grants increase first-author and last-author publications by 59% and 41%, respectively, in our RD estimates, substantially exceeding the 22% increase in total output. These gains extend to high-quality journals and citations. Complementary AIPW estimates for a broader sample of applicants are smaller in magnitude but point to the same qualitative conclusion: funding increases average publication output and raises first- and last-author publication counts beyond the funding margin. The larger RD estimates are consistent with the AIPW heterogeneity analysis, which finds larger first- and last-author publication effects for lower-ranked funded projects closer to the cutoff. Finding this pattern within AIPW strengthens the interpretation that differences in returns to funding contribute to the larger RD estimates. Some subgroup estimates, particularly the local RD estimates, suggest comparatively large effects for female PIs and for applicants without senior academic titles, consistent with the idea that grants matter most when alternative funding is more constrained. However, these patterns are not uniform across estimators and should therefore be interpreted cautiously.

Conceptually, project funding may affect scientific production through at least three related channels. First, a scale channel may increase total output by financing research time, personnel, data, equipment, and other inputs. Second, an organizational and leadership channel may enable the PI to initiate and execute a distinct research agenda, assemble or expand a team, allocate tasks, and coordinate and supervise the production of results. Evidence from other funding settings suggests that the incentives and autonomy associated with funding arrangements can affect the direction of scientific exploration, while funding may also alter subsequent collaboration patterns ([Azoulay *et al.*, 2011](#); [Davies *et al.*, 2022](#)). Third, a credit-allocation channel may change how scientific contributions are represented in the authorship order without an equivalent change in the underlying distribution of work.

These channels imply different empirical patterns. If funding mainly expands the scale of research or participation in collaborations organized by others, total publication counts may increase without a disproportionate change in first- or last-authorship. If funding instead strengthens the PI’s ability to initiate, execute, coordinate, or supervise research, first- and last-author publications may increase more strongly. Our results are therefore most in line with the organizational and leadership channel, although changes in team composition and authorship allocation could also contribute to the observed pattern ([Aliukonis & Gefenas, 2026](#)). The design does not separately identify these mechanisms.

Our contribution is threefold. First, we combine a local quasi-experimental RD design with broader-sample AIPW estimates, linking evidence at the funding margin to average

effects across a wider applicant sample. This comparison helps assess whether the qualitative conclusions extend beyond marginal applicants, while making the different estimands and identifying assumptions explicit.²

Second, we explicitly distinguish between publications reflecting observable PI leadership and total output within a grant-evaluation framework. While prior studies have recognized the relevance of authorship position (Park *et al.*, 2015; Jacob & Lefgren, 2011), most RD-based evaluations rely on aggregate counts without systematically conditioning on authorship role (Benavente *et al.*, 2012; Bol *et al.*, 2018; Ghirelli *et al.*, 2023). We show that this distinction has important quantitative implications: aggregate publication counts can mask substantially larger proportional gains in publications in which the PI appears in the first or last author position.

Third, we provide causal evidence on intermediate-size project grants awarded to established researchers—an instrument that has been comparatively understudied relative to elite awards or early-career schemes (Jacob & Lefgren, 2011; Bol *et al.*, 2018; Ganguli, 2017; Ghirelli *et al.*, 2023), but that accounts for a large share of research grant funding in many countries.

The remainder of the paper proceeds as follows. Section 2 describes the AZV program and its evaluation procedures. Section 3 presents data sources and the construction of our sample. Section 4 details the empirical methodology. Section 5 reports the main results and examines effect heterogeneity. Section 6 concludes.

2 AZV Grants

AZV is the Czech Ministry of Health’s agency for applied medical research funding. Operating since 2014, it administers competitive project grants and oversees proposal evaluation, funding decisions, and subsequent project implementation. During our study period, AZV supported projects in three broad program areas: (a) Public Health, (b) Pathogenesis and Development of Diseases, and (c) Innovative Solutions for Medicine.

Proposals are evaluated within nine expert panels corresponding to medical fields: P01 Metabolic and endocrine diseases, P02 Circulatory diseases, P03 Tumor diseases, P04 Neuroscience and mental health, P05 Immune and infectious diseases, P06 Organ dysfunction and critical care, P07 Age-specific groups, P08 Biomedical technologies, and P09 Public health and nursing. Because projects are assessed and ranked within these panels, the relevant funding competition takes place at the call-panel level rather than across the program as a whole.

²This approach is related in spirit to Ghirelli *et al.* (2023), who similarly combine a regression discontinuity design with a broader-sample empirical strategy to compare evidence across different estimands.

Eligibility rules are specified in each call. Applicants may be research organizations or businesses, and proposals may include co-applicants. The proposer becomes the principal investigator (PI) if funded and must satisfy the employment and qualification requirements stated in the call documentation. Foreign applicants may also participate, subject to additional administrative conditions where applicable.

AZV awards are project-specific grants for applied medical research. A proposal defines a research question, objectives, methodological approach, timetable, expected results, team structure, and budget, and the PI is responsible for coordinating the implementation of the approved project. Project resources can support personnel, operating inputs, and research infrastructure, subject to the rules of the relevant call. These characteristics create a plausible organizational link between funding and authorship position. An award may enable a PI to initiate a distinct project, support junior researchers and other collaborators, allocate research tasks, and integrate the resulting work into publications in which the PI occupies a first- or last-author role.

The evaluation process is multi-stage. After reception and compliance screening, proposals are reviewed by experts and assessed on the quality of the research team, the scientific merit and feasibility of the project, and the eligibility of proposed costs. Each proposal receives at least two independent reviews, while proposals advancing to later stages obtain additional external, often international, assessments. The AZV Scientific Council acts as an advisory body, and the Ministry of Health formally makes the final funding decision. Calls are announced and evaluated during year t_0-1 , with funded projects beginning in year t_0 .

For identification purposes, the key institutional feature is that funding is allocated within each call-panel in rank order until the available budget is exhausted. This creates a panel-specific funding threshold given by the rank of the last funded project. Proposals just above and just below this threshold face sharply different funding outcomes despite being close in the panel ranking, which motivates the regression discontinuity design used below.

For all calls, we observe the final within-panel rankings that determine funding. For the 2018–2019 calls, we additionally observe the underlying numerical evaluation scores that generated these rankings. These continuous scores allow us to examine potential manipulation of the running variable around the funding threshold using density tests. For earlier calls (2015–2017), only final rankings are recorded, although scores were used internally in the evaluation process.

One additional feature of the program is relevant for interpretation. After the scientific evaluation, projects undergo an economic assessment in which individual budget items may be reduced or deemed ineligible. Applicants may accept the revised budget or decline

support, in which case the project is recorded as unsupported. This stage may affect the final funded budget, but it does not provide a mechanism for changing a project’s scientific evaluation score or its ranking position. In a small number of cases, projects ranked above the funding threshold ultimately did not receive funding because the applicant declined the final agreement after the economic assessment stage. There are five such cases in the full sample. We omit them from the baseline sample; including them does not materially affect the estimates.

Funded projects submit annual progress reports and a final report upon completion, and weak or non-compliant performance can lead to reduced or terminated support.³ Table 1 summarizes the number of submitted applications, evaluated proposals, and applications within the rank-distance windows used by the two estimators, by call year.

Table 1: Number of project proposals by call

	2015	2016	2017	2018	2019	Total
Total applications						
Supported	156	139	89	84	79	547
Unsupported	499	489	384	298	312	1,982
Received ranking						
Supported	156	139	89	84	79	547
Unsupported	250	257	191	172	178	1,048
AIPW sample (rank distance ≥ -20)						
Supported	123	109	79	69	62	442
Unsupported	147	148	130	131	122	678
RD sample ($\text{rank distance} \leq 20$)						
Supported	111	102	79	69	62	423
Unsupported	147	148	130	131	122	678

Notes: “Received ranking” refers to proposals that passed the initial screening and were evaluated and assigned a ranking within each call-panel. The AIPW and RD rows apply only the rank-distance restriction. The estimation samples additionally exclude applications whose principal investigator receives AZV funding in the following call (see Section 3).

³For full details on program design, eligibility, funding structure, and evaluation procedures, see the General Rules of Programs of the Ministry of Health to Support Applied Medical Research, available at <https://www.azvcr.cz/en/vseobecna-pravidla/>.

3 Data

Our analysis combines three linked data sources covering AZV applications submitted between 2015 and 2019. The first source consists of AZV administrative records for all applications. These records provide the call year, expert-panel assignment, rank within the call-panel, funding decision, and information on the PI and home institution. For the 2018–2019 calls, the administrative data also include continuous evaluation scores, which are used in the density analysis reported in [Subsection 4.3](#).

The second source is the Czech Information System of Research, Development and Innovation (IS VaVaI), which contains researcher-level information on scientific outputs and research funding reported by Czech research organizations. A key advantage of IS VaVaI is that researchers are identified by a unique researcher identifier (VEDIDK), enabling high-reliability linking of PIs across applications, publications, and funding records.

The third source is Web of Science (WoS) and InCites, which provides additional bibliometric information used to construct our publication outcomes. These data include citation counts, journal impact measures, and author-order information. They allow us to distinguish between total publication output and publications in which the PI appears in first or last authorship position, and to construct quality-adjusted measures based on journal placement.

The main outcomes are measured cumulatively over a five-year post-treatment window, from t_0 to t_0+4 , where t_0 denotes the year in which the funded project begins. We examine three outcome measures, total Web of Science publications, Q1+Q2 publications, and citations, each for all, first-author, and last-author publications.⁴ Q1+Q2 publications are defined using the top two journal quartiles based on within-field Article Influence Scores. Pre-treatment publication, citation, and funding-history variables are measured over the five-year window from t_0-5 to t_0-1 , while researcher and institutional characteristics are measured in the application year t_0-1 .

Sample construction proceeds in several steps. We begin with the full population of 2,529 AZV applications submitted between 2015 and 2019, of which 547 were funded. We first restrict attention to proposals that passed the initial screening and entered panel evaluation, that is, proposals for which an official within-panel rank is observed. This excludes applications rejected before the formal review stage and ensures that all observations in the analysis come from the part of the process where projects are directly comparable within a call-panel ranking.

We then link PIs across the AZV, IS VaVaI, and Web of Science (WoS) and InCites data using the VEDIDK researcher identifier and apply a set of common data-cleaning

⁴Single-authored papers and papers with alphabetically ordered authors, for which author order does not signal relative contributions, are counted as both first-author and last-author publications.

restrictions. Specifically, we exclude observations with missing PI identifiers, PIs with no observed publications in the relevant observation window, and extreme publication-count outliers, defined as more than 50 publications in either the pre- or post-treatment window. These restrictions are intended to improve linkage quality and limit the influence of exceptionally large publication counts on the estimates.⁵ Alternative publication-count thresholds and the corresponding RD estimates are reported in [Table A.3](#).

To avoid contamination from subsequent treatment, we exclude applications if the same PI receives AZV funding in the immediately following call, regardless of whether the baseline application was funded. This ensures that control applicants do not become treated immediately afterward and that treated applicants are not funded again during the outcome window. Robustness to extending this restriction is reported in [Table A.1](#).

After these common restrictions, we impose estimator-specific sample definitions. The RD design focuses on applications close to the funding threshold within each call-panel. The main AIPW specification uses a broader sample of applicants but restricts the comparison group to unfunded projects that are not too far below the cutoff to improve overlap and comparability between treated and control observations.⁶

Unsuccessful AZV applications should not be interpreted as representing PIs without research support. An unsuccessful AZV applicant may receive funding from GACR (Czech Science Foundation) or another provider, participate in a project led by another investigator, or rely on institutional and other research resources. The estimated effects thus capture the effect of receiving AZV support relative to the alternative funding opportunities available to unsuccessful AZV applicants, rather than relative to a complete absence of research support.

[Table 2](#) reports descriptive statistics for all ranked applications that remain after the data-cleaning restrictions, before the rank-distance and next-call restrictions. The table shows that funded and unfunded applications are not observationally identical before treatment. Funded PIs tend to have higher baseline publication and citation counts and greater prior exposure to research funding, while differences in basic demographic and institutional characteristics are generally smaller. These patterns motivate the use

⁵The restrictions exclude 19 applications with missing PI identifiers, 86 PIs with no observed publications in the relevant observation window, and 130 PIs with more than 50 publications in either the pre- or post-treatment window. Because these restrictions partly rely on post-treatment publication outcomes, they may affect sample composition if publication activity is itself influenced by funding.

⁶Sample sizes differ across tables because the restrictions are applied at different stages. The descriptive statistics in [Table 2](#) cover all ranked applications remaining after the data-cleaning restrictions, before the rank-distance restriction and the exclusion of applications whose PI receives AZV funding in the following call (1,345 applications). The AIPW and RD rows of [Table 1](#) apply only the rank-distance restriction (1,120 and 1,101 applications, respectively). The estimation samples apply both restrictions, yielding 1,011 applications for the main AIPW specification and 971 for the baseline RD specification.

of designs that either compare projects locally around the funding threshold or adjust flexibly for observable pre-treatment differences.

Table 2: Descriptive statistics

	Control				Treated			
	Count	Mean	Median	SD	Count	Mean	Median	SD
All Pubs.	903	14.29	13.00	9.34	442	17.78	16.00	10.61
Q1+Q2 Pubs.	903	7.22	6.00	5.83	442	7.72	6.00	5.94
First A. Pubs.	903	2.13	2.00	2.27	442	2.14	2.00	2.30
First A. Q1+Q2 Pubs.	903	1.15	1.00	1.63	442	0.93	0.00	1.30
Last A. Pubs.	903	2.85	1.00	4.01	442	3.75	2.00	4.40
Last A. Q1+Q2 Pubs.	903	1.52	1.00	2.41	442	1.82	1.00	2.38
Citations	903	279.56	176.00	380.78	442	452.26	285.00	556.84
First A. Citations	903	36.02	15.00	58.81	442	47.87	16.50	93.34
Last A. Citations	903	48.49	14.00	86.29	442	73.79	28.00	115.91
Assoc. Prof. (1/0)	903	0.26	0.00	0.44	442	0.27	0.00	0.44
Full Prof. (1/0)	903	0.19	0.00	0.39	442	0.27	0.00	0.44
Experience (years)	903	9.09	10.00	1.97	442	9.38	10.00	1.54
Female (1/0)	903	0.28	0.00	0.45	442	0.23	0.00	0.42
Inst. Size	903	14.82	10.00	12.73	442	14.97	11.00	12.06
Inst. Avg. WoS pubs.	903	15.51	13.86	8.24	442	16.89	15.52	7.50
University (1/0)	903	0.72	1.00	0.45	442	0.69	1.00	0.46
Academy of Sci. (1/0)	903	0.06	0.00	0.23	442	0.08	0.00	0.27
Funding (CZK 1,000)	903	7708.41	1848.00	41364.88	442	11639.50	4761.00	54838.65
GACR Funding (1/0)	903	0.16	0.00	0.37	442	0.21	0.00	0.41
MoH Funding (1/0)	903	0.42	0.00	0.49	442	0.55	1.00	0.50

Notes: Experience denotes the years since the first publication, capped at 10. Inst. Size denotes the number of researchers in the same field at the researcher’s home institution. Inst. Avg. WoS pubs. denotes the average number of Web of Science publications in the researcher’s field produced by the researcher’s home institution. MoH funding is an indicator for whether the PI received any research funding from the Czech Ministry of Health during the five years before project start. Publication, citation, and funding-history variables are measured over the five years before project start ($t_0 - 5$ to $t_0 - 1$). Researcher and institutional characteristics refer to the application/evaluation year ($t_0 - 1$); gender is time-invariant. The sample covers all ranked applications remaining after the data-cleaning restrictions, before the rank-distance and next-call restrictions.

4 Methodology

4.1 Regression discontinuity design (RD)

We estimate the causal effects of the grants on the supported PIs using a sharp RD design that compares projects just above and just below the funding cutoff. For each call-panel (c, p) , we define the cutoff κ_{cp} as the rank of the last funded project and construct the running variable r_i as rank distance $r_i = \kappa_{cp} - \text{rank}_i$, where rank 1 denotes the best-evaluated project.

Applications with $r_i \geq 0$ are funded and those with $r_i < 0$ are not. We estimate local linear regressions on either side of the cutoff using triangular kernel weights and bias-corrected inference with robust standard errors following [Calonico *et al.* \(2014\)](#). We also show that the results are robust to alternative local polynomial specifications and kernel choices (see [Table A.8](#)). Our baseline specification uses a symmetric bandwidth of ± 20 ranks around the cutoff, but we also report results for wider and narrower bandwidths ($\infty, \pm 30, \pm 10$). We estimate the equation

$$Y_i^{t_0, t_0+4} = \alpha + \tau T_i + \beta_- r_i \cdot \mathbb{K}(r_i < 0) + \beta_+ r_i \cdot \mathbb{K}(r_i \geq 0) + \gamma Y_i^{t_0-5, t_0-1} + \theta_{cp} + \varepsilon_i, \quad (1)$$

where $T_i = \mathbb{K}(r_i \geq 0)$ indicates supported projects, $Y_i^{t_0, t_0+4}$ is the outcome variable during the post-treatment period, $Y_i^{t_0-5, t_0-1}$ is the outcome variable during the pre-treatment period, and θ_{cp} represents call-panel fixed effects. Standard errors are clustered at the PI level.

Our empirical strategy deliberately combines two approaches because they answer different but complementary questions. The regression discontinuity design identifies the causal effect of funding for applications at the call-panel cutoff, where funded and unfunded projects are the closest substitutes. The AIPW analysis addresses a broader question: whether similar patterns are visible in a broader applicant sample when selection is on observables. We therefore treat the two approaches as complementary. Agreement across them strengthens the substantive conclusion, while differences in magnitude are informative about heterogeneity in returns to funding away from the cutoff.

4.2 Augmented inverse probability weighting (AIPW)

As a complementary approach to the local RD estimand, we estimate the average treatment effect (ATE) of receiving AZV funding using augmented inverse probability weighting (AIPW). Under conditional unconfoundedness and overlap, AIPW delivers a consistent estimate of the ATE and is doubly robust: consistency holds if either the propensity-score model or the outcome regression is correctly specified ([Robins *et al.*, 1995](#); [Kurz, 2022](#)). This approach targets a different estimand than the RD design. While RD identifies a local average treatment effect at the funding cutoff, AIPW estimates an average treatment effect in a broader sample of applicants, accounting for selection on observables.

Treatment is defined at the application level. Let $T_i \in \{0, 1\}$ indicate whether application i is funded at t_0 . Outcomes Y_i are measured cumulatively over the post-treatment window (t_0 to t_0+4), while covariates X_i comprise publication, citation, and funding-history variables measured over t_0-5 to t_0-1 and researcher and institutional characteristics measured in the application year t_0-1 . Identification requires

$$\{Y_i(1), Y_i(0)\} \perp T_i \mid X_i, \delta_{cp} \quad \text{and} \quad 0 < \Pr(T_i = 1 \mid X_i, \delta_{cp}) < 1, \quad (2)$$

where δ_{cp} denotes call-panel fixed effects, which ensure that comparisons are made within the same evaluation environments. In practice, overlap is strengthened by the sample restrictions described below.

We first estimate the propensity score

$$e(X_i) \equiv \Pr(T_i = 1 \mid X_i, \delta_c, \delta_p), \quad (3)$$

and, in parallel, estimate outcome regressions for treated and control applications,

$$m_t(X_i) \equiv \mathbb{E}[Y_i \mid T_i = t, X_i, \delta_{cp}], \quad t \in \{0, 1\}. \quad (4)$$

In practice, we estimate the propensity score $e(\cdot)$ using a parametric logit model that includes the covariates and separate call and panel fixed effects, δ_c and δ_p . We estimate the outcome regressions $m_t(\cdot)$ using linear specifications that include the same substantive covariates and call-panel fixed effects, δ_{cp} . The covariates comprise nine pre-treatment publication and citation measures: total publications, Q1+Q2 publications, and citations, each measured for all, first-author, and last-author output. They also include researcher characteristics (academic rank, experience, and gender), institutional characteristics (institution size, average institutional publications, and institution type), and prior funding measures (total funding, GACR funding, and Ministry of Health funding).⁷

The AIPW estimator of the ATE is

$$\hat{\tau}_{AIPW} = \frac{1}{N} \sum_{i=1}^N \left[\widehat{m}_1(X_i) - \widehat{m}_0(X_i) + \frac{T_i(Y_i - \widehat{m}_1(X_i))}{\widehat{e}(X_i)} - \frac{(1 - T_i)(Y_i - \widehat{m}_0(X_i))}{1 - \widehat{e}(X_i)} \right]. \quad (5)$$

Inference is based on standard errors clustered at the principal-investigator level.

To improve overlap and to make the AIPW comparison group closer to the RD setting, the main AIPW analysis restricts the sample to applications that are not too far below the funding cutoff, retaining only unfunded projects with rank distance $r_i \geq -20$. This restriction reduces reliance on poorly ranked unfunded projects and strengthens comparability between treated and control applications. [Table A.2](#) assesses the sensitivity of the AIPW estimates to alternative rank-distance cutoffs.

⁷As a robustness check, [Table 6](#) compares AIPW estimates with estimates obtained using nearest-neighbor matching (NN), inverse probability weighting (IPW), and inverse probability-weighted regression adjustment (IPWRA).

4.3 Validity checks

Following standard practice, we assess the credibility of the identification strategies using two complementary sets of validity checks. We begin by testing whether funding status is associated with predetermined variables measured before treatment. These include publication outcomes and prior funding measured over the period $t_0 - 5$ to $t_0 - 1$, as well as researcher and institutional characteristics measured in the application year $t_0 - 1$.

We implement these placebo tests using both identification strategies employed in the paper. Tables 3 and 4 report the results of the placebo tests based on RD and AIPW, respectively.

Table 3: Placebo RD estimates: pre-treatment publication outcomes

Bandwidth	All publications			First author			Last author		
	All	Q1+Q2	Citations	All	Q1+Q2	Citations	All	Q1+Q2	Citations
Infinite	1.29 (1.39)	0.40 (0.86)	111.74 (82.87)	-0.17 (0.31)	-0.15 (0.20)	-0.12 (10.43)	0.23 (0.59)	-0.15 (0.39)	5.82 (12.57)
N (left)	785	785	785	785	785	785	785	785	785
N (right)	426	426	426	426	426	426	426	426	426
Wide	1.16 (1.44)	0.45 (0.85)	102.08 (86.57)	-0.23 (0.31)	-0.14 (0.19)	1.09 (10.88)	0.18 (0.56)	-0.14 (0.36)	4.70 (12.28)
N (left)	705	705	705	705	705	705	705	705	705
N (right)	422	422	422	422	422	422	422	422	422
Baseline	0.84 (1.65)	0.21 (0.98)	91.14 (96.80)	-0.23 (0.36)	-0.16 (0.22)	1.18 (12.40)	0.02 (0.65)	-0.21 (0.42)	2.54 (14.49)
N (left)	565	565	565	565	565	565	565	565	565
N (right)	406	406	406	406	406	406	406	406	406
Narrow	1.44 (2.11)	0.58 (1.24)	84.09 (112.58)	-0.17 (0.44)	-0.11 (0.28)	-2.87 (15.80)	0.01 (0.85)	-0.10 (0.54)	-7.38 (19.09)
N (left)	293	293	293	293	293	293	293	293	293
N (right)	317	317	317	317	317	317	317	317	317

Notes: *** 1%, ** 5%, * 10%. The table reports placebo RD estimates of the effect of AZV funding on publication outcomes in the pre-treatment period ($t_0 - 5$ to $t_0 - 1$). Estimates are based on estimating Equation 1 without the pre-treatment outcome control using local linear RD with a triangular kernel. Results are reported for the full sample and for symmetric bandwidths of 30, 20, and 10 ranks around the cutoff. All specifications include call-panel fixed effects. Standard errors are clustered at the PI level.

Across specifications, we find no systematic evidence that funding status predicts pre-treatment outcomes. Estimated coefficients are generally small and statistically insignificant, and they do not display consistent patterns across specifications or bandwidth choices. For PI characteristics, institutional characteristics and funding variables, only one coefficient is statistically significant: experience in the narrow-bandwidth RD specification, at the 10% level. This isolated result does not appear at other bandwidths or in

the AIPW placebo specification. Additional placebo estimates are reported in Appendix Tables A.4 to A.7.

Table 4: Placebo AIPW: pre-treatment publication outcomes

	All publications			First author			Last author		
	All	Q1+Q2	Citations	All	Q1+Q2	Citations	All	Q1+Q2	Citations
ATE	0.14 (0.31)	0.07 (0.15)	-11.75 (52.74)	0.00 (0.05)	-0.01 (0.04)	0.96 (1.47)	0.02 (0.06)	0.01 (0.05)	2.30 (1.85)
Observations	1011	1011	1011	1011	1011	1011	1011	1011	1011

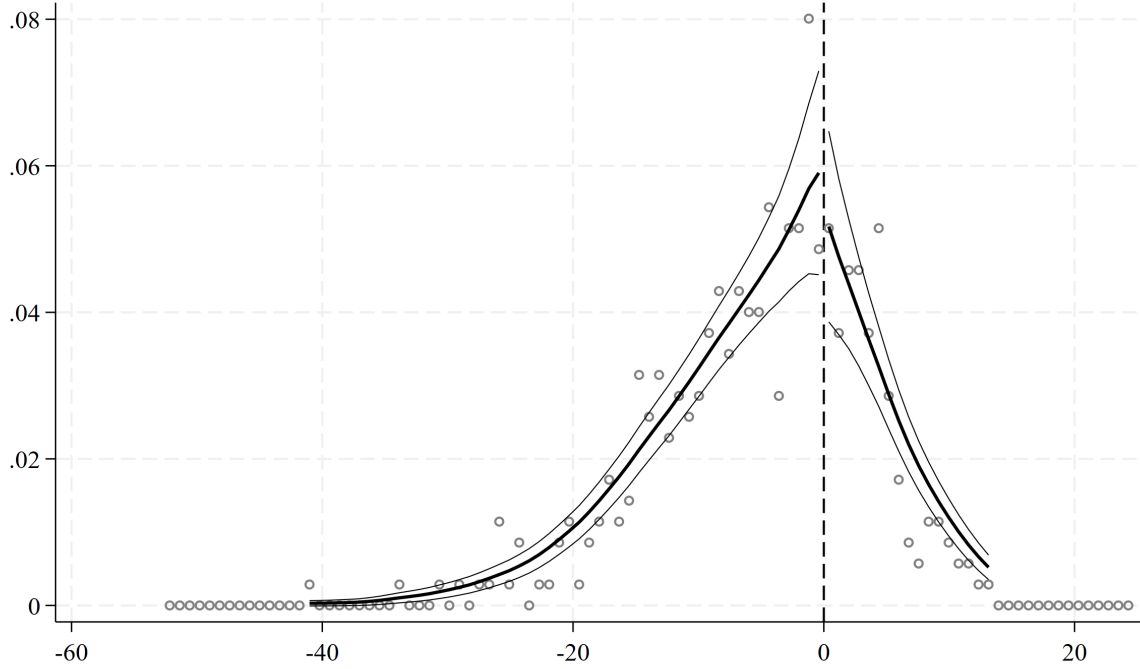
Notes: *** 1%, ** 5%, * 10%. The table reports placebo AIPW estimates for publication outcomes measured during the pre-treatment period from $t_0 - 5$ to $t_0 - 1$. Estimates are based on Equation 5. The treatment equation includes baseline covariates and separate call and panel fixed effects, while the outcome equation includes only call-panel fixed effects. Standard errors are clustered at the PI level.

While the placebo tests address balance in predetermined outcomes, a remaining concern is whether projects could strategically manipulate their evaluation scores to cross the funding threshold. This concern relates to the validity of the running variable used in the regression discontinuity design. As described in Section 2, the economic assessment that follows the scientific evaluation can change a project’s budget but provides no mechanism for altering evaluation scores or ranking positions.

We test for manipulation of the running variable using the McCrary (2008) density test. A significant discontinuity in the density at the cutoff would indicate potential strategic manipulation of project scores around the funding threshold, undermining the validity of the RD design. Figure 1 plots the density of project scores around the funding cutoff for the 2018–2019 calls, where continuous score data are available. Placing the cutoff midway between the last funded and the first unfunded project avoids mechanical bunching at zero that can arise from discrete ranking within call-panels. The estimated density shows no statistically significant discontinuity at the cutoff. While there is a small visual jump in the estimated density, the McCrary test fails to reject continuity ($p = 0.54$), providing no evidence of strategic manipulation of scores around the funding threshold.

The placebo tests and the density analysis support the validity of the identification strategies. We find no systematic evidence of imbalance in predetermined characteristics or of manipulation around the funding cutoff.

Figure 1: Density of project scores around the cutoff (2018–2019 calls)



Notes: The figure plots the density of project scores around the funding cutoff using the McCrary (2008) test. The running variable is constructed as the project’s score relative to a call-panel-specific cutoff, defined as the mean of the score of the last funded project and the first non-funded project. The shaded areas represent 95% confidence intervals.

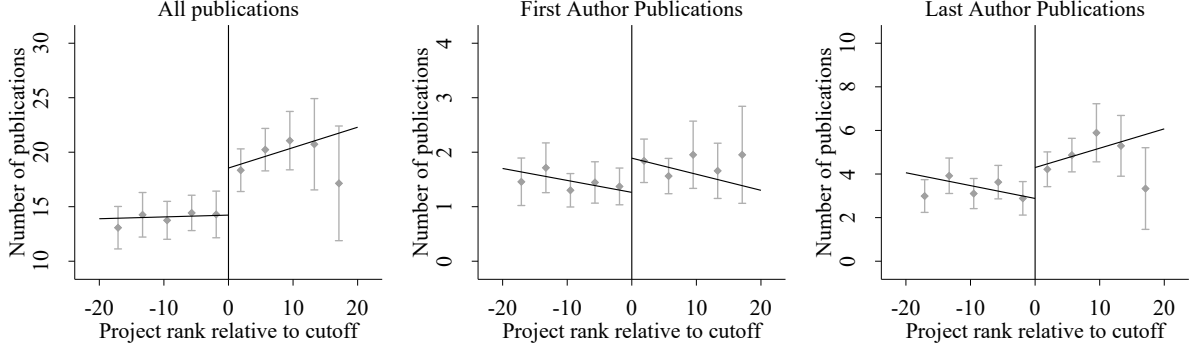
5 Results

With the identifying assumptions supported by the placebo and density tests, we next estimate the causal effect of AZV funding on subsequent publication outcomes.

Regression Discontinuity Estimates. The RD plots in [Figure 2](#) show the number of publications over the post-treatment period t_0 to $t_0 + 4$ for PIs whose projects ranked just below and just above the cutoff. The three panels depict, respectively, the counts of all publications in WoS journals, publications in which the PI was the first author, and publications in which the PI was the last author. All three panels show discontinuities at the funding cutoff that are consistent with higher publication output among supported PIs.

[Table 5](#) further explores the patterns observed in [Figure 2](#). It documents a positive effect of AZV funding on PIs’ research output, including all publications, first-author publications, and last-author publications. The results are robust across different bandwidth choices and, using the baseline bandwidth, statistically significant at the 1% level. Specifically, using the baseline bandwidth, we estimate that AZV funding led, on average,

Figure 2: Regression discontinuity plots: effects of grants on publication outcomes



Notes: The figure shows RD plots for publication outcomes measured cumulatively over the post-treatment period from t_0 to $t_0 + 4$ around the funding cutoff. The running variable is the project's rank distance to the cutoff. Points represent covariate-adjusted bin means with 95% confidence intervals. Solid lines show local linear fits estimated separately on each side of the cutoff. Estimates are based on estimating Equation 1 using a local linear specification with a triangular kernel and a baseline ranking bandwidth of 20.

to 3.1 additional publications, representing a 22% increase relative to the mean number of publications among unfunded PIs during the post-treatment period.^{8,9}

By comparison, AZV funding led to 0.9 additional first-author publications and 1.4 additional last-author publications. Importantly, these effects represent, respectively, 59% and 41% increases relative to the unfunded means. The proportional impact of the grants on the total publication counts (22%) would thus understate the boost they gave to research activities in which the supported PIs played central roles, either as lead authors or as senior investigators.

Positive funding effects also extend to publications in higher-tier journals. AZV funding significantly increased Q1+Q2 publication counts across all authorship categories. Roughly half of the additional first- and last-author publications appeared in higher-impact journals, compared with roughly one-third of the additional total publications. Total citations also increased significantly, with approximately 50 additional citations overall, including 11 for first-author publications and 12 for last-author publications.

The main results are also robust to the choice of outlier threshold (Table A.3). When the cap of 50 publications is relaxed, removed, or tightened to 30, the effects on total and first-author publications remain positive and statistically significant, and the last-author effect remains positive throughout. The main exception is total citations, which become imprecisely estimated once PIs with more than 50 publications are included. This is

⁸The unfunded PIs, on average, published 13.9 publications, 1.5 first-author publications and 3.3 last-author publications over the 5-year period after their (unsuccessful) grant application.

⁹For context, an average AZV project reports 6.5 WoS publications as outputs. Our estimates suggest roughly half represent causal effects, implying the remainder would have been produced without funding.

Table 5: RD estimates: effects of grants on publication outcomes

Bandwidth	All publications			First author			Last author		
	All	Q1+Q2	Citations	All	Q1+Q2	Citations	All	Q1+Q2	Citations
Infinite	2.76*** (0.91)	0.81 (0.55)	61.97** (25.70)	0.82*** (0.26)	0.30* (0.18)	9.63** (4.23)	0.90** (0.40)	0.41 (0.27)	8.29 (5.29)
N (left)	785	785	785	785	785	785	785	785	785
N (right)	426	426	426	426	426	426	426	426	426
Wide	3.18*** (0.94)	1.09* (0.57)	55.82** (25.23)	0.87*** (0.27)	0.36** (0.18)	9.47** (4.26)	1.08** (0.43)	0.59** (0.27)	10.79** (5.36)
N (left)	705	705	705	705	705	705	705	705	705
N (right)	422	422	422	422	422	422	422	422	422
Baseline	3.12*** (1.05)	1.14* (0.63)	52.12* (27.26)	0.89*** (0.30)	0.40* (0.21)	11.19** (4.92)	1.38*** (0.49)	0.83*** (0.30)	12.35** (6.26)
N (left)	565	565	565	565	565	565	565	565	565
N (right)	406	406	406	406	406	406	406	406	406
Narrow	3.00** (1.21)	1.43* (0.73)	33.72 (32.33)	1.19*** (0.35)	0.68*** (0.25)	14.51** (5.96)	1.90*** (0.60)	1.15*** (0.36)	10.18 (7.79)
N (left)	293	293	293	293	293	293	293	293	293
N (right)	317	317	317	317	317	317	317	317	317

Notes: *** 1%, ** 5%, * 10%. The table reports RD estimates of the effect of AZV funding on publication outcomes measured cumulatively in the post-treatment period from t_0 to $t_0 + 4$. Estimates are based on estimating Equation 1 using local linear RD with a triangular kernel. Results are reported for the full sample and for symmetric bandwidths of 30, 20, and 10 ranks around the cutoff. All specifications control for pre-treatment outcome variables and call-panel fixed effects. Standard errors are clustered at the PI level.

expected: such highly prolific PIs typically contribute to large collaborative teams whose publication and especially citation counts are large and highly variable, making it harder to detect the effect of a single project grant on these aggregate measures.

Overall, the results indicate that AZV funding particularly increased publications in which the PI appears in the first or last authorship position. A plausible interpretation is that the additional funding enabled PIs to pursue independent research projects or projects originating within their supervised teams, while PIs' participation in broader consortia was less influenced by the funding.

Augmented Inverse Probability Weighting (AIPW) Estimates. To complement the local RD estimates at the funding cutoff, we next report AIPW estimates that summarize average funding effects for a broader set of applicants under the selection-on-observables strategy. This complementary evidence helps assess whether the main patterns observed at the funding cutoff also extend beyond the immediate margin, while restricting the unfunded comparison group to applicants relatively close to the cutoff.

Table 6: Comparison across estimators: treatment effects of AZV funding on publication outcomes

	All publications			First author			Last author		
	All	Q1+Q2	Citations	All	Q1+Q2	Citations	All	Q1+Q2	Citations
AIPW	1.89*** (0.50)	0.37 (0.28)	22.77 (14.34)	0.29** (0.13)	0.01 (0.08)	2.84 (2.20)	0.39* (0.21)	0.15 (0.13)	0.89 (3.06)
Observations	1011	1011	1011	1011	1011	1011	1011	1011	1011
NN	1.87*** (0.62)	0.30 (0.32)	39.81** (19.62)	0.27* (0.14)	-0.06 (0.09)	3.20* (1.71)	0.31 (0.21)	0.13 (0.14)	0.16 (2.82)
Observations	1011	1011	1011	1011	1011	1011	1011	1011	1011
IPWRA	1.86*** (0.49)	0.35 (0.28)	23.50* (14.03)	0.28** (0.13)	0.00 (0.08)	2.65 (2.12)	0.37* (0.21)	0.14 (0.13)	0.73 (2.92)
Observations	1011	1011	1011	1011	1011	1011	1011	1011	1011
IPW	2.14*** (0.52)	0.47 (0.29)	30.49* (16.00)	0.28** (0.13)	-0.01 (0.08)	2.64 (2.15)	0.46** (0.22)	0.17 (0.13)	1.47 (3.13)
Observations	1011	1011	1011	1011	1011	1011	1011	1011	1011

Notes: *** 1%, ** 5%, * 10%. The table reports estimated treatment effects of AZV funding on publication outcomes measured cumulatively in the post-treatment period from t_0 to $t_0 + 4$. Columns report different publication measures. Rows correspond to alternative estimators: augmented inverse probability weighting (AIPW), nearest-neighbor matching (NN), inverse probability-weighted regression adjustment (IPWRA), and inverse probability weighting (IPW). AIPW estimates are based on Equation 5. All estimators condition on the same set of pre-treatment covariates. Fixed effects are included as follows: in AIPW and IPWRA, the outcome equation includes call-panel fixed effects, while the treatment equation includes separate call and panel fixed effects. NN matching is exact on panels and uses call-panel indicators in the bias adjustment. IPW includes separate call and panel fixed effects in the treatment model. Standard errors are clustered at the PI level.

Because RD and AIPW target different estimands, differences in magnitudes are expected. We therefore focus on whether the qualitative patterns align across outcomes.

The baseline AIPW estimates indicate that AZV funding increases total scientific output by about 1.9 Web of Science publications over the five-year post-treatment period. Relative to the control-group mean (about 14 WoS publications), this corresponds to an increase of roughly 13%. The AIPW estimates for Q1+Q2 publications and citations are positive but not statistically significant, although the estimated citation effect becomes statistically significant under several of the alternative estimators reported in Table 6. These estimates suggest that the increase in publication output is not confined to applicants at the funding margin but extends to a broader set of applicants, including those further from the cutoff. For authorship-position outcomes, the AIPW estimates imply smaller absolute gains than the RD results. AZV funding increases first-author publications by about 0.3 and last-author publications by about 0.4 over five years, with positive, statistically significant effects on these publication counts, but weaker, generally imprecise evidence for the corresponding quality-adjusted and citation outcomes. Overall,

the AIPW results point to positive average effects on publication output, while suggesting more modest effects on first-author and last-author publication outcomes than those observed at the funding margin.

Table 6 shows that the main qualitative pattern is similar across alternative estimators. Nearest-neighbor matching, IPWRA, and IPW yield effects on total WoS publications ranging from 1.9 to 2.1 and effects on first-author and last-author publications between 0.3 and 0.5. Estimated effects on total citations are positive across specifications and statistically significant for the alternative estimators, but not under AIPW. Citation effects for first- and last-author publications remain positive and are statistically insignificant except for the first-author estimate under nearest-neighbor matching, which is significant at the 10% level.

To illustrate the timing of these effects, Table A.9 reports separate-year AIPW estimates by event time. The estimates for total, first- and last-author publications are small in the first three post-award years and become more clearly positive from $t_0 + 3$, with the largest and most precisely estimated effects appearing at $t_0 + 4$. This delayed pattern is consistent with the time required for funded research to be initiated, conducted, and translated into publications. It is also compatible with evidence from other grant settings that funding-induced collaboration may emerge only after several years (Davies *et al.*, 2022).

The RD and AIPW estimates both indicate positive effects on publication output, with larger authorship-position effects in RD. To investigate this difference, we next use AIPW to compare funded projects at different positions in the call-panel ranking.

5.1 Effect Heterogeneity

We next examine whether average funding effects differ across projects and calls, using project ranking and call competitiveness as proxies for project quality and funding stringency. Ghirelli *et al.* (2023) suggest that funding effects may vary by project quality, motivating an examination of heterogeneity by project position in the ranking and by call competitiveness. Since the local RD design identifies effects only around the funding cutoff, the ranking-position analysis is based exclusively on AIPW.¹⁰

¹⁰Because some subgroups contain few observations per call-panel, several AIPW subgroup specifications replace call-panel fixed effects with separate call and panel fixed effects. The exact specification is reported in the notes to each table.

Table 7: AIPW: Funding Effects by Project Ranking and Call Competition

	All publications			First author			Last author		
	All	Q1+Q2	Citations	All	Q1+Q2	Citations	All	Q1+Q2	Citations
Panel A: By project ranking									
Top-ranked projects	2.66*** (0.78)	0.82* (0.45)	31.73 (20.05)	0.34** (0.17)	0.07 (0.11)	2.10 (2.29)	0.62** (0.26)	0.24 (0.18)	-1.07 (3.36)
Observations	737	737	737	737	737	737	737	737	737
Mid-ranked projects	2.17*** (0.78)	-0.04 (0.48)	1.03 (19.60)	0.28 (0.22)	-0.13 (0.13)	0.35 (2.85)	0.15 (0.29)	-0.11 (0.16)	2.40 (5.21)
Observations	720	720	720	720	720	720	720	720	720
Lower-ranked projects	2.00*** (0.64)	0.57 (0.36)	32.70* (17.17)	0.68*** (0.17)	0.25** (0.12)	8.97*** (3.14)	0.87*** (0.30)	0.44** (0.18)	3.10 (3.94)
Observations	736	736	736	736	736	736	736	736	736
Panel B: By call competition									
Low competition	2.30*** (0.75)	0.74* (0.40)	12.22 (20.16)	0.33* (0.18)	0.07 (0.11)	5.01* (2.70)	0.47 (0.33)	0.27 (0.20)	4.26 (4.27)
Observations	528	528	528	528	528	528	528	528	528
High competition	1.93*** (0.70)	0.13 (0.41)	34.47* (20.29)	0.20 (0.19)	-0.04 (0.13)	-0.61 (3.50)	0.43 (0.28)	0.09 (0.17)	-1.88 (4.21)
Observations	483	483	483	483	483	483	483	483	483

Notes: *** 1%, ** 5%, * 10%. The table reports AIPW estimates of the effects of AZV funding by project ranking (Panel A) and call competitiveness (Panel B). Outcomes are measured cumulatively over the post-treatment period from t_0 to $t_0 + 4$. Estimates are obtained using AIPW based on Equation 5. In Panel A, funded projects are ranked within each call-panel and divided into three groups of approximately equal size, corresponding to top-, middle-, and lower-ranked projects. Each ranking-specific specification compares one ranking subgroup of funded projects with the same pool of eligible unfunded control projects; consequently, the ranking-specific estimation samples are not mutually exclusive. In Panel B, call competitiveness is defined as the call-panel-level success rate. Call-panels are split at the median success rate into high-competition (below-median) and low-competition (above-median) groups. Covariates include pre-treatment publication and researcher characteristics. In all specifications except the one for mid-ranked projects, the treatment equation includes separate call and panel fixed effects and the outcome equation includes call-panel fixed effects. Because of the smaller number of observations, the specification for mid-ranked projects includes separate call and panel fixed effects in both equations. Standard errors are clustered at the PI level.

The estimates in Table 7 indicate that differences across ranking groups are modest for overall publication output. Estimated effects on total WoS publications are similar across ranking terciles (2.7 for top-ranked projects, 2.2 for mid-ranked projects, and 2.0 for lower-ranked projects). For quality-adjusted output, effects on Q1+Q2 publications are more pronounced for both top- and lower-ranked projects, while estimates for mid-ranked projects are close to zero, suggesting that quality upgrading is not monotonic in rank.

A more pronounced pattern across ranking groups emerges for authorship-position outcomes. For lower-ranked projects, the estimated effect on first-author publications is

about twice as large as for top-ranked projects, whereas effects for mid-ranked projects are small and not statistically significant. A similar, though somewhat less pronounced, pattern holds for last-author publications: estimates are largest for lower-ranked projects, while mid-ranked projects again show little change. The larger estimated gains for lower-ranked funded projects, which are closer to the cutoff, are consistent with the larger RD estimates relative to the broader-sample AIPW estimates. Because the ranking comparison uses AIPW throughout, this agreement strengthens the interpretation that heterogeneity in returns to funding contributes to the RD–AIPW difference.

Finally, heterogeneity by call competitiveness suggests slightly larger average effects on total WoS publications in lower-competition calls than in higher-competition calls. For Q1+Q2 publications and citations, however, the patterns are not systematic and estimates are generally imprecise. Overall, these results suggest that competitiveness explains relatively little of the variation in average effects, compared with project rank, for which differences are more visible in authorship-position outcomes.

Table 8: AIPW and RD estimates: funding effects by gender

	All publications			First author			Last author		
	All	Q1+Q2	Citations	All	Q1+Q2	Citations	All	Q1+Q2	Citations
Male (AIPW)	1.99*** (0.62)	0.60* (0.35)	37.34** (15.06)	0.37** (0.16)	0.09 (0.11)	4.50* (2.36)	0.53** (0.26)	0.23 (0.16)	4.07 (3.72)
Observations	745	745	745	745	745	745	745	745	745
Male (RD)	2.51* (1.29)	1.11 (0.77)	40.28 (33.13)	0.68** (0.34)	0.42* (0.24)	8.96 (5.72)	0.92 (0.62)	0.63* (0.36)	12.33* (7.47)
Observations	713	713	713	713	713	713	713	713	713
Female (AIPW)	2.83*** (1.00)	0.35 (0.52)	-2.62 (30.14)	0.01 (0.26)	-0.30** (0.15)	-1.01 (4.10)	0.42 (0.38)	0.19 (0.22)	-5.46 (5.55)
Observations	266	266	266	266	266	266	266	266	266
Female (RD)	5.25*** (2.00)	0.42 (1.22)	77.43 (62.86)	1.88*** (0.57)	0.50 (0.40)	26.10*** (9.10)	3.52*** (0.76)	1.98*** (0.55)	7.41 (12.51)
Observations	258	258	258	258	258	258	258	258	258

Notes: *** 1%, ** 5%, * 10%. The table reports AIPW and RD estimates of the effects of AZV funding on publication outcomes by gender. Outcomes are measured cumulatively over the post-treatment period from t_0 to $t_0 + 4$. RD estimates are based on Equation 1 using a local linear specification with a triangular kernel and a baseline ranking bandwidth of 20, while AIPW estimates are based on Equation 5. RD estimates control for the pre-treatment value of the outcome and include call-panel fixed effects. AIPW estimates control for pre-treatment researcher characteristics; because of the smaller subgroup samples, both AIPW equations include separate call and panel fixed effects. Standard errors are clustered at the PI level.

We next examine whether estimated funding effects also differ across applicant characteristics, focusing on PI gender and seniority. Table 8 explores effect heterogeneity by PI gender. It should be interpreted cautiously because dividing the sample by gender

substantially reduces statistical precision.¹¹ In the RD estimates, the estimated funding effects are larger for female PIs. AZV funding increased the total publication count of female PIs by 5.3 papers (40%), compared to 2.5 papers (18%) for male PIs. More importantly, the gains for women were concentrated in leading authorship positions: first-author publications increased by about 1.9 (130%) and last-author publications by about 3.5 (136%). Female PIs also show particularly large gains in last-author Q1+Q2 publications (2.0 papers, 160%). These patterns are consistent with potentially stronger effects for female applicants near the funding cutoff.

The AIPW estimates also suggest larger average gains for women in total output, but they do not show corresponding positive average effects for first-author and last-author publication outcomes; if anything, those estimates are generally small, imprecise, and in some cases negative. The analysis does not provide a formal basis for concluding that treatment effects differ systematically by gender, and the broader AIPW estimates do not reproduce the same leading-authorship pattern. We therefore interpret the female RD estimates as suggestive evidence concerning applicants near the funding cutoff rather than as evidence that AZV grants are generally more effective for women.

Table 9 then explores effect heterogeneity by PI seniority. In the RD estimates, AZV funding had stronger effects for less senior PIs (those without associate or full professor titles). Among these PIs, total, first- and last-author publications increased by 4.6, 1.2 and 1.8 papers (37%, 73% and 75%), respectively, with significant gains also in Q1+Q2 journals and citations. By contrast, the estimated effects for senior PIs (associate and full professors) are considerably smaller and statistically insignificant. As less senior PIs are likely to have fewer alternative funding options, these results are again consistent with the idea that similar grants have stronger effects for more funding-constrained PIs, at least around the funding cutoff.

The AIPW estimates are consistent with this interpretation in that average effects on total output remain positive, but they imply a weaker seniority gradient away from the cutoff. In particular, the AIPW estimates imply positive average effects on total WoS publications for both senior and non-senior PIs, with only small differences between groups compared to the RD results. For authorship-position outcomes, the AIPW estimates are positive but generally small and imprecisely estimated for both groups, providing limited evidence of strong seniority-based heterogeneity in first- and last-author publication outcomes in the broader sample. These patterns indicate particularly large gains for non-senior PIs among applicants close to the funding cutoff, while average effects farther from the margin are more similar across seniority groups.

¹¹In particular, the female RD specification contains 258 observations.

Table 9: AIPW and RD estimates: funding effects by seniority

	All publications			First author			Last author		
	All	Q1+Q2	Citations	All	Q1+Q2	Citations	All	Q1+Q2	Citations
Senior (AIPW)	2.35*** (0.79)	0.66 (0.40)	42.79* (23.41)	0.23 (0.19)	0.06 (0.12)	3.24 (3.40)	0.59* (0.34)	0.30 (0.21)	3.34 (4.19)
Observations	483	483	483	483	483	483	483	483	483
Senior (RD)	1.52 (1.70)	0.42 (1.01)	51.59 (45.57)	0.54 (0.43)	0.50 (0.30)	8.34 (7.18)	1.14 (0.82)	0.78 (0.52)	4.24 (10.00)
Observations	463	463	463	463	463	463	463	463	463
Non-senior (AIPW)	1.98*** (0.68)	0.25 (0.38)	13.37 (16.07)	0.23 (0.18)	-0.13 (0.11)	2.06 (2.32)	0.36 (0.27)	0.12 (0.13)	-3.83 (4.39)
Observations	528	528	528	528	528	528	528	528	528
Non-senior (RD)	4.60*** (1.41)	1.63** (0.81)	68.13** (32.68)	1.18*** (0.42)	0.35 (0.29)	20.63*** (7.05)	1.83*** (0.62)	0.99*** (0.30)	23.45*** (8.54)
Observations	508	508	508	508	508	508	508	508	508

Notes: *** 1%, ** 5%, * 10%. The table reports AIPW and RD estimates of the effects of AZV funding by researcher seniority. Senior researchers are defined as applicants holding the rank of Professor or Associate Professor at the time of application. Non-senior researchers are those not holding either of these ranks. Outcomes are measured cumulatively over the post-treatment period from t_0 to $t_0 + 4$. RD estimates are based on Equation 1 using a local linear specification with a triangular kernel and a baseline ranking bandwidth of 20, while AIPW estimates are obtained using Equation 5. RD estimates control for the pre-treatment value of the outcome and include call-panel fixed effects. AIPW estimates control for pre-treatment researcher characteristics; because of the smaller subgroup samples, both AIPW equations include separate call and panel fixed effects. Standard errors are clustered at the PI level.

6 Conclusion

The main contribution of this paper is not simply to show that grants increase publications, but to demonstrate that what grants appear to produce depends on both how scientific output is measured and which treatment effect is being estimated. In collaborative biomedical research, total publication counts are an incomplete metric: they combine publications in which the principal investigator (PI) occupies a leading scientific role with publications reflecting participation in broader team production. Our results show that funding increases overall output, but the increases are disproportionately larger for publications in which the PI is a leading author. Because authorship order is only an observable proxy for intellectual leadership, this should not be interpreted as a literal measure of individual effort. Even so, the consistent pattern across publication counts, higher-tier journal output, and citations indicates that grants affect not only the quantity of research output but also its composition.

The comparison between RD and AIPW is also part of the substantive contribution. The RD design identifies the effect of funding for applications at the call-panel cutoff, while the AIPW estimates summarize average effects across a broader applicant sample

under selection on observables. Both approaches indicate positive effects on publication output, with larger first- and last-author publication effects in RD. This difference is reinforced by the AIPW heterogeneity analysis, which finds larger leading-authorship gains for lower-ranked funded projects closer to the cutoff. The agreement between the comparison across estimators and the ranking comparison within AIPW strengthens the interpretation that returns to funding are higher for more marginally supported projects.

Separately, the local RD estimates suggest comparatively large gains for female PIs and for applicants without senior academic titles, although the smaller subgroup samples and the differences between RD and AIPW estimates mean that these patterns should be viewed as suggestive evidence. These subgroup patterns are consistent with the possibility that grants matter more when alternative funding options are limited.

Two broader implications follow. First, evaluations based solely on total publication counts are likely to understate the impact of grants on outputs that more plausibly reflect observable PI leadership in collaborative fields. Second, the design and targeting of science funding should consider not only proposal quality and the past achievements of PIs but also the availability (or lack) of alternative funding for different applicants.

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A Appendix

Table A.1: AIPW: Effect of Funding by Future Applications Restrictions

Application restriction	All publications			First author			Last author		
	All	Q1+Q2	Citations	All	Q1+Q2	Citations	All	Q1+Q2	Citations
All	1.70*** (0.47)	0.27 (0.27)	25.81** (12.79)	0.25** (0.12)	-0.01 (0.08)	3.51* (1.94)	0.39** (0.20)	0.12 (0.12)	2.21 (2.88)
Observations	1119	1119	1119	1119	1119	1119	1119	1119	1119
1	1.89*** (0.50)	0.37 (0.28)	22.77 (14.34)	0.29** (0.13)	0.01 (0.08)	2.84 (2.20)	0.39* (0.21)	0.15 (0.13)	0.89 (3.06)
Observations	1011	1011	1011	1011	1011	1011	1011	1011	1011
2	1.76*** (0.50)	0.31 (0.28)	23.67* (14.22)	0.26* (0.13)	-0.00 (0.08)	2.73 (2.20)	0.37* (0.22)	0.13 (0.13)	1.04 (3.07)
Observations	991	991	991	991	991	991	991	991	991
3	1.80*** (0.50)	0.38 (0.28)	25.50* (13.63)	0.27** (0.13)	0.00 (0.08)	3.30 (2.25)	0.36 (0.22)	0.16 (0.13)	1.16 (3.09)
Observations	970	970	970	970	970	970	970	970	970

Notes: *** 1%, ** 5%, * 10%. The table reports AIPW estimates of the effects of AZV funding under alternative restrictions on subsequent AZV funding. “All” uses the full estimation sample. In rows 1–3, applications are excluded if the same PI receives AZV funding within the subsequent 1, 2, or 3 years, respectively. Outcomes are measured cumulatively over the post-treatment period from t_0 to $t_0 + 4$. Estimates are obtained using AIPW based on Equation 5. The treatment equation includes separate call and panel fixed effects, and the outcome equation includes call-panel fixed effects. Standard errors are clustered at the PI level.

Table A.2: AIPW: Effect of Funding by Project Ranking Restriction

Rank restriction	All publications			First author			Last author		
	All	Q1+Q2	Citations	All	Q1+Q2	Citations	All	Q1+Q2	Citations
All	1.91*** (0.50)	0.51* (0.28)	5.17 (14.25)	0.21* (0.13)	-0.03 (0.08)	1.84 (2.01)	0.33* (0.20)	0.11 (0.13)	-0.59 (2.86)
Observations	1211	1211	1211	1211	1211	1211	1211	1211	1211
-30	1.84*** (0.49)	0.42 (0.28)	9.85 (13.80)	0.21 (0.13)	-0.03 (0.08)	2.12 (2.04)	0.35* (0.20)	0.13 (0.12)	0.24 (2.85)
Observations	1140	1140	1140	1140	1140	1140	1140	1140	1140
-20	1.89*** (0.50)	0.37 (0.28)	22.77 (14.34)	0.29** (0.13)	0.01 (0.08)	2.84 (2.20)	0.39* (0.21)	0.15 (0.13)	0.89 (3.06)
Observations	1011	1011	1011	1011	1011	1011	1011	1011	1011
-15	2.04*** (0.52)	0.38 (0.30)	25.78* (15.19)	0.31** (0.14)	0.01 (0.09)	2.42 (2.34)	0.40* (0.23)	0.16 (0.14)	-0.19 (3.34)
Observations	897	897	897	897	897	897	897	897	897
-10	2.37*** (0.53)	0.58* (0.33)	22.63 (18.28)	0.42*** (0.15)	0.07 (0.11)	3.78* (2.25)	0.74*** (0.24)	0.34** (0.16)	5.14* (3.10)
Observations	753	753	753	753	753	753	753	753	753

Notes: *** 1%, ** 5%, * 10%. Each row applies a different ranking restriction to the control group, defined as retaining only unfunded projects with rank distance greater than or equal to the reported cutoff. Less negative cutoffs (such as -10) impose stricter restrictions by keeping only higher-ranked unfunded projects. Estimates are obtained using AIPW based on Equation 5. Outcomes are measured cumulatively over the post-treatment period from t_0 to $t_0 + 4$. Baseline covariates are measured as described in Section 3. The outcome equation includes call-panel fixed effects and controls for the outcome-specific pre-treatment level, while the treatment equation includes separate call and panel fixed effects and the same baseline covariates. Standard errors are clustered at the PI level.

Table A.3: RD estimates: robustness to changing the outlier rule

Publication restriction	All publications			First author			Last author		
	All	Q1+Q2	Citations	All	Q1+Q2	Citations	All	Q1+Q2	Citations
No restriction	2.72* (1.54)	1.44** (0.71)	-38.04 (52.26)	1.22*** (0.32)	0.52** (0.21)	13.24*** (4.68)	1.33* (0.74)	0.76** (0.35)	18.86 (16.26)
N (left)	605	605	605	605	605	605	605	605	605
N (right)	467	467	467	467	467	467	467	467	467
Max 100	2.24* (1.32)	1.19* (0.63)	-28.62 (41.28)	1.17*** (0.33)	0.47** (0.21)	12.91*** (4.89)	0.97* (0.59)	0.65** (0.33)	8.84 (7.00)
N (left)	602	602	602	602	602	602	602	602	602
N (right)	462	462	462	462	462	462	462	462	462
Max 75	2.23* (1.30)	1.14* (0.63)	-26.86 (40.58)	1.18*** (0.32)	0.49** (0.21)	13.12*** (4.85)	0.81 (0.60)	0.63* (0.33)	5.73 (6.93)
N (left)	596	596	596	596	596	596	596	596	596
N (right)	454	454	454	454	454	454	454	454	454
Max 50 (Baseline)	3.12*** (1.05)	1.14* (0.63)	52.12* (27.26)	0.89*** (0.30)	0.40* (0.21)	11.19** (4.92)	1.38*** (0.49)	0.83*** (0.30)	12.35** (6.26)
N (left)	565	565	565	565	565	565	565	565	565
N (right)	406	406	406	406	406	406	406	406	406
Max 30	1.96** (0.91)	0.88 (0.61)	11.58 (24.97)	0.53** (0.26)	0.15 (0.19)	8.22** (3.93)	0.77* (0.40)	0.58** (0.25)	7.22 (5.85)
N (left)	494	494	494	494	494	494	494	494	494
N (right)	309	309	309	309	309	309	309	309	309

Notes: *** 1%, ** 5%, * 10%. The table reports RD estimates of the effect of AZV funding on publication outcomes measured cumulatively in the post-treatment period from t_0 to $t_0 + 4$. Estimates are based on estimating Equation 1 using local linear RD with a triangular kernel. Results are reported under alternative restrictions on the maximum number of publications. All specifications control for pre-treatment outcome variables and call-panel fixed effects. Standard errors are clustered at the PI level.

Table A.4: Placebo RD estimates: pre-treatment PI characteristics

Bandwidth	Assoc. prof.	Full prof.	Experience	Female	University	Acad. of Sci.
Infinite	-0.00 (0.06)	0.09 (0.06)	0.20 (0.24)	-0.01 (0.06)	0.10 (0.06)	-0.04 (0.03)
N (left)	785	785	785	785	785	785
N (right)	426	426	426	426	426	426
Wide	0.02 (0.06)	0.06 (0.06)	0.18 (0.26)	-0.01 (0.07)	0.08 (0.06)	-0.03 (0.03)
N (left)	705	705	705	705	705	705
N (right)	422	422	422	422	422	422
Baseline	0.07 (0.07)	0.04 (0.07)	0.41 (0.32)	0.02 (0.08)	0.09 (0.07)	-0.04 (0.04)
N (left)	565	565	565	565	565	565
N (right)	406	406	406	406	406	406
Narrow	0.11 (0.09)	0.04 (0.09)	0.75* (0.41)	-0.03 (0.09)	0.09 (0.09)	-0.06 (0.05)
N (left)	293	293	293	293	293	293
N (right)	317	317	317	317	317	317

Notes: *** 1%, ** 5%, * 10%. The table reports placebo RD estimates of the effect of AZV funding on PI characteristics measured in the application year ($t_0 - 1$). Estimates are based on estimating [Equation 1](#) without the pre-treatment outcome control using local linear RD with a triangular kernel. Results are reported for the full sample and for symmetric bandwidths of 30, 20, and 10 ranks around the cutoff. All specifications include call-panel fixed effects. Standard errors are clustered at the PI level.

Table A.5: Placebo RD estimates: pre-treatment institutional characteristics and funding

Bandwidth	Inst. size (staff)	Inst. Avg. WoS pubs.	GACR	Min. of Health funding
Infinite	-1.61 (1.70)	0.77 (1.09)	-0.01 (0.05)	0.05 (0.07)
N (left)	785	785	785	785
N (right)	426	426	426	426
Wide	-1.88 (1.81)	0.42 (1.15)	-0.04 (0.05)	0.09 (0.07)
N (left)	705	705	705	705
N (right)	422	422	422	422
Baseline	-2.14 (2.10)	-0.16 (1.32)	-0.08 (0.06)	0.10 (0.08)
N (left)	565	565	565	565
N (right)	406	406	406	406
Narrow	-3.32 (2.54)	0.63 (1.62)	-0.09 (0.08)	0.15 (0.10)
N (left)	293	293	293	293
N (right)	317	317	317	317

Notes: *** 1%, ** 5%, * 10%. The table reports placebo RD estimates of the effect of AZV funding on institutional characteristics, measured in the application year ($t_0 - 1$), and prior funding, measured over the pre-treatment period ($t_0 - 5$ to $t_0 - 1$). Estimates are based on estimating Equation 1 without the pre-treatment outcome control using local linear RD with a triangular kernel. Results are reported for the full sample and for symmetric bandwidths of 30, 20, and 10 ranks around the cutoff. All specifications include call-panel fixed effects. Standard errors are clustered at the PI level.

Table A.6: Placebo AIPW: pre-treatment PI characteristics

	Assoc. prof.	Full prof.	Experience	Female	University	Acad. of Sci.
ATE	0.01 (0.01)	-0.01 (0.01)	0.01 (0.03)	-0.00 (0.01)	0.01 (0.01)	-0.00 (0.01)
Observations	1011	1011	1011	1011	1011	1011

Notes: *** 1%, ** 5%, * 10%. The table reports placebo AIPW estimates of the effect of AZV funding on researcher and institution characteristics measured in the application year ($t_0 - 1$). Estimates are based on Equation 5. The treatment equation includes baseline covariates and separate call and panel fixed effects, while the outcome equation includes only call-panel fixed effects. Standard errors are clustered at the PI level.

Table A.7: Placebo AIPW: pre-treatment institutional characteristics and funding

	Inst. size (staff)	Inst. Avg. WoS pubs.	GACR	Min. of Health funding
ATE	0.30 (0.28)	0.10 (0.14)	-0.00 (0.01)	0.00 (0.01)
Observations	1011	1011	1011	1011

Notes: *** 1%, ** 5%, * 10%. The table reports placebo AIPW estimates of the effect of AZV funding on institutional characteristics, measured in the application year ($t_0 - 1$), and prior funding, measured over the pre-treatment period ($t_0 - 5$ to $t_0 - 1$). Estimates are based on Equation 5. The treatment equation includes baseline covariates and separate call and panel fixed effects, while the outcome equation includes only call-panel fixed effects. Standard errors are clustered at the PI level.

Table A.8: RD estimates: robustness checks

Specification	All publications			First author			Last author		
	All	Q1+Q2	Citations	All	Q1+Q2	Citations	All	Q1+Q2	Citations
Baseline	3.12*** (1.05)	1.14* (0.63)	52.12* (27.26)	0.89*** (0.30)	0.40* (0.21)	11.19** (4.92)	1.38*** (0.49)	0.83*** (0.30)	12.35** (6.26)
N (left)	565	565	565	565	565	565	565	565	565
N (right)	406	406	406	406	406	406	406	406	406
Zero-degree poly.	2.92*** (0.77)	0.76 (0.46)	52.73** (21.10)	0.71*** (0.21)	0.26* (0.14)	7.03** (3.32)	0.85** (0.35)	0.43* (0.23)	8.52** (4.22)
N (left)	565	565	565	565	565	565	565	565	565
N (right)	406	406	406	406	406	406	406	406	406
Quadratic poly.	2.81** (1.33)	1.17 (0.82)	48.79 (35.94)	1.19*** (0.39)	0.67** (0.27)	16.94** (6.61)	1.86*** (0.65)	1.11*** (0.39)	11.17 (8.58)
N (left)	565	565	565	565	565	565	565	565	565
N (right)	406	406	406	406	406	406	406	406	406
Uniform kernel	3.80*** (1.07)	1.40** (0.62)	49.59 (31.80)	0.75** (0.29)	0.32* (0.19)	8.29* (4.44)	1.28*** (0.46)	0.70** (0.29)	13.30** (5.66)
N (left)	585	585	585	585	585	585	585	585	585
N (right)	408	408	408	408	408	408	408	408	408
No outcome controls	4.11** (1.79)	1.07 (0.87)	84.81** (43.20)	0.73** (0.36)	0.26 (0.24)	10.90* (6.12)	1.45** (0.68)	0.64* (0.36)	13.52 (8.65)
N (left)	565	565	565	565	565	565	565	565	565
N (right)	406	406	406	406	406	406	406	406	406

Notes: *** 1%, ** 5%, * 10%. The table reports RD estimates of the effect of AZV funding on publication outcomes using alternative local polynomial specifications and kernel choices. All estimates use the baseline symmetric bandwidth of 20 ranks around the cutoff and are based on estimating Equation 1. We report results from a local linear specification (baseline), a local constant specification, and a local quadratic specification for the running variable, as well as a local linear specification with a uniform kernel. All specifications control for pre-treatment outcome variables (except the specification without outcome controls) and call-panel fixed effects. Standard errors are clustered at the PI level.

Table A.9: AIPW: Effect of Funding on Publications by Years After Funding

Years rel. to funding	All publications			First author			Last author		
	All	Q1+Q2	Citations	All	Q1+Q2	Citations	All	Q1+Q2	Citations
t_0	0.17 (0.15)	-0.02 (0.10)	10.81* (6.21)	0.02 (0.05)	-0.07** (0.03)	1.38* (0.82)	0.03 (0.07)	-0.04 (0.05)	0.47 (1.10)
Observations	1011	1011	1011	1011	1011	1011	1011	1011	1011
$t_0 + 1$	0.37** (0.16)	0.11 (0.10)	-3.04 (8.04)	0.05 (0.04)	0.02 (0.03)	-0.59 (0.76)	0.07 (0.07)	0.04 (0.04)	-0.24 (1.11)
Observations	1011	1011	1011	1011	1011	1011	1011	1011	1011
$t_0 + 2$	0.15 (0.15)	-0.05 (0.09)	3.51 (3.92)	0.04 (0.04)	0.02 (0.03)	0.53 (0.86)	-0.01 (0.06)	-0.01 (0.04)	-1.08 (1.05)
Observations	1011	1011	1011	1011	1011	1011	1011	1011	1011
$t_0 + 3$	0.44*** (0.15)	0.06 (0.09)	-3.88 (5.32)	0.06 (0.04)	-0.03 (0.03)	0.94 (0.61)	0.11 (0.07)	0.02 (0.04)	1.59 (1.12)
Observations	1011	1011	1011	1011	1011	1011	1011	1011	1011
$t_0 + 4$	0.76*** (0.18)	0.27*** (0.10)	15.37*** (4.41)	0.13*** (0.04)	0.06** (0.03)	0.59 (0.39)	0.18** (0.08)	0.13*** (0.05)	0.16 (0.94)
Observations	1011	1011	1011	1011	1011	1011	1011	1011	1011

Notes: *** 1%, ** 5%, * 10%. Each row corresponds to event time relative to funding (t_0 to $t_0 + 4$). Estimates are obtained using AIPW based on Equation 5. Outcomes are measured separately in each reported post-treatment year. Baseline covariates are measured as described in Section 3. The outcome equation includes call-panel fixed effects and controls for the outcome-specific pre-treatment level, while the treatment equation includes separate call and panel fixed effects and the same baseline covariates. Standard errors are clustered at the PI level.

Abstrakt

Článek zkoumá, zda výzkumné granty vedou k samostatnému výzkumu podpořeného hlavního řešitele. Publikace, v nichž je řešitel prvním nebo posledním autorem, což v biomedicínském výzkumu signalizuje vůdčí podíl na práci, odlišujeme od celkového publikačního výkonu. Na datech o českých grantech na zdravotnický výzkum udělených v letech 2015–2019 kombinujeme metodu regresní diskontinuity (RD) v okolí hranice podpory s rozšířeným inverzním vážením pravděpodobností (AIPW), které odhaduje průměrné efekty v širším vzorku žadatelů. Odhady RD ukazují, že granty zvyšují celkový počet publikací o 3,1 článku (22 %). Počet publikací, v nichž je řešitel prvním, resp. posledním autorem, vzroste proti kontrolní skupině o 59 %, resp. 41 %, tedy výrazně více než celkový publikační výkon. Tyto přínosy se projevují také u publikací ve vlivnějších časopisech a v počtu citací. Odhady AIPW jsou kvalitativně v souladu, ale menší. V rámci AIPW jsou efekty na publikace s řešitelem jako prvním či posledním autorem větší u podpořených projektů blíže hranici podpory, což svědčí o heterogenitě výnosů z financování. Explorativní odhady pro podskupiny naznačují poměrně velké lokální efekty u řešitelů a u méně seniorních řešitelů; vzhledem k menšímu počtu pozorování a odlišným výsledkům AIPW je však třeba je interpretovat opatrně.

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