Journal submissions, review and editorial decision patterns during initial COVID-19 restrictions

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Abstract: We use the full administrative records from four leading agricultural economics journals to study the impacts of the COVID-19 pandemic on manuscript submission, editorial desk rejection and reviewer acceptance rates, and time to editorial decision. We also test for gender differences in these impacts. Manuscript submissions increased sharply and equi-proportionately by gender. Desk rejection rates remained stable, leading to increased demand for reviews. Female reviewers became eight percentage points more likely to decline a review invitation during the early stage of the pandemic. First editorial decisions for papers sent out for peer review occurred significantly faster after pandemic lockdowns began. Overall, the initial effects of the pandemic on journal editorial tasks and review patterns appear relatively modest, despite the increased number of submissions handled by editors and reviewers. We find no evidence in agricultural economics of a generalized disruption to near-term, peer-reviewed publication.

Keywords: COVID-19; gender bias; scholarly journals; submission rate; review response rate; decision time; publishing.

1. Introduction

Within months of the onset of the COVID-19 pandemic, research universities around the world – at least 250 US institutions alone, by one partial count (Butler, 2021) – granted junior faculty one year tenure clock extensions. That policy was premised on the assumption that the pandemic adversely affected near-term research productivity, noting the potentially severe consequences of several months' disruption within what is typically an extended probationary period before filing of a tenure dossier. The assumption of disrupted near-term research productivity followed naturally from widespread popular and social media accounts of the sudden adversity many researchers faced. Many scholars endured illness, deaths of loved ones, lockdowns, travel bans, transition to online teaching, closure of schools and day care services, on top of the general anxiety surrounding the pandemic, all of which diverted time and attention away from research, especially during the initial months, as people were caught unaware and needed to adjust quickly, with limited information (Langin, 2020). Because tenure decisions at research universities depend critically on candidates' peer-reviewed publications records, a tenure clock extension seemed an appropriate response to the expectation that the pandemic would disrupt young scholars' productivity, as reflected in peer-reviewed publications, among other metrics.

But, did the pandemic disrupt near-term publication rates? Many scholars have – perhaps less publicly – reported enjoying an increase in time available for research after cancelling travel. And many editors reported (on social media and in informal conversations) a surge in manuscript submissions. What do the data tell us about the net

impacts of COVID-19 on research productivity? Did the pandemic really slow the submission and peer review of journal manuscripts in the initial stages of the pandemic, as tenure clock extension policies presumed? We offer an initial, and partial answer to this question, using journal administrative data to study the near-term impacts of the pandemic on journal manuscript submissions, reviews, and editorial decisions in agricultural economics.

The premise that the pandemic disrupted peer-reviewed journal manuscript submissions seems worth checking carefully since blanket tenure clock adjustments affecting all candidates can have unintended consequences. For example, gender-neutral tenure clock extension policies for all new parents had the unintended effect of substantially reducing female tenure rates while significantly increasing male tenure rates (Antecol et al., 2018). A policy change that presumes everyone suffered a temporary productivity decline may inadvertently aggravate pre-existing gender gaps. A careful assessment of the near-term impacts of the pandemic on peer-reviewed publication is needed, especially concerning any gender differences in those impacts.

A growing body of survey and anecdotal evidence suggests that the scholarly productivity impacts of COVID-19 might vary by gender, with female scholars disproportionately bearing the burdens of the pandemic and its lockdowns, and males perhaps enjoying the windfalls of reduced time spent in travel and meetings (Collins, 2020; Langin 2021). Myers et al. (2020) run a survey on more than four thousand researchers across Europe and the US, asking information about their working hours and time allocations after the onset of the pandemic. They found an overall decline in time devoted to research, but with great variation depending on gender and presence of young

dependents; the most affected are female scientists with young dependents, which reported a decrease in ability to devote time to research almost twice as large as the average (more than 40% reduction in time for research). They also found that the decrease in time devoted to research due to the onset of COVID-19 vary according to the scientists' discipline of research, with researchers relying on physical laboratories and time-sensitive experiments (such as in chemistry and biology disciplines) reporting the largest decline in research time. Squazzoni et al. (2020), considering editorial data from the full set of Elsevier journals on multiple disciplines, found that male authors submitted relatively more studies than their female counterpart during the first months of the pandemic, in all areas except for life sciences. Interestingly, they also found female scientists at intermediate or advanced stages of their career being the most affected by the pandemic in terms of submitted contributions, although with the exception of the area of social science and economics. Two studies found that female authors submitted less COVID-19 related manuscripts than males, a possible indication of disparity (Squazzoni et al., 2020; Bell and Fong, 2021). Deryugina et al. (2021) report survey evidence showing that female academics – especially those with young children – disproportionately reduced research time to attend to domestic responsibilities. Adams-Prassl et al. (2020) similarly found that women in Germany, the United Kingdom and the United States spent more time than men did on childcare and home schooling after COVID-19 school closures. On the other hand, Fox and Meyer (2021) based on editorial data in the ecology discipline found no evidence of a change in the proportion of female first authors since the start of COVID-19 disruptions. Amano-Patiño et al. (2020) found no change in women's share of contributions to two major economics working papers series in the early months of COVID-19 lockdowns,

but also report that the editors of two major journals, the *Journal of the European Economics Association* and the *Review of Economic Studies,* indicated a fall in women's share of manuscript submissions in spring 2020. Butler (2021) succinctly summarizes prevailing beliefs about COVID's impacts as follows:

> "The pandemic's impacts on faculty research have been increasingly well documented, both in nationwide studies and on the ground. … [F]aculty have encountered canceled conferences and shuttered galleries, navigated lab closures and new safety protocols for reopening, and restructured fieldwork and professional leaves. At the same time, the rapid transition to online or hybrid teaching, K-12 school closures, and increased care responsibilities have imposed on faculty new and relentless demands, further restricting if not eliminating the time and energy available to research. These latter demands often fall disproportionately on women and faculty of color, amplifying and deepening inequities, especially in service and teaching, that have long persisted in higher education."

Survey and anecdotal evidence necessarily suffer limitations, however, arising from non-random non-response patterns and non-classical measurement error in self-reported data. Further, the survey evidence to date focuses almost entirely on time use, a crucial input into the production of research, but not on the outputs – peer-reviewed journal article submissions – on which tenure decisions disproportionately depend. We analyze journals' administrative data to supplement the existing survey studies in order to flesh out what impacts, if any, the pandemic has had on journal publication patterns.

We analyze data from four leading agricultural economics journals for submissions received and reviewer invitations sent in the period from January 2018 to the end of July 2020, i.e., from a baseline of two years prior to the emergence of COVID-19 through the first several months of the pandemic. We estimate the impacts of the pandemic using country-specific COVID-19 restrictions. The basic patterns in our raw data hold when we control for prospective confounders using multiple regression analysis, and are robust to reasonable variations in classifications of lockdown periods, in regression specifications, and in estimation methods.

2. Methodology

2.1 Data

We study journal administrative data from four leading agricultural economics journals[1] (Clarivate Analytics, 2020) – the *American Journal of Agricultural Economics* (AJAE), *Applied Economic Perspectives and Policy* (AEPP), *Food Policy* (FP), and the *Journal of Agricultural Economics* (JAE) – covering 5,366 submissions and 6,480 associated reviewer invitations from 1 January 2018 through 31 July 2020.[2]

The four journals have different publishers (Elsevier and Wiley), and include association-owned journals (AEPP, AJAE, JAE) and one publisher-owned (FP). Their editors

[1] These four journals are arguably the leading peer-reviewed research outlets in the field, as reflected in any of several metrics. According to the latest data from the 2019 Journal Citation Reports (JCR) for the "Agricultural Economics & Policy" category (and excluding the *Annual Review of Resource Economics* which is a by-invitation-only review journal), these four journals account for 50% of total citations in the category and they publish more than 20% of all articles in the JCR-listed agricultural economics & policy journals. They are the four leading journals by impact factor (either including or excluding self-cites) and by Article Influence Score, and within the top six for any other indicator (Clarivate Analytics, 2020).

[2] Since a substantial proportion of submissions are desk rejected by all four journals, and editors typically invite at least two – and often many more – reviewers conditional on being sent for review, the number of invitations to review do not correspond to the total submissions (see Table 1 below).

span four continents, two with lead editorial offices in Europe (FP in Italy, JAE in UK) and two with editorial offices in the US. None is an Open Access only journal, but each publishes Open Access papers. At the time, these journals had the discipline's four highest impact factors among journals that were not invitation only (i.e., excluding the *Annual Review of Resource Economics*). Together, the editorial data from these four journals provide a reasonably accurate summary of a single academic field but with sufficient breadth of geographic coverage and journal models to provide insights that may be useful even outside the discipline of agricultural economics. Nonetheless, this set does not represent the full universe of all agricultural economics journals; it omits several regional journals and others more indirectly related to the field (e.g., *Agribusiness*, *European Review of Agricultural Economics*). This might introduce some selection bias of unknown sign.

Table 1 –Sample descriptive statistics

Descriptive Statistics	**N**
Number of submissions with complete author data, of which:	*5,366*
submissions related to COVID-19 topic	57
desk rejected	3,366
first editorial decision completed	5,201
percent submissions by female authors	31.2
percent submitted after COVID-19 school closure	19.6
percent submitted after COVID-19 stay-at-home orders	16.3
Number submissions with full reviewer information, of which:	*5,164*
percent sent for review	33.5
percent submitted after COVID-19 school closure	18.1
Mean (std dev) days to first decision	34.6
	(0.69)
Number of reviewer invitations sent, of which:	*6,480*
percent invitations sent to female reviewers	30.0
percent invitations sent after COVID-19 school closure	19.6
percent invitations accepted	63.0

Our administrative data include all submissions sent to, invitations to review sent from, and first editorial decision by the four journals over the period January 1, 2018 - July

31, 2020[3]. This generated a sample of 5,637 individual manuscript submissions. Each manuscript is a single observation; resubmissions data are appended to the manuscript-specific record. Of these, we omit 94 submissions that were withdrawn or transferred to other journals. We also omit 177 submissions because of unknown gender or country of authors. The final sample therefore includes 5,366 submissions. Of these manuscripts, 5,201 had received a first editorial decisions (i.e., accept, reject, or returned for revision and resubmission, R&R), and 4,942 had a final decision (accepted or rejected) within the study period. In the 2020 sub-sample, 57 submissions explored COVID-19 related topics, as defined by Squazzoni et al. (2020). Table 1 displays descriptive statistics. Because the editorial databases only reliably tie manuscript submission to a corresponding author – sometimes labelled 'submitting' or 'main' author – we use that author's attributes alone as a characteristic of the submission.[4] A total of 8,250 invitations were sent to expert peer reviewers. Of these, a number were dropped from analyses of reviewer behavior: 176 were dropped from the estimation sample because of missing gender; 1,561 observations were dropped because of missing country[5]; 33 observations were excluded because they were sent in the final two weeks of July 2020 and had no response from the invited reviewer as of July 31, making it uncertain whether the reviewer ultimately accepted the invitation. The

[3] Submissions and invitations to review were anonymized by each journal's editorial office after using affiliation country and first names to retrieve authors and invited review gender (see Section 2.3). The resulting databases are completely anonymized.

[4] Submission records input by corresponding authors do not always reliably include all co-authors' names. A nontrivial minority of submissions only reflect all co-authors on the title page of the manuscript, not in the administrative records on which we rely. Including co-authors would therefore both complicate analysis and introduce significant, non-classical measurement error.

[5] Data from AEPP did not include information about reviewer's country, therefore that one journal is not part of the analysis on reviewers.

final sample of individual reviews thus includes 6,480 invitations sent to potential reviewers during the period considered.

We do not study editors directly because the small sample size – especially disaggregated by country of residence – would effectively make it impossible to preserve individuals' anonymity even in anonymized data, because there are few editors in the sample (34 in total) and each journal's editors and their locations are matters of public record. We therefore include in some regressions a binary indicator variable to reflect the period during which COVID-19 lockdowns impacted most of the editors in the data, but we do not include any editor-specific data.

2.2 Gender classification

Editorial databases do not include an author or reviewer's gender. We identified gender using Gender-api (see https://gender-api.com/), an online tool that searches for first names and countries of residence through multiple data sources (e.g., publicly available governmental sources, social media, etc.) and predicts a gender classification with an associated level of accuracy.[6] The Gender-api database contains 3,216,769 validated names from 191 different countries. An editor from each journal was responsible for the de-identification of data and the gender coding each author and reviewer record[7].

Our dataset of names and countries includes 4,985 records, among which Gender-api could not classify 142 names, resulting in missing values that were erased from the submissions and reviewer invitations dataset. Of the 4,879 classified names, 1,784 were

[6] An anonymous reviewer rightly pointed out that Gender-api is based on country of origin naming but we know only the country of the author or reviewer's affiliation at time of manuscript submission or review invitation. International migration of scholars from their country of origin likely leads to some misclassification.
[7] The resulting complete database is fully anonymized and only contains information about the submission/review invitation along with authors'/reviewers' gender and country of affiliation.

classified as female and 3,059 as male. The Gender-api tool returns a level of accuracy for each classified name, in our case the average level of accuracy was 93.0% for female names and 94.4% for male names; 90% of observations we study have accuracy of 75% or higher. We dropped submissions records from authors and reviewers that gender-api could not classify as female or male (2.51% of observations). Throughout the period of study, women submitted roughly 30 percent of all manuscripts received by these four journals (Fig. 1), implying a sizable underlying gender gap in authorship. The total number of submissions started to increase after January 2020; this may be related to the high share of submissions from authors in China, where the school closure was implemented at the end of January (Table 2).

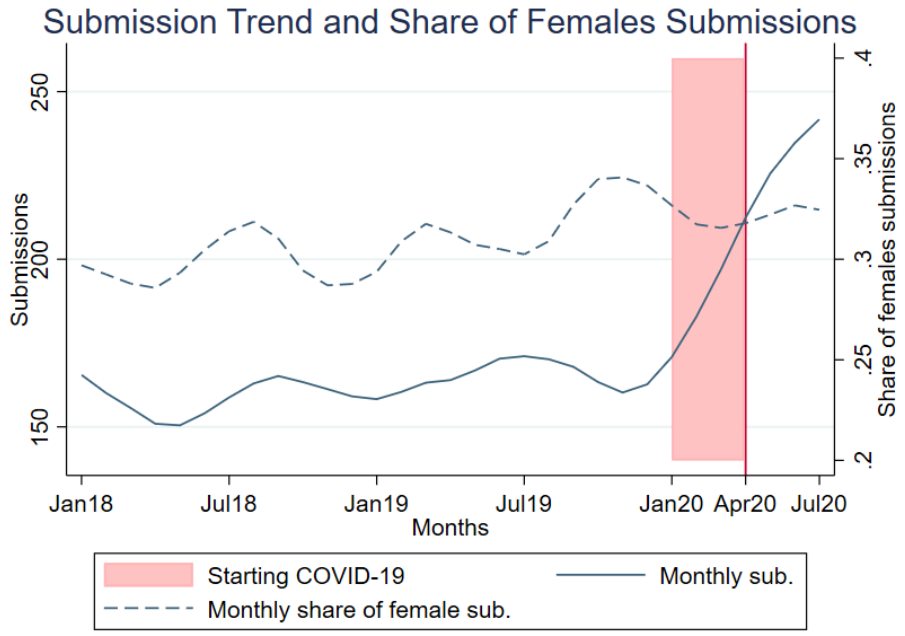

Fig. 1. Trends in monthly submissions and share of monthly submissions that are from female submitting authors, with LOWESS running-mean smoothing (bandwith = 0.3). The shaded red box corresponds to the first months of the pandemic when most of the variation in school shutdown and stay-at-home orders occurred. The share of authors affected by pandemic restrictions rose from 1.7% in January 2020 to 61.4% in March. The red line corresponds to April 2020. From this month onwards the share of affected authors was higher than 90%.

Table 2 – Number and proportion of submissions from main submitting countries, and school closure start date in each country.

Country of main author	Freq.	%	Cumulative %	School closure start date
United States	1284	23.93	23.93	Mar 23
China	567	10.57	34.49	Jan 26
India	301	5.61	40.10	Mar 13
Germany	249	4.64	44.74	Mar 16
United Kingdom	235	4.38	49.12	Mar 18
Italy	231	4.30	53.43	Feb 23
Australia	136	2.53	55.96	Mar 24
France	130	2.42	58.39	Mar 2
Spain	130	2.42	60.81	Mar 9
Canada	118	2.20	63.01	Mar 16

2.3 Defining exposure to COVID-19 lockdowns

Defining exposure to COVID-19 lockdowns is complicated by variation in the policy instruments countries employed as well as by individual scholar circumstances. We capture exposure to COVID-19 restrictions for each submitting author and reviewer on a country-specific basis using data from the Oxford COVID-19 Government Response Tracker (OxCGRT, Hale et al., 2020).[8] The start of the COVID-19 lockdown period for each author or reviewer is defined as the date when school closings were required at all levels in the respective country or territory ("country") - the most comprehensive category, coded 3, in the OxCGRT database. These dates vary from January 25 in Hong Kong to April 8 in Singapore. In the United States (US), the country of residence of the largest number of authors and reviewers, school closure dates varied by state or territory. As the editorial data do not record state or territory of residence, for the US we use the March 23 date by which time 90% of the US population was affected by statewide school closures (which began March 13, in Connecticut and West Virginia). Because most of the editors were

[8] Because data are not available at subnational level for many countries, we must rely on country-level indicators, which necessarily ignores within-country variation.

located in the UK or US, we use the third week of March as beginning date of COVID-19 lockdown effect in models that address the impacts on editors.

Overall, 19.6% of submissions came in a period subjected to COVID-19 lockdowns in the author's country and 19.6% review invitations were sent in a period subjected to COVID-19 lockdowns in the reviewer's own country. This largely reflects the timing of our data, as lockdowns occurred quickly and across most jurisdictions (Fig. 2). We note that many smaller jurisdictions did not enact school closures, or countries (e.g., Belgium, Finland, South Africa, Sweden, Vietnam) enacted partial closures of some but not all schools or other enterprises. In that sense, our lockdown exposure measure is conservative and any resulting measurement error due to misclassification should bias our inferences towards finding no effects since most jurisdictions classified as not having experienced a lockdown nonetheless suffered some sort of disruption of services.

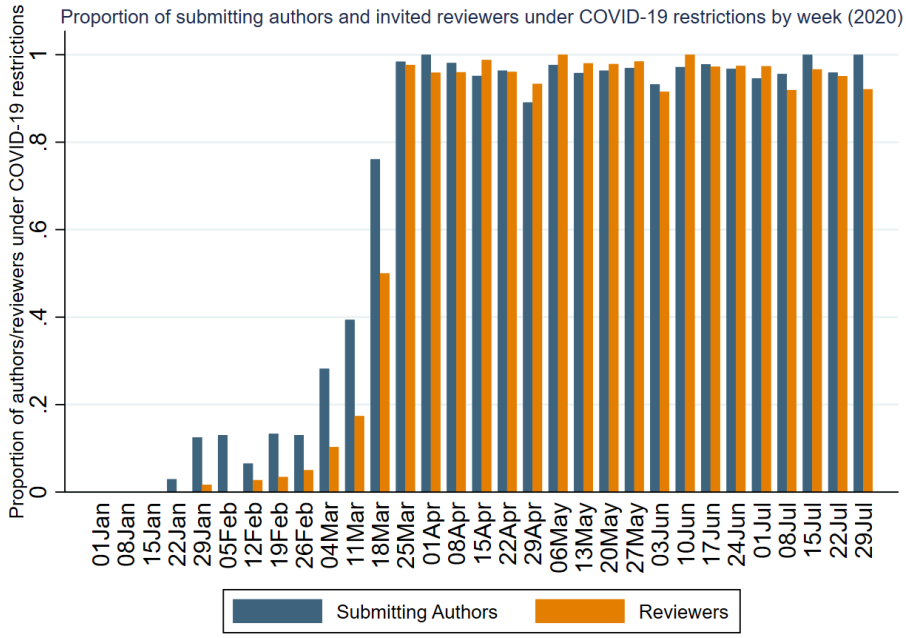

Fig. 2. Proportion of authors or invited reviewers subject to school closures, by week from 1 January – 31 July, 2020.

As an alternative measure of exposure to COVID-19-related restrictions, instead of school closures, we use government-imposed stay-at-home orders that required individuals not to leave their homes except for daily exercise, grocery shopping, and 'essential' trips (Hale et al., 2020). The first day when this requirement was implemented in each country begins the COVID-19 lockdown period, which continues for the remainder of the period even if the restriction is formally lifted later[9]. In some countries, this policy was never enacted and stay at home was only recommended (but not required) by the government (e.g., Canada, Japan, Switzerland). On average, the stay at home requirement was enacted 13 days later than the school closure policy. Variation in the strictness and enforcement of stay-at-home orders likely introduces greater heterogeneity in this measure than in the school closure measure, which we favor. We observe greater time variability in the stay at home policy measure than in the school closure measure, with fewer states employing stay at home restrictions (Fig. 3).

[9] It is reasonable to assume that the effects of the restrictions continue after they are lifted, since the life cycle of a manuscript preparation (and review) spans over several weeks. Hence, post-restriction outcomes are also influenced – at least partially – by the previous limitations.

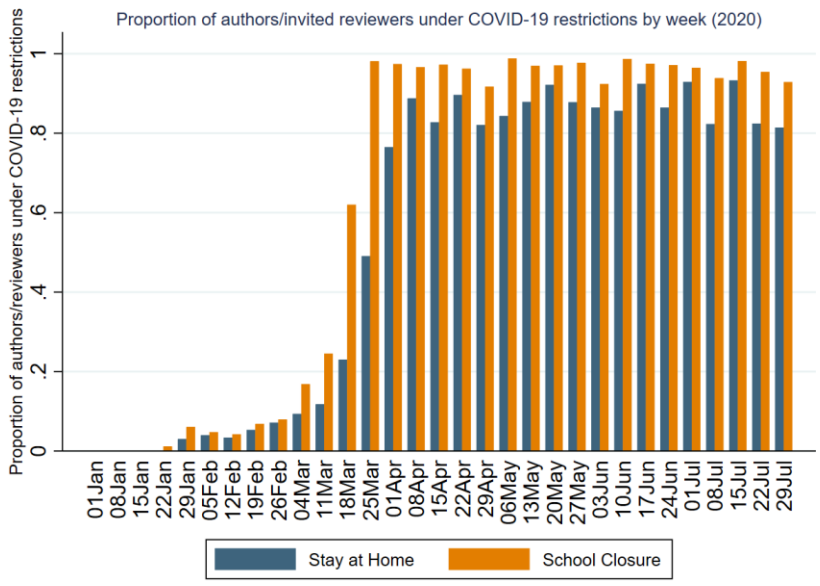

Fig. 3. Proportion of authors or invited reviewers subject to school closure or stay-at-home orders, by week from 1 January – 31 July, 2020.

2.4 Regression models

Because pre-existing trends and seasonality can confound inference about the near-term impacts of COVID-19 on research productivity, we supplement simple descriptive statistics and before-and-after COVID-19 comparisons with multiple regression analysis. We present a sequence of regression models that enable us to rigorously test for prospective impacts of COVID-19 on (i) manuscript submission volumes, (ii) gendered manuscript submission patterns, (iii) editorial desk rejections – which could pick up any induced change in authors submitting papers prematurely due to added time pressures – (iv) overall and gendered rates of peer reviewer acceptance of invitations to review manuscripts that editors did not desk reject, and (v) time to first editorial decision. These regressions enable us to test a core maintained hypothesis underpinning universal tenure clock extensions, that COVID-19 disrupted near-term research productivity across the board, resulting in fewer manuscript submissions and slower editorial decisions.

We identify the causal impacts of the pandemic by exploiting week-to-week exogenous variation in exposure to country-specific COVID-19 restrictions for each corresponding author and reviewer, based on the date when mandatory school closures or government stay-at-home orders were implemented in her or his country. In multivariate

regression analyses, we control for underlying time trends, seasonality, and unobservable, time invariant, journal-specific characteristics (e.g., relative reputation, association with a professional society) in estimating the gender-specific and overall impacts of the pandemic on author submission and editor desk rejection rates, on rates of acceptance of invitations to peer review, and on time to first editorial decision.

We estimated several different multivariate regression models. In this section we define their specification and the estimator(s), and offer a short description for each of the models. Unless expressly noted, we use a sandwich estimator or clustered sandwich estimator for panel models (White, 1980) so that all models' standard errors are robust to heteroskedasticity, and to within-panel serial correlation for panel models. Table 3 includes a list of estimated models, equations are displayed in the following subsections.

Table 3. Regression models

Models using submissions data:
1. Time series regression on weekly submissions
2. Panel regression of journal-specific weekly submissions
3. Panel Tobit regression of journal-specific weekly submissions disaggregated by author gender
4. Logit regression predicting likelihood that corresponding author is female, based on individual submissions observations.
5. Panel Tobit regression of journal-specific weekly submissions sent for peer review
6. Logit regression predicting likelihood that submission is desk rejected, based on individual submissions observations.
Models using reviewer invitations data:
7. Probability to accept invitation to review (logit on individual data)
Survival analysis model using submissions time to editorial first decision:
8. Cox proportional hazard model on time to first editorial decision for each submission.
9. Cox proportional hazard model on time to first editorial decision for submission sent and not sent to review.
10. Cox proportional hazard model on time to first editorial decision for submissions sent to review based on gender of invited reviewers.
11. Cox proportional hazard model on time to first editorial decision for submissions sent to review based on gender of reviewers that accepted the review invitations.

2.4.1 Models of COVID-19 effects on manuscript submissions

The first group of models (1 and 2) test the hypothesis that manuscript submissions – a key indicator of research productivity – were unchanged after COVID-19 restrictions began to

impact authors. The maintained hypothesis behind universal tenure clock extensions, that research productivity fell after the onset of the pandemic, would imply rejecting that null in favor of the alternate hypothesis that submission rates fell. Our findings reject the null. On the contrary, we find that submissions increased, no matter how we analyze the data, as indicated by the raw data shown in Figure 1.

First, we used data on submissions in all years to estimate the simple time series regression of weekly submissions on COVID-19 lockdown exposure, controlling for seasonality and pre-existing trends, with robust standard errors. Because the geography of paper submissions could be endogenous to COVID-19 lockdowns, we use the geographic distribution of submitting authors in each week of 2019 as a proxy for the geographic distribution of submitting authors in the same week in 2020; i.e., the proportion of papers sent in each week of 2019 that would have been subject to COVID-19 restriction in the same week in 2020. In this model we sum across journals to generate week-specific observations. The resulting regression is:

$$Sub_t = \beta_0^1 + \beta_1^1 Covid19Instr_t^a + \beta_2^1 PeriodTrend_t + \beta_3^1 Week_t + \varepsilon_t \quad (1)$$

where Sub_t is the number of submissions received in week t; $Covid19Instr_t^a$ is equal to zero in times without COVID-19 restrictions, and equal to the proportion of submissions in week $t-52$ (the previous year) that would have been affected by the COVID-19 restrictions in author's country in week t when COVID-19 restrictions are in place; $PeriodTrend_t$ is the linear 4-weekly time trend; $Week\_t$ is the weekly seasonality at time t during each year, i.e. 51 dummy variables in the model that identify each week during one year; ε_t is the error component.

Second, in the next set of regressions, we disaggregate the weekly submissions data in all years by journal. These panel regressions are estimated as random effects generalized least squares models, clustering standard errors by journal[10]:

$$Sub_{jt} = \beta_0^2 + \beta_1^2 Covid19Instr_{jt}^a + \beta_2^2 PeriodTrend_t + \beta_3^2 Week_t + \varepsilon_{jt} \quad (2)$$

[10] Fixed effects estimation returned similar results. Note that this is an unbalanced panel that only includes weeks with positive submission numbers. However, any endogenous sample selection in these models should be negligible as we only drop 2 weekly observations of 540 (135 weeks for each of 4 journals).

where Sub_{jt} is the number of submissions received by journal j in week t; the remaining variables and terms are defined corresponding to those used in (1) above.

Universal tenure clock extensions treat men and women equally. But if COVID-19 has had unequal impacts by gender, gender-blind policy can have inequitable results. We therefore turn in the next two models (3 and 4) to test the null hypothesis implicit to gender-blind policy, i.e., that there is no gender difference in the impact of COVID-related restrictions. In model 3 we disaggregate submissions by author gender and estimate random effects panel (journal/week) Tobit models on female- authored submissions, and separately on male-authored submissions. The regression specifications are the same, with left censoring at zero in weeks when there were no submissions from authors of the relevant gender (0.7% and 10.9% for male and female authors, respectively). Here we show the female version of the regression specification:

$$Sub_{jt}^{f} = \beta_0^3 + \beta_1^3 Covid19Instr_{jt}^{af} + \beta_2^3 PeriodTrend_t + \beta_3^3 Week_t + \varepsilon_{jt} \quad (3)$$

where Sub_{jt}^{f} is the number of submissions received by journal j in week t from female authors and the remaining variables are defined corresponding to those used in (2).

Then in model 4, we use the sample of all submitted manuscripts to test whether COVID-19 affected the female share of manuscript submissions. This builds on estimates in (3), using a logit regression model with the binary dependent variable that the submitting author is female, using robust standard errors[11]. The regression model is:

$$\begin{aligned} Pr(Auth_i = Female) \\ = f(\beta_0^4 + \beta_1^4 Covid19_i^a + \beta_2^4 Journal_i + \beta_3^4 MonthTrend_i \\ + \beta_4^4 Month_i + \varepsilon_i) \end{aligned} \quad (4)$$

where the dependent variable is the probability that the corresponding author of submission i is female; $Covid19_i^a$ is a binary variable equal to 1 if the submission i has been sent after COVID-19 restrictions were implemented in author's country; $Journal_i$ is a (set of) dummy variables for each journal; $Month_i$ is the monthly seasonality during each year,

[11] The same model was estimated both as a linear probability model (LPM) by ordinary least squares and as a Probit. These generated very similar estimates. We omit the additional results in the interests of brevity.

i.e. 11 dummy variables in the model; the remaining variables and terms are defined as in equations above.

Having tested whether COVID-related lockdowns and/or school closures had any impact on submissions rates, overall, or by gender, we now turn to explore whether COVID-19 changed the quality rather than the quantity of submissions. If scholars were suddenly more pressed for time, one can imagine researchers submitting less polished papers, resulting in higher rates of desk rejection. Compounding the prospective endogenous quality effects of COVID-induced time pressures on authors, editors suddenly faced with increased submissions (Figure 1) openly worried that pandemic lockdowns would make it harder to recruit peer reviewers, which may have induced editors to desk reject a larger share of the increased manuscript flow.

We use two different methods to explore the possibility of endogenous manuscript quality declines or stricter editorial standards to make it into full peer review by testing the null hypothesis of no change in desk rejection rates. In model 5 we estimate a random effects panel Tobit model of submissions sent for review. We use a Tobit estimator because the dependent variable is left censored at zero in weeks when the journal sent no submissions out for review (11.7%). Note that we use a generic, rather than country-specific, COVID-19 dummy variable – i.e., country-invariant variable that takes value zero before widespread pandemic lockdowns affected a majority of locations in the third week of March and one thereafter – since conditions for both the author and the editor are relevant, and the two will commonly differ and, as explained above, we cannot use editor-specific variables for human subjects' protection reasons. This model is written as:

$$SentOutForReview_{jt} = \beta_0^5 + \beta_1^5 Covid19Dummy_{jt} + \beta_2^5 PeriodTrend_t + \beta_3^5 Week_t + \varepsilon_{jt} \quad (5)$$

where $SentOutForReview_{jt}$ is the number of submissions sent to review by journal j in week t; $Covid19Dummy_{jt}$ is a binary variable that equals one in the third week of March 2020 and after; the remaining variables and terms are defined as in equations above.

Next, in model 6, we use individual submissions data to test the hypothesis originating from (5) that the likelihood of a submission being desk rejected increased during COVID-19 lockdown. We estimate a Logit model with the binary dependent variable that the submission was desk rejected:

$$\begin{aligned} Pr(Auth_i = DeskR) \\ &= f(\beta_0^6 + \beta_1^6 Female_i^a + \beta_2^6 Covid19_i^a + \beta_2^6 Covid19_i * Female_i^a \\ &+ \beta_4^6 TopicCovid_i + \beta_5^6 Journal_i + \beta_6^6 Journal_i * Female_i^a \\ &+ \beta_7^6 MonthTrend_i + \beta_8^6 MonthTrend_i * Female_i^a + \beta_9^6 Week_i \\ &+ \beta_{10}^6 Week_i * Female_i^a + \varepsilon_i) \end{aligned} \quad (6)$$

where the dependent variable is the probability that submission i is desk rejected; $Female_i^a$ is a binary variable equal to 1 if the corresponding author is female; $TopicCovid_i$ is a binary variable that equals one when the submission is on a COVID-19 related topic; the remaining variables and terms are defined corresponding to those used in models above.

2.4.2 Models of COVID-19 effects on acceptance of reviewer invitations

Universal tenure clock extensions may be justified if the pandemic slowed peer review processes. If so, junior scholars would suffer an exogenous slowdown in the processing of manuscripts of sufficient quality for editors to send for peer review. One candidate mechanism for slowdowns in peer review is that scholars began to decline review invitations at a higher rate after COVID-19 lockdowns began. We therefore expressly test the effect of COVID-19 restrictions on the probability that a reviewer accepts the invitation. We estimate a logit regression model with a binary dependent variable capturing acceptance of the invitation to review[12]. The regression model is:

[12] Again, OLS estimates based on LPM and from a Probit specification were very similar, and are not reported in this manuscript.

$$
\begin{aligned}
&Pr(Rev_i = Accept) \\
&\quad = f(\beta_0^7 + \beta_1^7 Female_i^r + \beta_2^7 Covid19_i^r + \beta_3^7 Female_i^r * Covid19_i^r \\
&\quad + \beta_4^7 Journal_i + \beta_5^7 MonthTrend_i + \beta_6^7 MonthTrend_i \\
&\quad * Female_i^r + \beta_7^7 Month_i + \beta_8^7 Month_i * Female_i^r + \varepsilon_i)
\end{aligned} \tag{7}
$$

where the dependent variable is the probability that the reviewer accepts the invitation i; $Female_i^r$ is a binary variable equal to 1 if the invited reviewer is female; $Covid19_i^r$ is a binary variable equal to 1 if the invitation i has been sent after COVID-19 restrictions were implemented in reviewer's country; $Journal_i$ is a (set of) dummy variables for each journal (excluding AEPP for which reviewers' data were not available); the remaining variables and terms are defined corresponding to those used in models above. We estimate the marginal effect of gender on the probability that a reviewer accepts the invitation during the COVID-19 lockdown period and during the pre-lockdown period.

2.4.3 Models of time to editorial first decision under COVID-19 shutdowns

The ultimate indicator of whether submitted manuscripts were slowed by the introduction of COVID-19 lockdowns and school closures is whether time to first editorial decision was unchanged after restrictions began. To test that hypothesis, we estimate Cox proportional hazards models of the association between time to first editorial decision and predictor variables for all submissions (model 8) and for the restricted sample of submissions sent to review (model 9). For 202 manuscripts, we only know that the manuscript was sent for review and there is no information about invitations to review. We drop these submissions from the data set and analyze data for the resulting sample of 5,164 submissions. Among these, 3,436 submissions were rejected or accepted without a review, and 1,728 submissions were sent to review (33.5%).

The survival model dependent variable is the time elapsed from initial submission to first editorial decision, which allows for censored observations, i.e., submissions without a first decision as of July 31, 2020. The explanatory variables include $Covid19Dummy_t$, a time-varying binary variable that equals one beginning 25 March 2020 and thereafter. For a submission sent before this date with first decision taken after this date, COVID-19 lockdown was considered as a treatment and the submission can

experience two different states: a pre-COVID-19 state from initial submission to 25 March 2020 (with $Covid19Dummy_t$ equal to zero), and a post-COVID-19 state from 25 March to their first decision date, or to the end of the period when a decision was not reached (with $Covid19Dummy_t$ = 1); the remaining variables and terms are defined corresponding to those used in models above. The equation for the Cox regression model is:

$$\begin{aligned} h_{Sub_i=FirstDec}(t) \\ &= h_0(t) \\ &* exp(\beta_1^8 Covid19Dummy_{it} + \beta_2^8 MonthTrend_i + \beta_3^8 Month_i) \\ &+ \varepsilon_i \end{aligned} \tag{8}$$

We estimate the hazard ratio associated with the first editorial decision on each submission i occurring at time t as a function of the covariates. The β_1^8 coefficient estimates the impact of COVID-19 lockdowns on the hazard rate for editorial decisions. This is the pure reduced form effect of COVID-19 on time to first decision, and captures the unconditional expectation of submitting authors, who cannot anticipate whether their submission will be desk rejected or sent for review.

Then we estimate a survival model accounting for differences between papers sent for review and papers for which a decision was made without review. That decision is endogenous to the editors' response to COVID-19 lockdown conditions. This equation identifies the COVID-19 impact on time to first editorial decision, conditional on the endogenous editorial decision to send the paper out for review. $SentToReview_i$ is a binary variable that equals one if the submission was sent out for review and zero if the editor reached a decision without sending for peer review. The equation for this model is:

$$\begin{aligned} h_{Sub_i=FirstDec}(t) \\ &= h_0(t) \\ &* exp(\beta_1^9 Covid19Dummy_{it} + \beta_2^9 SentToReview_i \\ &+ \beta_3^9 SentToReview_i * Covid19Dummy_{it} + \beta_4^9 MonthTrend_i \\ &+ \beta_5^9 SentToReview_i * MonthTrend_i + \beta_6^9 Month_i) + \varepsilon_i \end{aligned} \tag{9}$$

In this model, the β_1^9 coefficient estimate indicates the impact of COVID-19 lockdowns on the hazard rate for editorial decisions for the baseline case - without peer review (i.e., desk rejections or, far more rarely, quick acceptances), meaning manuscripts subject only to COVID-19's impacts on editors. The β_3^9 coefficient estimate indicates the differential association of COVID-19 lockdowns with the hazard rate for first editorial decision for manuscripts sent for review – i.e., those subject to prospective delays affecting both editors and reviewers – as compared to submissions not sent to review. The association between COVID-19 lockdowns and the hazard rate for first editorial decision for manuscripts sent for review is given by the sum $\beta_1^9 + \beta_3^9$.

In order to allow for time to decision effects that might vary with the gender of reviewers – in case COVID-19 lockdowns had a gender-differentiated effect on reviewing speed – we estimate a less restricted survival model considering the subsample of submissions sent out for review. Model 10 estimates the hazard ratio associated with the first editorial decision on each submission *i* occurring at time *t,* including covariates relative to the number of invitations/acceptances to review for each submission and the share of reviewers invited or who accepted the review invitation who were female. Model 10 uses invitations to review as the unit of reviewer measure:

$$\begin{aligned} h_{Sub_i=FirstDec}(t) \\ &= h_0(t) \\ &* exp(\beta_1^{10} Invitations_i + \beta_2^{10} Covid19Dummy_{it} \\ &+ \beta_3^{10} InvitFemaleShare_i + \beta_4^{10} Invitations_i \\ &* Covid19Dummy_{it} + \beta_5^{10} InvitFemaleShare_i \\ &* Covid19Dummy_{it} + \beta_6^{10} MonthTrend_i + \beta_7^{10} Month_i) + \varepsilon_i \end{aligned} \quad (10)$$

where $Invitations_i$ is the number of invitations sent for subission *i*; $InvitFemaleShare_i$ refers to the share of invitations that were sent to female reviewers. These variables are also interacted with $Covid19Dummy_t$.This specification allows for variation in time to decision based on the number and gender of reviewers invited. Because reviewer invitations may be endogenous to COVID-19 restrictions, the resulting COVID-19-related coefficient estimates may be biased. We therefore favor the reduced form in (8), but

offer this model as providing some indicative estimates as to whether time to first editorial decisions after review are associated with gender differences in reviewer composition.

Model 11 is the exact same model, but with the reviewer binary variables reflecting acceptance of the review invitation rather than invitation to review:

$$
\begin{aligned}
&h_{Sub_i=FirstDec}(t) \\
&\quad = h_0(t) \\
&\quad * exp(\beta_1^{11} Acceptance_i + \beta_2^{11} Covid19Dummy_{it} \\
&\quad + \beta_3^{11} AcceptFemaleShare_i + \beta_4^{11} Acceptance_i \\
&\quad * Covid19Dummy_{it} + \beta_5^{11} AcceptFemaleShare_i \\
&\quad * Covid19Dummy_{it} + \beta_6^{11} MonthTrend_i + \beta_7^{11} Month_i) + \varepsilon_i
\end{aligned}
\tag{11}
$$

3. Results

Together, the four journals received 1,902 submissions in 2018, and 1,979 in 2019, reflecting a 4.0% growth from 2018-19. But submissions sharply accelerated as the lockdowns began, rising to 1,485 through the end of July 2020, a 29 percent increase on an annualized basis from 2019 to 2020. Controlling for seasonality by considering only the February 1 - July 31 period over the three years – i.e., months affected by the COVID-19 pandemic in 2020 – submissions were 907, 985, and 1,316, respectively, implying de-seasonalized unconditional annual growth in submissions of 8.6% from 2018 to 2019 and 33.6% from 2019 to 2020.

Pandemic disruptions clearly had a relatively large and statistically significantly positive impact on submission numbers (model 1,

Table 4). We conducted robustness checks, first to exclude submissions related to COVID-19 issues, so as to ensure that the estimated increase in submissions was not wholly due to COVID-19-related topics. The estimation results are qualitatively identical. When we use stay-at-home orders instead of school closures as the indicator for COVID-19 restrictions, the results are again qualitatively identical with, if anything, a stronger positive submissions response to the COVID-19 lockdowns.

Table 4 – COVID19 effect on number of weekly submissions (Model 1).

	(1)	**(1a)** *excluding submissions related to COVID-19 issues*	**(1b)**
β_0	38.25***	38.15***	38.28***
	(5.53)	*(5.56)*	*(5.51)*
Covid19Instr – school closure	15.54***	12.49***	
	(3.80)	*(3.62)*	
Covid19Instr – stay at home			19.87***
			(4.52)
PeriodTrend	0.05	0.06	0.05
	(0.09)	*(0.08)*	*(0.08)*
R squared	0.58	0.55	0.60

Standard errors in parenthesis. *** p-value<0.01; ** p-value<0.05; * p-value<0.1. Average weekly submissions in 2019= 38.1; 51 weekly seasonal coefficients not shown.
N=135, aggregation of weekly submissions.

The estimation results for model 2 (journals separately identified) are shown in Table 5[13]. We again find a statistically significant positive impact of COVID-19 lockdowns on manuscript submissions, and statistically insignificantly different from one-quarter of the estimated effect on total submissions, as reported in model 1. If we modify the specification to allow for journal-specific COVID-19 effects, submissions sent to the *AJAE* did not increase significantly, but submissions to the other three journals did. When we exclude submissions on COVID-19-related topics, we again find no qualitative difference from the main findings. And when we use the definition of COVID-19 lockdown exposure based on stay-at-home orders instead of school closures, we again get statistically indistinguishable results.

[13] Fixed effects regression returned an almost identical Covid19Instr coefficient, significant at the 10% level with clustered standard errors and at the 1% significance level without clustering.

Table 5 - COVID19 effect on number of weekly submissions per journal (Model 2).

	(2)	(2a)	(2b) *excluding submissions related to COVID-19 issues*	(2c)
β_0	10.37**	10.53**	10.36**	10.19**
	(3.65)	*(2.02)*	*(3.65)*	*(3.63)*
Covid19Instr – school closure	3.57**		2.83*	
	(1.50)		*(1.50)*	
Covid19Instr – stay at home				3.62**
				(1.74)
PeriodTrend	0.02		0.02	0.03
	(0.02)		*(0.02)*	*(0.02)*
Covid19Instr – school closure AEPP		4.01***		
		(0.22)		
Covid19Instr – school closure AJAE		-0.11		
		(0.24)		
Covid19Instr – school closure FP		7.05***		
		(0.23)		
Covid19Instr – school closure JAE		3.74***		
		(0.28)		
PeriodTrend AEPP		-0.004		
		(0.01)		
PeriodTrend AJAE		0.04**		
		(0.01)		
PeriodTrend FP		0.04**		
		(0.01)		
PeriodTrend JAE		0.01		
		(0.01)		
R-squared (overall)	0.09	0.23	0.07	0.08

Standard errors in parenthesis. *** p-value<0.01; ** p-value<0.05; * p-value<0.1. Average weekly submissions per journal in 2019= 9.51; 51 weekly seasonal coefficients not shown. N=538, panel aggregation of weekly submissions by journal.

The results of model 3 are shown in Table 6. Submissions increased by a statistically significant amount for both female and male authors once they were subject to COVID-19 restrictions. The magnitude (and thus the statistical significance) of the estimated impacts was greater for male authors, but the male/female ratio of the point estimates of the impacts (2.42) is only slightly – and statistically insignificantly – higher than for the 2019 baseline (2.10). We more rigorously test the hypothesis of a gender-differentiated effect below, in model 4, using individual submissions data.

Table 6 – COVID19 effect on number of weekly submissions per journal by female/male authors (Model 3).

	(3a) *Female authors*	**(3b)** *Male authors*
β_0	2.56*	6.46***
	(1.41)	*(1.26)*
Covid19Instr – school closure	1.02**	2.48**
	(0.47)	*(0.98)*
PeriodTrend	0.02*	0.003
	(0.01)	*(0.01)*

Standard errors in parenthesis. *** p-value<0.01; ** p-value<0.05; * p-value<0.1. Average weekly submissions by female authors in 2019=3.1; Average weekly submissions by male authors in 2019=6.4; 51 weekly seasonal coefficients not shown.

The COVID-19 lockdown period had no statistically significant effect on the probability that a manuscript's submitting author is female (model 4, Table 7). This finding is robust to adding journal-specific COVID-19 effects, and/or week-frequency seasonality and trends rather than month-frequency. The estimated impacts of the COVID-19 lockdown are likewise unaffected by shifting the definition of the COVID-19 period to that based on stay-at-home orders.

Table 7 - COVID-19 effect on probability that a submitting author is female (Model 4).

	(4)		**(4a)**	
	Coeff.	**Av. Marg. Eff.**	**Coeff.**	**Av. Marg. Eff.**
β_0	-1.06***		-1.03***	
	(0.14)		*(0.14)*	
Covid19 – school closure	-0.06	-0.01		
	(0.11)	*(0.02)*		
Covid19 – stay at home			0.05	0.01
			(0.11)	*(0.02)*
MonthTrend	0.01	-0.001	0.003	0.001
	(0.004)	*(0.001)*	*(0.004)*	*(0.001)*
Journal AJAE	-0.14	-0.03	-0.14	-0.03
	(0.11)	*(0.02)*	*(0.11)*	*(0.02)*
Journal FP	0.33***	0.07***	0.34***	0.07***
	(0.10)	*(0.02)*	*(0.10)*	*(0.02)*
Journal JAE	0.14	0.03	0.14	0.03
	(0.11)	*(0.02)*	*(0.11)*	*(0.02)*
Pseudo R-squared	0.01		0.01	

Standard errors in parenthesis. *** p-value<0.01; ** p-value<0.05; * p-value<0.1.11 monthly seasonal coefficients not shown.

The results of model 5 are shown in Table 8. The number of manuscripts sent for review each week increased by an average of 1.1 per journal in the COVID-19 period. When

compared to the corresponding estimate of the number of additional weekly submissions received by each journal (3.57), we find that the share of estimated extra submissions sent for review (0.31) is only slightly – and statistically insignificantly - lower than the unconditional share of submissions sent for review in 2018 or 2019 (0.34-0.38, per Figure 4). When we estimate model 5 using the stay-at-home-orders definition of the COVID-19 lockdown, we find statistically indistinguishable results.

Table 8 – COVID-19 effects on manuscripts sent for review each week (Model 5).

	(5)	**(5a)**
β_0	3.99	3.99
	(2.57)	*(2.42)*
Covid19 dummy– school closure	1.12**	
	(0.44)	
Covid19 dummy – stay at home		1.12**
		(0.42)
PeriodTrend	0.01	0.01
	(0.01)	*(0.01)*

Standard errors in parenthesis. *** p-value<0.01; ** p-value<0.05; * p-value<0.1. Covid19 variable in this model is a generic dummy: for school closure it is 1 after 18 March 2020, for stay at home it is 1 after 25 March 2020. 2019 average weekly submissions sent to review per journal = 3.42; 51 weekly seasonal coefficients not shown.

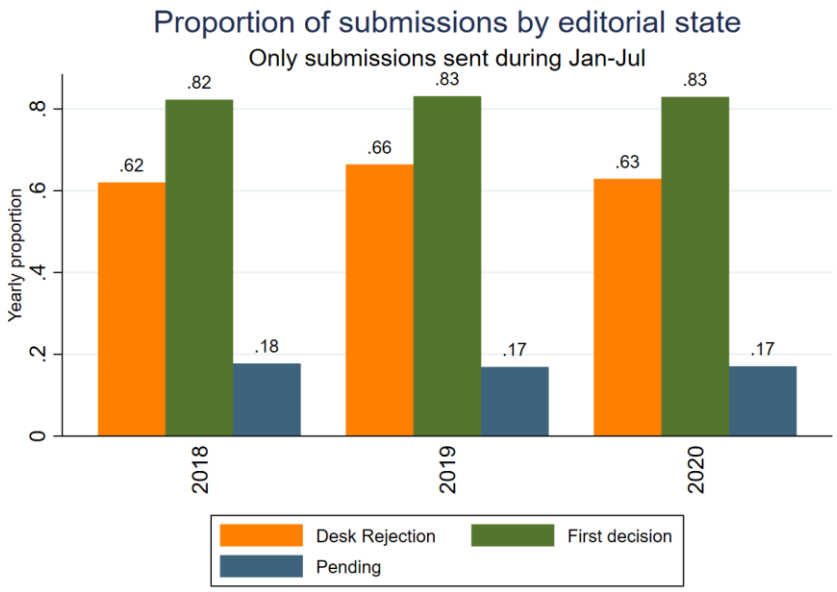

Fig. 4. Proportion of submissions received during January 1 – July 31 each year by editorial state as of July 31. Desk rejection rates have consistently fallen in the 62-66% range. In each year, 82-83% of papers submitted during the first seven months of the year had received an editorial decision by the end of July.

Model 6 offers a more rigorous test than model 5 of the hypothesis that desk rejection rates changed in the COVID-19 lockdown period. The COVID-19 lockdown period had no statistically significant effect on the probability that a manuscript is desk rejected (Table 9). Moreover, submissions by female authors have the same probability to be desk rejected as male authored submissions, both before and during the pandemic. When we estimate with the alternate COVID-19 indicator based on stay-at-home orders, we get similar results.

Table 9 - COVID-19 effects on probability of desk rejection (Model 6).

	(6)		(6a)	
	Coeff.	**Av. Marg. Eff.**	**Coeff.**	**Av. Marg. Eff.**
β_0	0.50*		0.48*	
	(0.25)		*(0.25)*	
Covid19 – school closure	-0.11	-0.001		
	(0.14)	*(0.02)*		
Covid19 – stay at home			-0.23*	-0.04
			(0.14)	*(0.02)*
Female	0.15	0.001	-0.22	0.001
	(0.46)	*(0.01)*	*(0.46)*	*(0.01)*
		Covid19=0		
		0.01		
Covid19 – school closure	0.33	*(0.02)*		
*** female**	*(0.25)*	*Covid19=1*		
		-0.02		
		(0.03)		
				Covid19=0
				0.01
Covid19 – stay at home *			0.16	*(0.01)*
female			*(0.24)*	*Covid19=1*
				-0.03
				(0.03)
TopicCovid	-0.41	-0.09	-0.35	-0.07
	(0.28)	*(0.06)*	*(0.28)*	*(0.06)*
MonthTrend	0.01	-0.0002	0.01*	-0.001
	(0.01)	*(0.001)*	*(0.005)*	*(0.001)*
MonthTrend *Female	-0.03**		-0.02**	
	(0.01)		*(0.01)*	
Journal AJAE	-0.84***	-0.19***	-0.85***	-0.19***
	(0.12)	*(0.02)*	*(0.12)*	*(0.02)*
Journal FP	0.22*	0.05**	0.22*	0.04**
	(0.11)	*(0.02)*	*(0.11)*	*(0.02)*
Journal JAE	0.67***	0.15***	0.67***	0.15***
	(0.14)	*(0.02)*	*(0.14)*	*(0.02)*
Journal AJAE*Female	0.22		0.22	
	(0.23)		*(0.23)*	
Journal FP*Female	-0.04		-0.05	
	(0.21)		*(0.21)*	
Journal JAE*Female	0.29		0.27	
	(0.25)		*(0.25)*	
Pseudo R-squared	0.07		0.07	

Standard errors in parenthesis. *** p-value<0.01; ** p-value<0.05; * p-value<0.1. 52+52 weekly seasonal coefficients not shown. Average desk rejection rate in 2019= 0.64. N=5,359 submissions (7 submissions still with editor excluded). Average marginal effects for the interaction between Covid19 and female are the marginal effects of female calculated before (Covid19=0) and after (Covid19=1) Covid19 restrictions.

With increased submissions and no change in desk rejection rates due to pandemic restrictions, the number of papers sent out for peer review inevitably increased; we estimate a 32 percent increase relative to an average of 3.4 manuscripts sent to peer review per week in 2019. The proportion of accepted review invitations in the January-July period was 68.9% in 2018, 68.3% in 2019 and 60.4% in 2020. But the decline reflects a pre-pandemic trend as review invitation acceptance rates fell before reviewers were subject to COVID-19 restrictions in 2020 (Fig. 5).

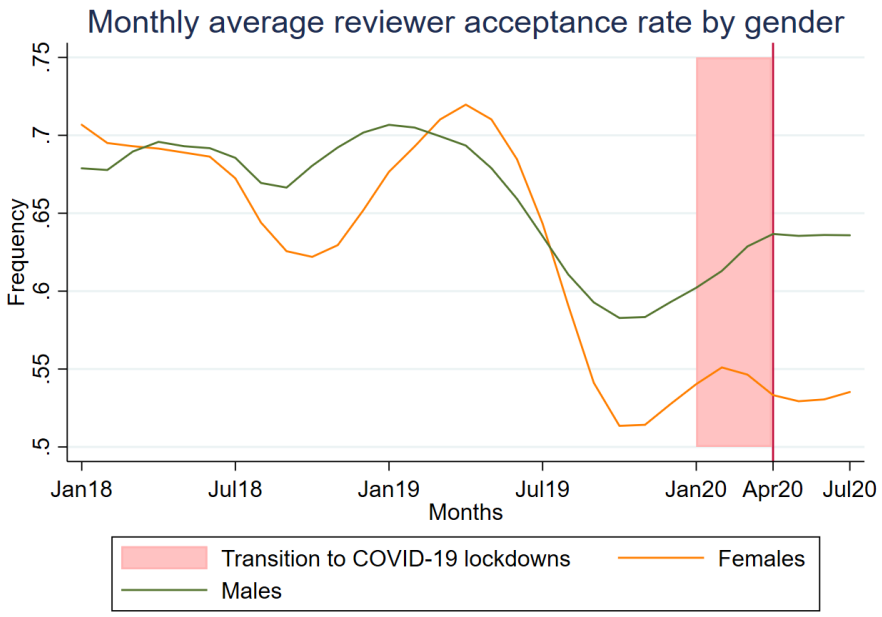

Fig. 5. Trend in monthly reviewer invitations acceptance rate for females and males (running-mean LOWESS smoothed regression). The proportion of invited reviewers affected by pandemic restrictions rose from 0.004% in January to 31.5% in March to 90% in April 2020 and thereafter. Male and female reviewers' trends were reasonably parallel (if slightly asynchronous) until February 2020, diverging noticeably during the February-April 2020 period when lockdowns were being initiated.

Indeed, the COVID-19 lockdown period had no statistically significant effect on the probability that an invitation to review is accepted (model 7, Table 10). However, after the onset of COVID-19 restrictions, the patterns of gender-specific acceptance rates diverge. Model 7 estimates indicate that – after accounting for trends, seasonality and journal specific effects – there was no significant difference between male and female propensity to accept a review invitation in absence of the COVID-19 restrictions. However, under COVID-19 restrictions, female reviewers became 8% less likely to accept an invitation to review

than their male counterpart. This finding is robust to the alternative definition of the COVID-19 period based on stay-at-home orders.

Table 10 - COVID-19 effects on reviewer invitation acceptance (Model 7).

	(7)		**(7a)**	
	Coeff.	**Av. Marg. Eff.**	**Coeff.**	**Av. Marg. Eff.**
β_0	0.98***		0.96***	
	(0.13)		*(0.13)*	
Covid19 – school closure	0.03	-0.01		
	(0.12)	*(0.02)*		
Covid19 – stay at home			-0.03	-0.03
			(0.12)	*(0.02)*
Female	0.35	-0.04***	0.35	-0.04***
	(0.24)	*(0.01)*	*(0.24)*	*(0.01)*
		Covid19=0		
		-0.02*		
Covid19 – school closure * female	-0.25	*(0.01)*		
	(0.21)	*Covid19=1*		
		-0.08***		
		(0.03)		
				Covid19=0
				-0.02*
Covid19 – stay at home * female			-0.27	*(0.01)*
			(0.21)	*Covid19=1*
				-0.09***
				(0.03)
MonthTrend	-0.01**	-0.004***	-0.01**	-0.003***
	(0.005)	*(0.001)*	*(0.005)*	*(0.001)*
MonthTrend *Female	-0.01		-0.01	
	(0.01)		*(0.01)*	
Journal FP	-0.37***	-0.08***	-0.37***	-0.08***
	(0.06)	*(0.01)*	*(0.06)*	*(0.01)*
Journal JAE	-0.56***	-0.12***	-0.55***	-0.13***
	(0.07)	*(0.02)*	*(0.07)*	*(0.02)*
Pseudo R-squared	0.02		0.02	

Standard errors in parenthesis. *** p-value<0.01; ** p-value<0.05; * p-value<0.1. 11+11 monthly seasonal coefficients not shown. Average acceptance rate in 2019= 0.62 N=6,480 invitations to review. Average marginal effects for the interaction between Covid19 and female are the marginal effects of female calculated before (Covid19=0) and after (Covid19=1) Covid19 restrictions.

Considering the speed of the editorial process, median time to first editorial decision (desk reject, invite resubmission of a revised manuscript/accept or reject after review) during the same January-July period decreases from 2019 to 2020, from 7 and 76 days for desk rejections and first decisions with peer review, respectively, to 4 and 62 days (Fig. 6).

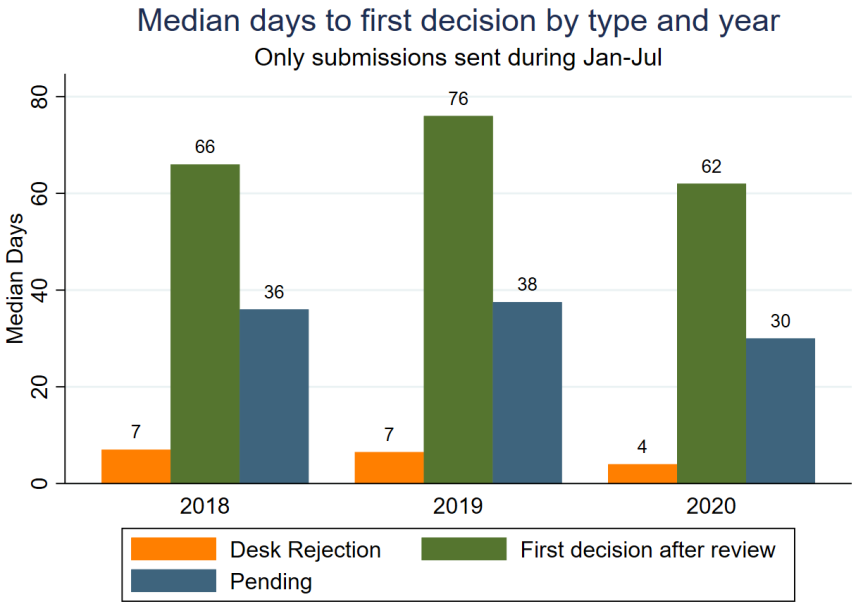

Fig. 6. Median days to first decision for desk rejected papers, papers sent out for review, and papers still pending on July 31 each year.

Survival analysis estimates of hazard rates on time to editorial decision are shown in Table 11. In model 8 the hazard ratio estimate on the COVID-19 dummy is significantly greater than one, meaning that the average time to decision has fallen after COVID-19 restrictions began, controlling for trends. In model 9 the coefficient estimate on the COVID-19 dummy is insignificant (testing the null hypotheses that each regression coefficient equals zero or, equivalently, that each hazard ratio equals one), meaning that overall the speed of first decisions without review (i.e., desk rejections) remains unchanged after COVID-19 restrictions were introduced, controlling for trends. Editors' desk rejection decisions were not slowed by the larger number of submissions received after COVID-19 lockdowns began.

Submissions sent out for peer review of course take significantly more time to first decision compared to submissions that do not go through the review process. Most remarkably, however, the time to first decision with peer reviews shortened significantly during pandemic lockdowns. The estimated median time to first editorial decision was 83 days for a paper prior to COVID-19 but fell to 69 days for a paper submitted after pandemic lockdowns began. A very modest, but statistically significant, trend existed pre-pandemic,

with desk rejections occurring quicker and decisions with peer review taking slightly longer.

Figure 7 shows the estimated survival function based on the number of days to first editorial decision, separately for submissions that were sent to review (top panel) and submissions that were not sent to review (bottom panel), plotted based on Cox model estimation. The speed of first editorial decisions with peer review increased significantly after COVID-19 restrictions, while for submissions not sent for review there is no significant difference in time to first editorial decision before and after COVID-19 lockdowns.

Estimation results for models 10 and 11 show that, for submissions sent out for review, COVID-19 restrictions are associated with faster first decisions. Pre- COVID-19, each extra reviewer invitation or acceptance slowed the editorial time to first decision. That effect was neutralized with respect to reviewer acceptances after COVID-19 restrictions began. The gender of reviewers invited or accepting does not seem to affect the time to first editorial decision for papers sent out for review. We emphasize that these estimates ignore prospectively endogenous changes to editors' decisions about the number and gender of reviewers to invite. But holding reviewer composition constant, COVID-19 appears to have accelerated time to first editorial decision regardless of the composition of the manuscript-specific reviewer pool. Although we would like to know whether individual reviewers' turnaround times have changed under COVID-19 lockdown, we cannot study the duration of time that individual reviewers take to return a review because of inconsistencies among journals in how they record and report the reviewers' time to review. Some journals record it from date of invitation, others from date of acceptance, and others from date of manuscript submission. The data are therefore not comparable.

Table 11 – COVID-19 effects on time to first editorial decision (Models 8-11).

	(8) All sub.	**(9)** All sub.	**(10)** Sub. sent out for review	**(11)** Sub. sent out for review
Covid19Dummy	1.24***	0.96	1.99***	1.18
	(0.06)	*(0.09)*	*(0.36)*	*(0.26)*
MonthTrend	1.00	1.01***	1.00	1.00
	(0.002)	*(0.003)*	*(0.005)*	*(0.004)*
SentToReview		0.07***		
		(0.01)		
SentToReview*Covid19Dummy		1.71***		
		(0.20)		
SentToReview* MonthTrend		0.98***		
		(0.005)		
Invitations			0.87***	
			(0.02)	
InvitFemaleShare			0.97	
			(0.11)	
Invitations*Covid19Dummy			0.98	
			(0.03)	
InvitFemaleShare*Covid19Dummy			0.69	
			(0.17)	
Acceptances				0.89**
				(0.04)
AcceptFemaleShare				1.03
				(0.09)
Acceptances*CovidDummy				1.19**
				(0.10)
AcceptFemaleShare*CovidDummy				0.85
				(0.17)
N	5,164	5,164	1,728	1,728

The table displays hazard ratios. 11 monthly dummy coefficients not shown.

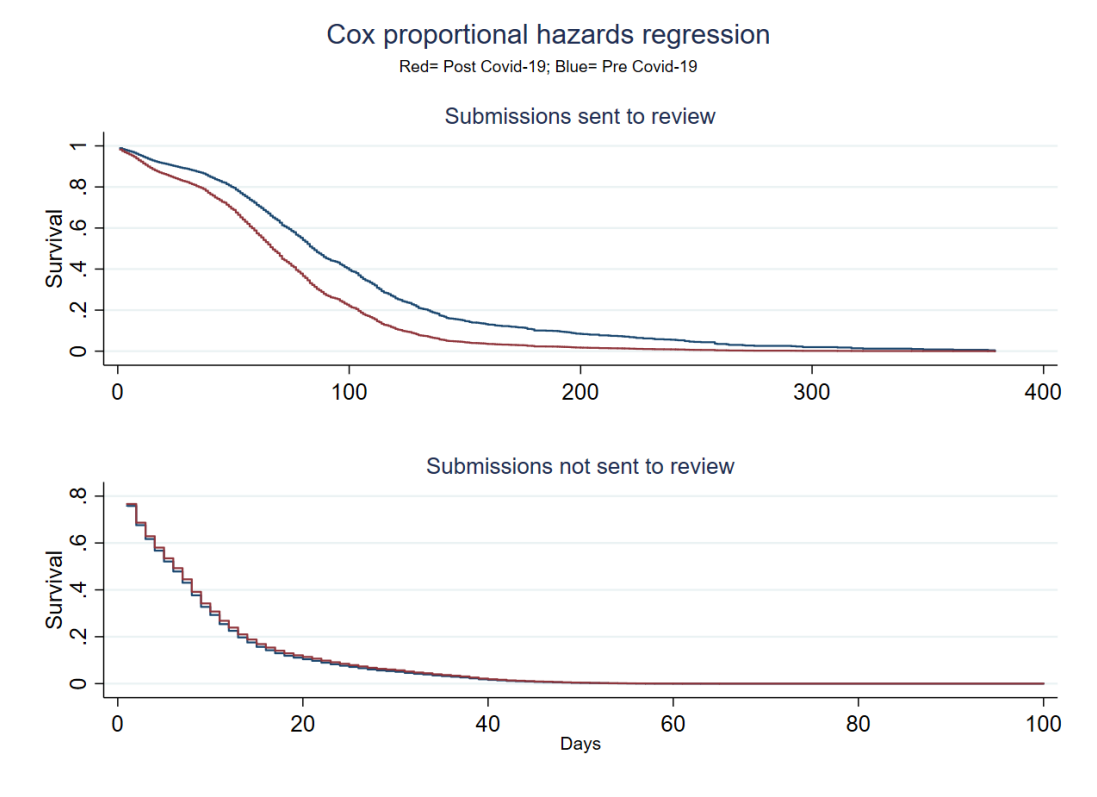

Fig. 7. Cox proportional hazards survival function associated with Model 9 before (blue line) and after (red line) COVID-19 restrictions began; the two graphs show survival function separately for submissions sent to review (top panel) and submissions for which a first decision was made without review (bottom panel). The survival functions plotted indicate the probability of manuscripts to be still without an editorial decision (accept, reject or R&R) based on days since submission. Plots generated using *stcurve* command in Stata at specific values: in the two graphs the month considered is the last one (July 2020); plot in the top panel considers only submissions sent to review and the two lines refer to $\boldsymbol{Covid19Dummy}$ equal to 1 or zero in the Cox model; plot in the bottom panel considers only submissions not sent to review and the two lines refer to $\boldsymbol{Covid19Dummy}$ equal to 1 or zero in the Cox model.

4. Discussion

The prior literature, based on anecdotal and survey evidence, strongly suggests that scholars suffered near-term productivity disruptions in the early stages of the pandemic, with women seemingly impacted more than men (Collins, 2020; Myers et al. 2020; Butler 2021; Deryugina et al. 2021; Langin 2021). The advantage of those studies is that they have more detail about individual respondents and thus can condition on characteristics such as caregiving responsibilities or personal experience of illness or familial deaths. The shortcoming of those studies is that they analyze self-reported data notoriously rife with non-classical measurement error and focus on inputs to research productivity, not on output such as journal manuscript submissions. We consider that our analysis

complements the survey-based literature. The other studies we find that use journal administrative data found, descriptively, either that (I) the pandemic widened gender gaps in submissions, but this was essentially found in a before-and-after analysis lacking controls to generate credible causal identification (Squazzoni et al. 2020), a result from a study performed on data from a single journal (Bell and Fong, 2021), or a descriptive result on number of female and male authored submissions from a single journal (Kibbe, 2020; McCormick, 2020); or (II) no evidence of a change in the proportion of female first authors since the start of COVID-19 disruptions based on editorial data in the ecology discipline, but with no country variation in starting date of COVID-19 (Fox and Meyer, 2021). Our findings differ from (I), and our methods provide better control for background seasonality and pre-existing trends with respect to (II), that could confound survey analysis.

We find that manuscript submissions exhibited modest growth across the four journals prior to the pandemic. Controlling for time trends, seasonality, and journal-specific differences, we estimate a conditional growth in submissions of 38% when restrictions were in place in all countries. The absolute number of submissions from men increased more than submissions from women during the COVID-19 lockdown period. But this follows naturally from the fact that men already submitted a much larger proportion of manuscripts to these journals, roughly 70 percent. There is no evidence that COVID-19 restrictions affect the slow upward trend in the female share of submitting authors, and multivariate regression models conditioning on journal-specific characteristics, seasonality and pre-existing trends corroborate this finding. The COVID-19 pandemic also had no differential effect on the probability of a female submission.

Despite the rise in submissions received during the lockdown, the desk rejection rate did not change after the onset of pandemic restrictions, nor did the proportion of submissions for which a decision had not been made by the end of July. Again, we find no gender differences in the probability that an author's submission was desk rejected, neither before the pandemic nor for authors subject to COVID-19 restrictions. Time-stressed female scholars do not seem to have maintained or increased their submissions rate by rushing lower-quality papers more likely to get rejected without review.

The resulting increased demand for reviewers, perhaps surprisingly, did not result in scholars accepting peer review invitations at a reduced rate. The unconditional, gender-

disaggregated trend in reviewer acceptances was reasonably similar, albeit with more pronounced seasonality among women, fluctuating around an acceptance rate of two-thirds during 2018, before falling to less than 60% by the second half of 2019. Our multivariate regression estimates that control for trends, seasonality and journal-specific effects indicate a statistically significant 8 percentage point decrease in the probability of a female scholar accepting an invitation to review during the COVID-19 lockdown period. Outside of COVID-19 lockdown, there is no statistically significant difference between men and women in the likelihood of accepting a review invitation. The COVID-19 lockdown had no statistically significant impact on male scholars' likelihood of accepting a review invitation. These findings suggest that female scholars, when confronted with the initial pandemic disruptions, rationally prioritized maintaining their own manuscript submissions and instead adjusted at the service margin, becoming slightly less likely to agree to provide peer review of others' submissions.

Despite female reviewers' decreased likelihood to accept review invitations during COVID-19 restrictions, the estimated time to first decision actually fell after the pandemic was declared, especially on submissions sent out for peer review. Gender of invited reviewers and reviewers who accepted the review invitations does not affect the time to first decision. Despite increased submissions volumes, COVID-19 does not appear to have slowed editorial review and decision processes. If anything, they accelerated slightly.

Our study has important limitations. We necessarily can only study aggregate and gender-disaggregated patterns and the initial effects of COVID-19 in the pandemic's first months (through end-July 2020). Our data – indeed, any journal's or publisher's data – cannot identify authors' or reviewers' race or caregiver status. Reasonable hypotheses that we cannot test include that the pandemic has had different effects among scholars based on their caregiving responsibilities (e.g., for children or elderly relatives). The existing survey-based evidence clearly suggests such heterogeneity among scholars exists (Deryugina et al. 2021, Similarly, because COVID-19 mortality rates have differed sharply by race, one might reasonably hypothesize that the health, emotional and caregiving burdens of the pandemic have fallen disproportionately on scholars of color. In addition, the effects of the pandemic may accumulate slowly, as scholars made extraordinary, but ultimately unsustainable,

adjustments in the initial period to maintain their research output during the initial pandemic period we observe. These plausible hypotheses are untestable in these data but merit future exploration. We emphasize that our findings reflect only the initial period of the pandemic and at aggregate or coarse, gender-disaggregated levels.

There is, nonetheless, value in understanding the broad patterns of the pandemic's impact on journal publication over the initial months of the pandemic. It appears that, overall, in the initial months of pandemic lockdown, scholars submitted and reviewed more papers and editors reached editorial decisions at least as fast as pre- COVID-19, with little meaningful difference between men and women authors or reviewers.

Researchers will be submitting COVID-19 impact statements as part of promotion and tenure reviews for several years. The general presumption of adverse near-term effects seems unfounded, though the longer-term effects could be substantial.

5. Conclusion

We estimate the impact of COVID-19 pandemic and resulting lockdowns and school closures on the volume of peer-reviewed journal manuscript submissions and the timeliness of editorial decisions on those submissions. Much of the academy enacted blanket tenure clock extensions within months of the pandemic's onset based on the assumption that this event disrupted near-term research productivity. Survey evidence on scholars' time use supports that assumption, also suggesting that the biggest effects were felt by women, especially those whose childcare responsibilities increased sharply with the closure of schools and day care (Deryugina et al. 2021; Yavorsky et al., 2021).

However, the impact on the ultimate output that most matters to tenure decisions – peer-reviewed publications – has received little attention. Using administrative data on manuscript submissions to four of the leading journals in the agricultural economics discipline, we find that near-term research productivity does not appear to have been disrupted. Journals experienced a significant increase, not decrease, in submissions after COVID-19 lockdowns began, desk rejection rates were unchanged, and the time to first editorial decision conditional on receiving peer reviews fell rather than increased. We also

find no difference in such effects between men and women, although we emphasize this is an average effect that could easily mask considerable within-group heterogeneity.

These results raise the prospect that blanket tenure clock extensions based on the assumption that COVID-19 significantly reduced research productivity for most scholars could have unintended consequences, since it clearly did not reduce near-term research productivity on average. For scholars who would otherwise have had to submit a tenure dossier during the clock extension, the policy change could have provided a windfall of time to get papers into and through peer review. In so far as young scholars' research productivity is commonly compared against recently tenured peers, this could easily set an inadvertently higher publication standard for young scholars further from the tenure moment, whose earlier stage research seems to have been badly disrupted (Myers et al. 2020; Deryugina et al. 2021; Pennisi 2021). If those effects have been disproportionately concentrated among women with caregiving responsibilities, as survey evidence strongly suggests, these policy changes could have adverse unintended effects on gender equity in the coming years, much as parental tenure clock extensions did (Antecol et al. 2018). Quantifying inequities is the first step towards achieving gender equity (Shamseer et al. 2021). Inequities by gender or cohort are likely to manifest in the medium-to-longer term. As a community, we should be alert to such possibilities and carefully examine longer-run effects in the years to come.

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