Can Political Instability Freeze Science? Evidence from the 2013 U.S. Government Shutdown and Scientific Research in Antarctica*

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ABSTRACT

We examine the impact of political instability on scientific productivity, through the lens of the 2013 U.S. federal government shutdown. The 16-day shutdown coincided with the start of the austral summer, a critical period for research in Antarctica, amplifying the effect and disrupting researchers' projects. Employing a difference-in-differences approach with a novel dataset, we identify significant declines in both the quantity and quality of publications among affected researchers, as well as altered collaboration patterns. Our results demonstrate that even short-lived political events can disrupt science, particularly in geographically and temporally sensitive research systems. Furthermore, they demonstrate how short-term instability in scientific institutions can cascade, hindering the production of new knowledge.

KEYWORDS: Science, Politics, Instability, Antarctica, Government Shutdown

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1 Introduction

Scientific progress hinges on the stability of funding, infrastructure, policy, inputs, and human capital. This basic insight laid out by Vannevar Bush in *Science – The Endless Frontier* in 1945 (Bush, 1945) motivated coordinated large-scale, long-term government support for scientific research and the creation of the U.S. National Science Foundation (NSF). However, recent years have seen many political shocks – such as electoral uncertainty, funding delays or cuts, geopolitical conflicts, strikes, moratoriums, regulatory freezes, visa delays, travel restrictions, withdrawal from international agreements, and institutional instability – that have disrupted the scientific enterprise. These disruptions, while often transient, can have lasting impacts, impeding research, delaying discoveries, and altering research trajectories altogether. This paper poses two key questions: Can political instability impact science and scientific productivity? And can small perturbations to science cascade into amplified, long-term consequences?

We construct a novel dataset to study these two phenomena through the lens of the 2013 U.S. federal government shutdown which impacted scientists conducting basic research in Antarctica – a sudden and somewhat unexpected 16-day stalemate that shut down federal operations and halted critical scientific projects due to political gridlock. Our setting is Antarctica, a rich research ecosystem that has been described as the "world's most important natural laboratory" (Shah, 2015, p.215). Many scientific disciplines conduct basic and applied research in Antarctica that would be impossible to conduct anywhere else in the world: earth, atmospheric and environmental sciences, geology, glaciology, (marine) biology, oceanography, geophysics, and astronomy.

On the one hand, the scientific process may be relatively insulated from disruptions, be it political or otherwise. Scientists may possess inherent resilience to short-term disruptions. They may anticipate potential shocks and build buffers into their workflows, such as stockpiling critical materials, securing alternative funding sources, or reallocating resources to projects less affected by volatility. Additionally, the collaborative and international nature of science can sometimes help mitigate local disruptions, as researchers often rely on decentralized networks of collaborators, datasets, and institutions to continue their work. These mechanisms might enable scientists to smooth inputs and resources, allowing them to withstand sudden shocks without significant long-term effects. On the other hand, disruptions could be so significant that they derail entire research projects and even scientific careers. But even small disruption can compound over time, creating cascading effects that amplify the initial shock. For example, a temporary funding delay or gap might lead to missed grant deadlines, equipment degradation, the loss of skilled personnel, or significant gaps in the collection of samples

and data over time, which can ripple through a project's timeline, affect its outcome, and ultimately impede scientific progress.

A temporary two-week government shutdown as the one we study may not seem consequential enough to cause significant disruption but this initial - ostensibly unrelated - political event compounded. The government shutdown led to an immediate halt to all federally funded activities deemed as non-essential. This included the U.S. Antarctic Program (USAP), which is in charge of all U.S. research activities in Antarctica and which itself is managed by the federally funded NSF. While the shutdown lasted for only 16 days, its impact on USAP was magnified by its timing: it coincided with the beginning of the austral summer, which is a critical albeit short period for field research conducted in Antarctica. Because USAP maintains and manages all critical U.S. scientific research infrastructure in Antarctica, the shutdown caused a major disruption of scientific research in the South Pole. Some research projects in Antarctica were either significantly delayed, often by an entire year, reduced in scope, or canceled altogether. At the same time, some researchers were not affected because they didn't need to be in the field that year or were able to still collect and analyze their data remotely. This setting allows us to analyze the impact of the government shutdown at the scientist-level. Taken together, the 2013 government shutdown provides us with a setting that allows us to shed light on how even seemingly short-lived political disruptions can ripple through scientific systems, causing measurable short- to medium-term impacts on research output.

Political disruptions such as the 2013 U.S. government shutdown are generally hard to study because the impact of events such as these on scientific research are difficult to isolate due to the complex nature of scientific research and many other potentially confounding factors. Our setting allows us to overcome these obstacles. We obtain data on individual scientists funded by NSF to conduct research in Antarctica. In principle, all scientists could have been affected by the shutdown. However, in practice, only the research of less than 20% of scientists was directly materially impacted by the shutdown. We then analyze the impact of the shutdown by comparing different measures of research output and quality between affected and unaffected researchers using a difference-in-differences approach. In addition to analyzing these first-order effects, we also investigate to which extent scientists were able to mitigate any negative effects from the funding disruption. We test for changes in the type of research that they conduct as well as changes in their research collaborations.

We estimate that the government shutdown led to an average treatment effect equivalent to a reduction of 5-10% of publications per scientist per year, as well as declines in their by-line weighted publications, and quality-adjusted publications. This is a direct loss to the rich body of scientific knowledge produced in an important context for many basic and applied scientific

fields including earth, atmospheric, and environmental sciences, geology, glaciology, marine biology, oceanography, geophysics, and astronomy.

Our analysis of how scientists cope with the shock finds that affected scientists adjust their collaboration patterns. They are more likely to work in foreign teams, and find non-statistically significant but directional magnitudes consistent with larger teams, and more new unique collaborators.

We also investigate how the shutdown differentially affected researchers earlier on in their careers (assistant professors or equivalent) compared to senior researchers (associate/full professors or equivalent). Likewise, we plan to further explore how the shutdown affected early career researchers in affected projects, such as graduate students and postdocs. Section 5 reports qualitatively that graduate students and postdocs may have disproportionately been affected, suggesting they exited academia, delayed graduation, or had to alter their research plans. By investigating these outcome variables, we hope to further shed light on whether early career researchers are more prone to periods of scientific instability, and the implications of this on their careers.

Our paper contributes to several strands of literature. First, we contribute to the literature on the determinants of scientific progress. Prior work has identified many different factors that impact scinetific output and progress, including peer effects (Waldinger, 2012), (Azoulay et al., 2010), (Mohnen, 2022), physical capital (Waldinger, 2016), (Baruffaldi and Gaessler, 2021), (Helmers and Overman, 2017), incentives (Hill and Stein, 2021) (Brown and Ramaswamy, 2007), (Azoulay et al., 2011), performance measures (Hager et al., 2024), funding (Ganguli, 2017) (Hu, 2020) (Babina et al., 2023) (Whalley and Hicks, 2014) (Vakili et al., 2015) (Blomfield and Vakili, 2023), luck (Hill, 2019), and institutions (Murray et al., 2016). This paper adds to this literature by focusing on the role that political instability has on scientific progress. Prior literature looking at how politics can influence has focused on macroeconomic conditions (Allard et al., 2012) or macro geopolitical tensions (Jia et al., 2024). Some papers have focused on changes in congressional appointees (Hegde and Mowery, 2008; Hegde, 2009). In contrast, this paper leverages a new dataset to directly study the impact of political instability, using the 2013 U.S. government shutdown as an exogenous political shock as a setting. This may help us understand how other forms of political instability may also setback science.

Second, there exists a large literature on the effects of disruptions to scientific inputs (Ganguli, 2017; Hu, 2020; Babina et al., 2023; Vakili et al., 2015; Blomfield and Vakili, 2023; Murray et al., 2016; Waldinger, 2016; Baruffaldi and Gaessler, 2021). In contrast to this line of literature, the focus of this paper is the fragility of science to brief perturbations. Indeed, we find that even short, seemingly orthogonal events can amplify and significantly disrupt

scientific productivity. One recent exception is Tham et al. (2024) who find that short funding delays in R01 grant renewals conferred by the National Institutes of Health (NIH) lead to a reduction in spending and employee turnover, particularly in smaller labs. In contrast to Tham et al. (2024), our study finds that there is a negative impact on the rate of science, i.e. the quantity and quality of publications.

Finally, this is the first paper quantifying the direct negative impact of government shutdowns on science. Shutdowns disrupt a wide array of government services and programs. This has been shown to reduce government revenue and reduce economic growth. For example, Standard and Poor found that the shutdown had taken 24 billion out of the economy and reduced the annualized fourth-quarter annualizes 2013 GDP by 0.6 percent (Burwell, 2013). However, the impact on science has yet to be documented, despite receiving significant attention in the media by many newspapers report fears of science being hurt by government shutdowns. Due to the highly contentious political climate in the U.S., the threat of government shutdowns has become an annually recurrent fixture of U.S. politics. While not all as long or severe as the 2013 shutdown, there have been 11 federal shutdowns since 1980, and at least 16 state-wide shutdowns. Our paper demonstrates how government shutdowns can directly disrupt science.

2 Scientific research in the Antarctic and U.S. government shutdown

2.1 Scientific research in the Antarctic

Due to its geographical position, climate and atmospheric conditions, the Antarctica provides unique opportunities for basic and applied science, attracting researchers across diverse scientific disciplines, including earth, atmospheric, and environmental sciences, geology, glaciology, marine biology, oceanography, geophysics, and astronomy to investigate fundamental questions about the universe (NSF, 2023).

There are several strands of scientific research that are specific to Antarctica. The NSF states that "Antarctica's extreme environment and isolation make it a prime location for unique research that cannot be replicated elsewhere" (NSF, 2025). For example, the Antarctic ice sheet plays a critical role in the global ecosystem, with its melting contributing significantly to rising sea levels. Moreover, deep ice cores extracted from the ice sheet provide an extraordinary window into paleoclimatic records dating back as far as 800,000 years (Weller et al., 1987; Smith, 2020). The region's rapid and pronounced responses to climate change also make it an ideal location to study marine wildlife and ecosystems, yielding valuable insights

into the future of our planet. Additionally, Antarctica's harsh weather conditions, extreme cold, and prolonged periods of darkness offer a unique analog for exploring the potential for life on other planets, such as Mars. These unique opportunities underscore the region's critical importance for advancing our understanding of the Earth, its history, and its place in the universe.

Research in Antarctica is typically limited to the relatively short austral summer, which spans from mid-October to February, due to the continent's extreme climate and remote location. During the longer winter months, field research comes to a complete halt, and only essential operational personnel remain to maintain research facilities.

Since 1959, the United States has maintained a comprehensive federally funded research initiative in Antarctica, known as the United States Antarctic Program (USAP). Managed by the NSF, this program oversees logistics and facilities, including three permanent research stations on the continent and research vessels operating in the Southern Ocean. Additionally, the NSF administers a dedicated grant program to support Antarctic research.

2.2 2013 U.S. Government Shutdown

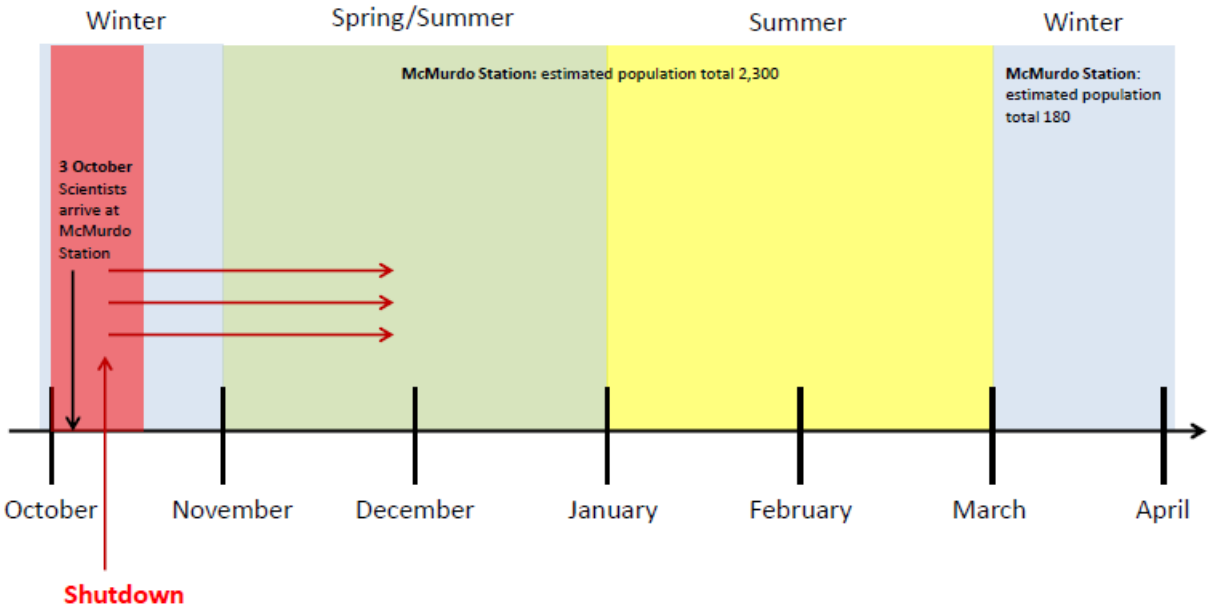
In the U.S., Congress has to pass legislation every fiscal year to finance the federal government. If Congress fails to appropriate funds for the next fiscal year, the federal government enters a 'shutdown.' A shutdown has far-reaching consequences for the federal government as well as all agencies and operations that rely on federal funding. For example, federal employees are furloughed, only very few "excepted" employees continued to work. Shutdowns are a relatively common occurrence in the U.S. in recent decades due to often deep political divisions between the country's two main parties. However, they vary significantly in length. Some last only a couple of hours while others have lasted for weeks. One of the longest shutdowns to date occurred in the fall of 2013. Congress failed to pass legislation appropriating funds for fiscal year 2014. The failure was caused by a deep division between the Republican-led House and Democratic-led Senate and President Obama mainly over funding for Obamacare. The 2013 shutdown was one of the most significant ones in recent history, with an estimated overall economic cost of $2-6 billion (Burwell, 2013).

The shutdown began on October 1st and lasted until October 17 when federal government operations resumed after Congress had passed the Continuing Appropriations Act. Overall, this implies a total duration of the shutdown of 16 days.

What began as political gridlock, had consequential downstream implications on science. As a

direct result of the government shutdown, USAP was put into caretaker status.[1] This meant immediate suspension of all non-essential activities and even outright cancellation of some research activities for the entire 2013-2014 season. This was an unprecedented step because it was the first interruption since the USAP's formation in 1959. While the disruption due to the shutdown was temporary, its impact was magnified substantially due to its timing. As shown in Figure 1, the government shutdown coincided with the onset of the austral Summer, which is the critical time period when scientists return to Antarctica to conduct their research during the short summer period. The NSF acknowledged this, stating that "some activities cannot be restarted once seasonally dependent windows for research and operations have passed." After the shutdown had ended, the NSF stated in a press release that "49 of the 77 scheduled projects in the McMurdo area will deploy this season, with some of those 49 deploying with reductions or modifications in scope." (NSF, 2013). The impact of the shutdown on scientific research in Antarctica did not go unnoticed by science outlets as well as the popular press. A large number of newspaper articles reported on the impact on individual scientists.[2]

Figure 1: Timing of shutdown magnified impact on Federally funded research in the Antarctic



Notes: The figure shows the timing of the U.S. federal government shutdown and how it affected USAP's research activities in Antarctica.

[1] Caretaker status means that activities in Antarctica are reduced to an absolute minimum only enough to ensure protection of government property and safeguarding of human lives

[2] See for example: Science, 10 October 2013; Nature, 4 October 2013; Scientific American, 17 October 2013; New York Times, 14 October 2013; NBC News, 7 October 2013.

3 Data

We begin by collecting the entire portfolio of grants conferred by the NSF by searching the NSF grant database for title and/or abstract that mention the term Antarctic between 1993 and 2013 dropping any project that ended before October 1st 2013, the beginning of the government shutdown.

With this, we have a core sample of 568 projects with a total of 413 Principal Investigators (PIs)[3] who were actively conducting research on the Antarctica during the period in which their research coincided with the government shutdown. We exclude grant recipients who were not focused on research such as artists, operational support etc.

We obtained information from the NSF on projects directly affected by the shutdown. Specifically, the NSF provided us with a list of 16 PIs that were "officially" affected. However, anecdotal evidence suggested that the set of affected researchers identified by the NSF was incomplete. Therefore, we contacted all PIs in our sample and asked them to fill out a short questionnaire about any potential impact of the shutdown on their NSF-funded research projects.[4] Apart from asking PIs whether they were directly affected by the shutdown, we elicited specific information about why they were affected or not. In addition, we also asked them to identify other researchers that they believed to have been affected by the shutdown. We used the peer-identification of affected researchers as a check of the self-reported information by PIs. Overall, we identify 71 PIs that were affected by the shutdown, which corresponds to 17% of all PIs in our sample.[5]

We collect additional information on the PIs in our sample. We track their work history from 2003 to 2020 including affiliation, job title, and whether the PI retired or passed away. The information allows us to determine when PIs retire, die, or leave science. We take this information into account in our analysis to construct an unbalanced panel of PIs between 2003 and 2020.

In order to measure the research output of PIs, we use OpenAlex (Priem et al., 2022) to collect scientometric information. We obtain the entire publication output for all PIs in our data for the period 2003-2020. For accuracy, we hand-curate the ORCID or OpenAlex IDs, which are mostly unique identifiers of PIs. In some instances, some PIs have more than

[3] Some PIs may have more than one project.

[4] More information is provided in the appendix. The survey received IRB approval. PIs were sent up to two follow-up emails. No incentives were provided to participants to complete the survey.

[5] Out of the 71 PIs, 16 were identified by the NSF, 28 were self-identified, and 44 were peer-identified. As expected, there is some overlap between these categories, hence the smaller number of scholars who were affected than identified. Among the overlap: 6 were peer and NSF-identified, 4 were self and peer-identified, and 1 was NSF, peer, and self-identified.

one identifier, in which case their data is merged. We remove papers that are not research-focused such as obituaries, book reviews, awards, grant announcements etc. To ensure the accurateness of our data, and to minimize the occurrence of false positives, we reviewed the entire publication portfolios of 15% of PIs in our sample manually. In addition, we identify publications that likely resulted from fieldwork in Antarctica by searching publication titles and abstracts for a large number of Antarctica-related keywords.[6]

4 Empirical approach

4.1 Impact on PIs

Our goal is to estimate the impact of the temporary shock caused by the federal government shutdown on publication output by NSF-funded scientists. In principle, all field research conducted in Antarctica through the USAP during the field season 2013/2014 was affected by the shutdown. As explained in Section 2, the shutdown was due to political tensions in Washington D.C. and thus exogenous to individual PIs. This allows us to estimate the impact of the shutdown on scientific output using a difference-in-differences model at the PI-level.[7]

We estimate the following specification:

$$y_{it} = \alpha + \beta_1 \text{Shutdown}_t + \beta_2 \text{Affected}_i \times \text{Shutdown}_t + \delta_t + \theta_i + \epsilon_{it} \quad (1)$$

where y_{it} denotes a measure of research output, for example the total the number of articles published by PI i in year t. The dummy variable Shutdown_t switches to one from 2015 onwards since the shutdown affected the field season in 2013/14, its impact on publications is therefore unlikely to have materialized before 2015 due to publication lags. Affected_i is a dummy variable that is equal to one for all affected scientists. δ_t and θ_i are year and scientists dummies, respectively. ϵ_{it} is a random error term where we cluster standard errors at the scientist-level. We estimate equestion (1) either using a Poisson estimator or using OLS depending on whether the dependent variable is a count variable.

We measure the total publication output of PIs in different ways. First, we count all publica-

[6] These key words include geographic locations in Antarctia, such as Whillans Ice Stream, Ross Sea, Thwaites Glacier, Pine Island Glacier, etc. as well as specific animal species such as Adélie penguin(s) and Gentoo penguin(s), and research stations such as McMurdo Station.

[7] Pre-treatment characteristics of the shutdown are similar. For example, t-tests between the productivity of affected and unaffected scholars are not statistically different. We are currently in the process of collecting further information on gender, institutional prestige, and the seniority of the scientists to conduct balance tests.

tions by PI i in year t without applying any weights. We then only count PI i's publications based on field-research conducted in Antarctica. Next, we take into account an author's position in the byline. We do that by only counting articles where PI i appears either as the first or last author in an article's byline. Alternatively, we use an author's position in the byline as weight, e.g. if PI i appears as the 4th author in a byline with more than four authors, we count the article 1/4 times. If the scientist is the last author, the article still obtains a weight of 1 given the byline convention in the sciences.

In addition to estimating the overall impact of the shutdown on PIs publication output, we also capture changes in a PI's output along other margins. We look for changes in the quality of publications by factoring in journal quality, proxied by impact factor, citations, and citations accrued within three, four, and five-year windows counting from an article's publication date. This allows us to not only measure the quantity of scientific output affected by the shutdown but also assess whether the disruption altered the impact and reach of the resulting research.

We also investigate whether PIs collaborate internationally more, proxied by the first or last author being from a non-US country, as well as the number of authors from a foreign institution. We also look at whether the overall team size increases, and the number of additional *new* co-authors. Examining changes in international collaboration, team composition, and team size changes helps us identify how affected PIs sought to mitigate the impact or were forced to adapt. These adjustments provide insight into the strategies employed to sustain research output when faced with unexpected challenges.

4.2 Impact on Early Career Scientists

We are currently examining how the shutdown impacted principal investigators (PIs) at different career stages, specifically comparing early-career PIs (e.g., assistant professors or equivalent) to later-stage PIs (e.g., associate or full professors or equivalent). Additionally, we aim to investigate how the shutdown affected early-career researchers within PIs' labs, including graduate students and postdoctoral researchers. As highlighted in Section 5, qualitative evidence suggests that graduate students and postdocs often faced significant disruptions, including exiting academia, delaying graduation, or substantially altering their research. By analyzing these outcome variables, we seek to deepen our understanding of whether early-career researchers are particularly vulnerable to periods of scientific instability and to explore the broader implications of such disruptions on their career trajectories.

5 Results

5.1 Qualitative Evidence

Before describing our quantitative results, we briefly discuss some qualitative evidence obtained from our scientist-level survey. The qualitative evidence allows us to better understand why or why not scientists were affected by the shutdown and how/why this manifested.

Overall, the main impact appears to have come from the shutdown's impact on data collected through fieldwork. That impact occurred in various ways, including significant delays of projects, often by an entire year. One PI for example stated that "*we were unable to conduct our field season and had to wait an additional year.*" or, "*It pushed the first year of fieldwork for our project into the next year, which meant that the planned interval between our two years of fieldwork was shortened, which may have affected our results*". Likewise, some projects experienced substantial reductions in the scope of research projects. For example, one PI reported that they "*lost roughly 60% of our field time and reduced our field team size by 50%. We ended up with 20-25% of our planned person-hours. The shortened season was also more prone to weather-related delays (which are consistent in Antarctic research) so overall we ended up with only 16% of our planned field days (losing 5 out of 6).*." Another PI stated that the "*shutdown caused weeks of delay in getting personnel to Antarctica [...]. Ultimately NSF decided that they cannot support this ambitious project in the face of the shutdown-caused disturbance. Instead, they supported a much smaller drilling effort [...].*"

Others experienced the outright cancellation of field projects, which arguably had the most drastic impact on research projects. This sometimes has further follow-on repercussions such as graduate students exiting academia, "*Cancellation of fieldwork seriously limited research productivity, delayed important field observations on the stability of the West Antarctic Ice Sheet. This complicated future field planning and led several graduate students to drop out of the research program entirely.*" Another PI reported that the "*shutdown canceled many field projects and we were not able to deploy [to the Antarctic]. This impacted graduate student education, sample collection and analyses, research publications, etc. [...] The shutdown also occurred 'last minute' which meant that significant time and resources had already been invested in planning; this effort and the cost associated with it was essentially lost.*".

Even after the end of the shutdown, scientists often had to rush to conduct their field work within the remaining available time of the austral summer, which also caused problems. See for example "*Hasty assembly of reagents and equipment resulted in mistakes, failure to assemble necessary equipment and reagents and minimal time to prepare field crews adequately for the project. This resulted in data loss of data and compromised data for some measurements*

that were central to the project."

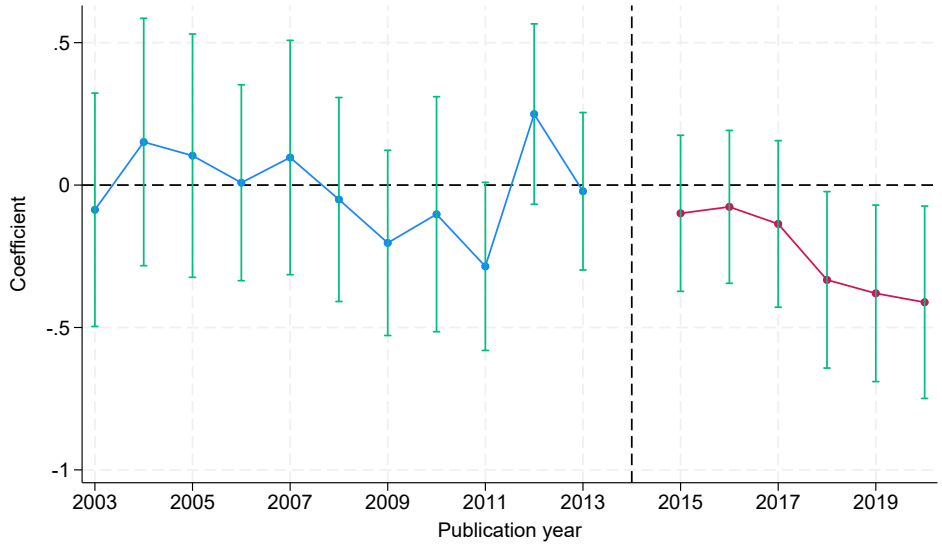
The survey results also help us understand why the majority of scientists in our sample were largely unaffected by the shutdown. For example, some researchers had already conducted their fieldwork and collected their data prior to the shutdown and were now focused on analyzing the data at their home institutions, "*The research cruise in the Ross Sea took place in February and March 2013, well before the government shutdown. By the time of the shutdown in October 2013, the project participants were working at their home institutions on sample and data analysis, so less susceptible to being impacted.*" or "*My part of this project involved only analysis of data that was communicated in near real time. Transmission of this digital data was not affected by the shutdown.*" or "*By 2013, we no longer had active field program in Drake Passage and were busy analyzing our data sets.*" or "*Data was in hand during the shut down so we were able to continue to function normally with data analysis, paper writeups, etc.*" or *our research cruise sailed before the shut down was enacted. We were already at sea.*". The survey also revealed that some scientists were largely unaffected despite instruments failing to collect data during the 2013/14 field season because the available data turned out to be sufficient. For example "*Enough data for the project research had already been obtained and the instrument failed to collect any additional data.*" Others were less dependent on NSF funding or had received the necessary funds prior to the shutdown and were not dependent on the USAP infrastructure. For example "*Received the money before the shutdown and due to external funding were allowed to work and charge to it at the university*" or "*Our project office is based at an academic/research nonprofit [name of the institution], so we continued to function, with NSF funds already in hand to support the OCB Project Office and its activities.*".

5.2 Quantiative Evidence

We begin by tracing the impact of the government shutdown over time. Specifically, Figure 2 plots the coefficients associated with the set of affected scientists over time from the following specification: $y_{it} = \alpha + \sum_t \beta_t(\text{Affected}_i \times D_t) + \sum_t \theta_t D_t + \theta_i + \epsilon_{it}$ where $t = 2003, 2004, ..., 2020$ with 2014 as the omitted category. The dependent variable are Antarctica-related publication counts. The event study graph suggests the absence of pre-trends in publication counts. However, we see a drop in affected PI's publication output shortly after the disruption caused by the government shutdown which increases over time.

Table 1 reports our main results on the impact of the shutdown on the output of affected scientists. In columns (1)-(2), we report results for all publications while columns (3)-(4) report results when we restrict our focus on Antarctica-related publications. Compared to

Figure 2: Event study of shutdown effect on Antarctica-related publications



Notes: This figure plots the estimated coefficients for affected principal investigators (PIs) over time, showing the relative decline in Antarctica-related publications after the disruption in 2013/14. Coefficients and 95% confidence intervals are derived from a difference-in-differences model.

unaffected scholars, affected scholars produce fewer publications and by-line weighted publications. Depending on the specification, Table 1 suggests that affected scholars produce approximately 5-10% fewer publications per year.

In Table 2, we show our results when we take into account the quality of the journals in which scientists published as well as the impact of publications. This is proxied by impact facotr, total citations, and the number of citations scientists receive within the first 3, 4, and 5 years from publication.

Table 3 looks at collaboration patterns. We find that compared to unaffected scholars, affected scholars are more likely to work in teams where the first or last author is not from the US. Furthermore, although not statistically significant, columns 2-7 all point in the direction that affected scholars work more in teams with more foreign scholars (columns 2/3), in larger teams (cols 5/6), and with new co-authors they hadn't collaborated with before (column 7). These changes in collaborative patterns may because scientists are forced to 'cope' or try to mitigate the damage from the shutdown.

Table 1: The effect of the government shutdown on publication counts

	All		Antarctic	
	All	Byline	All	Byline
	(1)	(2)	(3)	(4)
Shutdown × Affected	-0.157**	-0.103***	-0.202**	-0.0716**
	(0.0630)	(0.0381)	(0.101)	(0.0363)
Observations	5439	4778	5385	4778
R^2	0.240	0.390	0.292	0.426

Notes: The dependent variable in column (1) is the total number of publications for each principal investigator (PI). In column (2), the dependent variable is the total number of publications, weighted by the PI's byline position within each publication (e.g., first, middle, or last author). Columns (3) and (4) focus exclusively on Antarctica-specific publications, with column (4) weighting the dependent variable by the PI's byline position. All dependent variables are counts, and so the models are estimated using Poisson regression. All specifications include PI fixed effects and time (year) fixed effects to account for unobserved heterogeneity at the individual and temporal levels. Standard errors are clustered at the PI level. A constant is included in all regressions but not reported. All specifications include time (year) and PI fixed effects and include a constant. Conventional significance levels are denoted as follows: * significant at 10%, ** at 5%, *** at 1%.

Table 2: The effect of the government shutdown on the quality of publications

	Impact Factor	Citations			
		All	3 years	4 years	5 years
	(1)	(2)	(3)	(4)	(5)
Shutdown × Affected	-3.151**	-0.155*	-9.516*	-14.33*	-17.48*
	(1.414)	(0.0903)	(4.924)	(7.339)	(9.341)
Observations	4778	4578	4778	4778	4778
R^2	0.464	0.473	0.376	0.376	0.374

Notes: The dependent variable in column (1) is the impact factor of journals. In column (2), the dependent variable is the total number of citations a PI receives. In columns (3)-(5), the dependent variable restricts the citation window to citations accrued within 3, 4, and 5 years of publications, respectively. All dependent variables are counts, and so the models are estimated using Poisson regression. All specifications include PI fixed effects and time (year) fixed effects to account for unobserved heterogeneity at the individual and temporal levels. Standard errors are clustered at the PI level. A constant is included in all regressions but not reported. Conventional significance levels are denoted as follows: * significant at 10%, ** at 5%, *** at 1%.

Table 3: The effect of the government shutdown on collaboration patterns

	First/Last	Foreign Authors		Team Size	Collaborators	
	U.S. Author	Count	Ratio		New	All
	(1)	(2)	(3)	(4)	(5)	(6)
Shutdown × Affected	-0.136**	0.418	0.00371	0.644	19.02	0.0420
	(0.0609)	(0.440)	(0.0218)	(0.613)	(15.33)	(0.0484)
Observations	4778	4734	4734	4778	6348	6348
R^2	0.191	0.477	0.405	0.598	0.781	0.887

Notes: The dependent variable in column (1) is number of first or last authored papers based in the U.S. Columns (2) and (3) capture whether teams accrue more foreign (non U.S. based) teams. In Column (2), the dependent variable is the number of foreign authors. In Column (3), the dependent variable is the ratio of foreign authors to total authors. In Column (4), the dependent variable is the total team size. In Columns (5) and (6) the dependent variable is the number of new collaborators. Columns (1), (2), (4), and (5) are count variables and so are estimated using Poisson regressions. Columns (3) and (6) are ratios and so are estimated using OLS. All specifications include PI fixed effects and time (year) fixed effects to account for unobserved heterogeneity at the individual and temporal levels. Standard errors are clustered at the PI level. A constant is included in all regressions but not reported. Conventional significance levels are denoted as follows: * significant at 10%, ** at 5%, *** at 1%.

6 Conclusion

This study provides compelling evidence that even short-term political instability, such as the 16-day U.S. government shutdown in 2013, can have significant and lasting impacts on scientific progress. By leveraging the unique timing and scope of the shutdown's effects on Antarctic research, we demonstrate declines in both the quantity and quality of research output among affected scientists, as well as shifts in collaboration patterns. These findings highlight the fragility of the scientific enterprise to instability in scientific institutions.

Furthermore, our results suggest that even brief disruptions can create cascading effects, delaying critical experiments, reducing data collection opportunities, and impairing the professional trajectories of researchers and their collaborators. The findings also illustrate the broader implications of short disruptions to scientific inputs on the global scientific community, particularly for research dependent on time-sensitive or geographically specific fieldwork, such as climate-sensitive research in the Arctic or tropical regions, long-duration space missions, large-scale field experiments, time-sensitive agricultural research, conservation biology projects, and regulatory-dependent health research such as clinical trials.

In light of these findings, there may be some potential policy interventions to mitigate the vulnerability of science to such shocks. First, establishing contingency funding mechanisms, such as bridge loans for affected researchers, could help sustain research during unexpected disruptions. Second, recognizing the broader economic and societal costs of government shutdowns, policymakers could prioritize stability in funding and operational support for critical scientific programs.

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Online Appendix

Can Political Disruptions Freeze Science?
Evidence from the 2013 U.S. Government Shutdown and Scientific Research in Antarctica

Kris Gulati and Christian Helmers

A NSF Principal Investigator Survey

The survey has two key strengths. First, capturing the impact of short/political events is tough to measure, which is why we chose this research setting. Our study is not feasible without using a survey to identify affected and unaffected scholars, allowing us to construct a new dataset. Second, the survey allowed us to supplement our quantitative findings with qualitative data points.

However, surveys also have weaknesses. First, surveys suffer from issues with the respect to response rate. The survey we conducted received a 23.1 percent response rate. This is in line with other surveys on academic scientists in the US that received response rates less than 10 percent (see (Hill and Stein, 2021), (Myers et al., 2023), and (Baruffaldi and Gaessler, 2021).

Second, surveys may introduce measurement bias by accidentally classifying scholars in the control group as treated for instance. There are reasons to believe our results are not driven by this. For example, the data that is not prone to this bias (i.e. data received from the NSF points towards a negative effect). Second, we leveraged the fact that the research conducted in the Antarctica is a relatively closed environment. As such, we asked participants to both identify if they were affected but also nominate others who they knew of who were impacted. Focusing solely on peer-identified PIs also points to a negative effect. Finally, due to the nature of the treatment, it is likely that individuals hurt by the shutdown are more likely to respond and to be identified by peers and the NSF, thus lowering the prevalence measurement error.

B Appendix: Tables

	Before			After			
	Obs.	Mean	SD	Obs.	Mean	SD	Diff.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
All publications							
Affected	840	2.877	2.881	331	3.785	2.872	0.908
Unaffected	3,705	2.756	3.187	1,472	4.239	3.622	1.483
Antarctica							
Affected	840	1.127	1.809	331	1.543	2.046	0.416
Unaffected	3,705	0.858	1.547	1,472	1.44	1.873	0.582
Byline weighted							
Affected	599	2.582	1.857	299	2.312	1.680	-0.27
Unaffected	2,551	2.545	1.983	1,329	2.583	2.104	-0.038
Byline weighted (Antarctica)							
Affected	599	0.947	1.194	299	0.875	1.140	-0.072
Unaffected	2,551	0.763	1.099	1,329	0.832	1.071	0.069
Impact Factor							
Affected	599	15.736	14.779	299	20.381	17.615	4.645
Unaffected	2,551	14.549	14.652	1,329	21.948	19.954	7.399
Three Year Citation Window							
Affected	599	47.305	61.604	299	53.1	64.252	5.795
Unaffected	2,551	47.308	72.85	1,329	61.291	83.883	13.983
Four Year Citation Window							
Affected	599	71.903	92.311	299	79.541	98.16	7.638
Unaffected	2,551	71.809	105.574	1,329	91.607	125.161	19.798
Five Year Citation Window							
Affected	599	96.764	123.247	299	102.699	128.512	5.935
Unaffected	2,551	95.911	138.554	1,329	115.942	157.490	20.031
First/Last Author US-based							
Affected	599	3.081	2.275	299	3.280	2.218	0.199
Unaffected	2,551	2.919	2.523	1,329	3.483	2.906	0.564
Foreign Institution Counts							
Affected	595	1.805	3.114	299	3.006	6.257	1.201
Unaffected	2,518	2.041	4.199	1,322	2.825	4.818	0.784
Foreign to Domestic Author Ratio (Mean)							
Affected	595	0.178	0.186	299	0.217	0.211	0.039
Unaffected	2,518	0.22	0.242	1,322	0.254	0.237	0.034
Author Count							
Affected	599	6.578	5.506	299	9.263	8.75	2.685
Unaffected	2,551	6.704	7.985	1,329	8.782	9.534	2.83
New Co-authors							
Affected	840	66.152	72.887	331	215.682	149.586	149.53
Unaffected	3,705	61.968	74.074	1,472	192.082	138.623	130.114

Table A-1: Descriptive statistics. Columns (1) and (4) are the number of observations before and after the shutdown. Columns (2) and (5) provide the means before and after the shutdown. Columns (3) and (6) provide the standard deviations before and after the shutdown. Column 7 provides the difference[ii] between the affected and unaffected groups means for each dependent variable.