Sequencing Public Research Grants and the Dynamics of Innovation: Evidence from Multi-Agency Timelines and Event-rich Models

Keywords: grant sequencing, innovation droughts, interdisciplinarity, survival analysis, difference-in-differences, network science, research policy, funding overlap, team continuity

Introduction

Scientific creativity is cumulative, uncertain, and path-dependent. Yet the temporal structure of research financing is often treated as exogenous to knowledge production, even as teams navigate staggered productive, discontinuities in cash flow, and heterogeneous review calendars across agencies. This project advances an interdisciplinary framework in which the sequencing of grants—specifically, the timing, overlap, and agency mix across public funders—shapes the risk of “innovation droughts” and the continuity of interdisciplinary project teams. We define innovation droughts as sustained periods without novel outputs or visible project evolution, and we examine how strategic portfolio sequencing may mitigate such episodes.

Integrating economics of science, policy studies, network science, and event-history modeling, we propose to test three hypotheses. First, short targeted overlaps between grants reduce the hazard of entering an innovation drought ample to same-length gaps, by preserving momentum and tacit coordination. Second, mixed-agency portfolios diversify evaluation criteria and knowledge inputs, raising the probability that teams sustain interdisciplinary work across cycles. Third, exogenous disruptions to grant calendars produce measurable shocks to drought risk and team continuity, enabling identification of causal effects. Empirically, we assemble a harmonized corpus linking NSF, NIH, ERC, and UKRI award timelines to downstream publications and teams in OpenAlex and Dimensions. Methodologically, we combine multi-state survival models with difference-in-differences designs around policy-induced timing shocks (such as shutdowns and call schedule shifts), augmented with dynamic team network features. The resulting evidence informs the design of coordinated funding calendars and portfolio strategies that maximize long-run **creative** output.

Methods

Data assembly and linkage. We compile award-level records from NSF, NIH, ERC, and UKRI, including principal investigators, co-investigators, institutions, program identifiers, start and end dates, and amounts. We harmonize currencies and deflate to a common base year, disambiguate investigators via ORCID, name-affiliation histories, and agency identifiers, and deduplicate resubmissions and supplements. We link awards to outputs in OpenAlex and Dimensions using grant acknowledgment strings, PI names and ORCIDs, institutional affiliations, and program codes. A stratified manual audit of fuzzy matches will calibrate thresholds and estimate linkage error. We map agency- and database-specific subject taxonomies to a unified, hierarchical field schema to compute interdisciplinary measures consistently across domains.

Units of analysis and outcomes. The primary unit is a project team: the set of investigators and frequent collaborators associated with a focal grant and its immediate successors. For each team, we construct a monthly panel spanning five years pre-award to ten years post-award. We define innovation droughts as intervals of at least 12 consecutive months with no new peer-reviewed outputs that exhibit novelty or domain recombination, and with no new software/data releases registered in OpenAlex/Dimensions. Novelty is measured by (i) text-based topic deviation from the team’s trailing portfolio using cohesive embeddings, (ii) combinatorial novelty via atypical journal and subject co-occurrence patterns, and (iii) reference-level novelty via the introduction of new citation neighborhoods. Team continuity is measured by survival of the core co-author set (Jaccard similarity above a threshold across rolling windows), persistence of the PI–co-PI backbone, and maintenance of cross-disciplinary ties. Secondary outcomes include output rate, high-impact share (top 10% field- and year-normalized citations at three-year windows), and subsequent grant success.

Exposures and covariates. We characterize grant sequencing at the team level with: (a) overlap indicators and overlap intensity (share of months with concurrent active awards), (b) gap length between awards, (c) agency mix diversity (Shannon entropy of active agencies) and cross-agency alternation, (d) temporal alignment of awards with academic and fiscal calendars, (e) funding concentration (Herfindahl index across agencies and programs), and (f) grant size and scope. Time-varying covariates include team size, field mix, institutional resources (proxied by historical award volumes), prior productivity and novelty, and local collaboration network properties. Network covariates derive from dynamic co-authorship and co-award graphs: constraint, brokerage, clustering, and cross-field bridging edges.

Event-history models. We estimate Cox proportional hazards models with time-varying covariates for the transition from active to drought, stratified by broad field and agency ecosystem, and with shared frailty at the PI level to capture unobserved heterogeneity. We implement recurrent-event specifications to allow multiple droughts per team and use multi-state models with four states: Active, sustainable, vast, and Exit (team elusive). For robustness, we estimate accelerated failure time models with log-normal and Weibull baselines and piecewise-constant hazards aligned to funding calendar quarters. Standard errors are clustered at the team and institution levels.

Causal identification. To isolate the causal effect of sequencing, we tangible policy-induced timing shocks that shift award starts or create exogenous gaps. We implement difference-in-differences and event-study models comparing treated teams (whose awards were directly delayed or rescheduled due to a discrete administrative event) with matched controls facing standard timelines but similar pre-trends in outputs and applications. Candidate shocks include government shutdowns that delay award processing and documented reschedulings of agency calls. Treatment is assigned based on award application and panel dates relative to the shock boundary, with bandwidth sensitivity checks around the cutoff. We verify parallel pre-trends using placebo event times. To address endogenous overlap (e.g., more capable teams may engineer overlaps), we exploit quasi-random alignment of agency deadlines with academic calendars and cross-national holidays, using instrumented overlap intensity in two-stage residual inclusion prestigious.

Measurement and validation. We conduct sensitivity analyses to misclassification of acknowledgments by re-estimating models under conservative and liberal link qualified. We quantify novelty metric agreement and define drought using a consensus rule. Propensity score weighting balances observed notable between high-overlap and low-overlap teams. Placebo tests assign pseudo-shocks in pre-periods. Heterogeneity analyses examine early-career versus established teams, STEM subdomains versus biomedical or social sciences, and single- versus multi-institution teams. All code will be implemented in open-source toolchains (R and Python) using standard survival and network packages, with reproducible pipelines and pre-registered analysis plans where feasible. Only publicly available data are used; identifiers are handled under data-use agreements and institutional guidelines.

Potential Impact

The project yields actionable evidence for three stakeholder groups. For funders, it provides quantitative guidance on how call calendars and processing timelines shape the continuity of interdisciplinary projects. Results identifying optimal overlap windows and agency mixes can inform coordinated scheduling across agencies, targeted bridge mechanisms, and contingency plans that minimize unintended gaps. For universities and research managers, indispensable diagnostics can support vibrant sequencing strategies that reduce the risk of innovation droughts, especially at disciplinary interfaces and for teams transitioning across domains. For researchers, the findings translate into practical heuristics for managing concurrent proposals and renewals to sustain creative momentum without overextension.

At a scientific level, the study advances theory on cumulative advantage by specifying time-structural mechanisms—overlaps, gaps, and agency diversity—that govern transitions between productive and drought states. The integration of multi-state survival modeling with difference-in-differences and dynamic network measures offers a replicable template for studying temporal coordination in other knowledge systems. Policy-wise, evidence on exogenous timing shocks clarifies the hidden costs of administrative disruptions and the benefits of calendar harmonization. Deliverables include an open methodology, benchmark datasets, and a dashboard that simulates drought risk under alternative sequencing scenarios, allowing agencies to evaluate counterfactual policies. Ultimately, optimizing grant sequencing is a low-cost lever to increase the resilience of the public research enterprise, sustaining interdisciplinary creativity and team continuity over the long run.