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Short communication

Congestion on the information superhighway: Inefficiencies in economics working papers☆

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ABSTRACT

Using data on the NBER working paper series, we show that the dissemination of economics research suffers from a congestion problem: An increase in the number of weekly released working papers on average reduces downloads, abstract views, and media attention for each paper. Subsequent publishing and citation outcomes are harmed as well. Papers written by prominent authors are not immune to this congestion effect. Finally, suggestive evidence on viewership and downloads implies that working papers substitute for the dissemination function of publication. Our results highlight how readers face time and cognitive constraints, with increased congestion in working papers leading to real impacts on how research is consumed.

1. Introduction

Publishing in an economics journal takes a very long time (Hadavand et al., 2021). The mean time from submission to a journal to its acceptance is over two years. The right tail of the distribution is even more staggering, where one in 10 submissions take over three and a half years to acceptance (and over four years to publication). These numbers stand in stark contrast to those from other social sciences (sociology, psychology and political science) and the "hard" sciences, where the mean durations are 13 months and 6 months, respectively. Perhaps most concerning, top economics journals are extremely selective relative to other fields,[3] and these publication lag statistics ignore any rejections from prior journal submissions, and so the true lifespan of a paper likely stretches across many years. With junior faculty facing tenure clocks as short as five years, this publication lag has large implications for tenure and promotion (Conley et al., 2013).[4]

Such lengthy time to publication has obvious ramifications for the public dissemination of economic research. In nearly all of academia outside of economics, results are not disseminated until after the completion of the peer review process. Economics, on the other hand, does not conform to this norm. Instead, many economists release "working" versions of their papers, presenting preliminary findings to media outlets and at research conferences. Junior faculty will often highlight working papers on their curriculum vitae, and department's hiring and promoting decisions can hinge on a faculty's "pipeline" of working papers. Today, econpapers.repec.org houses over 1 million working papers released across over 5300 working paper series. The widely-accepted practice of working papers in economics helps bypass its lengthy publication process, but comes with a potential drawback: With no barrier to entry or peer review, the field of working papers could suffer from overcrowding. Assuming readers have limited time or cognition devoted to consuming

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[3] The average acceptance rate into the "Top Five" is six percent, whereas the average across three top social science journals and two top natural science journals is 10 percent and 15 percent, respectively (Hadavand et al., 2021).

[4] One reason for the substantial lags in economics reviewing is that journal editors often require multiple sequences of referee reports. Many submissions require up to five revisions before acceptance (Ellison, 2002; McAfee, 2010). Hadavand et al. (2021) provide a detailed exercise into potential culprits for publication lags, and their evidence largely points toward author dilatory behavior in resubmitting revisions.

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research, each additional paper in the working paper space could reduce the visibility and viewership of "competing" research.[5] Figure A1 suggests this potential issue could be especially pertinent today, where the number of working papers has steadily increased since 1990, with a drastic increase in releases in 2020 during the pandemic. Despite their ubiquity, only a handful of studies have investigated working paper series in economics.[6]

In this study, we investigate questions related to the efficiency of the dissemination of working papers in economics by focusing on the National Bureau of Economic Research (NBER) working paper (WP) series. In particular, we focus on congestion: whether the release of a NBER WP impacts outcomes for other NBER WPs. Focusing on the NBER WP series is advantageous for several reasons. First, it is largely regarded as the premier WP series in economics, producing what is likely the most important and impactful research via working papers in the profession. Second, only NBER affiliates are allowed to release papers on the NBER WP series, and NBER affiliates are a highly selected group of economists. Thus, the NBER WP series does possess a barrier to entry that may serve as a substitute for peer review — NBER authors produce papers that are presumably more likely to publish (in better regarded journals) than others. Therefore, any evidence of congestion in the NBER WP series may understate the prominence of congestion in other, "less selective" working paper series.

A final advantage to studying the NBER WP series comes from *how* the NBER disseminates papers. Throughout the course of each week, NBER affiliates submit their working papers to the NBER without knowing how many other papers have been submitted that week. Then, on Monday of the following week, all submissions are released together and distributed to subscribers. Hence, these weekly releases generate plausibly exogenous variation in the "crowdedness" of the working paper space. As such, any systematic variation within the calendar year in both research productivity and quality can be accounted for in models with higher dimensional time fixed effects (e.g. week-of-year fixed effects), with only idiosyncratic variation remaining.

Overall, our results show strong evidence that the NBER WP series suffers from overcrowding and congestion: An increase in the number of weekly released working papers harms each individual paper's outcomes.[7] In the short run, papers experience significantly fewer abstract views and paper downloads as the number of weekly released WPs increases. This effect is particularly sharp in the first several months of the paper's release. Using data from Altmetric, a company that tracks academic papers across news outlets, blogs, and social media (e.g. Twitter), we find that NBER WPs also receive less media attention when the number of weekly NBER WPs increases. Doubling the number of weekly releases reduces a paper's probability of being covered in the media by over 30%. Further highlighting the importance of these dissemination findings, we find that the NBER WP version of eventually-published papers receives more downloads and abstract views than their published counterpart. Thus, working versions of papers substitute for the dissemination function of the publication process, yet suffer from idiosyncratic variation in the crowdedness of the working paper space.

Perhaps most importantly, we also find that publication prospects and citations are harmed from this working paper congestion. Doubling the number of weekly NBER WPs reduces a paper's probability of publishing by over 4%.[8] Interestingly, we find no effects on the "quality" of the publishing journal, suggesting a net loss in publishing outcomes for papers when released with a greater number of peer papers. Subsequent citations drop as well: doubling the number of NBER releases reduces citations by approximately 7.5%.

The presence of working paper congestion does not necessarily imply an overall reduction in the efficiency of the dissemination and publication of economic research. It may be that, for example, audiences are capable of "filtering out" the noise generated by working paper congestion, and that the "important" papers receive their due attention. We conduct a series of investigations to test for this possibility, but find little evidence that certain paper types are immune to the congestion effect. First, we find that working papers from more prominent authors, as proxied by the authors' prior publication histories and citations, suffer just as much from working paper congestion as other authors. Furthermore, we estimate quantile regressions for viewership and citation outcomes to find that the higher quantiles of the distribution experience sharper losses in viewership, suggesting that if anything, ex post more "important" papers suffer *more* from working paper congestion.

In total, our results highlight significant and damaging consequences from congestion in the profession's diffusion of working papers. Perhaps this is not so surprising given that congestion/limited attention may help explain why the NBER working paper series is so heavily followed. That is, in the absence of congestion, there is no need for a working paper series as audiences would find the papers anyway. What is more concerning is that even papers from prominent authors are harmed by the release of working papers from their lesser-prominent peers, even within a highly prestigious organization such as the NBER, suggesting audiences do not perfectly "filter out" the noise generated by working paper congestion. Moreover, the identified congestion problem likely carries sharper impacts in contexts of greater urgency, such as during the Covid pandemic, where as highlighted in Figure A1, working paper releases drastically increased. Similarly, as the size of both the profession and the number of NBER affiliated authors grows, new members likely impose congestion externalities on existing members. As such, during periods when policymakers need to rely on immediate and up-to-date research, our results indicate economics working papers likely cannibalize each other both in terms of immediate viewership and their longer run publication and citation prospects. Finally, given the exclusivity of NBER, we believe it is likely that non-NBER authors (who release working papers in spaces with little to no barriers) suffer from even steeper challenges in dissemination and crowdedness of working papers.

2. Data and institutional setting

Our study draws upon three data sets. The first comes from publicly available information on the National Bureau of Economic Research (NBER) website. The NBER is a network of over 1700 prominent economists who hold academic appointments in North American institutions. These economists are admitted into the NBER through a highly selective process.[9] The central purpose of the NBER is "conducting

[5] Several studies have investigated media competition for customer attention and the consequences of "information overload" (e.g. Van Zandt, 2004; Anderson and De Palma, 2009, 2012).

[6] These include Feenberg et al. (2017) who use nearly identical data as our study to investigate ordering effects in weekly releases of NBER working papers (e.g. papers listed first on the weekly release receive more attention than papers listed second). Novarese and Wilson (2013) study similar hypotheses as Feenberg et al. (2017) but utilize data from Research Papers in Economics (RePEc). A descriptive paper from Baumann and Wohlrabe (2020) also utilizes RePEc data to find that over 25% of working papers never publish. A recent working paper from Ziegler (2021) investigates the extent to which NBER working papers are covered in the media.

[7] Our main sample focuses on working papers released through 2019 in order to avoid any confounding issues with the pandemic. When focusing on publication and citation outcomes, we restrict our sample to papers released through 2017.

[8] Despite the highly selected sample of NBER papers, we find that 26% of NBER WPs never publish.

[9] Visit https://www.nber.org/about-nber and http://www2.nber.org/wp_metadata/ for more information on the NBER and the relevant downloadable data.

and disseminating nonpartisan economic research"(NBER, 2023). The primary method through which the NBER disseminates research is through its working paper (WP) series. Each week, NBER affiliates submit their working papers to the NBER WP series for release on the following Monday. Importantly, when an affiliate submits a paper, they have no knowledge of how many other papers have also been submitted that same week. Each year, over 1200 WPs are released to over 900 subscribing organizations and many more subscribing individuals. NBER WPs are explicitly not peer reviewed when they are submitted to the series. For our study, we collect information on the week that each paper was released, author(s), the NBER program(s) the paper was submitted under, and a draft of the paper itself.

Second, we match each NBER WP to its webpage on RePEc (Research Papers in Economics).[10] While the NBER is often regarded as the primary distributor of high quality working papers in economics, RePEc.org is often regarded as the lead distributor of all research (working and published papers) in economics. The website houses about 2.8 million research pieces from 3200 journals and 5000 working paper series with over 55,000 registered authors. We use data from RePEc to measure abstract views, downloads, citations, and publication outcomes for each paper.

Lastly, we use data from Altmetric.com to detect potential media attention for each NBER WP. Altmetric is a company devoted to tracking how much online attention academic articles receive. Altmetric records attention for individual papers across an array of media sources, including the news, blogs, and social media (e.g. Twitter). Their measures additionally include how many people have been exposed to and engage in individual papers. Each NBER WP is provided a public identifier that matches with Altmetric's database. We use the Altmetric database to measure whether a paper received any media attention, how many media sources discussed the paper, and Altmetrics overall "attention score". The attention score is a weighted measure based on the volume of media attention, types of sources (e.g., newspaper vs. Twitter), and the types of authors (e.g., scholars vs. journal website).

2.1. Descriptive statistics

Table 1 presents descriptive statistics for our sample of NBER WPs. In total we observe 16,403 WPs released across 799 weeks from 2004 to 2019. The first panel of Table 1 presents our outcomes of interest. On average, NBER WPs receive 43 abstract views and 35 downloads on RePEc within the first six months of the paper's release. Our next set of outcomes use data from Altmetric. About 15% of NBER WPs receive some media attention.[11] When focusing on number of media outlets as an outcome, we see that the majority of NBER WPs that receive media attention do so in only one outlet. We also see a mean and standard deviation of 1.49 and 11.27, respectively, in Altmetric's Attention Score. Turning to publication and citation outcomes, we see that 74% of NBER WPs subsequently publish, and on average they accumulate over 19 citations on RePEc.[12]

The second panel of Table 1 describes our model covariates. The primary covariate of interest is presented in the first row, "# of (weekly) NBER WPs", which captures the total number of NBER WPs that were released in a specific week. On average, the NBER WP series releases 23.5 papers every week during our time frame. The data also include information on the authors' prior NBER WP submissions. Overall NBER authors are highly productive: the average number of prior NBER WPs written across authors on a paper's release is roughly 15.5. NBER WPs on average have 2.5 co-authors, and contain 16,195 words. Finally, each WP is submitted under at least one NBER program. The most popular NBER programs include Economic Fluctuations and Growth (21%), Labor Studies (21%), and Public Economics (20%).

Table 1
Descriptive statistics.

	Count	Mean	S.D.
	Outcomes		
Abstract views in the first 6 months	16,403	43.33	55.16
Downloads in the first 6 months	16,403	35.23	36.31
Received any media attention	16,403	0.15	0.35
# of media outlets	16,403	0.15	1.21
Altmetric Attention Score	16,403	1.49	11.27
Citations (N=13,963)	13,963	19.05	43.28
Publication (N=13,963)	13,963	0.74	0.44
Publication rank (N=8,752)	8,752	92.7	191.42
	Covariates		
# of (weekly) NBER WPs	16,403	23.51	8.24
Paper-authors' max(# of prior NBER WPs)	16,403	27.21	28.83
Paper-authors' mean(# of prior NBER WPs)	16,403	15.46	18.53
Paper-authors' max(# of citations)	15,454	3.74	6.51
# of co-authors	16,403	2.48	1.05
# of words in manuscript	16,403	16195.06	7325.83
NBER programs:			
- Economics of Aging	16,403	0.06	0.25
- Asset Pricing	16,403	0.11	0.31
- Corporate Finance	16,403	0.10	0.30
- Children	16,403	0.08	0.26
- Development of the American Economy	16,403	0.06	0.25
- Development Economics	16,403	0.06	0.24
- Economics of Education	16,403	0.08	0.27
- Environment and Energy Economics	16,403	0.06	0.24
- Health Care	16,403	0.07	0.26
- Economic Fluctuations and Growth	16,403	0.21	0.41
- Health Economics	16,403	0.10	0.30
- International Finance and Macroeconomics	16,403	0.12	0.32
- Industrial Organization	16,403	0.08	0.27
- International Trade and Investment	16,403	0.09	0.28
- Law and Economics	16,403	0.05	0.22
- Labor Studies	16,403	0.21	0.41
- Monetary Economics	16,403	0.11	0.31
- Public Economics	16,403	0.20	0.40
- Political Economy	16,403	0.07	0.25
- Productivity, Innovation, and Entrepreneurship	16,403	0.10	0.29
- Technical Working Papers	16,403	0.02	0.13
Number of NBER WPs	16,403		
Number of weeks	799		

Notes: Full sample includes all NBER working papers released from 2004 to 2019. We restrict our sample to papers released through 2017 when investigating publication and citation outcomes.

3. Econometric specifications

Our main specification estimates the following equation:

$$Y_{pwy} = \alpha + \beta[ln(\text{Num\_NBER\_WP})]_{wy} + \lambda_w + \lambda_y + X_p + \epsilon_{pwy} \quad (1)$$

where each NBER WP p is released on a specific calendar week w (one through 53) in year y (2004–2019). We consider several outcomes for Y, including abstract viewership and paper downloads (within the first six months of the paper's release), media attention, citations, and publication outcomes. Num_NBER_WP_{wy} measures the total number of NBER WPs that were released on week w in year y. λ_w and λ_y capture week and year fixed effects, respectively, while our vector X_p include paper level controls such as the word count of the paper, indicators for the NBER programs the paper was submitted under, the number of co-authors, the average number of prior NBER WPs across the paper's authors, and the maximum number of prior NBER WPs across the paper's authors. For ease of interpretation and comparison, we take the

[10] The NBER WP series on RePEc can be found at https://econpapers.repec.org/paper/nbrnberwo/.

[11] This percentage is similar to the media coverage of NBER WPs in Ziegler (2021), who estimates roughly one in 11 NBER WPs receives some media attention within a month of its release.

[12] We focus on papers released through 2017 when focusing on publication and citation outcomes in order to allow adequate time for each NBER WP to publish and accumulate citations.

Table 2
Abstract views and Downloads in the first 6 months.

	(1)	(2)	(3)	(4)
	ln(# of Abstract views)		ln(# of Downloads)	
ln(# of NBER WPs)	−0.058	−0.047	−0.070	−0.059
	(0.022)	(0.021)	(0.032)	(0.031)
# of co-authors		0.003		−0.017
		(0.006)		(0.007)
max(# of prior NBER WPs)		0.005		0.003
		(0.000)		(0.000)
mean(# of prior NBER WPs)		0.002		0.006
		(0.001)		(0.001)
Observations	16,403	16,403	16,403	16,403
R-squared	0.362	0.446	0.053	0.155
Week FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Program FE		Y		Y

Notes: Observations unique at the paper level. The primary covariate of interest "# of NBER WPs" measures the total number of released NBER WPs during the week that an observed paper was released. Even columns additionally control for manuscript length (in number of words). Standard errors clustered at the week-year level.

natural log of our primary covariate Num_NBER_WP$_{wy}$ and all continuous outcomes (abstract views, downloads, number of media outlets, Altmetric attention score, citations, and publication rank). Hence, if overcrowdedness harms paper outcomes, then we'd expect a negative coefficient for β.

This two way fixed effect specification utilizes variation across week-years in the number of released NBER WPs in order to isolate the effect of "crowdedness" on paper level outcomes. Year fixed effects account for aggregate annual trends on the crowdedness of the NBER WP series that affect the paper's attention and impact. Week fixed effects account for any weekly, across year trends in how many papers are released and paper the paper's attention and impact. In turn, week fixed effects also account for any potential "seasonalities" in WP releases if, for example, certain times of the year have fewer/greater number of papers produced and consumed. This specification, paired with the institutional setting where NBER authors have no knowledge of how crowded the WP space will be when their paper is released, effectively isolates the causal effect of how the number of NBER WPs released each week affects each paper's outcomes. To illustrate the randomness of our primary covariate, in Figure A3 we plot the residuals from a regression of the number of weekly NBER WPs released on year and week fixed effects. We also later conduct several robustness checks and placebo tests, including estimating models with and without paper level controls, replacing year fixed effects with finer time fixed effects, testing various sample year cutoffs, regressing future week releases on present paper outcomes, verifying the confounding effect of superstar papers, and obtaining Poisson estimates for count outcomes.

4. Results

4.1. Abstract views and downloads

We begin with Table 2 which estimates two variants of specification (1) with the log of abstract views and downloads within the first six months of the paper's release as outcomes. In the first column for each outcome, we consider a model with only week and year fixed effects. In the second column for each outcome, we test the robustness of the estimates to including paper level controls: word count of the paper, indicators for the NBER programs the paper was submitted under, the number of co-authors, the average number of prior NBER WPs across the paper's authors, and the maximum number of prior NBER WPs across the paper's authors. Standard errors are clustered at the week-year level.

Across both model specifications, we first find that an increase in the number of NBER WP weekly releases reduces the number of abstract views for each paper. Estimates are precisely estimated at the 1% level in the first model and at the 5% level in the second model. Focusing on the fully specified model in column (2), we estimate that a doubling of the number of weekly releases leads to a nearly 5% drop in abstract viewership for each paper. A similar pattern holds for paper downloads in columns three and four, though estimates are slightly more noisy: A doubling of weekly releases decreases downloads by nearly 6% (significant at the 10% level). Also worth noting are the coefficients on the paper controls: Papers written by more productive authors (as proxied by author prior NBER history) tend to receive more abstract views and downloads. In Figure A4, we estimate our full specification but break down the outcomes into two-month time intervals to find that the effects dissipate over time and disappear after six months for abstract views and after two months for downloads.

4.2. Media attention

We utilize the Altmetric data to investigate media outcomes for each NBER WP. Table 3 presents results for three outcomes of interest: (1) Whether the paper received any media attention, (2) the log of the number of media outlets that covered the WP, and (3) the log of overall readership of the WP as measured through Altmetric's Attention Score. Results across all three outcomes are large and statistically significant at the 1% level, and paint a similar picture as our prior results: When the number of weekly NBER WP releases increases, each paper experiences worsened outcomes. From column (2), we predict a 4.7 percentage point drop in the likelihood a paper receives any media attention in response to a doubling of the number of weekly NBER WPs released. Given around 15% of NBER WPs receive media attention, this translates to an over 30% drop in the probability of a paper receiving any media attention. The corresponding drop from column (6) in the paper's Altmetric Attention Score, which aggregates overall media attention, is 10.6%.

4.3. Publication and citations

We finish our estimations of specification (1) by considering publication and citation outcomes for each NBER WP. These results are presented in Table 4. Once again, we find consistent and robust evidence of negative outcomes for papers when they were released with a higher number of peer NBER WPs. From column (2), we estimate a 2.1 percentage point drop in the likelihood a paper publishes in response to a doubling of the number of NBER WPs released. Given 74% of NBER WPs eventually publish, this effect is equivalent to a nearly 3% decrease in publishing probability for each paper. The corresponding estimate in column (4) suggests that citations drop by 7.5% when the number of weekly NBER WPs doubles. Both of these estimates are precisely estimated at the 5% level.

To test whether the quality of publication is also affected by overcrowding, we collected journal ranking data from IDEAS/RePEc "Aggregate Rankings for Journals" (https://ideas.repec.org/top/top.journals.all.html). Approximately 88% of published papers did so in a "ranked" economics journal.[13] In the final two columns of Table 4, our outcome is the log of the published paper's journal rank. Across both specifications, we find no evidence that the specific outlets of published journals differed in quality in response to the number of NBER weekly releases. Thus, in total, increasing the crowdedness of the working paper space reduces the likelihood a paper publishes without changing the quality of the journal outlet.[14]

[13] The remaining 12% published as books, in conference journals, or in journals outside of economics.

[14] In Table A2, we replicate Table 4 while dropping all papers that published in unranked economics journals (i.e. papers that published in books, in

Table 3
Media coverage.

	(1)	(2)	(3)	(4)	(5)	(6)
	Received any media attention		ln(# of media outlets)		ln(altmetric attention score)	
ln(# of NBER WPs)	−4.951	−4.721	−0.037	−0.036	−0.111	−0.106
	(1.379)	(1.383)	(0.011)	(0.011)	(0.031)	(0.031)
# of co-authors		0.351		0.002		0.009
		(0.311)		(0.002)		(0.006)
max(# of prior NBER WPs)		−0.001		−0.000		−0.000
		(0.020)		(0.000)		(0.000)
mean(# of prior NBER WPs)		0.028		0.000		0.001
		(0.031)		(0.000)		(0.001)
Observations	16,403	16,403	16,403	16,403	16,403	16,403
R-squared	0.175	0.190	0.177	0.185	0.195	0.211
Week FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Program FE		Y		Y		Y

Notes: Observations unique at the paper level. The primary covariate of interest "# of NBER WPs" measures the total number of released NBER WPs during the week that an observed paper was released. Even columns additionally control for manuscript length (in number of words). Indicator for "Received any media attention" scaled to 0 or 100 for ease of interpretation; for example, from column (3), doubling the number of weekly NBER WPs reduces media attention by 4.7 percentage points. Standard errors clustered at the week-year level.

Table 4
Publication and citations.

	(1)	(2)	(3)	(4)	(5)	(6)
	Published		ln(citations)		ln(publication ranks)	
ln(# of NBER WPs)	−2.108	−2.148	−0.102	−0.075	−0.049	−0.052
	(1.023)	(1.014)	(0.031)	(0.029)	(0.053)	(0.046)
# of co-authors		0.726		0.118		−0.069
		(0.447)		(0.012)		(0.021)
max(# of prior NBER WPs)		−0.016		0.001		0.003
		(0.029)		(0.001)		(0.001)
mean(# of prior NBER WPs)		0.023		0.003		0.003
		(0.046)		(0.001)		(0.002)
Observations	13,963	13,963	13,963	13,963	8,752	8,752
R-squared	0.044	0.049	0.060	0.194	0.017	0.209
Week FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Program FE		Y		Y		Y

Notes: Observations unique at the paper level. Even columns additionally control for manuscript length (in number of words). Sample for Columns 1 through 4 restricted to years through 2017 to allow adequate time for publication and citation accumulation. Indicator for "Published" scaled to 0 or 100 for ease of interpretation; for example, from column (2), doubling the number of weekly NBER WPs reduces a paper's likelihood of publishing by 2.1 percentage points. Sample for Columns 5 and 6 restricted to papers released through 2017 and eventually published. It includes those that published in a ranked economics journal on https://ideas.repec.org/top/top.journals.all.html. The primary covariate of interest "# of NBER WPs" measures the total number of released NBER WPs during the week that an observed paper was released. Standard errors clustered at the week-year level.

4.4. No evidence of substitution across papers

On a basic level, our results may not be that surprising: assuming readers have limited time or capacity to read working papers, then increasing the crowdedness of the working paper space will reduce viewership for each paper (which in turn harms their publication prospects). Importantly, this "average" effect may not necessarily be a "bad" thing *if* viewers are shifting their attention away from "bad" papers in favor of "good" papers. In other words, it may be that readers are substituting their attention toward papers that ultimately prove to be more important or impactful. Readers could potentially be doing this by relying on signals of paper quality, such as the prominence of the paper's authors. In this case, one could argue that the observed congestion problem is not concerning.

To examine this possibility, we conduct a series of investigations finding little evidence that certain paper types are immune to the congestion effect. First, we find that working papers from more prominent authors, as proxied by the authors' prior publication histories and citations, suffer just as much from working paper congestion as other authors. For example, in Table 5, we consider our primary models while interacting $ln(\text{Num\_NBER\_WP}_{uy})$ with the number of citations across the paper's authors from previous publications (i.e. before the NBER WP release). Assuming citations is a proxy for author prominence, this model tests for whether papers with more prominent authors are immune to congestion effects. Across all seven outcomes, we find no evidence that papers with more prominent authors avoid the congestion effect. The only coefficient with statistical significance (10%) comes for the outcome of paper citations, which suggests that papers with more prominent coauthors receive even *fewer* citations in response to congestion compared to papers from less prominent coauthors.[15]

conference journals, or in non-economics journals). Our results remain robust to this sample: Increasing the number of weekly NBER WPs reduces each paper's likelihood of publishing and subsequent citations.

[15] In Table A3 and Table A4, we consider interactions across author prior number of NBER WP releases and author RePEc ranking to similarly find that prominent authors are not immune to the congestion effects.

Table 5
Heterogeneous analysis — Interacting main effects with number of citations from most highly cited author.

	(1) Abstract views	(2) Downloads	(3) Attention dummy	(4) # of media outlets	(5) Att score	(6) Published	(7) Citations
ln(# of NBER WPs)	−0.056	−0.068	−5.236	−0.036	−0.113	−1.263	−0.038
	(0.024)	(0.034)	(1.472)	(0.012)	(0.033)	(1.222)	(0.035)
Interaction term	−0.002	−0.004	0.065	−0.000	0.000	−0.258	−0.010
	(0.004)	(0.003)	(0.127)	(0.001)	(0.003)	(0.167)	(0.006)
max(# of citations)	0.024	0.027	−0.022	0.002	0.003	1.173	0.065
	(0.011)	(0.011)	(0.400)	(0.003)	(0.009)	(0.517)	(0.018)
# of co-authors	0.004	−0.016	0.351	0.002	0.009	0.760	0.123
	(0.006)	(0.008)	(0.328)	(0.002)	(0.007)	(0.462)	(0.013)
max(# of prior NBER WPs)	0.001	−0.000	−0.032	−0.000	−0.001	−0.082	−0.005
	(0.000)	(0.001)	(0.022)	(0.000)	(0.000)	(0.032)	(0.001)
mean(# of prior NBER WPs)	0.004	0.007	0.041	0.000	0.001	0.069	0.006
	(0.001)	(0.001)	(0.032)	(0.000)	(0.001)	(0.047)	(0.001)
Observations	15,454	15,454	15,454	15,454	15,454	13,062	13,062
R-squared	0.455	0.166	0.191	0.183	0.210	0.055	0.216
Week FE	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y
Program FE	Y	Y	Y	Y	Y	Y	Y

Notes: Observations unique at the paper level. "Interaction term" interacts "ln(# of NBER WPs)" with "max(# of citations)." max(# of citations) measures the number of citations accumulated before the observed working paper is released for the most highly cited author on the paper. It is scaled to be divided by 100 for ease of presentation. Standard errors clustered at the week-year level.

Finally, in Table A5, we estimate quantile regressions for our continuous outcomes (viewership and citations) to find that the higher quantiles of the distribution experience sharper losses in viewership and citations. Again, this suggests that ex post more prominent papers are not immune to congestion effects; if anything, the stronger effects for higher quantiles suggest that ex post more "important" papers suffer *more* from working paper congestion.

4.5. Robustness checks and placebo tests

In this section, we consider several robustness checks and placebo tests. First, our primary model estimates week fixed effects, which control for any seasonalities that vary at the week level across all years. This control would not be adequate in situations where there are any season-year specific shocks that both (1) lead to a greater number of NBER WPs released and (2) produce lower quality papers (which inherently experience worse outcomes). For example, from Figure A1 we can see a huge jump in NBER WP releases soon after the outbreak of Covid — if these papers are also systematically lower quality, then week and year fixed effects would not adequately control for this shock.[16] A similar potential jump can be seen in the Fall of 2007, just after the Great Recession. To account for these potential season-year shocks, in Table A6 and Table A7 we re-estimate specification (1) but replace our year fixed effects with month-year and quarter-year fixed effects, respectively. These models rely on variation in the NBER WP space across weeks within each month-year and quarter-year, respectively, and thus account for any season-year specific shocks, so long as the level of the shock is not finer than the month or quarter levels. The results from these models confirm those from our main findings, and in fact generally produce more precise estimates (e.g. the effects on publishing are significant at the 1% level from Table A6 and Table A7).

Next, we test the sensitivity of the publishing and citation outcomes to different year cutoffs for our sample. Recall that our primary analyses focused strictly on papers released through 2017 in order to allow at least three years for each paper to be published and accumulate citations. In Table A8, we estimate our full model but consider various year cutoffs, starting with 2015 and ending with the full sample (2019). Our main estimates remain statistically significant across all sample selections. Moreover, estimates slowly attenuate toward zero as the sample includes more recent years, further justifying a focus on earlier years when investigating these outcomes.

Since our data also include author identifiers for each paper, we can also estimate models with "author fixed effects". However, since each paper observation can contain more than one author, and since not all authors of NBER WPs have multiple NBER WPs, as a robustness check, we utilize author information by estimating dummies for each author with two or more papers within our dataset. These dummy variables switch on for each author of a single paper observation. For example, a paper with two authors who wrote multiple NBER WPs will have two dummy variables switch on, one for each of the two authors. A total of 5574 authors of NBER WPs have written multiple NBER WPs, and so 5573 dummy variables are estimated. The results from this exercise are presented in Table A9. We find that our results remain robust to this consideration, suggesting different types of authors are not any more or less likely to release their work on weeks with more NBER WPs in total.

As a placebo test, in Table A10 we estimate specification (1) but with the subsequent week's number of NBER WPs released as the main covariate. Assuming no serial correlation, the *future* crowdedness of the NBER WP space should have no impact on today's paper's outcomes. Indeed, across all seven of our primary outcome variables, we fail to estimate a significant relationship between future NBER WP releases and present NBER WP outcomes.

Next, it may be the case that a greater number of weekly NBER WP releases is correlated with some other week-level characteristic, which itself is harming other paper's outcomes. For example, it may be that on weeks when a superstar economist releases a NBER WP, readers ignore the other NBER WPs (and weeks with a higher number of releases are more likely to contain a superstar paper).[17]

We explore this potential superstar channel in two ways. First, in Table A11, we additionally control for the weekly number of "top author" WPs in order to disentangle a potential superstar effect from

[16] Note that our main sample focuses on papers released through 2019 and thus avoids this Covid-specific shock.

[17] Such an effect is akin to that of Brown (2011), who finds that the mere presence of Tiger Woods in a golf tournament harms the performance of other golfers. Of course, in our setting papers are not directly competing with each other, and authors have no ability to know which other papers and authors they will be paired with ahead of time.

the weekly number of WPs. We code a paper as a "top author" WP if one of the paper's NBER affiliated authors released a working paper whose citations were ranked in the top 90 percentile among all papers released that year. We find that the magnitude and statistical significance of the number of working papers remain robust. The coefficients on the number of "top author" papers, in contrast, are positive for some outcomes, including viewership, citation and publication outcomes, suggesting that if anything, "top authors" could draw more attention for peer papers released the same week. Secondly, in Table A12, we re-estimate specification (1) but replace our main covariate with a proxy for this hypothesis — for each week, we calculate the maximum number of prior released NBER WPs across that week's authors. The assumption then is that authors who release more NBER WPs tend to be more well-known. Naturally, this measure will be correlated with our main covariate, the weekly number of NBER WP releases. Still, across our seven outcomes, we only estimate statistical significance at the 10% level for abstract views and downloads. Estimates for media attention and publication and citation outcomes are precisely estimated zeroes. We thus conclude that our observed effects cannot be attributed to the presence of a single superstar author, or the presence of papers written by superstar authors, and are more likely driven by general crowdedness in the NBER WP space.

Finally, we obtain Poisson estimates for non-negative count variables in Table A13. The magnitude and statistical significance of the number of working papers remain robust.

4.6. Popularity of NBER working papers

In this section, we provide several descriptive figures on NBER viewership in order to further highlight the importance of the prior results. In Figure A2, we first take the sample of NBER WPs that ex post published. We then plot average (a) abstract views and (b) downloads by month since the NBER WP's release (in red) against the corresponding abstract views and downloads for the published version of the NBER WP since publication (in blue). These results highlight two findings. First, abstract views for NBER WPs are slightly higher than their published counterpart. Second, NBER WP downloads drastically outpace downloads from the published version, with twice the number within the first year of release.[18]

These patterns first highlight how working papers have come to substitute for the dissemination function of journal publication. This is perhaps unsurprising — working papers come out prior to the publication, and, thus, carry more novelty with the findings. Moreover, working paper series typically have fewer barriers of access, whereas most journals require some form of subscription or payment. These patterns additionally highlight the importance of working papers overall — if a central purpose of academic research is to disseminate findings, then it is of great importance that we understand how working papers have come to substitute for publications and how efficient working paper series are in reaching audiences.

5. Conclusion

This study examines issues related to potential congestion in the dissemination of working papers in economics. Whether overcrowding brings negative effects on economic research dissemination is an empirical question. On the one hand, more research papers bring different perspectives and insights, which is critical for knowledge production. On the other hand, increasing the number of papers enhances the difficulty for potential viewers to select and read papers. In the context of working papers, where releases have yet to be peer reviewed, the presence of "lower quality" papers may reduce viewership of "higher quality" papers, particularly if readers cannot easily distinguish paper quality.

Our study utilizes data from the NBER WP series, which is largely regarded the premier WP series in economics. The NBER's dissemination process creates a natural experiment where weekly releases generate exogenous variation in the "crowdedness" of the working paper space. In short, after controlling for any potential seasonalities in WP quality with week-of-year and year fixed effects, our models are able to isolate how an increase in the number of simultaneously-released WPs impacts an individual WP's outcomes.

Our results show strong evidence that economics working papers suffer from overcrowding. Firstly, we find that increases in the total number of weekly released NBER WPs lead to fewer abstract views and downloads for each paper, particularly in the first several months of the paper's release. We also find negative effects from overcrowding on media attention. Furthermore, these negative effects hold for papers written by authors with more prior citations, suggesting that overcrowding still harms viewership even for "higher quality" papers. Further highlighting the importance of these findings, we find that working papers receive more abstract views and downloads than their published counterparts, suggesting that working papers (at least partially) substitute for the dissemination function of publication.

Finally, and perhaps most importantly, we find overcrowding harms long-run publication prospects and the number of citations. Doubling the number of weekly NBER WPs reduces a paper's chance of publishing by nearly 3% and the number of citations decreases by 7.5%. We find no effect on the "quality" of the publishing journal, suggesting a net loss in publishing outcomes for papers when released with a greater number of peer papers.

In conclusion, consumers of economic research face time and cognitive constraints. Our results show that when the space of working papers becomes more crowded, reader attention becomes divided, leading to reduced viewership for each individual paper. Given the barrier to entry into the NBER WP series, congestion issues in other, "less selective" working paper spaces are likely to be far greater. As more and more economists release working papers, and as viewers increasingly place more dependency on working papers, both viewership prospects and publication prospects are harmed for all papers, regardless of their inherent quality. This congestion problem is likely even more pertinent in contexts where timely research is needed, such as during the Covid pandemic: drastic events attract greater research output, but increased working paper releases cannibalize viewership across all papers, effectively hamstringing the potential positive impacts of timely economic research.

Declaration of competing interest

None of the authors on this paper have any conflicts of interest. We have received no funding from parties interested in this project.

Data availability

Data will be made available on request

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.jpubeco.2023.104978.

[18] One caveat to this juxtaposition is that we rely strictly on viewership within . It is possible that viewers attain working papers from different sources from published papers. For instance, this juxtaposition will undersell viewership of published versions of manuscripts if more people view published articles straight from the journal's website (or through printed versions) compared to viewers of NBER manuscripts straight fromm the NBER website.

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