

Governing Knowledge Reuse through Research Infrastructure: Evidence from the arXiv License Interface

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Abstract

The AI era makes a long-standing distinction in open science newly consequential: papers that are free to read are not necessarily free to reuse, and permissions to mine, translate, adapt, or incorporate them into computational systems are often assigned through routine submission workflows. This paper asks whether research infrastructures can govern those permissions through interface design. We study a natural experiment on arXiv: on November 9, 2020, the platform reordered its license menu, moving Creative Commons Attribution (CC BY), a license that permits broad reuse with attribution, to the most prominent position and adding a non-commercial no-derivatives Creative Commons option. In a local 90-day regression-discontinuity-in-time design, the redesign increased adoption of Creative Commons Attribution and Attribution-ShareAlike licenses (CC BY/CC BY-SA) by 27.8 percentage points from a pre-cutoff baseline of 5.8%. The response is immediate, broad across fields, and aligned with the timing of the platform redesign rather than with contemporaneous funder mandates. We find no citation premium once citation-age accumulation is addressed, and no comparable shift in publisher-side open access. The findings show that modest changes

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in submission interfaces can materially reallocate the legal freedoms through which scientific work is copied, adapted, mined, and built upon at scale.

Keywords: platform governance; open science; open licensing; research infrastructure; Creative Commons; choice architecture

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1 Introduction

Open science is often framed as a problem of access: who can read scientific work, and at what cost. Yet free access to read does not imply legal freedom to reuse, a distinction made newly consequential as scientific outputs are mined, translated, adapted, and incorporated into computational systems. This paper asks whether legal openness is shaped not only by funder mandates, but also by the infrastructure through which scientists submit and disseminate their work. The question matters because scientific communication is increasingly mediated by platforms that do not merely host content. They structure the workflows in which researchers make low-salience but legally consequential choices about how their work can be reused.

Open licensing provides a useful setting because licenses make legal reuse rights explicit, standardized, and observable. Creative Commons Attribution (CC BY), which permits broad reuse with attribution, is central to open-science policy because it standardizes rights and reduces the transaction costs of lawful downstream use. In practice, license adoption is implemented through repository submission interfaces and menu designs that present legal options at the point of choice. arXiv is a particularly useful setting because the access margin is largely fixed: papers posted on arXiv are freely readable, but the legal permissions governing reuse vary across submissions. While prior work has studied arXiv preprints, journal publication, and scholarly attention (Larivière et al., 2014; Davis and Fromerth, 2007), the licensing margin—whether arXiv papers are legally open for downstream reuse—has received much less attention.

We use arXiv’s November 9, 2020 license-interface redesign as a natural experiment. The redesign moved Creative Commons Attribution (CC BY) to the most prominent standard position in the license menu and added a non-commercial no-derivatives Creative Commons option, while leaving authors free to choose and imposing no default. We assign treatment by first-version submission date and estimate a local regression-discontinuity-in-time design around the redesign. Because public arXiv metadata report paper-level licenses rather than

version-specific license histories, the main analysis restricts to single-version papers, yielding a preferred ± 90 -day sample of 49,677 papers. The timing of the redesign also permits comparison between the repository-interface channel and nearby funder-mandate pressures.

The redesign produced a sharp and immediate shift toward attribution-based Creative Commons licensing. In the preferred local regression-discontinuity-in-time specification, CC BY/CC BY-SA adoption increased by 27.8 percentage points from a pre-cutoff baseline of 5.8%. The estimate is stable across bandwidths, robust to field and author-count controls, and not accompanied by a discontinuity in submission volume. Additional timing and heterogeneity checks support a repository-interface interpretation rather than a broad funder-mandate interpretation.

We also examine whether the licensing shift translated into outcomes beyond the legal status of the arXiv preprint. We find no evidence of a positive citation premium once citation age is addressed, and no comparable shift in the publisher-side open-access status of the eventual journal version. These results reinforce the distinction between legal openness and access openness: changing reuse rights on an already-free-to-read preprint reshapes the legal conditions for downstream use without necessarily increasing citations or changing publisher-side access.

The paper makes three contributions. First, it contributes to research policy and the economics of science by showing that the legal conditions for knowledge circulation can be shaped not only by funders, publishers, intellectual-property rules, and access mandates, but also by the design of research infrastructure (Furman and Stern, 2011; Murray and Stern, 2007; Gans et al., 2017). Second, it contributes to platform governance, infrastructure studies, and choice architecture by showing that ordinary submission workflows can allocate legally consequential reuse rights (Star and Ruhleder, 1996; Gawer, 2014; Boudreau and Hagi, 2009; Tiwana et al., 2010; Gorwa, 2019; Johnson et al., 2012). Third, by holding reading access largely fixed, the paper separates access openness from legal openness and shows why a large shift in reuse rights need not generate a citation premium or change

publisher-side open-access status (Suber, 2012; Davis, 2011; McCabe and Snyder, 2014; Piwowar et al., 2018). The broader implication is that research infrastructures are not neutral conduits: routine repository workflows can determine the legal freedoms attached to scientific work at scale.

2 Institutional Background

2.1 arXiv as Research Infrastructure

arXiv was founded in 1991 by Paul Ginsparg as an electronic repository for physics preprints and subsequently became a central infrastructure for rapid dissemination in the physical, mathematical, and computational sciences (Ginsparg, 2011; arXiv, 2026a). It now serves physics, mathematics, computer science, quantitative biology, quantitative finance, statistics, electrical engineering and systems science, and economics, and hosted roughly three million scholarly articles by early 2026 (arXiv, 2026a,e). This scale and disciplinary concentration make arXiv a useful setting for studying policy choices embedded in scientific communication infrastructure rather than in a single journal, funder, or field.

arXiv is not merely a passive hosting site. It has been institutionalized through Cornell and developed into a community-supported research infrastructure with formal governance, community funding, submission rules, moderation, endorsement, and licensing procedures (arXiv, 2026a,c,b,d). These features position arXiv as a de facto governance entity for the disciplines it serves: it does not peer review papers, but it structures how research is submitted, screened, archived, and legally distributed.

The relevant institutional feature for this paper is that the access margin is largely fixed. Articles posted on arXiv can be viewed and downloaded freely through the repository, but submitters must still choose the legal terms under which the work can be distributed and reused. This choice is part of the ordinary submission process: arXiv states that the license is chosen by the submitter, that the submitter must certify the right to grant it, and that funder

and journal policies may constrain the choice (arXiv, 2026d). Prior work has used arXiv to study the relationship between preprints, journal publication, and scholarly attention (Larivière et al., 2014; Davis and Fromerth, 2007); the licensing terms attached to arXiv submissions have received substantially less attention.

2.2 Licensing as Legal Infrastructure

Licensing is the central institutional margin in this paper. In arXiv’s setting, a paper’s license does not determine whether the paper can be read: arXiv articles can be viewed and downloaded freely through the repository. Instead, the license determines the rights that other actors receive after access has been obtained. The empirical outcome is therefore not open access in the narrow sense of access to reading, but the legal openness of scientific outputs (arXiv, 2026d).

Table 1 summarizes the license options available around the November 2020 redesign, their implications for third-party reuse, their relationship to Plan S licensing rules, and their position in the arXiv selection menu. The main contrast is between CC BY and the arXiv perpetual non-exclusive license. CC BY allows third parties to redistribute, adapt, build upon, and commercially use the work, provided that attribution is given. By contrast, the arXiv perpetual non-exclusive license gives arXiv limited rights to distribute the article but does not itself grant broad reuse permissions directly to other entities or individuals (arXiv, 2026d,f; Creative Commons, 2026).

This distinction makes licensing an economically meaningful outcome. Standardized ex ante reuse rights reduce the transaction costs of lawful downstream use by repositories, publishers, firms, educators, translators, indexing services, and text-mining systems. Conversely, restrictive or platform-specific licenses preserve author control but shift permission-seeking costs to users who want to copy, adapt, redistribute, or incorporate scientific work into other products or infrastructures. The distinction also disciplines the interpretation of later results. Because arXiv already removes price and access barriers to reading, a shift toward CC BY

Table 1: The arXiv license menu before and after the November 2020 redesign

License	Third-party reuse rights	Plan S route ^a	Main ordering		2019 share (%)
			Before	After	
CC BY 4.0	Broad reuse, including redistribution, adaptation, and commercial use, with attribution.	Default	2	1	3.4
CC BY-SA 4.0	Broad reuse with attribution; adapted works must be licensed under identical terms.	Alternative	3	2	0.7
CC BY-NC-SA 4.0	Non-commercial redistribution and adaptation, with attribution and share-alike.	No	4	3	2.1
CC BY-NC-ND 4.0 ^b	Non-commercial redistribution with attribution; no derivative works.	No	–	4	–
arXiv perpetual non-exclusive	No direct third-party reuse grant; arXiv receives limited distribution rights.	No	1	5	92.1
CC0 1.0 ^c	Public-domain dedication; reuse without attribution or other conditions where legally possible.	Alternative	–	–	0.9

Notes. “Before” and “After” refer to each license’s position in the main reuse-license ordering before and after the November 9, 2020 redesign. A lower number denotes more prominent placement within that ordering. The redesign added CC BY-NC-ND 4.0 and reordered the main reuse licenses. License descriptions are based on arXiv’s license documentation and Creative Commons license summaries (arXiv, 2026d,f; Creative Commons, 2026). Shares are author calculations from arXiv submission metadata for January–December 2019 and may not sum to 100% because of residual or legacy license categories.

^a Plan S route classifies the license type under the cOAlition S publication-licensing framework. CC BY is the default route; CC BY-SA and CC0 are accepted alternatives (cOAlition S, 2026e). This column does not imply that Plan S generally requires arXiv preprints themselves to carry these licenses.

^b CC BY-NC-ND 4.0 was added to the arXiv license menu on November 9, 2020 (arXiv, 2020).

^c CC0 is shown because it was available as a license option, but it is excluded from the main reuse-license ordering because it is a public-domain dedication rather than a standard copyright-retention license.

need not generate a large citation response. Its main effect may instead lie in changing the legal infrastructure through which scientific knowledge can circulate, be recombined, and be incorporated into downstream applications.

2.3 The Pre-Intervention License Regime

Before the November 2020 redesign, the arXiv perpetual non-exclusive license occupied the first position in the main reuse-license ordering. This was the most platform-specific option: it granted arXiv distribution rights while leaving broad third-party reuse permissions outside the license itself (arXiv, 2026f). As shown in Table 1, the pre-intervention distribution of choices was highly concentrated. In 2019, approximately 92% of submissions used the arXiv perpetual non-exclusive license, whereas CC BY accounted for only 3–4% of submissions.

This concentration is useful for interpretation. The redesign did not occur in a setting where authors were evenly distributed across legally meaningful alternatives. It occurred in a setting where legal access to papers was already broad, but legally open reuse remained rare. The pre-intervention equilibrium therefore provides a clear baseline for evaluating how a change in platform governance altered the legal terms attached to scientific outputs.

2.4 The November 2020 Platform Intervention

On November 9, 2020, arXiv changed the license-selection interface used by submitting authors. The change had three components: it reordered the main reuse-license menu, added CC BY-NC-ND 4.0 as a new option, and accompanied the interface change with an institutional statement that arXiv “values openness and encourages choosing a liberal license” (arXiv, 2020). In arXiv’s description, the new ordering placed the main reuse licenses along a gradient from more liberal to more limited reuse, with CC0 treated as an exception. As a result, CC BY became the most prominent standard license option, while the arXiv perpetual non-exclusive license moved away from its previous first position. We refer to this package of simultaneous changes as the bundled redesign.

The documented intervention was not a mandate to use CC BY. License choice remained part of the submission workflow, and arXiv continued to describe the choice as the submitter’s responsibility (arXiv, 2026d). The available public archival evidence documents the addition of CC BY-NC-ND and the reordering of the license options; it does not document the rendered default state of the login-protected submission form. We therefore interpret the treatment as a bundled change in the documented license-choice environment rather than as a separately identified default intervention.

This intervention is a platform-governance intervention in a specific sense. Platforms govern not only by prices or formal rules, but also by structuring access, participation, architecture, and permissible interactions among users (Gawer, 2014; Boudreau and Hagiu, 2009; Tiwana et al., 2010). The arXiv redesign is therefore related to, but distinct from, the mechanisms emphasized in the choice-architecture literature: it is not a pure default effect (Johnson and Goldstein, 2003), nor a pure ordering or primacy effect (Bar-Hillel, 2015). It is also related to policy designs in scientific publishing that use workflow design, editorial rules, or low-cost signals to shift research practices, including open-practice badges, Registered Reports, and mandatory data-availability policies (Kidwell et al., 2016; Nosek and Lakens, 2014; Hardwicke et al., 2018). Our estimates capture the effect of the bundled redesign as a whole; they cannot separately identify the contribution of each component.

2.5 Plan S and Funder-Mediated Open Access Mandates

Plan S provides the main contemporaneous policy environment against which the arXiv redesign must be interpreted. Launched by cOAlition S, Plan S applies to peer-reviewed scholarly publications based on research funded fully or partially by cOAlition S member organizations, rather than to all publicly funded research in general (cOAlition S, 2026d). cOAlition S was launched in 2018 with support from the European Commission and the European Research Council (cOAlition S, 2026a). The ERC Scientific Council later announced in July 2020 that it would pursue open-access implementation independently of cOAlition S

(European Research Council, 2020). Implementing funders relevant to the policy environment include Wellcome, UKRI, NWO, FWF, and ANR (cOAlition S, 2026b). By contrast, researchers funded primarily by non-cOAlition S agencies—for example, the U.S. National Science Foundation or many Asian national funders—were not directly covered by Plan S. This boundary is central for interpreting differences in exposure to formal open-access mandates.

Plan S differs from the arXiv redesign in its governance channel. The bundled redesign operated through the submission interface rather than through grant conditions, journal publication routes, rights-retention requirements, or publisher-side licensing rules. Plan S, by contrast, is funder-mediated: compliance is tied to grant conditions, journal publication routes, rights-retention requirements, repository deposition, and the licensing of the Version of Record or Author Accepted Manuscript (cOAlition S, 2026c). A Plan S effect on arXiv licensing would therefore likely be indirect, arising if funded authors aligned preprint licenses with later publication requirements, became more attentive to licensing because of funder rules, or faced compliance constraints through journals and repositories.

This distinction matters for identification. A platform-interface effect should appear immediately after November 9, 2020, should be broad across authors exposed to the same arXiv interface, and may affect licenses not required by Plan S. A funder-mandate effect should appear closer to the January 2021 implementation window, or be concentrated among authors, countries, fields, or institutions more exposed to cOAlition S funding. The temporal proximity of the two events is therefore useful because they imply different empirical signatures. We use this proximity in Section 5 to distinguish platform-governance effects from formal funder-mandate effects.

3 Empirical Predictions

The institutional setting implies three testable predictions. We use these predictions to distinguish the platform-interface channel from contemporaneous funder-mandate exposure and to characterize whether the licensing shift carries over into later submissions.

First, if the arXiv redesign operated through the common submission workflow, CC BY/CC BY-SA adoption should change discontinuously at the November 9, 2020 cutoff. The effect should appear immediately, should be visible in local RDiT specifications, and should not be accompanied by discontinuities in submission volume or predetermined paper characteristics. Because the redesign bundled menu reordering, the addition of CC BY-NC-ND, and an institutional openness signal, the empirical estimand is the effect of the composite platform intervention rather than the separate effect of any single interface component.

Second, the platform channel and the Plan S channel imply different timing and scope. A platform-interface response should occur at the arXiv redesign date, should affect authors exposed to the same submission interface, and may shift license categories beyond those required for Plan S compliance. A mandate-dominant response should instead appear closer to the January 1, 2021 Plan S implementation window or be larger among papers with greater exposure to cOAlition S funders. We therefore test for an additional January 1 discontinuity, examine license-category movements, estimate field-level heterogeneity, and interact the cutoff with affiliation-country proxies for Plan S exposure.

Third, the redesign may affect later submissions by the same submitter, but there are two distinct forms of persistence. A durable exposure effect would imply that submitters first exposed to the redesigned interface are more likely to choose CC BY/CC BY-SA on their next eligible submission, even after controlling for prior licensing behavior. A weaker workflow-carryover interpretation would imply that the license actually chosen on the focal paper predicts later choices, without requiring a large reduced-form effect of exposure itself. We therefore estimate reduced-form carryover effects and separately report descriptive transition rates by focal license.

These predictions guide the empirical analysis. The main RDiT estimates test the immediate platform effect. The timing, license-category, field, career-stage, and Plan S-exposure analyses assess whether the response is broad or mandate-concentrated. The repeat-submitter analysis distinguishes reduced-form exposure carryover from descriptive persistence in the license actually chosen.

4 Data and Sample Construction

4.1 arXiv metadata and paper-level measures

The analysis begins from a March 2026 snapshot of the public arXiv metadata archive, which contains 2,989,000 records. The unit of observation is an arXiv paper. For each paper, the metadata record reports the arXiv identifier, title, abstract, author list, subject categories, license, DOI and journal reference when available, and the paper’s version history. The version history is central to the empirical design because it allows us to distinguish the date on which a paper first entered arXiv from subsequent revisions or metadata updates.

We construct the running variable from the timestamp of the paper’s first recorded version in the arXiv version history. The timestamp is reduced to the date level and measured in days relative to November 9, 2020, the date of the license-interface redesign. Papers first posted on November 9, 2020 are coded as post-treatment. This convention assigns treatment status according to the date on which the author first encountered the submission workflow for the paper, rather than according to later metadata changes.

The paper-level analysis file also records the number of versions, author count, publisher DOI availability, journal-reference availability, license indicators, and disciplinary field. We classify papers by the first listed arXiv category in the metadata, treating this as the primary category for cross-listed papers. Categories are then aggregated into broad fields: computer science, physics, mathematics, statistics, economics and quantitative finance, electrical engineering and systems science, quantitative biology, and other fields. Publisher DOI

availability excludes arXiv self-DOIs and is used for analyses that require publisher-side metadata; papers without publisher DOIs or journal references remain in the main arXiv sample.

The empirical analysis focuses on papers first posted between 2019 and 2022. This period brackets the November 2020 platform change while avoiding a long pre- or post-period in which arXiv’s disciplinary composition and licensing environment may have changed for other reasons. The main estimates further restrict to single-version papers, for the measurement reasons described in the next subsection. Sample sizes for the study-period file, the regression-discontinuity windows, and the linked external-data samples are reported in Section 4.4.

4.2 Licensing outcomes and version-history measurement

The main licensing outcome is an indicator for whether the paper is distributed under a standardized attribution-based Creative Commons license that grants broad third-party reuse rights. The indicator equals one for CC BY or CC BY-SA licenses and zero otherwise. We refer to this outcome as CC BY/CC BY-SA adoption. CC BY-SA is included because it is legally and institutionally closer to CC BY than to the arXiv perpetual non-exclusive license on the margin studied here: both are standardized Creative Commons licenses that grant broad reuse rights subject to attribution, although CC BY-SA additionally requires adapted works to be licensed under identical terms. All other license categories, including the arXiv perpetual non-exclusive license, non-commercial Creative Commons licenses, no-derivatives licenses, CC0, missing license values, legacy license strings, and unclassified license values, are coded as zero for this outcome. CC0 is kept separate because it is a public-domain dedication rather than an attribution-based copyright license.

A central measurement issue is that the public arXiv metadata do not contain a version-specific license history. The metadata record contains a single paper-level license field, while each element of the version history records the version number, posting date, and file size,

but not the license selected for that version. The version history therefore allows us to recover when each version was posted, but not the license that was active at each version. In a metadata snapshot, the observed license is consequently the current paper-level license recorded for the paper, rather than a complete history of license choices over time.

This structure creates a mechanical measurement problem for designs that use all papers around the November 9, 2020 interface change. Consider a paper first posted before the cutoff under the arXiv perpetual non-exclusive license and later revised after the redesigned license interface was introduced. If the author selected CC BY when submitting the revision, the metadata snapshot would record the paper as CC BY even though the paper first entered arXiv before treatment. Assigning treatment status by first-version date would then place the paper in the pre-treatment period, while the observed license would partly reflect a post-treatment choice. Conversely, assigning timing by a metadata update date would conflate new submissions with revisions of older papers. The issue is therefore both an outcome-measurement problem and a timing problem.

We assess the magnitude of this concern using multi-version papers. Among 62,744 multi-version papers whose version histories straddle the November 9, 2020 cutoff, 8.83% are observed with a CC BY/CC BY-SA license in the March 2026 metadata snapshot. Among 654,395 multi-version papers whose version histories lie entirely before the cutoff, the corresponding share is 1.86%. Because the latter all-time comparison group contains older cohorts with much lower baseline use of Creative Commons licenses, we also compute a recent-cohort benchmark. Restricting the all-pre-cutoff comparison group to multi-version papers first posted in 2019 or later raises the baseline share to 4.70% ($N = 84,473$), while the cross-cutoff share remains 8.76% ($N = 51,750$). These diagnostics are not causal estimates. They show that cross-cutoff revisions can mechanically contaminate the observed license status of papers first submitted before the interface change.

Our preferred specification therefore combines two restrictions. First, treatment status is assigned using the first-version posting date, measured in days relative to November 9, 2020,

rather than a metadata update date. Second, the main analysis is restricted to single-version papers. For these papers, the cross-cutoff revision channel is mechanically absent: there is no later paper version through which an author could encounter the redesigned submission interface and alter the license attached to an earlier submission. The public metadata still do not preserve a separate license-change history, so purely retroactive license edits that occur without a new paper version cannot be recovered from the archive. The single-version restriction should therefore be interpreted as eliminating the observable cross-cutoff revision channel, not as reconstructing an unobserved historical license log.

This restriction has a cost. Single-version papers may differ from revised papers in author experience, field composition, or paper-development process. We therefore report all-paper and alternative-timing specifications in the Appendix as diagnostics. The main estimates, however, use the single-version sample because it provides the cleanest mapping available in the public metadata between the submission interface encountered by the author and the license observed for the paper.

4.3 External data sources and matching

We link the arXiv analysis file to external bibliometric and institutional metadata for three secondary analyses: citation effects, country-level exposure to open-access mandates, and publisher-side open-access outcomes. These linked samples are not used to define the main regression-discontinuity sample. The baseline licensing estimates rely only on arXiv metadata, first-version dates, and the single-version restriction described above. The external matches are used for downstream and heterogeneity analyses where information outside arXiv is required.

Our primary cumulative-citation source is Semantic Scholar. We match arXiv papers to Semantic Scholar records using arXiv identifiers, which avoids conditioning citation measurement on the availability of a publisher DOI. This match covers 49,484 of the 49,677 single-version papers in the preferred ± 90 -day regression-discontinuity window, or 99.6% of

the sample. For each matched paper, we use total citation counts and influential citation counts. Because these counts are cumulative outcomes measured at a common extraction date, they are used primarily to document citation-age sensitivity rather than as the preferred citation-effect estimate.

For the age-robust citation analysis, we use OpenAlex yearly citation counts. OpenAlex does not provide citation-event dates in our data, but it reports yearly citation trajectories through `counts_by_year`. This allows us to construct fixed calendar-year citation outcomes, including calendar-2022 citations, which provide a common observation window for all papers in the preferred ± 90 -day sample. This OpenAlex yearly-citation sample contains 16,363 papers, corresponding to 32.9% of the preferred RDiT sample. Because the sample is DOI-linked and more selective than the Semantic Scholar arXiv-identifier match, we interpret the citation analysis as a secondary downstream check rather than as part of the main licensing design.

We also use OpenAlex to recover author-affiliation countries. The match is conducted using arXiv identifiers and publisher DOIs where available. The country variable refers to the country of an author’s institutional affiliation in OpenAlex, not to nationality, citizenship, or the location of the funder. We use these affiliation countries to construct several paper-level proxies for exposure to cOAlition S funders: first-author country, any-author country, last-author country, first-or-last author country, and the continuous share of authors affiliated with Plan S countries. In the preferred ± 90 -day window, the country-exposure analysis sample contains 15,713 papers, corresponding to 31.6% of the single-version analysis sample. Papers without matched affiliation countries are retained in the main RDiT and citation analyses but are excluded from the country-exposure heterogeneity analysis.

Finally, for the publisher-side open-access appendix, we use OpenAlex metadata for papers matched to publisher-side records. This sample is distinct from the main arXiv licensing sample because it conditions on the availability of publisher-side metadata. We use OpenAlex `oa_status` to classify the eventual publisher version as publisher-side open access, Green-

only open access, Bronze open access, or Closed. Publisher-side open access is coded as one for Gold, Hybrid, Bronze, or Diamond status and excludes repository-only Green open access. In the preferred ± 90 -day window, the publisher-side OA sample contains 38,129 papers; the corresponding ± 180 -day sample contains 77,523 papers. These analyses are reported in the Appendix because they address a separate institutional margin: whether the platform-induced change in preprint licensing affected the open-access status of the later publisher version.

Across these linked analyses, missing external matches are treated as sample restrictions for the corresponding secondary outcome rather than as missing values in the main analysis. This distinction is important because the main estimates concern license adoption on arXiv and do not require citation records, author-country metadata, or publisher-side open-access information. The linked samples are therefore interpreted as auxiliary analysis samples, with their coverage and selection limits reported alongside the relevant results.

Appendix Table A2 summarizes the coverage and selection patterns for the linked samples. Semantic Scholar coverage is near-complete in the preferred RDiT window. By contrast, the OpenAlex yearly-citation and country-exposure samples are strongly DOI-selected and should be interpreted as secondary analyses on a more formally published subset. Publisher-side OA coverage is higher because OpenAlex also indexes many arXiv preprints by arXiv DOI.

4.4 Analysis samples

Table 2 summarizes the analysis samples generated from the metadata, timing, version-history, and external-linkage rules described above. The main regression-discontinuity-in-time estimates are based on single-version arXiv papers and assign treatment status using the first-version posting date. The preferred specification uses the ± 90 -day window around the November 9, 2020 license-interface redesign; wider windows are used for robustness and timing checks. The Semantic Scholar, OpenAlex country, and publisher-side open-access

samples are linked samples used only for the corresponding secondary analyses and are not required for the main arXiv licensing estimates.

Local pre/post descriptive statistics for the preferred ± 90 -day single-version sample are reported in Appendix Table A5. Expanded descriptive statistics across the study-period and RDiT samples are reported in Appendix Table A6. These descriptive tables document sample composition and local covariate patterns; the regression-discontinuity estimates and validity diagnostics are reported in Section 6.

Table 2: Analysis Samples

Sample	Definition	N
Full arXiv metadata archive	Public arXiv metadata snapshot obtained in March 2026.	2,989,000
2019–2022 single-version sample	Single-version papers with valid first-version dates in the study period.	394,573
Preferred RDiT sample, ± 90 days	Single-version papers within ± 90 days of the November 9, 2020 redesign.	49,677
Robustness RDiT sample, ± 180 days	Single-version papers within ± 180 days of the November 9, 2020 redesign.	100,862
One-year RDiT window, ± 365 days	Single-version papers within ± 365 days of the November 9, 2020 redesign.	199,719
Semantic Scholar cumulative-citation sample	Preferred ± 90 -day sample matched to Semantic Scholar by arXiv identifier.	49,484
OpenAlex yearly-citation sample	Preferred ± 90 -day sample with OpenAlex yearly citation counts.	16,363
OpenAlex country-exposure sample	Preferred ± 90 -day sample with matched author-affiliation country data used in the Plan S exposure analysis.	15,713
Publisher-side open-access sample	Preferred ± 90 -day sample matched to OpenAlex publisher-side open-access metadata.	38,129

Notes. The unit of observation is an arXiv paper. RDiT samples restrict to single-version papers and use the first-version posting date as the running variable. Papers first posted on November 9, 2020 are coded as post-cutoff. Linked samples are used only for the corresponding citation, country-exposure, and publisher-side open-access analyses; they are not restrictions on the main licensing estimates.

5 Empirical Strategy

5.1 Overview and Estimands

The unit of observation in the main analysis is an arXiv paper, dated by its first-version submission date. The primary outcome is CC BY/CC BY-SA adoption, an indicator equal to one for papers licensed under CC BY or CC BY-SA. We also examine related outcomes, including broader liberal-license categories, non-commercial Creative Commons licenses, author-level persistence in subsequent submissions, and downstream citations. The main estimand is the local effect of the November 9, 2020 arXiv redesign on license choice for papers submitted near the cutoff. As Sections 2 and 3 make clear, this effect should be interpreted as the effect of the bundled redesign rather than as the effect of reordering alone.

The empirical analysis proceeds in five steps. We first estimate a regression-discontinuity-in-time design around the arXiv cutoff. We then assess the validity of the temporal discontinuity using submission-volume, balance, placebo, donut, and bandwidth checks. Next, we use timing, license categories, and exposure heterogeneity to distinguish platform-interface effects from contemporaneous funder mandates. We then examine whether the initial licensing response carries over in repeat submissions by the same normalized submitter. Finally, we study downstream citation and publisher-side open-access outcomes. The primary cutoff analysis uses the single-version sample described in Section 4.2; analyses involving repeat submitters or linked external data are treated as separate, explicitly defined designs.

5.2 The Platform Cutoff: Regression Discontinuity in Time

Our primary design is a regression discontinuity in time, using November 9, 2020 as the cutoff at which arXiv changed the license-selection interface. Let c denote the cutoff date, t_i the first-version submission date of paper i , $r_i = t_i - c$ the running variable measured in days, and $D_i = \mathbf{1}\{t_i \geq c\}$ an indicator for submissions after the redesign. For papers submitted within a symmetric bandwidth h around the cutoff, we estimate the local linear

specification

$$Y_i = \alpha + \tau D_i + \beta_1 r_i + \beta_2 (D_i \times r_i) + \mathbf{X}'_i \gamma + \varepsilon_i, \quad |r_i| \leq h, \quad (1)$$

where Y_i is the licensing outcome, primarily CC BY/CC BY-SA adoption. The coefficient τ is the local discontinuity in license choice at the platform redesign. We allow the slope in calendar time to differ on the two sides of the cutoff, so that identification comes from the jump at the cutoff rather than from imposing a common time trend.

The baseline specification uses first-version submission dates and the single-version sample defined in Section 4.2. This restriction avoids conflating the redesigned submission interface with later revisions of papers that may have been created under the pre-intervention interface or may inherit earlier licensing decisions. We report estimates without controls and with a parsimonious vector \mathbf{X}_i consisting of broad-field fixed effects and author count. These covariates are not required for identification in the local design, but they improve precision and provide a check that the estimated discontinuity is not driven by observable composition changes.

The identifying assumption is local continuity: absent the interface redesign, the conditional expectation of the licensing outcome would have evolved smoothly through November 9, 2020. Under this assumption, τ identifies the local effect of the bundled redesign on papers submitted near the cutoff. Because the running variable is calendar time and many observations share the same submission date, we cluster standard errors by submission date in the main specifications. The baseline estimates use local linear regressions, consistent with standard recommendations for regression-discontinuity designs (Lee and Lemieux, 2010; Calonico et al., 2014). Higher-order polynomials are not used as primary specifications; local quadratic fits and alternative bandwidths are reported as robustness checks rather than as coequal main estimates (Gelman and Imbens, 2019).

5.3 Validity of the Temporal Cutoff

The regression-discontinuity-in-time design requires that, absent the redesign, potential licensing outcomes would have evolved smoothly through November 9, 2020. Because the running variable is calendar time, the main threats are not only manipulation of the running variable, but also discontinuous changes in the composition of submissions or other contemporaneous shocks. We therefore assess the credibility of the cutoff using four sets of tests.

First, we examine sorting around the cutoff. Authors could in principle delay or accelerate submissions if they anticipated the interface change, which would threaten the local comparison. We test for discontinuities in the daily number of first-version submissions using the same local linear structure as in Equation (1). Since the running variable is discrete at the daily level, we treat this as a submission-volume test rather than as a literal continuous-density test, while following the logic of manipulation tests in regression-discontinuity designs (McCrary, 2008).

Second, we test for balance in predetermined paper and author characteristics. For each covariate Z_i , we estimate

$$Z_i = \alpha_z + \kappa_z D_i + \beta_{1z} r_i + \beta_{2z} (D_i \times r_i) + u_i, \quad |r_i| \leq h, \quad (2)$$

where Z_i includes field or category indicators, author-country indicators where available, team size, prior arXiv experience, and other characteristics determined before license choice. A credible cutoff should not generate systematic jumps in these predetermined attributes.

Third, we estimate placebo discontinuities at alternative cutoff dates that do not correspond to known institutional changes. The purpose is to check whether the estimated November 9 effect is unusually large relative to discontinuities that arise from ordinary time-series variation in licensing behavior. Fourth, we report robustness to donut specifications that exclude observations submitted very near the cutoff, as well as to alternative bandwidths

and local polynomial choices. These exercises address concerns about transition-day ambiguity, short-run implementation frictions, and sensitivity to functional-form assumptions. We treat these checks as diagnostic evidence on the local continuity assumption, not as substitutes for the institutional argument that the interface change was sharp and externally imposed.

5.4 Distinguishing Platform Governance from Funder Mandates

A central empirical challenge is that the arXiv redesign preceded the main Plan S implementation window by only seven weeks. We therefore use the difference in timing and scope between the two governance channels to distinguish a platform-interface effect from a funder-mandate effect. A platform channel predicts an immediate and broad change at the November 9 cutoff. A mandate channel predicts an incremental change closer to January 1, 2021, or stronger effects among authors more exposed to cOAlition S funders.

Our first approach is a two-cutoff interrupted-time specification. Let $A_i = \mathbf{1}\{t_i \geq c_A\}$, where c_A is the arXiv redesign date, and let $S_i = \mathbf{1}\{t_i \geq c_S\}$, where c_S is January 1, 2021. We estimate

$$Y_i = \alpha + \tau_A A_i + \tau_S S_i + \phi(t_i) + \mathbf{X}'_i \gamma + \varepsilon_i, \quad (3)$$

where $\phi(t_i)$ is a flexible time trend, and τ_S captures any additional shift at the Plan S implementation date after accounting for the arXiv cutoff. We interpret τ_A as evidence on the platform redesign and τ_S as evidence on a separate contemporaneous mandate channel. Because Plan S implementation varied across funders, this specification is not intended to estimate a single universal Plan S treatment effect; it is a timing-based diagnostic.

Second, we examine license categories that are not required by Plan S. A mandate mechanism centered on Plan S should primarily affect CC BY and other compliant routes. By contrast, a platform redesign may also affect non-commercial Creative Commons licenses if authors respond to the changed menu or the broader salience of licensing. We therefore

estimate the same cutoff design for non-commercial licenses, especially CC BY-NC-SA. We treat CC BY-NC-ND separately because it was introduced as part of the arXiv redesign; changes in that category reflect the menu-expansion component of the platform intervention rather than a clean placebo outcome.

Third, we exploit variation in exposure to formal mandates. We classify papers by proxies for cOAlition S exposure, including first-author country and field-level exposure to European funders where available. We then estimate the cutoff effect separately by exposure group and through interaction specifications of the form

$$Y_i = \alpha + \tau D_i + \eta(D_i \times E_i) + \theta E_i + \beta_1 r_i + \beta_2(D_i \times r_i) + \mathbf{X}_i' \gamma + \varepsilon_i, \quad |r_i| \leq h, \quad (4)$$

where E_i denotes higher exposure to cOAlition S funders. A funder-mandate channel predicts larger effects among more exposed groups. A platform-interface channel predicts a broader and less exposure-dependent shift among authors using the same arXiv interface. These exposure measures are proxies rather than direct observations of individual grant funding, so we interpret them as evidence on mechanism rather than as a separate causal design.

5.5 Persistence in Repeat Submissions

We examine persistence using a submitter-level focal-next design. Repeat submitters are identified using normalized arXiv submitter names. The submitter is the individual recorded in the arXiv metadata as submitting the paper and need not correspond to every coauthor. We therefore interpret this analysis as submitter-level carryover rather than as a fully disambiguated author-level panel.

For each normalized submitter s , we define the focal submission as the submitter’s first single-version paper within ± 90 days of the November 9, 2020 redesign. We then identify the submitter’s next eligible single-version paper submitted after the focal paper, after the redesign, and within 365 days. The main outcome is whether this next submission is licensed

under CC BY or CC BY-SA. We estimate

$$Y_s^{\text{next}} = \alpha + \rho D_s^{\text{focal}} + \beta_1 r_s^{\text{focal}} + \beta_2 (D_s^{\text{focal}} \times r_s^{\text{focal}}) + \delta \bar{Y}_s^{\text{pre}} + \mathbf{X}'_s \gamma + \varepsilon_s, \quad (5)$$

where Y_s^{next} is CC BY/CC BY-SA adoption on the next eligible submission, D_s^{focal} indicates whether the focal submission occurred after the arXiv redesign, r_s^{focal} is the focal-submission running variable, and \bar{Y}_s^{pre} summarizes the submitter’s pre-redesign licensing history. The coefficient ρ measures whether exposure to the redesigned interface at the focal submission has a reduced-form effect on the next licensing choice.

This design is intentionally interpreted as evidence on carryover, not as a structural estimate of habit formation. A later license choice may reflect the submitter’s own prior decision, coauthor preferences, journal constraints, field norms, or ambiguity in name-based submitter identifiers. We therefore supplement Equation (5) with descriptive transition tables that relate the license chosen on the focal submission to the license chosen on the next submission.

5.6 Downstream Citation and Publisher-Side OA Outcomes

We examine citations and publisher-side open access as secondary downstream outcomes. Citation counts are accumulated outcomes, so a simple RDiT using cumulative citations measured at a common extraction date can mechanically favor papers submitted before the cutoff, which have had more time to accumulate citations. We therefore report two complementary citation analyses. First, we document the common-extraction-date cumulative-citation estimates using Semantic Scholar, which has near-complete coverage of the preferred ± 90 -day sample. Second, as our preferred citation check, we use OpenAlex yearly citation counts to construct fixed calendar-year citation outcomes. Calendar-2022 citations provide the cleanest common observation window for the preferred local sample.

For the citation analysis, let L_i denote whether paper i is licensed under CC BY or

CC BY-SA, and let C_i denote a citation outcome. We estimate a fuzzy RDiT using exposure to the November 9, 2020 redesign as an instrument for L_i :

$$L_i = \pi_0 + \pi_1 D_i + \pi_2 r_i + \pi_3 (D_i \times r_i) + \mathbf{X}'_i \lambda + \nu_i, \quad |r_i| \leq h, \quad (6)$$

$$\log(1 + C_i) = \alpha + \beta \hat{L}_i + \delta_1 r_i + \delta_2 (D_i \times r_i) + \mathbf{X}'_i \gamma + \varepsilon_i, \quad |r_i| \leq h. \quad (7)$$

The coefficient β is interpreted as a local IV estimate for papers whose CC BY/CC BY-SA adoption was shifted by the platform redesign. Because the redesign was a bundled intervention, the exclusion restriction is strong: the estimate should be read as evidence on whether the composite intervention and induced licensing change are accompanied by detectable citation changes, not as the full welfare effect of licensing. All citation specifications include the same local running-variable terms as Equation (1), broad-field fixed effects, and author count, with standard errors clustered by first-version submission date.

For publisher-side open access, we estimate the same local RDiT design using OpenAlex `oa_status` outcomes. These estimates test whether the repository-side preprint licensing intervention spilled over into the later publisher-side open-access status of the paper.

6 The Effect of the Platform Intervention on Licensing

6.1 Main RDiT Estimates

Figure 1 presents the main regression-discontinuity-in-time evidence. Panel A plots daily mean CC BY/CC BY-SA adoption rates within ± 90 days of the November 9, 2020 redesign, while Panel B plots weekly means within ± 180 days. Both panels overlay separate local linear fits on the two sides of the cutoff. The visual break is sharp: before the redesign, adoption remains near 5–7%; immediately after the redesign, adoption rises to roughly one-third of submissions. The figure is therefore consistent with a discrete change at the interface redesign rather than a smooth continuation of the pre-existing trend.

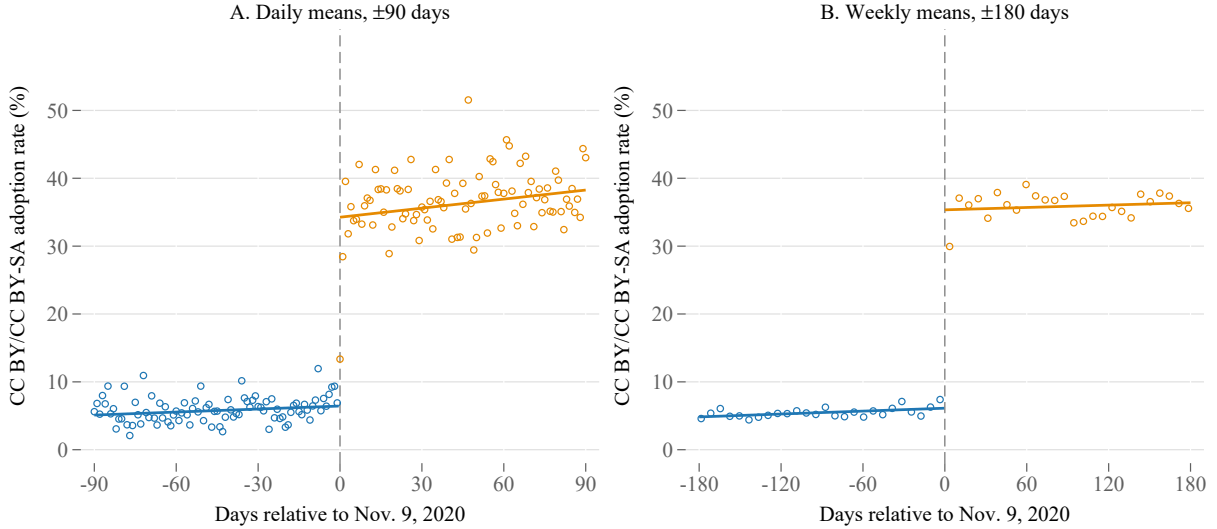


Figure 1: CC BY/CC BY-SA adoption around the arXiv redesign

Notes. Panel A shows daily means within ± 90 days; Panel B shows weekly means within ± 180 days. Lines are separate local linear fits, and the vertical dashed line marks November 9, 2020. The sample consists of single-version papers dated by first-version posting.

Table 3 reports the corresponding local linear RDiT estimates across symmetric bandwidths. The preferred ± 90 -day specification estimates a discontinuity of 27.82 percentage points, with a submission-date-clustered standard error of 1.46 percentage points. Adding broad-field fixed effects and author count leaves the estimate essentially unchanged at 27.99 percentage points, with a standard error of 1.45 percentage points. The magnitude is large relative to the local pre-cutoff baseline: in the preferred window, CC BY/CC BY-SA adoption was 5.78% before the redesign and 36.19% afterward.

The estimates are stable across local bandwidths. Across the five main bandwidths, the uncontrolled estimates range from 24.71 to 29.45 percentage points, while the controlled estimates range from 24.79 to 29.60 percentage points. This stability indicates that the result is not driven by a particular bandwidth choice or by observable shifts in broad field composition or team size. The estimates should be interpreted as the local effect of the bundled redesign on papers submitted near the cutoff. They do not isolate menu reordering from the other components of the intervention.

Appendix Table A9 reports local-polynomial regression-discontinuity estimates computed

Table 3: Main RDiT estimates for CC BY/CC BY-SA adoption

Bandwidth	Estimated discontinuity (pp)		N	Date clusters
	No controls	With controls		
± 30 days	24.71 (3.30)	24.79 (3.26)	17,852	61
± 60 days	26.90 (2.02)	27.10 (2.01)	34,083	121
± 90 days (preferred)	27.82 (1.46)	27.99 (1.45)	49,677	181
± 120 days	29.45 (1.20)	29.60 (1.20)	66,502	241
± 180 days	29.23 (0.88)	29.34 (0.88)	100,862	361

Notes. Each entry reports the coefficient on the post-redesign indicator from Equation (1). Standard errors clustered by first-version posting date are reported in parentheses. The dependent variable is CC BY/CC BY-SA adoption, equal to one for papers licensed under CC BY or CC BY-SA and zero otherwise. Estimates are reported in percentage points. All specifications restrict to single-version papers, use the first-version posting date as the running variable, code papers first posted on November 9, 2020 as post-cutoff, and include separate linear slopes on each side of the cutoff. The with-controls specifications add broad-field fixed effects and author count. The preferred specification uses the ± 90 -day bandwidth. All reported estimates are statistically significant at $p < 0.001$.

with `rdrobust`, using robust bias-corrected inference, date-clustered standard errors, and adjustment for repeated values of the calendar-time running variable (Calonico et al., 2014, 2017). Under manual uniform-kernel bandwidths, the conventional `rdrobust` estimates coincide with the uncontrolled fixed-window estimates in Table 3; under data-driven MSE- and CER-optimal bandwidths, the estimated jump remains in the 22–27 percentage-point range with robust confidence intervals excluding zero.

Appendix Table A7 examines the external-validity implications of the single-version restriction. Single-version papers constitute 56.3% of the preferred local window, and 44.4% of multi-version papers are classified as straddling the redesign using available first-version and last-update dates. The discontinuity remains large in all-paper, non-straddling, and reweighted single-version diagnostics, so we retain the single-version sample as the cleanest

identification sample while treating broader-sample results as external-validity checks.

6.2 Validity of the Temporal Cutoff

The main RDiT design requires that, absent the arXiv redesign, licensing outcomes would have evolved smoothly through November 9, 2020. We assess this condition using submission-volume tests, placebo cutoffs, covariate balance checks, and donut specifications that remove observations close to the implementation date.

Figure 2 reports the two main visual diagnostics. Panel A examines sorting around the cutoff by plotting the daily number of first-version, single-version submissions in the preferred ± 90 -day window. The figure shows the expected weekday–weekend variation in submission activity, but no visible bunching or discontinuous change at the redesign date. The corresponding local linear estimate is small and statistically indistinguishable from zero: the discontinuity is 4.69 submissions per day, with a standard error of 26.95 ($p = 0.862$). This reduces concern that authors anticipated the interface change and strategically delayed or accelerated submissions.

Panel B reports placebo discontinuities at alternative cutoff dates in the same calendar period, excluding placebo windows that overlap the November 9 redesign or the January 1 Plan S implementation window. The true November 9 estimate is an extreme outlier. Placebo estimates are centered near zero, with mean -0.04 percentage points and standard deviation 1.02 percentage points. The largest positive placebo estimate is approximately 2.11 percentage points, compared with the true discontinuity of 27.82 percentage points. The main estimate is therefore not a generic feature of ordinary time-series variation in licensing behavior.

Additional validity checks are reported in Appendix Table A8. Predetermined covariates are broadly stable around the cutoff, and donut specifications that drop observations on or near November 9 leave the licensing discontinuity close to 30 percentage points. These checks support the interpretation that the main estimate reflects a sharp change in the license-

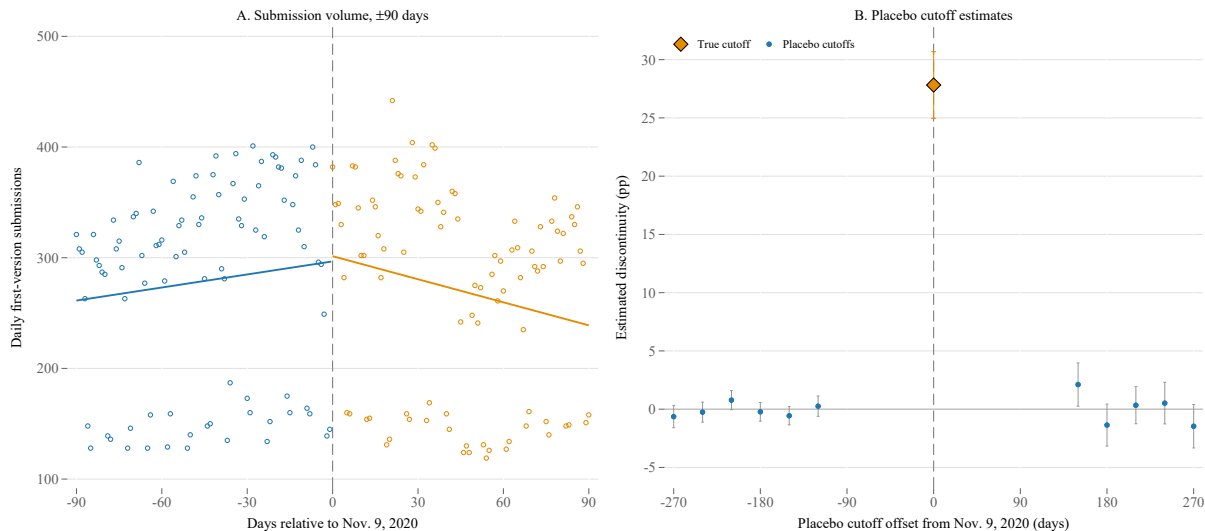


Figure 2: Temporal-cutoff diagnostics

Notes. Panel A plots daily first-version submission counts in the preferred ± 90 -day single-version window. Panel B plots placebo-cutoff estimates for CC BY/CC BY-SA adoption; the diamond marks the true November 9, 2020 cutoff, circles mark placebo cutoffs, and vertical bars denote 95% confidence intervals. Placebo windows overlapping the redesign or the January 1, 2021 Plan S window are excluded.

selection environment rather than sorting, ordinary time-series variation, or transition-day ambiguity.

6.3 Platform Governance versus Funder Mandates

The timing and scope of the licensing response provide evidence on whether the November 2020 discontinuity reflects the arXiv platform intervention or contemporaneous funder mandates. A funder-mandate explanation would predict either an additional break around the January 1, 2021 Plan S implementation window or larger effects among authors more exposed to cOAlition S funders. The evidence points in the opposite direction: the main discontinuity occurs at the arXiv redesign, affects license categories not required by Plan S, appears broadly across fields, and is not larger among papers affiliated with Plan S countries.

Table 4 reports two mechanism diagnostics that distinguish the platform-interface channel from a funder-mandate channel. Panel A uses the seven-week separation between the arXiv redesign and the January 1, 2021 Plan S implementation date. Panel B examines whether the

cutoff shift is confined to Plan S-relevant attribution licenses or instead affects the broader license menu.

Panel A shows that the discontinuity is concentrated at the arXiv redesign. The November 9 coefficient is 27.64 percentage points in the ± 365 -day window and 27.45 percentage points in the ± 180 -day window. By contrast, the January 1 Plan S coefficient is small, negative, and statistically insignificant in both windows. This timing evidence does not detect an additional discontinuous shift at the formal Plan S implementation date after accounting for the arXiv redesign.

Panel B shows that the response is broader than a narrow shift into the Plan S default route. The main CC BY/CC BY-SA outcome increases by 27.82 percentage points, while the arXiv perpetual non-exclusive license falls by 36.71 percentage points, indicating that most of the shift comes from movement away from the pre-intervention platform-specific license. Non-commercial Creative Commons categories also move at the cutoff. CC BY-NC-SA, which is not a Plan S route, increases by 1.61 percentage points. CC BY-NC-ND increases by 5.44 percentage points, but this category should be interpreted as part of the menu-expansion component of the platform intervention because it was added on November 9, 2020. These category-level patterns are consistent with a broad response to the redesigned choice environment rather than a licensing shift driven primarily by formal Plan S compliance.

Appendix Figure A1 provides descriptive monthly context for these category-level patterns. It shows the contemporaneous rise in CC BY/CC BY-SA adoption, the corresponding decline in arXiv perpetual non-exclusive licensing, and broadly parallel transitions across fields and journal-reference status. The figure is descriptive and is not used for identification; the local RDiT estimates in Figure 1 and Table 3 remain the identifying evidence.

The response is also broad across fields. Estimating the same local linear RDiT separately across broad arXiv fields yields positive and statistically significant discontinuities in all 17 fields with at least 200 papers in the preferred window. The magnitudes are heterogeneous

rather than uniform: estimates range from 16.66 percentage points in quantitative finance to 39.34 percentage points in general relativity and quantum cosmology. Large fields sit near the center of this range, including computer science at 27.68 percentage points, mathematics at 29.00 percentage points, and physics at 26.65 percentage points. This pattern is difficult to reconcile with a mandate channel operating only through fields with high exposure to European funders.

Appendix Table A10 further shows that the licensing response is not concentrated by author career stage. Using OpenAlex-indexed publication histories through 2019, we classify first and last authors into within-field academic-age terciles and estimate interaction RDiT specifications. The first-author junior and senior interactions are +0.88 and +1.19 percentage points, while the last-author junior and senior interactions are +1.43 and +0.20 percentage points; all are statistically insignificant. First-by-last-author cells show no monotonic power-dynamics pattern. The response therefore appears broad across observable career-stage groups in the OpenAlex-matched sample as well as across fields.

Table 5 provides a more direct exposure test using OpenAlex affiliation-country data. We classify papers using several proxies for exposure to cOAlition S funders and estimate interaction RDiT specifications in the country-matched ± 90 -day sample. The country match covers 15,713 papers, or 31.6% of the preferred RDiT sample. These exposure measures are proxies for mandate exposure rather than observations of grant-level funding status.

Across all five definitions, the interaction between the post-redesign indicator and Plan S-country exposure is negative. Under the preferred any-author definition, the interaction is -5.91 percentage points, with a date-clustered standard error of 1.07 percentage points. Descriptively, papers without any Plan S-country author increase from 3.38% to 35.81%, while papers with at least one Plan S-country author increase from 5.63% to 32.07%. The continuous Plan S-author-share measure gives an even larger negative interaction of -7.85 percentage points. The other authorship-position definitions produce similar estimates, ranging from -6.36 to -6.64 percentage points.

These exposure results should be interpreted as mechanism evidence, not as a separate causal design. Country of affiliation is an imperfect proxy for funder exposure: not all researchers in Plan S countries are funded by cOAlition S signatories, and some researchers outside those countries may hold covered grants. The matched-country sample is also a subset of the main RDiT sample. Nevertheless, the sign and consistency of the exposure results are informative. A mandate-compliance channel would predict larger immediate jumps among more exposed papers; the estimated interactions instead imply smaller jumps among Plan S-exposed papers. Taken together with the absence of a January 1 discontinuity and the movement in non-Plan S license categories, the results point to a broad platform-interface response rather than a licensing shift driven primarily by formal funder mandates.

Table 4: Timing and license-category evidence on platform governance

<i>Panel A. Two-cutoff timing specification</i>					
Sample window	Nov. 9 arXiv redesign		Jan. 1 Plan S		<i>N</i>
	Coef.	SE	Coef.	SE	
One-year window, ± 365 days	27.64	2.24	-2.08	1.68	199,719
Robustness window, ± 180 days	27.45	2.25	-1.31	1.75	100,862

<i>Panel B. License-category RDiT estimates, preferred ± 90-day window</i>					
Outcome	Pre mean	Post mean	Coef.	SE	<i>N</i>
CC BY/CC BY-SA adoption	5.78	36.19	27.82	1.46	49,677
CC BY-NC-SA	1.89	3.37	1.61	0.28	49,677
CC BY-NC-ND	0.00	6.41	5.44	0.43	49,677
Any non-commercial CC	1.89	9.79	7.05	0.57	49,677
arXiv perpetual non-exclusive	91.68	52.00	-36.71	1.84	49,677

Notes. All means and coefficients are reported in percentage points. Panel A estimates a two-cutoff interrupted-time specification with separate post indicators for the November 9, 2020 arXiv redesign and the January 1, 2021 Plan S implementation date. The specification includes a piecewise-linear time trend with knots at both dates, broad-field fixed effects, and author count. Standard errors are clustered by first-version posting date. The arXiv redesign coefficients are significant at $p < 0.001$; the Plan S coefficients have $p = 0.218$ in the ± 365 -day window and $p = 0.457$ in the ± 180 -day window. The January 1 coefficient should be interpreted as a timing diagnostic, not as a grant-level Plan S treatment effect. Panel B reports separate local linear RDiT estimates in the preferred ± 90 -day single-version sample, using first-version posting date as the running variable. Pre and post means are unadjusted sample means. “Any non-commercial CC” includes CC BY-NC-SA and CC BY-NC-ND. CC BY-NC-ND was introduced on November 9, 2020 and therefore reflects menu expansion rather than a clean placebo category. Standard errors are clustered by first-version posting date. All Panel B discontinuity estimates are significant at $p < 0.001$.

Table 5: Plan S country-exposure heterogeneity

Exposure measure	Non-exposed	Exposed	Interaction coef. (pp)	SE (pp)
	Pre → Post (%)	Pre → Post (%)		
First-author Plan S country	3.90 → 35.65	5.64 → 31.05	-6.36	1.11
Any-author Plan S country (<i>preferred</i>)	3.38 → 35.81	5.63 → 32.07	-5.91	1.07
Plan S-author share (<i>continuous</i>)	3.65 → 35.67	5.61 → 31.80	-7.85	1.35
First- or last-author Plan S country	3.82 → 35.91	5.61 → 31.06	-6.64	1.09
Last-author Plan S country	3.93 → 35.37	5.88 → 30.80	-6.47	1.35

Notes. The table reports interaction RDiT estimates in the ± 90 -day single-version sample matched to OpenAlex author-affiliation country data. The dependent variable is CC BY/CC BY-SA adoption. The regression sample contains 15,713 papers, corresponding to 31.6% of the preferred ± 90 -day single-version RDiT sample. Pre and post columns report unadjusted group means in percentage points. For binary exposure measures, “exposed” denotes papers satisfying the exposure definition in the row. For the continuous Plan S-author-share row, the descriptive exposed group consists of papers with a positive share of authors affiliated with Plan S countries, while the interaction coefficient corresponds to a full-unit increase in the share of Plan S-country authors. The interaction coefficient is $\hat{\eta}$ from Equation (4). Controls include broad-field fixed effects and author count. Standard errors are clustered by first-version posting date. All interaction coefficients are significant at $p < 0.001$. Country exposure is a proxy for mandate exposure and should not be interpreted as observed grant-level funding status.

6.4 Persistence in Repeat Submissions

We next ask whether the platform-induced licensing change carried over into later submissions by the same submitter. This analysis is secondary to the main RDiT estimates. It uses normalized arXiv submitter names to construct a repeat-submitter sample and should therefore be interpreted as submitter-level evidence rather than as a fully disambiguated author-level panel. For each normalized submitter, we identify the first single-version focal paper within ± 90 days of the November 9, 2020 redesign. We then observe whether the submitter’s next eligible single-version paper, submitted after the redesign and within 365 days of the focal paper, is licensed under CC BY/CC BY-SA.

The focal sample contains 39,308 repeat submitters in the local window, of whom 13,173 have a subsequent post-redesign single-version submission within 365 days. Table 6 reports reduced-form carryover estimates. The coefficient on focal-post exposure is small and statistically insignificant across specifications. In the preferred specification, which controls for the submitter’s pre-redesign licensing history, focal-field fixed effects, and focal-paper author count, the estimated effect is 1.60 percentage points with a standard error of 1.62 percentage points. This estimate is small relative to both the main contemporaneous RDiT effect and the focal-pre mean of 34.99% in the next-submission outcome. Appendix Table A12 reports robustness checks that add next-submission field and month fixed effects, exclude the most prolific submitters, and vary the follow-up horizon. None produces a large or statistically precise reduced-form carryover effect.

Table A13 provides a complementary descriptive view of persistence in the license actually chosen. Among focal-post submitters whose focal paper used CC BY/CC BY-SA, 76.27% also used CC BY/CC BY-SA on the next eligible submission. Among focal-post submitters whose focal paper used the arXiv perpetual non-exclusive license, only 14.54% used CC BY/CC BY-SA on the next submission, while 79.53% remained in the same broad license family. In the corresponding two-by-two comparison, focal-CC submitters are 60.44 percentage points more likely to choose CC BY/CC BY-SA again than focal-non-CC sub-

mitters.

These results distinguish two forms of persistence. Exposure to the redesigned interface at the focal submission does not, by itself, generate a large additional reduced-form effect on the next submission once prior licensing behavior is controlled for. By contrast, the license selected on the focal paper is strongly predictive of the license selected later. The evidence is therefore consistent with submitter-level carryover in licensing practices, but not with a strong claim that the platform intervention mechanically created durable author-level habits. The persistence analysis also has two limitations. The submitter field may conflate distinct individuals with common names or split the same individual across name variants, and the submitter need not represent every coauthor on a paper. For this reason, we interpret the results as evidence on repeat submitters’ workflow behavior rather than as a complete author-level path-dependence test.

Table 6: Submitter-Level Carryover After the arXiv Redesign

Specification	$\hat{\rho}$	SE	p -value	N
Local linear only	1.63	(1.63)	0.319	13,173
+ Pre-history controls	1.70	(1.62)	0.293	13,173
+ Focal-field FE and author count	1.60	(1.62)	0.322	13,173

Notes: The unit of observation is a normalized arXiv submitter. The focal submission is the submitter’s first single-version paper within ± 90 days of the November 9, 2020 redesign. The dependent variable is CC BY/CC BY-SA adoption on the submitter’s next eligible single-version paper submitted after the redesign and within 365 days of the focal submission. Estimates are reported in percentage points. All specifications include separate local linear terms in the focal-submission running variable on the two sides of the cutoff. Pre-history controls include the submitter’s pre-redesign CC BY/CC BY-SA adoption rate and prior submission count. The preferred specification is the third row. The focal-pre mean of the dependent variable is 34.99%. Standard errors are in parentheses. Because each submitter contributes one observation to this focal-next design, clustering at the submitter level is equivalent to heteroskedasticity-robust inference. The estimates are interpreted as reduced-form carryover effects, not as structural estimates of habit formation.

6.5 Downstream Outcomes: Citations and Publisher-Side Open Access

We finally examine whether the licensing shift translated into downstream outcomes beyond the legal status of the arXiv preprint. We focus first on citations. This analysis is secondary to the license-adoption results. The economic margin studied in this paper is legal reuse rather than access to reading: arXiv papers are already freely available. A null citation effect therefore would not imply that the platform intervention was unimportant. It would indicate that broader reuse rights did not translate into a measurable citation premium in the observed window.

A naive citation analysis using cumulative Semantic Scholar citations measured at a common extraction date produces a negative fuzzy-RDiT estimate. We do not interpret this as evidence that liberal licensing reduces citations. Citation counts are accumulated outcomes, and papers submitted just after the cutoff have had less time to accumulate citations than papers submitted just before it. Because submission age is mechanically tied to the running variable in a common-extraction-date design, standard age adjustments cannot fully resolve this problem within the same cumulative citation sample. Appendix Figure A3 shows that the negative common-extraction-date estimate disappears once citations are measured in a common calendar-year observation window.

Our preferred citation check therefore uses OpenAlex yearly citation counts. This sample is more selective than the Semantic Scholar citation sample because it requires a DOI-linked OpenAlex record with yearly citation trajectories, but it allows us to define fixed calendar-year outcomes. The cleanest outcome is citations received in calendar year 2022: all papers in the preferred ± 90 -day window had entered arXiv by February 2021, so calendar 2022 provides a common 12-month observation window. Table 7 reports the corresponding estimates. The first stage remains strong: the licensing discontinuity is 26.12 percentage points and the first-stage F -statistic is 193.1. The fuzzy-RDiT estimate for $\log(1 + \text{total citations in 2022})$ is 0.0468 log points with $p = 0.722$. Calendar-year alternatives yield the same conclusion:

the estimates are small and statistically indistinguishable from zero.

The appropriate interpretation is therefore narrow. We find no evidence of a positive citation premium from CC BY/CC BY-SA licensing after correcting for citation-age accumulation. This finding is consistent with the institutional setting: because arXiv already removes access barriers to reading, the main effect of licensing may operate through downstream legal reuse—copying, redistribution, adaptation, text mining, indexing, or commercial incorporation—rather than through additional scholarly citations. The citation estimates should also be interpreted cautiously because the fuzzy design relies on a strong exclusion restriction for the bundled redesign. They are best read as evidence on whether the bundled redesign and the induced licensing shift are accompanied by detectable citation changes, not as the full welfare effect of open licensing.

Appendix Table A16 shows no comparably large spillover into publisher-side open-access status, consistent with the view that repository-side licensing and publisher-side access are institutionally distinct margins.

Appendix Table A17 reports additional `rdrobust` local-polynomial checks for the downstream modules (Calónico et al., 2014, 2017). The fixed-calendar-year citation fuzzy-RDiT retains a strong first stage, while the fuzzy citation estimates remain small and their robust bias-corrected confidence intervals include zero under manual and data-driven bandwidth choices. The publisher-side open-access checks likewise remain small and show no positive shift.

Taken together, the downstream analyses show that the arXiv redesign substantially changed the legal reuse terms attached to preprints, but we do not find evidence that this change translated into a positive citation premium or a comparably large change in publisher-side open-access status.

Table 7: Citation Effects under Fixed Calendar-Year Observation Windows

Citation window	First stage	FS F	Reduced form	RF p	Fuzzy RDiT	IV p
Calendar 2021 citations	26.12	193.1	-0.0092	0.791	-0.0353 (0.1321)	0.789
Calendar 2021–2022 citations	26.12	193.1	0.0036	0.930	0.0139 (0.1576)	0.929
Calendar 2022 citations	26.12	193.1	0.0122	0.724	0.0468 (0.1316)	0.722

Notes: The table reports controlled fuzzy-RDiT estimates using OpenAlex yearly citation counts. The treatment is CC BY/CC BY-SA adoption, and the instrument is exposure to the November 9, 2020 arXiv redesign. Outcomes are $\log(1 + \text{citations})$ in the indicated calendar-year window. The OpenAlex yearly-citation sample contains 16,363 papers in the preferred ± 90 -day window, corresponding to 32.9% of the main RDiT sample. Calendar 2022 is the cleanest common observation window because all papers in the preferred local sample had entered arXiv by February 2021. All specifications include separate linear slopes on each side of the cutoff, broad-field fixed effects, and author count. Standard errors, in parentheses, are clustered by first-version submission date. The first stage is reported in percentage points; reduced-form and fuzzy-RDiT estimates are reported in log points. Influential-citation yearly counts are not available.

7 Discussion

7.1 Infrastructure Governance and Formal Mandates

The results identify repository interfaces as governance sites for legally consequential choices. The arXiv redesign did not change reading access, impose a mandate, or directly alter the legal content of the available licenses. It changed how a reuse-rights choice was presented at submission, and this change shifted the legal terms attached to a large set of scientific outputs. This interpretation connects platform governance to the broader view that infrastructures and platforms shape behavior by embedding classifications, standards, rules, and routines into ordinary practice (Star and Ruhleder, 1996; Gawer, 2014; Gorwa, 2019).

The evidence also clarifies the relationship between platform governance and formal mandates. We do not claim that interface design generally dominates formal mandates. Rather, in this setting, the immediate shift in licensing aligns more closely with the repository interface than with broad-based Plan S compliance. Platform governance may complement mandates by making compliance easier, substitute for them in uncovered populations, or

preempt them by changing behavior before formal rules bind. Open-science mandates may therefore be most effective when implemented through the infrastructures where researchers actually make legally consequential choices.

7.2 AI-Mediated Reuse and the Value of Legal Openness

The AI era changes the stakes of open licensing because scientific outputs are not only read by researchers; they are also searched, mined, embedded in retrieval systems, and incorporated into model-training and evaluation pipelines. Large language-model corpora already include academic and professional sources, and recent dataset-building efforts explicitly treat public-domain and openly licensed text as a route toward legally and ethically safer model development (Gao et al., 2020; Kandpal et al., 2025). At the same time, audits of AI datasets document widespread uncertainty, omission, and misclassification in license information, showing that legal provenance has become a practical constraint in the AI data supply chain (Longpre et al., 2024).

This context gives the present result a broader interpretation. The arXiv redesign did not merely change a publication label; it changed the standardized permissions attached to scientific texts at the point where they enter a major research infrastructure. In AI-mediated reuse, such permissions can matter for whether scientific work can be lawfully copied, mined, translated, indexed, used in retrieval-augmented systems, or included in openly documented training corpora. The legal implications of Creative Commons licenses for AI training remain complex and jurisdiction-dependent, and the copyright status of generative-AI training is still contested in policy debates (Szkalej and Senftleben, 2024; Creative Commons, 2025; U.S. Copyright Office, 2025). We do not measure AI reuse directly. The point is instead institutional: when scientific communication is mediated by computational systems, repository license workflows govern not only access to read, but also the downstream legal freedoms through which scientific knowledge can be operationalized at scale.

7.3 Legal Openness Beyond Access and Citations

The downstream results distinguish legal openness from access openness. Because arXiv papers are already freely readable, the licensing intervention changed standardized reuse rights rather than access to reading. The absence of a detectable citation premium is therefore not evidence that licensing is irrelevant. It suggests instead that the value of open licensing may lie in uses not captured by citations, including redistribution, text mining, translation, educational reuse, derivative works, indexing, and commercial or computational incorporation. The publisher-side open-access results point in the same direction: legal openness, reading access, and publisher-side open access are related but institutionally distinct margins (Suber, 2012; Murray and Stern, 2007; Gans et al., 2017).

7.4 Repeated Workflows and Limited Carryover

The repeat-submitter evidence should be read narrowly. Interface exposure alone has limited reduced-form carryover once prior licensing behavior is controlled for, but the license actually chosen on the focal paper is strongly predictive of later choices. This pattern is consistent with submitter-level workflow carryover, not with a claim of structural habit formation or full author-level path dependence. The policy-relevant effect of interface design may therefore operate less through durable exposure effects than through the initial selection of a legally consequential option that repeat users subsequently understand, remember, and reuse.

7.5 Identification and Measurement Limits

Several identification limitations remain. First, the treatment is bundled, so we cannot separately identify the effects of menu reordering, menu expansion, and normative signaling. Second, the main design uses single-version papers to avoid observable cross-cutoff revision contamination, which improves internal validity but limits external validity. Single-version papers constitute roughly 57% of the preferred local window, and all-paper diagnostic results

in the Appendix show qualitatively similar patterns with attenuated magnitudes. Third, Plan S exposure is measured with affiliation-country proxies rather than grant-level funding data, so the mechanism tests cannot rule out smaller, delayed, or grant-specific mandate effects.

Several measurement limitations also remain. The persistence analysis uses normalized submitter names rather than a fully disambiguated author panel, and the submitter need not represent every coauthor on a paper. Citations and publisher-side open-access status measure only selected downstream outcomes. The OpenAlex yearly-citation sample requires DOI-linked records, and the publisher-side open-access analysis conditions on linked publisher-side metadata. These results therefore show that the platform intervention did not generate a detectable citation premium or a comparably large publisher-side open-access shift; they do not measure the full welfare, reuse, or innovation consequences of standardized open licenses.

8 Conclusion

This paper studies how the legal infrastructure of open science is governed. Using arXiv’s November 2020 license-interface redesign as a natural experiment, we show that a bundled platform intervention increased CC BY/CC BY-SA adoption by 27.8 percentage points in the preferred local RDiT specification. Timing, license-category, field, and country-exposure evidence point to a broad platform-interface response rather than a licensing shift driven primarily by formal Plan S compliance.

The evidence has three implications. First, the intervention changed downstream reuse rights rather than access to reading; consistent with that distinction, we find no evidence of a positive citation premium or a comparably large publisher-side open-access spillover. Second, the repeat-submitter evidence qualifies the dynamic interpretation: interface exposure alone does not generate a large additional effect on the next submission, but the license actually

chosen on the focal submission is strongly predictive of later choices. Third, the results show that legally consequential research-policy margins can be implemented through routine workflow design, even when authors retain formal choice over the available options.

The arXiv setting is distinctive: access to reading is already open, license choice is legally important but low-salience, and formal mandates operate through separate funder and publisher channels. The same intervention may have different effects elsewhere. Nonetheless, as scientific communication becomes increasingly platform-mediated, research policy should treat repository design, license menus, and submission workflows as governance instruments alongside mandates, funder rules, and publisher contracts.

Data and Code Availability

The analysis uses public arXiv bibliographic metadata from a March 2026 snapshot of the arXiv metadata corpus. The raw snapshot contains 2,989,000 records and is identified in the replication materials by record count and SHA-256 checksums. The analysis datasets are derived from this public corpus and from external bibliometric metadata linked to arXiv records. Semantic Scholar citation data are subject to the Semantic Scholar Open Data License. OpenAlex yearly-citation, affiliation-country, and open-access-status metadata are available under OpenAlex's CC0 terms.

Replication code and derived analysis files will be deposited in a public replication archive before publication. The replication package will include the Stata and Python scripts used to construct the analysis samples and reproduce the reported tables and figures from the deposited derived files, together with checksums for the principal raw, processed, and output files. Because live bibliometric databases can change over time, the replication archive will include the frozen derived Semantic Scholar and OpenAlex linkage files used in the analyses when redistribution is permitted by source terms; otherwise, it will provide the public-source identifiers and regeneration instructions. The main analyses require Stata 19 and Python 3.12. No API keys are required to reproduce the reported estimates from the deposited derived data.

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Appendix

A.1 Additional Data and Sample Documentation

This appendix documents data provenance, external-data linkage, and archival evidence for the treatment definition. The main estimates use only arXiv metadata, first-version posting dates, and the single-version restriction. External linked data are used for secondary citation, country-exposure, and publisher-side open-access analyses. Because several linked samples are selective, especially the OpenAlex yearly-citation and country-exposure samples, we report match coverage and selection patterns separately from the main RDiT sample. We also document the arXiv metadata schema underlying the single-version restriction and the public archival evidence for the November 2020 license-interface redesign.

A.1.1 Data Provenance and Reproducibility

Table A1 summarizes the principal data sources, their roles in the analysis, and the documentation status of each source. Table A2 reports match coverage and selection patterns across the linked external samples.

A.1.2 Archival Evidence for the License-Interface Redesign

Because the treatment is a documented change in the arXiv license-choice environment, we report archival web evidence supporting the treatment definition. Table A3 summarizes the primary and corroborating archival sources, together with what each source does and does not establish.

A.1.3 arXiv Metadata Schema and Version-History Measurement

The single-version restriction in the main analysis is motivated by the structure of the public arXiv metadata. Table A4 documents the relevant metadata elements: each record carries a

Table A1: Data sources and reproducibility documentation

Source	Use in analysis	Version, access, and reproducibility status
arXiv metadata corpus	Main paper-level metadata: license field, version history, first-version dates, categories, DOI, and journal-reference fields.	March 2026 public metadata snapshot; 2,989,000 raw records. The replication package identifies the snapshot by SHA-256 checksums and record counts, and includes the source URL and access date.
Processed arXiv analysis files	Construct the RDiT samples, license outcomes, field variables, and paper-level controls.	Derived from the March 2026 arXiv snapshot and deposited with the replication code.
Semantic Scholar	Cumulative total and influential citation counts.	Linked by arXiv identifier; extracted via the Semantic Scholar Open Data API in February 2026. Coverage is near-complete in the preferred RDiT sample. The frozen derived linkage files are deposited in the replication archive where source terms permit.
OpenAlex yearly citations	Fixed-calendar-year citation outcomes based on yearly citation trajectories.	OpenAlex snapshot extracted in February 2026 via the OpenAlex API. DOI-linked and selective; used only for secondary downstream citation analyses.
OpenAlex affiliation countries	Author-affiliation country proxies for Plan S exposure.	OpenAlex snapshot extracted in February 2026 via the OpenAlex API. Country exposure is an affiliation-country proxy, not grant-level funding status.
OpenAlex OA status	Publisher-side OA, Green-only OA, Bronze OA, and Closed classifications.	OpenAlex snapshot extracted in February 2026 via the OpenAlex API. The match uses OpenAlex OA-status metadata and includes arXiv DOI matches.
Archival web evidence	Documents the arXiv license-menu treatment definition.	arXiv blog post and Wayback Machine snapshots captured between October 2020 and December 2020. Public evidence supports CC BY-NC-ND addition and menu reordering, but not default or pre-selection status in the login-protected submission UI.

Notes. The table summarizes the principal data sources used in the paper. The replication package includes machine-readable manifests, SHA-256 checksums for principal raw and derived files, and the scripts used to reproduce the reported tables and figures from the deposited derived data. Where redistribution is permitted by source terms, the package deposits the frozen derived Semantic Scholar and OpenAlex linkage files; otherwise it provides public-source identifiers and regeneration instructions. CC0 licensing covers OpenAlex metadata, and Semantic Scholar data are redistributed under the Semantic Scholar Open Data License.

Table A2: Coverage and selection of linked external-data samples

Linked sample	Matched N	Coverage	DOI-selective?	Main selection pattern
Semantic Scholar cumulative citations	49,484	99.6%	No	Near-complete match by arXiv identifier; the small unmatched set consists mainly of very-large-collaboration papers.
OpenAlex yearly citations	16,363	32.9%	Yes	Strongly selected on publisher-DOI availability; used only for secondary fixed-calendar-year citation checks.
OpenAlex country exposure	15,713	31.6%	Yes	Strongly selected on publisher-DOI availability and journal-reference observability; used for Plan S country-exposure heterogeneity.
Publisher-side OA status	38,129	76.8%	No	Higher coverage because OpenAlex indexes many arXiv preprints by arXiv DOI; near-balanced on author count and journal-reference status.
Publisher-DOI-conditioned sample	19,211	38.7%	Defines sample	Used to distinguish publisher-DOI availability from the broader OpenAlex OA-status match.

Notes. The denominator is the preferred ± 90 -day single-version RDiT sample, $N = 49,677$. Coverage is the share of that sample linked to the external source listed in the row. The OpenAlex yearly-citation and country-exposure samples are strongly DOI-selected and should be interpreted as secondary analyses on a more formally published subset. Publisher-side OA coverage is higher because OpenAlex indexes many arXiv preprints by arXiv DOI. Pre/post match coverage is balanced across the cutoff in the audit files.

Table A3: Archival evidence for the November 2020 arXiv license-interface redesign

Evidence	Date / capture	What it establishes	Evidentiary status
arXiv blog announcement	Published November 9, 2020; Wayback capture November 10, 2020.	Announces the addition of CC BY-NC-ND 4.0 and states that license ordering in the submission system changed, with non-CC0 licenses ordered from most liberal reuse to most limited reuse.	Direct primary evidence.
Wayback help/license page, pre-change	Captured October 3, 2020.	Lists CC BY, CC BY-SA, CC BY-NC-SA, CC0, and the arXiv non-exclusive license; CC BY-NC-ND is absent.	Direct archival evidence of pre-change license set.
Wayback help/license page, post-change	Captured December 1, 2020; page footer reports last modified November 18, 2020.	Lists CC BY, CC BY-SA, CC BY-NC-SA, CC BY-NC-ND, arXiv perpetual non-exclusive, and CC0; ordering matches the liberal-to-limited description.	Direct archival evidence of post-change license set and ordering.
Current arXiv help page and documentation source	Accessed May 21, 2026.	Shows the same post-2020 license options and ordering.	Corroborating evidence of persistent post-change state.
Submission-form default status	Not captured.	The live submission form is login-protected and was not crawlable via Wayback; public evidence does not document whether a license option was pre-selected before or after the redesign.	Not web-verifiable from collected public evidence.

Notes. The archival evidence supports the treatment definition as a documented change in the arXiv license-choice environment: CC BY-NC-ND 4.0 was added and the principal reuse licenses were reordered around November 9, 2020. The collected public web evidence does not support a claim about whether the login-protected submission form had a pre-selected default license. The paper therefore treats the intervention as a bundled menu-reordering, menu-expansion, and platform-signaling intervention, not as an independently verified default intervention.

single paper-level license field, while version-history entries record posting dates and version numbers but not license status.

Table A4: arXiv metadata schema evidence for paper-level license measurement

Metadata element	What is observed	Implication for design
Record-level <code>license</code>	Each arXiv metadata record contains a single paper-level license field.	The public metadata do not report a version-specific sequence of license choices.
<code>versions[] .date</code>	Each version-history entry contains a posting date.	The first-version posting date can be recovered and used as the RDiT running variable.
<code>versions[] .version</code>	Each version-history entry records the version number, such as v1 or v2.	Multi-version papers can be identified.
<code>versions[] .size</code>	Each version-history entry records file size.	Version histories record technical submission information, not license status.
<code>versions[] .license</code>	No license field is present inside version-history entries in the sampled raw records.	The license active at each version cannot be reconstructed from the public metadata.

Notes. The public arXiv metadata contain a single paper-level license field and a version-history array with version date, size, and version number. Because version entries do not contain license fields, the first-version posting date is recoverable but the license chosen at each individual version is not. This measurement structure motivates the main single-version restriction: for single-version papers, the observable cross-cutoff revision channel is mechanically absent.

A.1.4 Local Descriptive Statistics

Table A5 reports pre- and post-cutoff means for the preferred ± 90 -day single-version sample. Apart from the licensing outcomes themselves, predetermined paper-level and field-share variables are broadly balanced across the cutoff, with standardized differences below 0.05 for all reported covariates.

A.1.5 Expanded Descriptive Statistics

Table A6 reports expanded descriptive statistics across the 2019–2022 study-period sample, the ± 180 -day window, and the preferred ± 90 -day window. The three samples exhibit similar

Table A5: Local Descriptive Statistics by Cutoff Status

Variable	Pre-cutoff	Post-cutoff	Difference	Std. diff.
	Mean	Mean	Post – Pre	
<i>License outcomes</i>				
CC BY/CC BY-SA adoption	5.78	36.19	30.40	–
arXiv perpetual non-exclusive license	91.68	52.00	-39.69	–
Other Creative Commons license	2.53	11.82	9.28	–
<i>Paper-level characteristics</i>				
Author count	4.78	4.73	-0.05	0.00
Has publisher DOI	38.79	38.55	-0.24	0.00
Has journal reference	22.69	22.63	-0.06	0.00
<i>Field composition</i>				
Computer science	34.30	32.83	-1.46	-0.03
Physics	37.83	38.74	0.91	0.02
Mathematics	16.14	17.57	1.43	0.04
Other fields	11.73	10.86	-0.87	-0.03
Observations	25,093	24,584		49,677

Notes. The sample consists of single-version arXiv papers within ± 90 days of the November 9, 2020 license-interface redesign. Treatment status is assigned using the first-version posting date. Papers first posted on November 9, 2020 are coded as post-cutoff. All entries are percentages except author count, standardized differences, and observations. The difference column reports post-cutoff minus pre-cutoff means. Standardized difference is the difference divided by the pooled standard deviation, $\sqrt{(\sigma_{\text{pre}}^2 + \sigma_{\text{post}}^2)/2}$. Standardized differences are not reported for license outcomes because these are treatment outcomes rather than balance covariates. CC BY/CC BY-SA adoption equals one for CC BY or CC BY-SA licenses and zero otherwise. “Other Creative Commons license” includes Creative Commons licenses not classified as CC BY or CC BY-SA, including non-commercial, no-derivatives, and public-domain-dedication variants. “Has publisher DOI” excludes arXiv self-DOIs beginning with 10.48550/arxiv. Field shares are based on the first listed arXiv category.

field composition and paper-level characteristics, supporting the interpretation of the local samples as representative of the broader single-version population.

Table A6: Expanded Descriptive Statistics for Single-Version arXiv Samples

Variable	2019–2022	± 180 days	± 90 days
	Mean (SD)	Mean (SD)	Mean (SD)
CC BY/CC BY-SA adoption	0.2394 (0.4267)	0.2066 (0.4049)	0.2083 (0.4061)
arXiv perpetual non-exclusive license	0.6775 (0.4674)	0.7188 (0.4496)	0.7204 (0.4488)
Other Creative Commons license	0.0831 (0.2761)	0.0746 (0.2628)	0.0713 (0.2573)
Post-cutoff indicator	0.5666 (0.4955)	0.4994 (0.5000)	0.4949 (0.5000)
Author count	4.69 (16.49)	4.63 (15.88)	4.76 (17.90)
Has publisher DOI	0.3752 (0.4842)	0.3850 (0.4866)	0.3867 (0.4870)
Has journal reference	0.2069 (0.4051)	0.2234 (0.4165)	0.2266 (0.4186)
Computer science	0.3390 (0.4734)	0.3390 (0.4734)	0.3357 (0.4722)
Physics	0.3789 (0.4851)	0.3753 (0.4842)	0.3828 (0.4861)
Mathematics	0.1743 (0.3794)	0.1703 (0.3759)	0.1685 (0.3743)
Statistics	0.0243 (0.1539)	0.0253 (0.1572)	0.0251 (0.1564)
Economics and quantitative finance	0.0107 (0.1030)	0.0125 (0.1113)	0.0125 (0.1110)
Electrical engineering and systems science	0.0526 (0.2233)	0.0565 (0.2309)	0.0553 (0.2285)
Quantitative biology	0.0139 (0.1172)	0.0153 (0.1227)	0.0148 (0.1208)
Other field	0.0062 (0.0787)	0.0058 (0.0761)	0.0054 (0.0731)
Observations	394,573	100,862	49,677

Notes: The table reports expanded descriptive statistics for single-version arXiv papers. The 2019–2022 sample contains all single-version papers with valid first-version dates in the study period. The ± 180 -day and ± 90 -day samples use first-version posting dates relative to the November 9, 2020 license-interface redesign. CC BY/CC BY-SA adoption equals one for CC BY or CC BY-SA licenses and zero otherwise. “Other Creative Commons license” includes Creative Commons licenses not classified as CC BY or CC BY-SA, including non-commercial, no-derivatives, and public-domain-dedication variants. “Has publisher DOI” excludes arXiv self-DOIs beginning with 10.48550/arxiv. Field shares are based on the first listed arXiv category.

A.1.6 Single-Version Restriction and External Validity

Table A7 examines the external-validity implications of the single-version restriction. The preferred design restricts to single-version papers because the public arXiv metadata record paper-level rather than version-specific license history, so multi-version papers revised across the cutoff can contaminate the mapping between first exposure to the redesigned submission interface and the observed license. The table reports sample accounting, composition differences between single- and multi-version papers, RDiT estimates in broader samples, and reweighted single-version estimates targeting the full local sample.

Table A7: Single-version restriction and external-validity checks

<i>Panel A. Sample accounting in the preferred ± 90-day window</i>					
Sample	N	Share	Straddling risk		
All papers	88,226	100.0%	—		
Single-version	49,677	56.3%	None		
Multi-version	38,549	43.7%	44.4% of multi-version papers		
Non-straddling multi-version	21,448	24.3%	0%		
Straddling multi-version	17,101	19.4%	100%		
<i>Panel B. Selected composition differences in the preferred ± 90-day window</i>					
Covariate	Full	Single-version	Multi-version	Std. diff.	
Author count	5.24	4.76	5.87	−0.02	
Has publisher DOI	0.43	0.39	0.49	−0.09	
Has journal reference	0.28	0.23	0.34	−0.12	
Computer science	0.31	0.34	0.29	+0.05	
Physics family	0.39	0.39	0.39	−0.01	
Mathematics	0.19	0.17	0.23	−0.07	
OpenAlex match	0.91	0.91	0.91	+0.01	
<i>Panel C. Licensing discontinuity estimates for CC BY/CC BY-SA adoption</i>					
Sample / specification	Bandwidth	N	Pre mean	Estimate	SE
Single-version (<i>preferred</i>)	± 90	49,677	5.78	27.99	(1.45)
All papers	± 90	88,226	6.83	25.43	(1.21)
Non-straddling all papers	± 90	71,125	5.76	26.51	(1.24)
Non-straddling multi-version only	± 90	21,448	5.53	24.08	(1.91)
Single-version, IPW-reweighted	± 90	49,677	5.78	27.70	(1.45)
Single-version, entropy-balanced	± 90	49,677	5.78	27.67	(1.42)
Single-version (<i>preferred</i>)	± 180	100,862	5.48	29.34	(0.88)
All papers	± 180	180,440	6.45	26.37	(0.72)

Notes. Straddling multi-version papers are pre-cutoff first-version papers with a metadata last-update date on or after November 9, 2020. Panel B reports sample-composition diagnostics; standardized differences compare the single-version sample with the full local sample. “Physics family” groups physics-related arXiv archives.

Panel C estimates the same local-linear RDiT as Table 3, with first-version posting date as the running variable, November 9 coded post, separate linear slopes, broad-field fixed effects, author count, and date-clustered standard errors. Estimates are percentage points; standard errors are in parentheses. All Panel C estimates have $p < 0.001$.

Rewighted rows target the full local sample using broad field, log author count, DOI, journal-reference status, and indexing-match measures. IPW uses stabilized inverse-probability weights; entropy balancing is side-specific. These are diagnostics, not the preferred design.

A.1.7 Descriptive Licensing Transitions Around the Redesign

Figure A1 provides descriptive monthly evidence on licensing transitions in the surrounding months, complementing the local RDiT estimates in the main text. The figure plots monthly CC BY/CC BY-SA adoption rates, license-family composition, field-level patterns, and adoption by journal-reference status. November 2020 is split into pre-redesign and post-redesign bins to avoid combining records from before and after the November 9 cutoff. These panels are descriptive and are not used for identification; they illustrate the broader temporal context in which the discontinuity occurs.

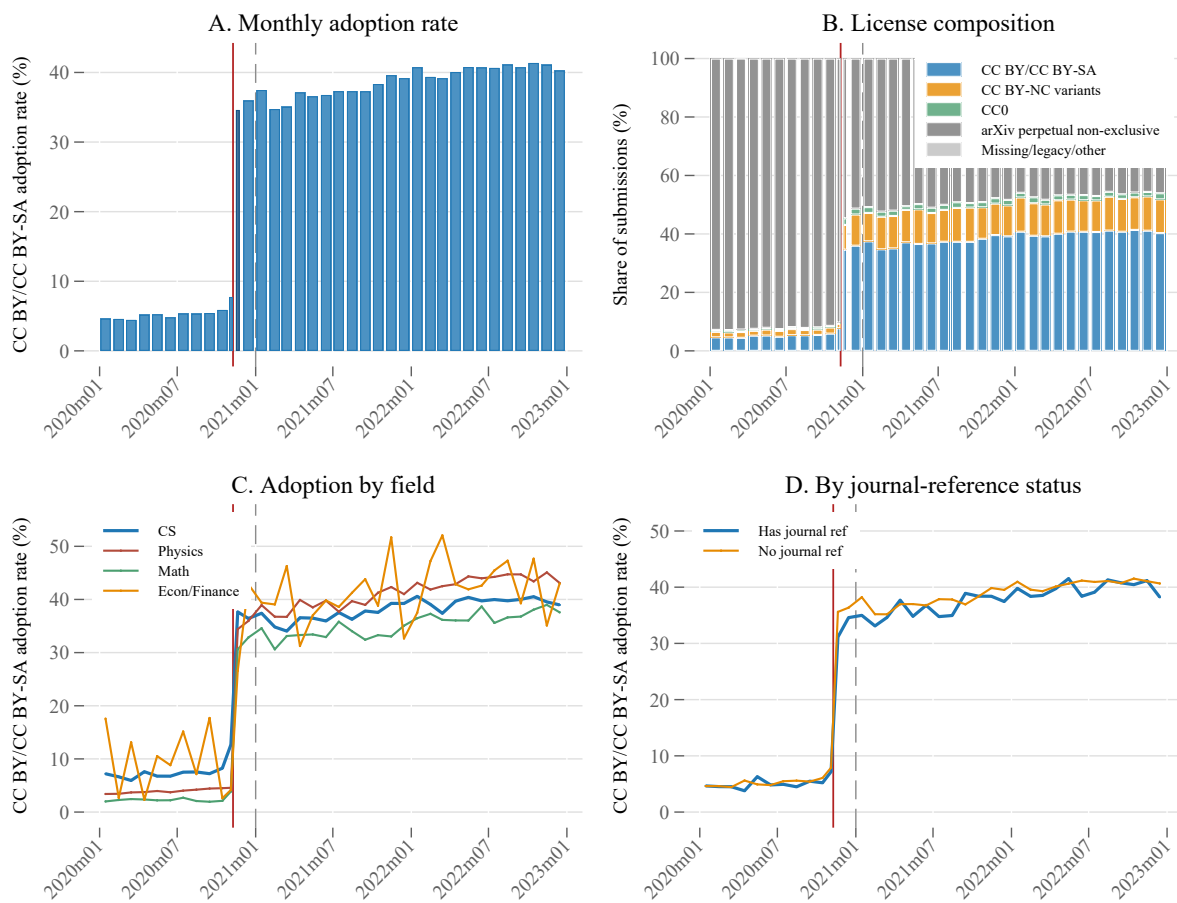


Figure A1: Monthly descriptive licensing transition around the arXiv redesign
Notes. The figure reports descriptive monthly licensing patterns for single-version arXiv papers from January 2020 through December 2022, using first-version posting dates. Panel A reports monthly CC BY/CC BY-SA adoption rates. Panel B reports monthly license-family composition, with each bar summing to 100%. Panel C reports monthly CC BY/CC BY-SA adoption rates by broad field. Panel D reports monthly adoption rates by journal-reference status as observed in the metadata snapshot. November 2020 is split into pre-redesign and post-redesign bins so that records from before and after November 9, 2020 are not combined. The vertical solid line marks the November 9, 2020 arXiv license-interface redesign, and the vertical dashed line marks the January 1, 2021 Plan S implementation window. These panels are descriptive and are not used for RDiT identification; the main estimates use local windows around the November 9 cutoff.

A.2 RDiT Validity

A.2.1 Cutoff Diagnostics and Sensitivity

This subsection reports additional diagnostics for the temporal cutoff. Table A8 summarizes the submission-volume test, selected covariate balance checks, donut specifications, and bandwidth sensitivity checks. Figure A2 further shows that the visible high- and low-volume bands in the submission-count diagnostic reflect regular weekday–weekend submission cycles rather than sorting around the redesign.

Table A8: Validity Checks for the Temporal Cutoff

Check	Estimate	SE	<i>p</i> -value
<i>Panel A. Submission-volume test</i>			
Daily first-version submissions	4.69	26.95	0.862
<i>Panel B. Selected covariate balance</i>			
Author count	-0.20	0.31	0.520
Has journal reference	1.30	0.80	0.110
Computer science share	-5.30	1.40	< 0.001
Mathematics share	1.60	0.80	0.040
<i>Panel C. Donut and bandwidth checks</i>			
Main estimate, ± 90 days	27.82	1.46	< 0.001
Donut: drop cutoff date	29.07	0.87	< 0.001
Donut: drop ± 1 day	29.49	0.81	< 0.001
Donut: drop ± 3 days	29.69	0.82	< 0.001
Donut: drop ± 7 days	29.60	0.85	< 0.001
Bandwidth: ± 30 days	24.71	3.30	< 0.001
Bandwidth: ± 180 days	29.23	0.88	< 0.001

Notes. Panel A estimates a local linear RDiT using the daily number of first-version, single-version submissions as the outcome. Panel B reports selected predetermined covariate balance tests using the preferred ± 90 -day window. Estimates for binary variables and field shares are reported in percentage points; author count and daily submissions are in their original units. Panel C reports robustness checks for the main CC BY/CC BY-SA adoption outcome. All specifications use separate linear slopes on each side of the November 9, 2020 cutoff. Standard errors are clustered by first-version submission date, except for the daily submission-volume test, which is estimated at the date level.

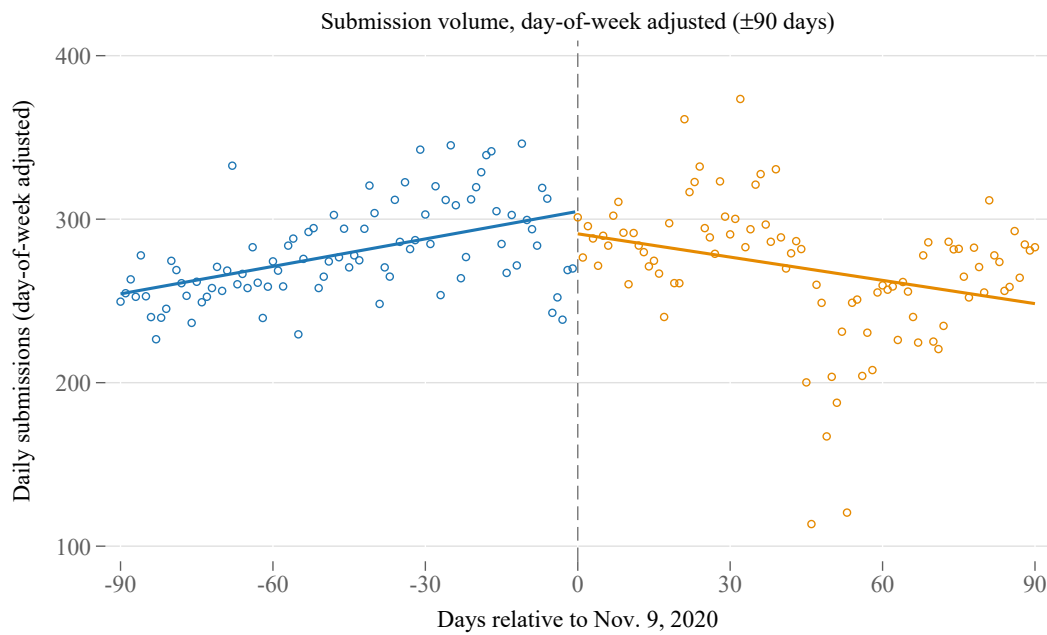


Figure A2: Submission volume around the cutoff, day-of-week adjusted
Notes. The figure plots daily first-version, single-version arXiv submission counts within ± 90 days of the November 9, 2020 license-interface redesign after residualizing daily counts on day-of-week indicators and adding back the grand mean. Lines are separate local linear fits estimated on each side of the cutoff. The vertical dashed line marks November 9, 2020. This diagnostic shows that the high- and low-volume bands in Figure 2, Panel A, reflect regular weekday–weekend submission cycles rather than sorting around the redesign.

A.2.2 Robust Local-Polynomial RD Inference

As a methodological robustness check, Table A9 re-estimates the main discontinuity using the `rdrobust` local-polynomial RD procedures. The table reports both manual bandwidths matching the fixed-window RDIT specifications and data-driven MSE- and CER-optimal bandwidths. The manual uniform-kernel estimates reproduce the uncontrolled fixed-window discontinuities in Table 3, while the robust bias-corrected estimates remain positive, large, and statistically precise under alternative bandwidth and kernel choices.

Table A9: Robust local-polynomial RD estimates for CC BY/CC BY-SA adoption

Specification	Kernel / selector	h_l/h_r	Conventional $\hat{\tau}$	Bias-corrected $\hat{\tau}$	Robust 95% CI
<i>Panel A. Manual fixed-bandwidth checks</i>					
Manual, $h = 30$	Uniform	30.0	24.71	17.64	[8.26, 27.02]
Manual, $h = 60$	Uniform	60.0	26.90	24.42	[17.43, 31.41]
Manual, $h = 90$	Uniform	90.0	27.82	25.42	[20.04, 30.79]
Manual, $h = 120$	Uniform	120.0	29.45	25.95	[21.73, 30.16]
Manual, $h = 180$	Uniform	180.0	29.23	28.48	[25.27, 31.69]
Manual, $h = 90$	Triangular	90.0	26.85	24.59	[18.15, 31.02]
<i>Panel B. Data-driven bandwidth checks, triangular kernel</i>					
± 365 days	MSE-rd	79.9	26.51	25.80	[21.00, 30.60]
± 365 days	CER-rd	57.4	25.69	25.34	[19.50, 31.17]
± 180 days	MSE-rd	54.2	25.49	24.69	[18.16, 31.22]
± 180 days	MSE-two	37.5/53.3	24.85	23.93	[17.24, 30.62]
± 180 days	CER-rd	40.4	24.10	23.64	[16.25, 31.02]
± 180 days	CER-two	28.0/39.7	23.01	22.48	[14.96, 30.00]

Notes. The table reports local-polynomial regression-discontinuity estimates for CC BY/CC BY-SA adoption around the November 9, 2020 arXiv license-interface redesign, computed with `rdrobust` (Calonico et al., 2014, 2017). The sample is restricted to single-version papers. The outcome is scaled in percentage points. The running variable is first-version posting date measured in days relative to November 9, 2020; the cutoff is normalized to zero, and papers posted on November 9, 2020 are coded as post-cutoff. All specifications use local linear estimation, $p = 1$, with local quadratic bias correction, $q = 2$. Standard errors are clustered by first-version posting date, and all specifications apply mass-point adjustment for repeated values of the discrete calendar-date running variable. “Conventional” reports the local-polynomial point estimate. “Bias-corrected” and the robust confidence interval use robust bias-corrected inference. h_l/h_r are the left and right estimation bandwidths in days; a single value indicates a symmetric bandwidth. In Panel A, the manual uniform-kernel conventional estimates coincide with the uncontrolled fixed-window OLS discontinuities in Table 3. In Panel B, bandwidths are chosen by the MSE-optimal `mserd/msetwo` and CER-optimal `cerrd/certwo` selectors implemented in `rdrobust`; “rd” denotes a common bandwidth and “two” denotes separate left and right bandwidths.

A.3 Author Career-Stage Heterogeneity

A.3.1 Main Heterogeneity Estimates

This appendix examines whether the arXiv licensing response is concentrated among authors at particular career stages. The test distinguishes two possible mechanisms. Junior researchers may be more responsive to workflow design because they have fewer established licensing routines, while senior researchers may be more responsive if the redesign primarily activates awareness of open-science norms or if senior coauthors have greater influence over licensing decisions. The evidence supports neither pattern.

We measure career stage using OpenAlex-indexed publication histories. For each paper in the preferred ± 90 -day single-version window, we identify first and last authors and reconstruct academic age using publication activity observed through 2019. Authors with no OpenAlex-indexed publication through 2019 are coded as having zero prior academic age and are retained, so the seniority measure is predetermined relative to the focal submission. The benchmark RDiT uses the 38,774 papers with both first- and last-author seniority observed. The baseline RDiT estimate in this sample is 28.66 percentage points, compared with 27.99 percentage points in the full preferred window. The first/last-author heterogeneity specifications use the 30,925 first-author-observed papers in contribution-order fields, after excluding lexical-authorship fields where first and last author positions are less informative about seniority.

Seniority terciles are defined within broad arXiv fields. The main interaction specifications estimate the same local RDiT design as Equation (1), adding junior and senior indicators and their interactions with the post-redesign indicator, with the mid-career tercile omitted. All specifications include separate linear slopes on each side of the cutoff, broad-field fixed effects, and author count, with standard errors clustered by first-version submission date.

Table A10 reports the main results. In the first-author specification, the junior inter-

action is +0.88 percentage points, with a 95% confidence interval of $[-1.45, 3.21]$, and the senior interaction is +1.19 percentage points, with a 95% confidence interval of $[-1.19, 3.57]$. Last-author interactions are similarly small: +1.43 percentage points for junior last authors and +0.20 percentage points for senior last authors. The first-by-last-author cells show no monotonic power-dynamics pattern. The largest corner-cell interaction is the junior–junior cell, +3.23 percentage points, but it is statistically insignificant ($p = 0.111$) and above the Bonferroni-adjusted threshold for eight cell tests.

We interpret this pattern as evidence that the arXiv redesign operated broadly across observable career-stage groups in the OpenAlex-matched sample. The effect is not concentrated among junior authors, senior authors, or particular first–last author configurations. The result supports the platform-governance interpretation: the intervention changed a common submission workflow encountered by submitters across career stages, rather than targeting a subgroup defined by career position, funder exposure, or field-specific policy incentives.

A.3.2 Career-Stage Heterogeneity Robustness

Table A11 reports robustness checks for the career-stage heterogeneity analysis. The main specification excludes lexical-authorship fields and retains mixed-convention fields, interacting the post-redesign indicator with first-author career-stage measures constructed from OpenAlex-indexed publication histories. We examine sensitivity to alternative seniority definitions (continuous academic age, absolute age cutoffs, works-count terciles, winsorization, and reconstruction through 2020), to alternative sample restrictions (excluding paper-level alphabetical-ordering fields, dropping suspicious OpenAlex profiles, and restricting to lexical-authorship fields), and to the no-prior-publication and first \times last career-stage cell specifications. Across all 21 specifications, the interaction estimates are small and statistically indistinguishable from zero, consistent with the absence of career-stage heterogeneity in the main analysis.

Table A10: Career-stage heterogeneity in the CC BY/CC BY-SA licensing discontinuity

Group	N	Pre (%)	Post (%)	η vs. mid (SE)	95% CI
<i>Panel A. First-author academic age, within-field tercile</i>					
Junior	10,313	7.00	37.55	0.88 (1.19)	[-1.45, 3.21]
Mid (ref.)	10,304	6.89	36.53	—	—
Senior	10,308	5.37	36.17	1.19 (1.22)	[-1.19, 3.57]
<i>Panel B. Last-author academic age, within-field tercile</i>					
Junior	10,273	7.77	38.98	1.43 (1.06)	[-0.65, 3.52]
Mid (ref.)	10,261	5.66	35.52	—	—
Senior	10,268	5.91	35.94	0.20 (1.09)	[-1.94, 2.35]
<i>Panel C. First \times last tercile, omitted category = mid-mid</i>					
JJ	3,979	8.47	40.59	3.23 (2.03)	[-0.74, 7.20]
JM	3,237	5.81	36.84	1.95 (1.87)	[-1.72, 5.61]
JS	3,001	6.53	34.36	-0.98 (2.06)	[-5.02, 3.06]
MJ	3,538	8.33	38.54	1.31 (1.89)	[-2.40, 5.02]
MM	3,454	5.88	34.78	—	—
MS	3,217	6.47	36.39	0.97 (1.97)	[-2.89, 4.83]
SJ	2,691	6.05	36.85	2.02 (2.08)	[-2.07, 6.10]
SM	3,514	5.27	35.12	0.98 (2.05)	[-3.03, 4.99]
SS	3,997	4.98	36.72	2.76 (1.81)	[-0.78, 6.30]

Notes. The table reports interaction RDiT estimates for CC BY/CC BY-SA adoption, in percentage points, among single-version arXiv papers within ± 90 days of the November 9, 2020 redesign. Lexical-authorship fields are excluded from the first/last-author specifications; mixed-convention fields are retained. Seniority is measured using OpenAlex-indexed publication histories through 2019 and is cut into within-broad-field terciles. Authors with no OpenAlex-indexed publication through 2019 are coded as zero academic age and retained. All specifications include separate linear slopes on each side of the cutoff, broad-field fixed effects, and author count. Standard errors are clustered by first-version submission date. In Panel C, J, M, and S denote junior, mid-career, and senior terciles for first and last authors, respectively.

Table A11: Robustness of author career-stage heterogeneity estimates

Specification	Interaction	Estimate	95% CI	<i>N</i>
Main: exclude lexical, retain mixed	First-author junior \times Post	0.88	[-1.45, 3.21]	30,925
Main: exclude lexical, retain mixed	First-author senior \times Post	1.19	[-1.19, 3.57]	30,925
Exclude lexical and mixed fields	First-author junior \times Post	1.05	[-1.35, 3.46]	29,939
Exclude lexical and mixed fields	First-author senior \times Post	1.47	[-0.99, 3.93]	29,939
Continuous academic age	$\log(1 + \text{age}) \times$ Post	0.06	[-0.65, 0.77]	30,925
Absolute age cutoffs	Junior (≤ 6 years) \times Post	-0.48	[-2.76, 1.80]	30,925
Absolute age cutoffs	Senior (≥ 20 years) \times Post	1.24	[-1.38, 3.86]	30,925
Works-count terciles through 2019	First-author junior \times Post	0.30	[-2.03, 2.64]	30,925
Works-count terciles through 2019	First-author senior \times Post	-0.17	[-2.37, 2.03]	30,925
Winsorize academic age at 45 years	First-author junior \times Post	0.88	[-1.45, 3.21]	30,925
Winsorize academic age at 45 years	First-author senior \times Post	1.19	[-1.19, 3.57]	30,925
Reconstruct seniority through 2020	First-author junior \times Post	0.88	[-1.45, 3.21]	30,925
Reconstruct seniority through 2020	First-author senior \times Post	1.19	[-1.19, 3.57]	30,925
Exclude paper-level alphabetical ordering	First-author junior \times Post	1.15	[-1.28, 3.59]	28,380
Exclude paper-level alphabetical ordering	First-author senior \times Post	0.90	[-1.58, 3.37]	28,380
Drop suspicious OpenAlex profiles	First-author junior \times Post	0.61	[-1.67, 2.88]	30,010
Drop suspicious OpenAlex profiles	First-author senior \times Post	0.94	[-1.46, 3.33]	30,010
No prior OpenAlex-indexed publication through 2019	No-prior first author \times Post	1.92	[-0.85, 4.68]	30,925
No prior OpenAlex-indexed publication through 2019	No-prior last author \times Post	3.45	[-1.21, 8.11]	30,802
Lexical-authorship fields only	Team-median seniority \times Post	0.72	[-2.19, 3.62]	8,221
Largest first \times last corner cell	Junior-junior \times Post	3.23	[-0.74, 7.20]	30,628

Notes. The table reports robustness checks for career-stage heterogeneity in CC BY/CC BY-SA adoption. Estimates are in percentage points. Unless otherwise stated, the specification uses single-version papers within ± 90 days of the November 9, 2020 redesign, excludes lexical-authorship fields, retains mixed-convention fields, and interacts the post-redesign indicator with first-author career-stage measures. All specifications include separate linear slopes on each side of the cutoff, broad-field fixed effects, and author count, with standard errors clustered by first-version submission date. Seniority variables use OpenAlex-indexed publication histories and are predetermined through 2019 except in the explicit reconstruction-through-2020 sensitivity check. The first \times last specification includes eight cell interactions; the largest is the junior-junior cell, with $p = 0.111$, above the Bonferroni-corrected threshold $0.05/8 = 0.00625$.

A.4 Persistence Robustness and Transitions

Table A12: Robustness of Submitter-Level Carryover Estimates

Specification	$\hat{\rho}$	SE	p -value	N
Preferred specification	1.60	(1.62)	0.322	13,173
+ Next-submission field FE	1.68	(1.62)	0.299	13,173
+ Next-submission month FE	1.38	(1.63)	0.398	13,173
+ Next-submission field and month FE	1.46	(1.63)	0.369	13,173
Exclude top 1% most prolific submitters	1.21	(1.71)	0.480	11,688
Follow-up horizon: 180 days	2.70	(2.09)	0.197	7,533
Follow-up horizon: 730 days	-0.27	(1.36)	0.843	19,212

Notes: The unit of observation is a normalized arXiv submitter. The dependent variable is CC BY/CC BY-SA adoption on the submitter’s next eligible single-version paper. Estimates are reported in percentage points. All specifications include separate local linear terms in the focal-submission running variable on the two sides of the November 9, 2020 cutoff and control for the submitter’s pre-redesign CC BY/CC BY-SA adoption rate, prior submission count, focal-field fixed effects, and focal-paper author count unless otherwise stated. The preferred specification uses a 365-day follow-up horizon. Next-submission month fixed effects are calendar year-month fixed effects for the next eligible submission. The prolific-submitter exclusion drops the top 1% of normalized submitters by total single-version submissions in 2019–2022 (≥ 11 papers). Standard errors are in parentheses. Because each submitter contributes one observation to this focal-next design, clustering at the submitter level is equivalent to heteroskedasticity-robust inference. The estimates are interpreted as reduced-form carryover effects, not as structural estimates of habit formation.

Table A13: License Transitions in Repeat Submissions

Focal license family	N	Next CC BY/CC BY-SA	Same family	Days to next
CC BY/CC BY-SA	2,145	76.27	76.27	146.7
arXiv perpetual non-exclusive	3,151	14.54	79.53	148.3
Other license	684	21.78	59.21	136.6
Focal CC minus focal non-CC	5,980	60.44	–	–

Notes: The sample consists of focal-post submitters with a subsequent eligible single-version submission within 365 days. The unit of observation is a normalized arXiv submitter. “Next CC BY/CC BY-SA” reports the share of submitters whose next eligible submission used CC BY or CC BY-SA. “Same family” reports the share whose next eligible submission remained in the same broad license family as the focal submission. For the CC BY/CC BY-SA row, this is identical to next CC BY/CC BY-SA adoption. The final row reports the two-by-two difference between focal CC BY/CC BY-SA submitters and focal non-CC submitters in the probability of next-submission CC BY/CC BY-SA adoption. Transition rates are descriptive and should not be interpreted causally.

A.5 Citation and Publisher-Side Robustness

A.5.1 Citation-Age Diagnostics

This subsection reports supplementary citation analyses. The first diagnostic illustrates the bias in cumulative citation counts measured at a common extraction date. The second diagnostic reports age-adjustment checks. These analyses motivate the preferred fixed-calendar-year citation outcomes reported in Table 7.

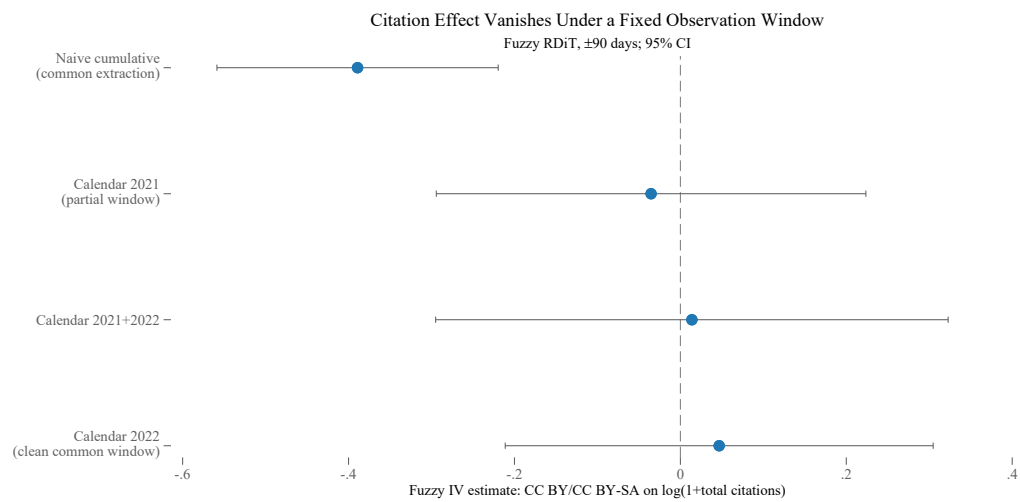


Figure A3: Citation effects under common-extraction and fixed calendar-year windows

Notes. The figure reports fuzzy-RDiT estimates for the effect of CC BY/CC BY-SA adoption on $\log(1 + \text{total citations})$. The first row uses cumulative citations measured at a common extraction date. The remaining rows use OpenAlex yearly citation counts. Calendar 2022 is the cleanest fixed observation window because all papers in the preferred ± 90 -day window had entered arXiv by February 2021 and therefore share the same 2022 citation-observation period. Horizontal lines denote 95% confidence intervals.

Table A14: Naive common-extraction-date citation RDiT

Bandwidth	First stage (pp)	FS F	Reduced form	RF p	Fuzzy RDiT	IV p
<i>Panel A. Outcome: $\log(1 + \text{total citations})$</i>						
± 60	27.16	183.0	-0.1219	< 0.001	-0.4489 (0.0975)	< 0.001
± 90	27.97	372.7	-0.1088	< 0.001	-0.3891 (0.0865)	< 0.001
± 120	29.60	611.0	-0.1043	< 0.001	-0.3522 (0.0715)	< 0.001
± 180	29.35	1110.3	-0.0925	< 0.001	-0.3152 (0.0629)	< 0.001
<i>Panel B. Outcome: $\log(1 + \text{influential citations})$</i>						
± 60	27.16	183.0	-0.0743	< 0.001	-0.2736 (0.0507)	< 0.001
± 90	27.97	372.7	-0.0557	< 0.001	-0.1993 (0.0446)	< 0.001
± 120	29.60	611.0	-0.0482	< 0.001	-0.1629 (0.0381)	< 0.001
± 180	29.35	1110.3	-0.0490	< 0.001	-0.1669 (0.0339)	< 0.001

Notes. The sample consists of single-version papers matched to Semantic Scholar by arXiv identifier. Outcomes are cumulative citation counts measured at a common extraction date. The treatment is CC BY/CC BY-SA adoption, and the instrument is exposure to the November 9, 2020 arXiv redesign. The first stage is reported in percentage points; reduced-form and fuzzy-RDiT estimates are reported in log points. Standard errors for fuzzy-RDiT estimates are reported in parentheses beneath the estimates and are clustered by first-version posting date. These estimates are not preferred because cumulative citations are mechanically affected by citation age: papers posted before the cutoff are older at the extraction date than papers posted after it. The age-robust fixed-calendar-window estimates are reported in Table 7.

Table A15: Cumulative-count age-adjustment checks

Outcome / window	Reduced form	RF p	Fuzzy RDiT	IV p
<i>Citation-rate diagnostics</i>				
$\text{asinh}(\text{total citations}/\text{year})$	-0.0941	< 0.001	-0.3363	< 0.001
$\text{asinh}(\text{influential citations}/\text{year})$	-0.0305	< 0.001	-0.1092	< 0.001
<i>Narrow-window cumulative diagnostics</i>				
± 30 days, $\log(1 + \text{total citations})$	-0.0783	0.034	-0.3147	0.029
± 60 days, $\log(1 + \text{total citations})$	-0.1219	< 0.001	-0.4489	< 0.001
± 90 days, $\log(1 + \text{total citations})$	-0.1088	< 0.001	-0.3891	< 0.001

Notes. The sample consists of single-version papers matched to Semantic Scholar. All specifications include separate linear slopes on each side of the cutoff, broad-field fixed effects, and author count, with standard errors clustered by first-version posting date. Citation-rate outcomes divide cumulative citations by exposure years measured from first-version posting to the extraction date. Because exposure time is mechanically related to the running variable in a common-extraction-date design, these adjustments are diagnostic rather than preferred. The preferred age-robust citation outcomes use OpenAlex fixed calendar-year citation windows.

A.5.2 Publisher-Side Open-Access Checks

This subsection examines whether the arXiv licensing intervention affected the later open-access status of the publisher version. These estimates test whether repository-side licensing spilled over into publisher-side open access; they are not part of the main licensing outcome.

Table A16: Publisher-side open access around the arXiv redesign

Outcome	Bandwidth	Pre mean	Estimate	SE	<i>p</i> -value
Publisher-side OA	±90	14.61	-1.440	(0.673)	0.034
Publisher-side OA	±180	14.37	-0.768	(0.516)	0.137
Green-only OA	±90	84.51	1.581	(0.712)	0.028
Green-only OA	±180	84.84	0.909	(0.546)	0.097
Bronze OA	±90	5.67	-1.170	(0.373)	0.002
Bronze OA	±180	5.46	-0.564	(0.262)	0.032
Closed	±90	0.87	-0.141	(0.171)	0.412
Closed	±180	0.79	-0.140	(0.126)	0.266

Notes. The table reports RDiT estimates for publisher-side open-access outcomes using OpenAlex metadata. Estimates are reported in percentage points. The ±90-day sample contains 38,129 papers, and the ±180-day sample contains 77,523 papers. Publisher-side OA equals one for Gold, Hybrid, Bronze, or Diamond status and excludes repository-only Green open access. Green-only OA captures repository-only open access without publisher-side OA. Bronze OA refers to papers free to read on the publisher site without an open license. All specifications use first-version submission dates, separate linear slopes on each side of the cutoff, broad-field fixed effects, and author count. Standard errors are clustered by first-version submission date. These estimates test whether the arXiv preprint-license intervention spilled over into publisher-side open-access status; they are not part of the main licensing outcome.

A.5.3 Robust Local-Polynomial Checks for Downstream Outcomes

Table A17 reports local-polynomial robustness checks for the downstream citation and publisher-side open-access analyses. These checks use `rdrobust` with robust bias-corrected inference, date-clustered standard errors, and adjustment for repeated values of the calendar-date running variable. The citation fuzzy-RDiT estimates remain small with robust confidence intervals that include zero, while the publisher-side open-access estimates remain small and show no positive shift.

Table A17: Robust local-polynomial checks for secondary outcomes

<i>Panel A. Fixed-calendar-year citation fuzzy-RDiT</i>					
Outcome	Specification	h_l/h_r	First stage	Fuzzy est.	Robust 95% CI
2021 citations	Manual $h = 90$, uniform	90.0	26.04	-0.050	[-0.443, 0.377]
2021–2022 citations	Manual $h = 90$, uniform	90.0	26.04	-0.003	[-0.547, 0.502]
2022 citations	Manual $h = 90$, uniform	90.0	26.04	+0.030	[-0.464, 0.423]
2022 citations	Manual $h = 90$, uniform, cov.	90.0	26.12	+0.047	[-0.479, 0.386]
2022 citations	MSE-rd, triangular	99.9	25.00	+0.009	[-0.326, 0.374]
2022 citations	CER-rd, triangular	71.8	24.65	+0.025	[-0.381, 0.449]
<i>Panel B. Publisher-side open access, sharp RDiT</i>					
Outcome	Specification	h_l/h_r	Conventional	Bias-corrected	Robust 95% CI
Publisher-side OA	Manual $h = 90$, uniform, cov.	90.0	-1.44	-0.02	[-1.81, 1.77]
Publisher-side OA	MSE-rd, triangular	77.2	+0.19	+0.47	[-1.63, 2.57]
Green-only OA	Manual $h = 90$, uniform, cov.	90.0	+1.58	+0.20	[-1.70, 2.09]
Bronze OA	Manual $h = 90$, uniform, cov.	90.0	-1.17	-1.23	[-2.34, -0.13]

Notes. Local-polynomial RD checks computed with `rdrobust` (Calonico et al., 2014, 2017), using single-version papers and first-version posting date as the running variable. h_l/h_r are estimation bandwidths in days; “cov.” adds author count and broad-field dummies; MSE-rd and CER-rd are data-driven common-bandwidth selectors. Panel A reports fuzzy estimates with CC BY/CC BY-SA adoption instrumented by post-redesign exposure on $\log(1 + \text{calendar-year citations})$ (sample $N = 16,363$). Panel B reports sharp estimates on publisher-side OA outcomes in percentage points (sample $N = 38,129$). Robust 95% confidence intervals are bias-corrected. Outcome definitions and full estimation details are in Appendix ??.