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The silver lining of COVID-19 restrictions: research output of academics under lockdown

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Abstract
Serious concerns have been raised on the potentially negative impact of public measures to contain the COVID-19 pandemic on academic research, including the closure of research facilities, and the challenges of lockdown. However, it is unclear whether COVID-related mobility restrictions have penalized academic productivity, and if this is the case, whether it has had an equal impact on all research areas and countries. Here, we examined about 9.2 million submissions to 2689 Elsevier journals in all research areas in 2018–2021 and estimated the impact of anti-COVID mobility restriction policies on submissions to journals. Results showed that anti-contagion public measures had a positive impact on academic productivity. However, submission patterns changed more in non-Western academic countries, with the exception of Italy, which had stringent lock-down measures. During the early stages of the pandemic, the abnormal peak of submission was dominated by health & medical researchers, whereas later, there was an increase in submissions to social science & economics journals. Although anti-contagion public measures have contributed to change academic work, it is difficult to estimate whether they will have any potentially long-term effect on the academic community- either positive or negative.

Keywords COVID-19 pandemic · Submissions · Scholarly publishing · Peer review · Research on research · Journals · Research areas · Country-effects · Elsevier

Introduction

The COVID-19 pandemic has caused an increasing demand for research with abnormal requests for preprints, journal submissions, and COVID-related publications (Fraser, 2021; Abramo et al., 2022; Watson, 2022). However, this so called "covidization of research" has not affect all academic groups equally (Ioannidis et al., 2022). For instance, research has shown that during the first wave of the pandemic, junior women submitted proportionally fewer manuscripts than men (Squazzoni, 2021; Madsen et al., 2022), and that this penalty was even more prominent for junior women working in less prestigious academic organisations located in less gender-equal countries (Kwon et al., 2023). Studies also found that academics doing COVID-related research had the easiest and fastest publications compared

Extended author information available on the last page of the article

to those doing non-COVID related research (Aviv-Reuven & Rosenfeld, 2021), thus determining various potentially intertwined forms of inequality (Santos, 2022).

On the one hand, the pandemic had a negative impact on the work habit and routine of many organizations and institutions due to difficult access to lab facilities, suspension of fieldwork, and competing demands from family obligations due to home-schooling and parental care (Petts et al., 2021; EU Commission, 2023; Esquivel et al., 2023). On the other hand, the public measures to contain the pandemic, including especially strong mobility restrictions, could also have potentially benefitted certain academics by providing time to complete existing work or adapting existing research to new opportunities. As for employees in other sectors (Deole et al., 2023), working from home might have caused reduced working time for busy parents, but saving time for mobility and face-to-face meetings could have benefited those who could either rely on family support or did not have children or old parents to care for (Carr, 2021; Parlangeli et al., 2022).

However, it is difficult to assess these heterogeneous effects of the pandemic at the global level without a careful comparison of pre- and post-pandemic data that considers all research areas. Here, we have tried to fill this gap by examining the impact of the COVID-19 pandemic with full and complete data on about 9,2 million submissions to 2689 Elsevier journals from 2018 to 2021. We reconstructed academic origins from the affiliation of each author and assigned a research area to each submission via journal information.

This allowed us to reconstruct the growth rate of submissions and its global temporal patterns before and during the pandemic per country of authors' affiliation and research area. Furthermore, we considered heterogeneity effects on submissions due to country-level anti-contagion measures. This permitted us to estimate the effect of the pandemic on academic productivity more systematically than in previous research.

Methods

Data

Our dataset included about 9.2 million submissions to 2689 Elsevier journals from January 1, 2018 to May 31, 2021 in four research areas: Health & medicine sciences (HMS), Life sciences (LS), Physical sciences (PS), and Social sciences & economics (SSE) (Table 1). Data access required a confidential agreement to be signed on 12th May 2020 between Elsevier and each author of this study (Squazzoni et al., 2017). We used the e-mail (sometimes various e-mails) associated with each submission's author in the different submission

Table 1 Number of journals and submissions by year and research area

	HMS	LS	PS	SSE	Total
Submissions 2018	508519	358840	1148223	179294	2194876
Submissions 2019	566304	392965	1287904	199603	2446776
Submissions 2020	867409	497912	1593131	266762	3225214
Submissions January-May 2021	335167	203596	679601	114692	1333056
Total submissions	2277399	1453313	4708859	760351	9199922
Number of journals	1006	461	895	327	2689

systems used by Elsevier journals (i.e., Editorial Manager, Elsevier Editorial System, and EVISE) to reconstruct the country of affiliation of each author for each submission. Each submission was also assigned a unique research area depending on the journal which it was submitted to. To distinguish COVID related and non-related manuscripts, we used an internal Boolean flag from the manuscript submission systems used by journals in the Elsevier data. This allowed us to use a taxonomy of terms related to diseases caused by the same family of viruses to track back COVID-19 related manuscripts before the start of the pandemic (Squazzoni, 2021).

To estimate the submission growth rate over time, we performed a seasonal trend decomposition using Loess, isolated periodical events, and focused on unexplained events in our time series. This decomposition was performed by using the STL method from the Stats[1] library in R.[2] To calculate and compare changes between different periods of our time series, we used the Autocorrelation-based dissimilarity method from the package TSdist.[3]

To control for mobility restrictions, we used the COVID-19 stringency index, i.e., a composite measure based on nine policy responses. These nine measures included: school closures, workplace closures, cancellation of public events, restrictions on public gatherings,; closures of public transport, stay-at-home requirements, public information campaigns, restrictions on internal movements, and international travel controls. Calculated on a daily basis, the index considered the mean score of all nine metrics and takes a value between 0 and 100. A higher score indicates the introduction of stricter policy responses to the pandemic (Hale, 2021).

Results

The COVID-19 pandemic caused an abnormal rate of manuscript submissions to journals compared to the pre-pandemic period, mostly concentrated between February and May 2020 (see Fig. 4, Table 1 in the Methods Section, and Table 3 in the Appendix). This abnormal trend showed significant country- and research area-specific differences. While before the pandemic, the number of submissions from China, India, the United States, and Western European countries was comparable, the first wave of the COVID-19 pandemic created a more prominent growth rate of submissions from authors from China and India (+ 55% of submissions in 2018–2020: 674,180 submissions in 2018 vs. 1,048,717 in 2020) compared to authors from the United States and Europe (+35% of submissions in 2018–2020: 406,336 submissions in 2018 vs. 542,706 in 2020). We also found higher growth rates from certain peripheral countries, such as Bangladesh, Vietnam, Saudi Arabia, Indonesia, and Turkey (see the left panel in Figs. 1 and 4 in the Appendix).

To provide a more robust measurement of the submission patterns that also considered seasonality and temporal trends, we first calculated an autocorrelation-based dissimilarity index between pre and post-pandemic submission time series per country. Given that this measurement considers seasonality of submission trends, it could be considered as a proxy of how academics restructured their own research agenda and

[1] https://stat.ethz.ch/R-manual/R-devel/library/stats/html/00Index.html
[2] https://www.r-project.org/
[3] https://cran.r-project.org/web/packages/TSdist/TSdist.pd.

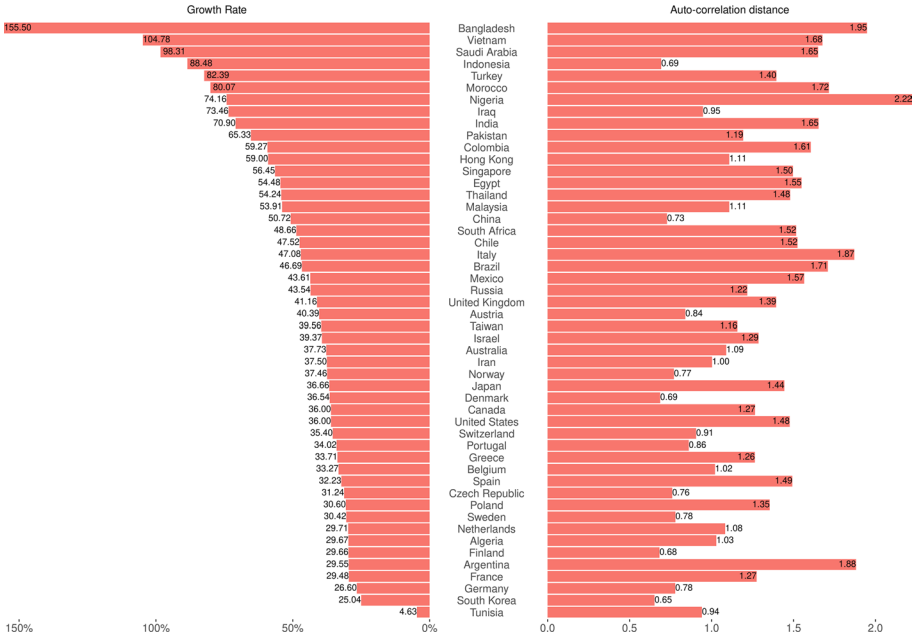

Fig. 1 The submission growth rate and the auto-correlation index in 2018-2020 for the top 50 countries for number of submissions

manuscript submission routines. Our results suggest that the countries most positively affected by the pandemic, were Nigeria (2.22), Bangladesh (1.95), Argentina (1.88), and Italy (1.87) (see the right panel in Fig. 1).

Furthermore, besides regional effects, this abnormal trend did not have the same impact in all research areas. Indeed, in the earlier onset of the pandemic, i.e., in February–May 2020, in correspondence with the highest peaks of submission growth rate, submissions were also mostly addressed to journals in Health & Medical Sciences. However, in later periods, research directed to Social Sciences & Economics journals became more prominent, probably reflecting the persistent interest of the academic community in examining the psychological, socioeconomic, and political implications of the pandemic (see Fig. 2).

To check the hypothesis that the anti-COVID mobility restriction measures introduced, i.e., mobility restrictions, could have affected these patterns, we estimated a mixed-effect model where we used the stringency index calculated by the Oxford COVID-19 Government Response Tracker (Hale et al., 2020). This was to predict the auto-correction distance between pre-post pandemic submission trends.

Table 2 shows a positive and significant effect of the stringency index on the abnormal rates of submissions to journals, even when controlling for other variables, including the growth rate trends, and country-specific factors. For each increase of 10 in the value of the stringency index, we found an increase of 1% in the auto-correlation distance between pre- and post-pandemic submission trends. This suggests that mobility restrictions and other anti-contagion public measures at the country level had an effect on disrupting submission trends.

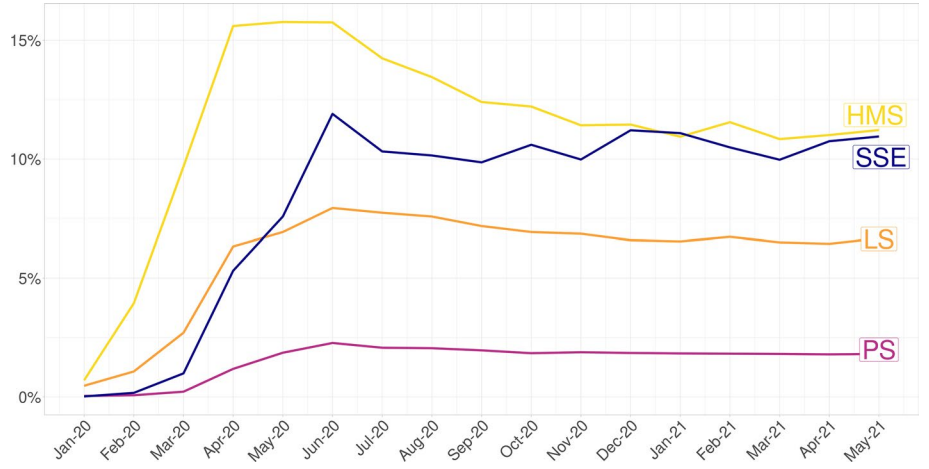

Fig. 2 Percentage of COVID-related submissions on the total number of submissions by research area: Health and Medicine Sciences in yellow, Social Sciences & Economics in blue, Life Sciences in orange and Physical Sciences in purple

Table 2 Anti-contagion measures and submission patterns. Note that the auto-correlation distance was standardized, data were grouped by country, and divided into year quarters; we included a random-effect for countries. Estimate values can be interpreted as percentages over the auto-correlation distance

	Dependent variable: Auto-correlation distance (scaled)
Stringency	0.09*** (0.01)
Growth rate	7.49*** (0.58)
Constant	26.95*** (0.90)
Random effects	Std. Dev.
Country	54.08
Residual	98.16
Observations	1,176

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

Figure 3 shows a visual representation that confirms that countries with the strongest mobility restriction policies were also those where the country-specific pattern of submissions to journals varied more compared to their own pre-pandemic trends (e.g., Italy, Argentina, and India). In Northern European countries, where mobility restrictions were either not contemplated or only softly recommended, the effect of the pandemic on changing pre and post-pandemic submission patterns was weaker (e.g., Finland, Sweden, and Denmark) (more country-based detail in Table 6 in the Appendix). Although there is heterogeneity in the effect for certain specific countries, results suggest that generally strongest mobility restriction policies had a positive effect on submission trends.

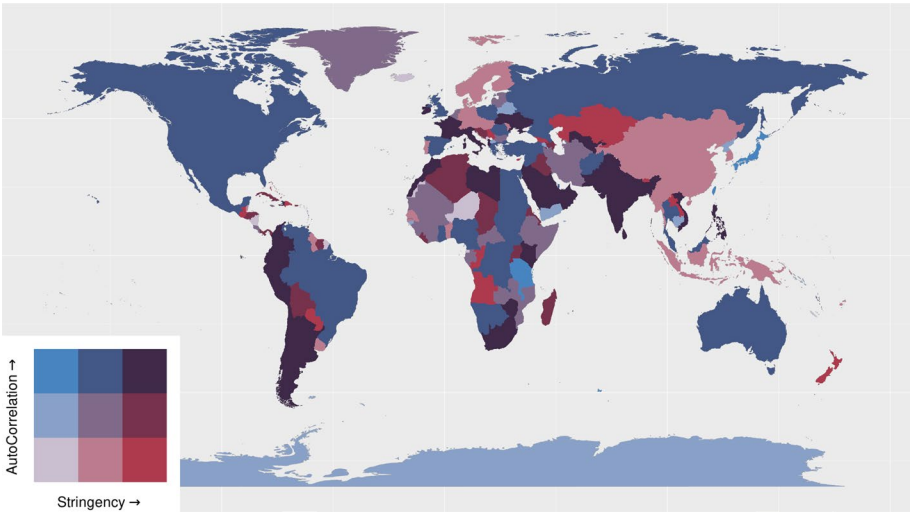

Fig. 3 The effect of the stingency index on country-level patterns of submissions to journals in 2018–2020

Discussion and conclusions

Previous evidence has suggested that the annual growth rate of scientific publications globally was around 4% percent (Bornmann et al., 2021). Our results showed that the COVID-19 pandemic and the associated mobility restrictions boosted this trend with huge submission growth rates for certain countries. Besides the increasing demand for research to tackle the multi-faceted challenges of the global pandemic, previous research has suggested the anti-contagion measures have contributed to shape new routines and changing practices, including lecturing from home, and reduced time from daily work commuting and in-person meetings, which could have boosted productivity in the short-term (Pellegrini et al., 2020; Commission, 2023).

Our findings showed that mobility and anti-contagion restrictions had the positive effect of boosting manuscript submissions to journals and disrupting previous submission trends and their seasonality. We also found prominent country and research area-specific effects, with the emergence of a relatively new geography of the pandemic research with certain peripheral countries and non-Western regions in a prominent position. In general, with the exception of Italy at the frontline of COVID-19 spread, and therefore introducing stringent anti-contagion policies, submissions grew especially from non-Western countries (Santos, 2022).

Furthermore, we found an interesting area-specific trend in COVID-related research. While the highest peaks of the submission growth rate were initially addressed to journals in Health & Medical Sciences, a later growth of submissions was also visible for submissions to Social Sciences & Economics journals. This showed the changing focus of research from health issues to more general societal implications of the pandemics, echoing previous studies on temporal trend dynamics of adaptation of the scientific community to the complex nature of the pandemic crisis (Santos., 2022).

This said, our study has also certain limitations. The assumption of our study is that the country of affiliation of authors and their country of residence during the pandemic in 2020/2021 were the same. It is possible that some global academics could have decided to

relocate in their home country to reunite with their family, thus anticipating the possible effect of restrictions either in the country of their affiliation or in the country of their family. However, given the large scale nature of our dataset, we believe that these cases would be randomly distributed across countries in the sample without affecting our results.

Furthermore, our study cannot help to estimate the long-term effect of these changes in the submission patterns. Although previous survey research has emphasized the expected long-lasting effects of the pandemic on the academic community (Gao et al., 2021), understanding the long-term implications of these new practices, including the co-existence of on/off line meetings and lectures, the new work-life balance of academics, and the expected reduction of international conferences, in terms of potential changes in the annual growth of scientific activities and their unequal distribution between research areas, requires more research (Ashencaen et al., 2021; Jack & Glover, 2021).

Furthermore, by providing new opportunities for fast publications, the abnormal submission growth due to the pandemic could have compromised ethical standards of research integrity, and weakened the filters of peer review, thus undermining the quality of scientific publications (Bauchner et al., 2020; Horbach, 2021; Faust et al., 2023). Research that considers the interplay of these multiple, quantitative and qualitative factors is also needed to inform possible interventions and understand how to maintain rigorous standards of research and scholarly communication in periods of global shocks.

Appendix

Table 5 shows the number of COVID-19 vs. non-COVID-19 submissions by year and research areas. Note that, following Squazzoni et al. (2021), we used data from the manuscript submission systems used by Elsevier journals to distinguish COVID related and non-related manuscripts. This allowed us to track any manuscript focusing on diseases caused by a COVID-like family of viruses before the start of the pandemic. Results suggest a more prominent increase of COVID-related submissions in HMS journals in 2020 compared to 2019 and in SSE journals in 2021 compared to 2020 and 2019, as mentioned in the main text.

The decomposition of the series based on a Holt-Winter's model indicated a growing trend of submissions in the whole period, with an acceleration in 2020 (Fig. 4). Unsurprisingly, the trend showed a seasonality dynamics, with a sharp reduction in submissions from the Northern hemisphere during the winter break. Despite the overall growing trend, during the first wave of the COVID-19 pandemic, i.e., Feb–May 2020, we found important positive residuals. This suggests a breakthrough in the long-term trends of journal submissions: The first wave of the COVID-19 pandemic caused a system-level shock, which was eventually absorbed by the system by the end of 2020, where the number of submissions returned to pre-pandemic trends. To better analyse this, we compared submissions in 2019, 2020, and the first five months of 2021 with those from 2018, which were used as baseline (note that we only used the first five months of 2018 for comparison to 2021). We then built a measure of dissimilarity based on the auto-correlation distance function that reflected trend differences and variations for each period.

Note that the autocorrelation-based dissimilarity is a measure of the difference between two time series, and is calculated as the dissimilarity between their estimated autocorrelation coefficients (Montero et al., 2014). This index takes an unbounded value between 0 and an infinite number, with higher values indicating higher dissimilarities between the

Table 3 Number of COVID-19 vs non-COVID 19 submissions by year and research area

	HMS	LS	PS	SSE
2018				
COVID	1235 (0.24%)	1148 (0.32%)	415 (0.04%)	25 (0.01%)
Non-COVID	507284 (99.76%)	357692 (99.68%)	1147808 (99.96%)	179269 (99.99%)
2019				
COVID	1357 (0.24%)	1376 (0.35%)	408 (0.03%)	31 (0.02%)
Non-COVID	564947 (99.76%)	391589 (99.65%)	1287496 (99.97%)	199572 (99.98%)
2020				
COVID	104595 (12.06%)	29302 (5.88%)	23700 (1.49%)	20491 (7.68%)
Non-COVID	762814 (87.94%)	468610 (94.12%)	1569431 (98.51%)	246271 (92.32%)
2021 (Jan–May)				
COVID	37182 (11.09%)	13361 (6.56%)	12304 (1.81%)	12228 (10.66%)
Non-COVID	297985 (88.91%)	190235 (93.44%)	667297 (98.19%)	102464 (89.34%)
Total				
COVID	144369	45187	36827	32775
Non-COVID	2133030	1408126	4672032	727576

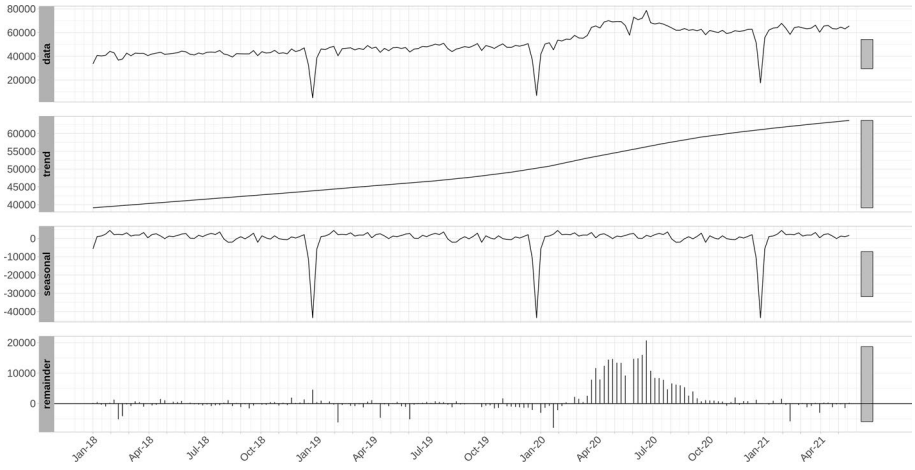

Fig. 4 Trend dissimilarities in journal submission rates from January 2018 to May 2021, scaled on a weekly basis

pair of time series. For our time series, the maximum values of the autocorrelation-based dissimilarity were around 2.5.

Figure 5 shows variations in time series for the first 50 world countries for the highest numbers of submissions during the pandemic. The top panel, i.e., 2019–2018 comparison, shows the pre-pandemic increase trend in the number of submitted manuscripts. The middle panel (2020 vs 2018) shows a significant departure from the previous trend. Not only did the number of submissions accelerate, there were abnormal positive values in most countries severely affected by the COVID-19 pandemic. Finally, the 2021–2018

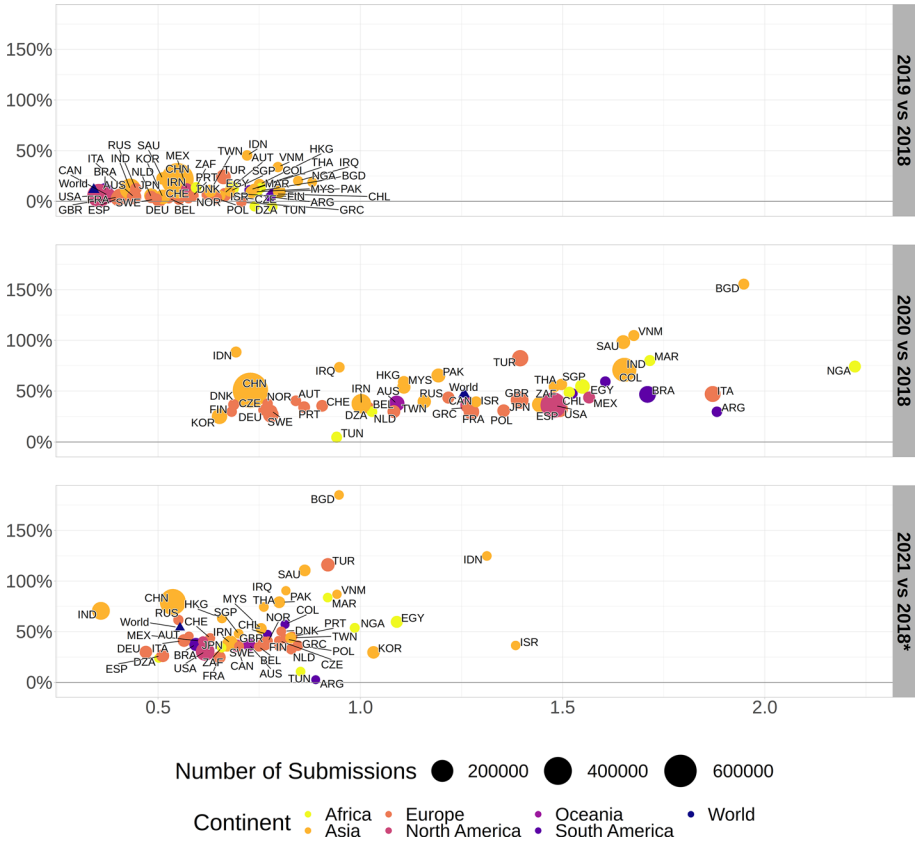

Fig. 5 Time series changes for the top 50 countries with the highest number of submissions during the pandemic. The triangle symbol shows aggregated world values. The y axis represents submission growth rates, while the x axis represents the auto-correlation distance between the two years under comparison. Note that for 2021 vs. 2018*, we only considered the first 5 months to ensure full comparability and rule out any seasonality effect

comparison (bottom panel) shows a return to pre-pandemic submission trends for most countries.

Table 4 shows that the growth rate of submissions and the auto-correlation distance were both more prominent in Africa, South America, and Asia. In Europe, the auto-correlation distance was mostly due to Southern Europe, with countries such as Italy and Spain with the most prominent distance from previous trends (see also Table 5 for a list of countries by growth rate and Table 6 for a list of countries by auto-correlation distance).

Table 4 The submission growth rate (= Growth) and the auto-correlation distance (= Dist) by regions in 2018–2020

Continental Region	Growth/Dist	Statical Region	Growth/Dist
Africa	54.04/1.72	Northern Africa	45.09/1.41
		Sub-Saharan Africa	67.27/1.84
Asia	53.82/0.99	Eastern Asia	47.38/0.66
		Central Asia	95.14/1.14
		Southern Asia	60.66/1.53
		South-eastern Asia	65.27/1.36
		Western Asia	78.64/1.52
Europe	38.76/1.25	Eastern Europe	34.86/0.96
		Northern Europe	38.93/1.14
		Southern Europe	37.22/1.59
		Western Europe	29.95/0.96
North America	36.56/1.45	Northern America	36.56/1.45
South America	47.05/1.79	Latin America and the Caribbean	47.05/1.79
Oceania	37.24/1.04	Australia and New Zealand	37.24/1.04

Table 5 The submission growth rate 2018–2020 per country (country codes from https://www.iso.org/obp/ui/)

Country	Growth (%)	Country	Growth (%)	Country	Growth (%)	Country	Growth (%)
LCA	400.00	TLS	78.26	RWA	47.15	HND	28.37
BES	333.33	ERI	77.78	ITA	47.08	TON	27.27
WLF	316.67	CAF	76.00	BRA	46.69	HRV	27.08
ATG	300.00	BIH	75.73	HTI	45.76	DEU	26.60
AND	292.86	GGY	75.00	SEN	45.40	BFA	26.49
CYM	290.91	LBY	74.61	MNE	45.07	KOR	25.04
BLM	287.50	NGA	74.16	MEX	43.61	IMN	24.24
ALA	231.03	SDN	73.84	ZWE	43.60	SVK	23.33
SXM	220.00	CYP	73.61	RUS	43.54	LUX	22.27
GIB	193.75	IRQ	73.46	URY	42.71	SMR	22.22
BVT	183.33	UGA	71.21	MTQ	42.67	MYT	22.22
TCA	180.00	BEN	71.09	CRI	42.40	MLI	21.43
BGD	155.50	IND	70.90	GBR	41.16	GUY	21.05
GRD	151.85	KHM	69.95	TTO	40.71	MDG	20.22
COG	150.36	BDI	69.84	AUT	40.39	MUS	20.09
NIU	150.00	NAM	68.25	HUN	39.67	SLE	20.00
PCN	150.00	MWI	67.70	TWN	39.56	TKM	20.00
ETH	141.54	PHL	67.47	ISR	39.37	SGS	20.00
SOM	140.00	ZMB	66.94	PRK	39.31	STP	20.00
AFG	136.76	MLT	66.88	UKR	39.26	MNG	18.09
DOM	133.33	GMB	66.67	PRI	38.86	TGO	17.92
SHN	133.33	PAK	65.33	AUS	37.73	LSO	17.39
NPL	128.76	KEN	65.10	IRN	37.50	LAO	16.25
SUR	123.81	SSD	65.00	NOR	37.46	GUF	16.00
TCD	122.06	CMR	64.14	NZL	37.36	MDA	15.72
SYC	117.65	TZA	63.85	VEN	36.68	GEO	15.51
PAN	116.11	JOR	63.11	JPN	36.66	GRL	14.81
QAT	113.38	SPM	62.50	DNK	36.54	GNB	13.79
SYR	108.92	COD	61.60	USA	36.00	COM	13.16
KNA	106.06	MOZ	61.50	CAN	36.00	HMD	12.50
VNM	104.78	ALB	61.05	LVA	35.78	SRB	11.63
WSM	104.35	MSR	60.00	LTU	35.42	IOT	11.36
KAZ	100.95	COL	59.27	CHE	35.40	ARM	10.91
UZB	100.56	DJI	59.26	MRT	35.00	BHS	9.68
VCT	100.00	HKG	59.00	AIA	35.00	SLV	9.09
PER	98.76	CXR	58.48	PRT	34.02	BOL	8.65
SAU	98.31	ECU	57.57	GRC	33.71	MKD	8.20
CCK	93.26	LBN	56.90	JAM	33.47	PYF	7.77
BHR	93.24	GHA	56.66	VGB	33.33	TJK	7.69
BWA	92.78	SGP	56.45	BEL	33.27	FRO	7.14
LKA	91.15	BLR	55.75	SVN	33.21	ATF	5.26
NER	90.74	MCO	54.92	ESP	32.23	LIE	4.92
GTM	90.28	EGY	54.48	GAB	31.93	TUN	4.63
BRN	88.58	THA	54.24	BGR	31.88	BLZ	0.00

Table 5 (continued)

Country	Growth (%)	Country	Growth (%)	Country	Growth (%)	Country	Growth (%)
IDN	88.48	MYS	53.91	EST	31.87	NFK	0.00
BMU	86.67	PRY	53.16	CZE	31.24	COK	0.00
ARE	86.46	IRL	53.16	CUB	31.04	TUV	0.00
BRB	84.00	REU	52.08	POL	30.60	JEY	− 1.19
KGZ	83.90	PSE	51.94	ISL	30.49	LBR	− 4.84
MMR	83.08	CIV	50.89	SWE	30.42	ASM	− 6.90
TUR	82.39	CHN	50.72	NIC	30.00	CPV	− 8.05
GLP	82.29	SWZ	50.00	MDV	30.00	AGO	− 8.65
YEM	82.26	ABW	50.00	AZE	29.89	SJM	− 10.00
MAC	81.35	VIR	50.00	NLD	29.71	GNQ	− 10.53
MAR	80.07	FLK	50.00	DZA	29.67	ESH	− 12.50
GIN	79.66	TKL	50.00	FIN	29.66	CUW	− 16.67
OMN	79.41	KWT	49.33	ARG	29.55		
BTN	79.27	ZAF	48.66	FRA	29.48		
DMA	78.57	CHL	47.52	ROU	29.41		

Note that the outlier countries in top ranked positions are small countries, such as Saint Lucia (LCA), where even minimal variations in the rate of submissions have necessarily prominent effects

Table 6 Auto-correlation distance between 2018 and 2020 per country (country codes from https://www.iso.org/obp/ui/)

Country	Dist	Country	Dist	Country	Dist	Country	Dist
NGA	2.22	TWN	1.16	IRN	1.00	NER	0.85
ARE	2.16	TZA	1.16	GMB	1.00	KGZ	0.85
BGD	1.95	SSD	1.15	CAF	1.00	GTM	0.84
OMN	1.93	NAM	1.15	GAB	1.00	URY	0.84
COD	1.93	HTI	1.15	BIH	0.99	SHN	0.84
ARG	1.88	GIB	1.14	GIN	0.99	AUT	0.84
ITA	1.87	TTO	1.13	MLI	0.99	NFK	0.84
NPL	1.82	SYC	1.13	BGR	0.99	ESH	0.84
SDN	1.73	IOT	1.12	TKM	0.99	GEO	0.84
MAR	1.72	AFG	1.12	AIA	0.99	IMN	0.83
BRA	1.71	ECU	1.11	SMR	0.98	MYT	0.83
QAT	1.71	HKG	1.11	ZMB	0.98	KNA	0.83
VNM	1.68	MYS	1.11	CIV	0.98	GUF	0.83
IND	1.65	PSE	1.11	MDG	0.98	NZL	0.82
SAU	1.65	LBY	1.10	PAN	0.97	SXM	0.82
PER	1.64	SWZ	1.10	RWA	0.97	HMD	0.82
COL	1.61	MDV	1.10	GGY	0.96	VIR	0.81
BRB	1.60	PCN	1.09	ERI	0.96	BLM	0.80
MEX	1.57	MAC	1.09	VCT	0.96	PRY	0.80
EGY	1.55	AND	1.09	SUR	0.95	HUN	0.79
CHL	1.52	AUS	1.09	JEY	0.95	STP	0.79
ZAF	1.52	ALB	1.09	PRI	0.95	SWE	0.78
GHA	1.51	MWI	1.09	IRQ	0.95	SPM	0.78
SGP	1.50	GLP	1.08	ATG	0.94	DEU	0.78
ESP	1.49	NLD	1.08	TUN	0.94	MMR	0.77
BHR	1.48	MUS	1.08	LVA	0.94	LSO	0.77
THA	1.48	BFA	1.08	CRI	0.93	GUY	0.77
USA	1.48	PRK	1.07	MLT	0.93	NOR	0.77
JPN	1.44	LBR	1.07	GNB	0.93	NIC	0.77
TUR	1.40	MCO	1.07	SVN	0.92	BES	0.77
GBR	1.39	CXR	1.07	SLE	0.92	DOM	0.76
UKR	1.39	BLR	1.07	MOZ	0.92	TGO	0.76
POL	1.35	SOM	1.07	MSR	0.91	CZE	0.76
PHL	1.35	JAM	1.06	EST	0.91	CUW	0.75
BWA	1.31	WSM	1.06	HND	0.91	MDA	0.75
ZWE	1.31	AZE	1.06	FLK	0.91	BLZ	0.75
KEN	1.30	ARM	1.06	TCD	0.91	LAO	0.75
KWT	1.29	UGA	1.05	CYM	0.91	SEN	0.75
MTQ	1.29	SGS	1.05	GNQ	0.91	CHN	0.73
ISR	1.29	DJI	1.05	CHE	0.91	VGB	0.73
BRN	1.28	MRT	1.04	BMU	0.90	COK	0.73
LKA	1.28	YEM	1.04	ISL	0.90	GRD	0.72
FRA	1.27	SLV	1.04	DMA	0.89	SVK	0.71
CAN	1.27	GRL	1.04	MNE	0.89	TCA	0.71
LBN	1.27	CUB	1.04	LUX	0.89	MNG	0.71
GRC	1.26	PYF	1.03	CYP	0.88	COM	0.71

Table 6 (continued)

Country	Dist	Country	Dist	Country	Dist	Country	Dist
VEN	1.25	HRV	1.03	CCK	0.88	TLS	0.71
ROU	1.24	BOL	1.03	BHS	0.88	BTN	0.71
UZB	1.23	FRO	1.03	BEN	0.87	LCA	0.70
RUS	1.22	DZA	1.03	NIU	0.87	IDN	0.69
IRL	1.21	KHM	1.03	REU	0.87	DNK	0.69
PAK	1.19	MKD	1.03	CPV	0.87	FIN	0.68
ATF	1.19	ABW	1.03	TJK	0.87	KOR	0.65
SYR	1.19	ETH	1.03	KAZ	0.86	TON	0.61
LIE	1.18	BEL	1.02	AGO	0.86	TKL	0.58
BDI	1.17	WLF	1.02	PRT	0.86	TUV	0.55
BVT	1.17	ASM	1.01	COG	0.86		
JOR	1.17	LTU	1.01	SRB	0.86		
CMR	1.17	SJM	1.00	ALA	0.85		

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Data availability The dataset for replication is available at this link: https://doi.org/10.7910/DVN/DUBP4U.

Declaration

Conflict of interest Bahar Mehmani declares a competing interest, being currently employed as Reviewer Experience Lead at Elsevier. However, she had no access to the database, elaborated any version of the dataset, or was involved in data analysis. The authors declare no other competing interests.

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