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The Impact of the Russo-Ukrainian War on Ukrainian Scholarly Publishing and Research Directions: A Bibliometric Analysis

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Abstract

Objectives. Russia's aggression against Ukraine has unfolded in two phases: the onset of the Donbas war and the annexation of Crimea in 2014, and the full-scale invasion in 2022. We examined the changes in Ukrainian scholarly publishing across these disruption periods. **Methods.** Using Web of Science Core Collection and InCites data (1991–2024), we analyzed publication trends in Ukraine and Croatia, disciplinary composition, leading universities, city-level output in occupied territories, and international collaboration. Interrupted time series (ITS) models were specified with breakpoints at 2014 and 2022. **Results.** Ukraine's output increased from 331 articles in 1991 to 12,475 in 2021, then declined by 14.6% to 10,649 in 2024, whereas Croatia's output remained comparatively stable. The segmented ITS showed significant growth before 2014, a steeper upward trend after 2014, and a decline after 2022. Croatia showed continued growth with a smaller, non-significant post-2022 slowdown. In Ukraine, the largest post-2022 declines were observed in Physical Sciences and Social Sciences, while Engineering and Technology appeared more resilient. City-level analyses in occupied territories showed an early break in 2014 in Donetsk and Luhansk, while output linked to Simferopol and Sevastopol was rapidly reclassified after 2014, with records increasingly indexed under Russia. After 2022, collaboration with Russia collapsed, whereas partnerships with Poland, Germany, and the USA expanded. **Conclusion.** Ukrainian scholarly publishing showed phase-specific shifts in output and collaboration patterns that coincided with major geopolitical disruptions.

Key Words: Ukraine ▪ Russo-Ukrainian War ▪ Scientific Publishing ▪ Full-Scale Invasion.

Introduction

Russia's full-scale invasion of Ukraine on February 24, 2022, disrupted nearly all aspects of life, including academia, through displacement, infrastructure loss, and military mobilization (1). A 2022 survey found that 18.5% of researchers had emigrated and 17.6% had left academia, reducing national research capacity by 20%, while damage to scientific institutions and equipment further disrupted research activity (2-4). An estimated 10% decline in scientific output after 2022 has been attributed primarily to human capital loss rather than infrastructure damage (5). Recent studies have documented important war-related changes in Ukrainian academic publishing. These studies show declining productivity, shifts in research priorities toward war-related topics, and increased reliance on international collaborators for statistical, language, and publishing support (6-9). In our previous study, Ukrainian researchers described major wartime barriers to publishing, including limited funding, methodological support needs, language difficulties, and psychological stress (10). In the present study, we extend those findings by examining how such challenges may be reflected in changes in publication output.

Several international organizations have provided support to Ukrainian scientists. Short-term

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grants and scholarships have helped researchers remain connected to the global academic community (8), while newer initiatives have included participation in business incubators focused on post-war recovery projects (7). Our prior research also identified the Giving Voice initiative as an important support mechanism, providing mentorship, editorial assistance, and technical guidance that helped Ukrainian researchers continue publishing and gain international visibility (10, 11). Coordinated by the TRIBE doctoral program at the University of Split School of Medicine, it supports Ukrainian researchers in publishing war-related experiences and the war's impact on scientific work (11).

As a continuation of these efforts, we analyzed Ukrainian publication activity (1991–2024), with particular attention to institutions in temporarily occupied territories, specifically universities in Luhansk, Donetsk, Simferopol, and Sevastopol. These "stolen universities" have faced major disruption since 2014, following the Russian Federation's illegal annexation of Crimea and its support for the so-called Donetsk People's Republic (DPR) and Luhansk People's Republic (LPR) (12). During the occupation, many universities were either relocated to Ukrainian government-controlled areas or taken over by occupation authorities and re-registered under Russian jurisdiction, often continuing to operate under the original institutional names. According to Sych et al., the annexation and war led to the displacement of at least 18 higher education institutions, involving over 3,500 academic staff and approximately 40,000 students (13).

In this context, the present study aimed to describe how the Russo-Ukrainian war changed Ukrainian scholarly publishing and research directions. We examined national output, disciplinary composition, leading universities, international collaborations, and publication activity linked to universities from occupied territories.

Materials and Methods

Study Design and Setting

Our bibliometric study was designed as a descriptive and historical analysis of publication patterns during a period of overlapping systemic disruptions, rather than as a definitive causal evaluation of the effects of war on scientific output. Two major phases of Russian aggression were identified. The first phase began in 2014 with the annexation of Crimea and the war in Donbas, causing major regional disruption in the occupied areas (14). The second phase began in 2022 with the full-scale invasion and remains ongoing, with widespread destruction, displacement, and substantial disruption to daily life, including higher education and research.

Beyond the war, Ukraine's research community experienced COVID-19, which shifted research priorities toward pandemic-related topics and coincided with declines in other areas (15, 16). Following the WHO's March 2020 declaration, we defined the COVID-19 period as 2020–2021 (17), capturing the peak, globally synchronized disruption to higher education and research. Vaccine rollout from late 2020 and throughout 2021 supported gradual reopening and adaptation in many settings.

To capture these major disruptions, we defined four contextual periods: the pre-war baseline (1991–2013), the Donbas war period (2014–2021), the COVID-19 pandemic period (2020–2021), and the full-scale invasion period (2022–2024). These periods serve as historical context markers rather than mutually exclusive analytical regimes. In the interrupted time series (ITS) analysis, breakpoints at 2014 and 2022 were specified for the national series and for analyses of Crimea- and Donbas-affiliated academics, reflecting the 2014 annexation/onset of the Donbas war and the 2022 full-scale invasion. The Donbas war and the COVID-19 pandemic were treated as overlapping background disruptions that may influence publication trends but were not modeled as separate intervention points.

Our analysis starts in 1991, Ukraine's year of independence. Before then, Web of Science indexed institutions in present-day Ukraine under the Soviet Union or the Ukrainian SSR, and records do not reliably distinguish authors across former Soviet republics. Retrospective attribution would require unjustified assumptions based on

bibliometric metadata. Independence is the most defensible starting point for assessing scientific output in a new sovereign state. Low early-1990s counts reflect the post-independence transition and this methodological boundary, not a lack of scientific activity.

Croatia was used as a comparative benchmark rather than a strict counterfactual. Both countries became independent in 1991 and developed post-socialist academic systems with broadly similar trajectories of restructuring and internationalization. Croatia's relative geopolitical stability provides a historically grounded reference for interpreting changes in Ukraine's publication trajectory amid global shifts in publishing and indexing, including the COVID-19 period. The focus on temporal trends rather than absolute publication volume further strengthens the choice of Croatia as a comparator.

Data Sources and Data Collection

The primary sources of bibliometric data were the Web of Science Core Collection (WoS CC) and the InCites Benchmarking & Analytics platform (Clarivate). Data were retrieved using the InCites platform in July 2025 and covered the period from 1991 to 2024. The final dataset included 282,863 publications for Ukraine and 157,943 for Croatia, although these numbers may be subject to minor updates due to ongoing indexing.

To examine how Ukrainian scientific output was distributed across disciplines and which fields were more resilient or vulnerable over time, we classified publications by research field using the InCites Global Institution Profiles Project (GIPP) categories. The categories were Arts & Humanities; Clinical, Pre-Clinical & Health; Engineering & Technology; Life Sciences; Physical Sciences; and Social Sciences. The "Overall" category was excluded to focus the analysis on specific disciplinary trends.

We also assessed institutional scientific productivity for leading Ukrainian universities, identified through the Shanghai and Times Higher Education (THE) rankings. We included the five highest-ranked Ukrainian institutions listed in the 2025 Academic Ranking of World Universities (ARWU – Shanghai Ranking) and the 2025 Times Higher Education (THE) World University Rankings (overall tables). The 2025 rankings were used because the data were retrieved in July 2025, making them the most current rankings available at the time and providing a stable institutional reference set.

Analysis of the scientific production in occupied territories accounted for the complex institutional transformations resulting from the ongoing war. Many Ukrainian universities originally located in occupied territories were relocated to regions under Ukrainian control, where displaced staff continued their work under the umbrella of these relocated institutions, which retained their legal status and preserved institutional continuity under Ukrainian law (e.g., Donetsk National University was relocated to Vinnytsia, and Luhansk Taras Shevchenko National University moved to Poltava). In parallel, occupation authorities continued to operate institutions in the occupied territories under Russian administrative control using the same names. Although these institutions bear the same names, they should not be regarded as identical, as they do not operate under Ukrainian law. To evaluate the impact of these transformations, we analyzed publication outputs from the cities of Crimea (Simferopol and Sevastopol), Donetsk, and Luhansk. To track the publication activity of academic institutions using affiliation of those cities but different countries, we used the WoS platform and the following query structure: AD=(city) AND AD=(country) AND DT=(Article), where "AD" indicates the author's institutional address, "city" was replaced sequentially with Donetsk, Luhansk, Simferopol, and Sevastopol. Because the WoS country field is a database label derived from recorded affiliations (and does not constitute a legal designation) and may change under occupation or administrative reassignment, we ran each city query twice, specifying the country as "Ukraine" and as "Russia," to capture shifts in the country label associated with address records under occupation. The query was

limited to the document type "Article" to ensure consistency with the rest of our dataset.

Finally, to understand how international collaboration patterns evolved over time and which countries were consistently the most active scientific partners for Ukraine, we used the Collaboration tab in the InCites analytics platform and selected "Location" as the primary filter, setting it to Ukraine. This allowed us to identify partner countries and track collaboration trends in publication output from 1991 to 2024. We applied the document type filter to include only "Articles." From the automatically generated list, we selected the 10 most productive collaborating countries.

Statistical Analysis

To examine changes in Ukraine's scientific output around the 2022 full-scale invasion, we conducted an ITS analysis using ordinary least squares regression in R (version 4.5.1; R Core Team, 2025) in RStudio. The outcome was the annual count of WoS-indexed Articles. Models included a continuous time variable (years since 1991) and breakpoint terms for 2014 and 2022 (post-indicators and time-after terms) to estimate level and slope changes at each breakpoint. Model fit was evaluated using R^2 and residual diagnostics, and observed versus predicted values were inspected with vertical markers at the breakpoints. Croatia was included as a comparator series to contextualize Ukraine's trends relative to broader publishing and indexing dynamics. COVID-19 was treated as a contextual background rather than modeled as a separate breakpoint because it overlaps with the war period and broader time-varying publishing and indexing dynamics.

Results

National Publication Trends in Ukraine and Croatia

Scientific publication output in Ukraine increased steadily from 1991 to 2021, from 331 to 12,475 articles annually, with a marked increase between 2019 and 2021 (Figure 1A). Croatia showed a similar upward trend at lower absolute levels, from 434 in 1991 to 6,934 in 2021 (Figure 1B). After the 2022 invasion, Ukraine's growth slowed sharply, falling from 12,475 articles in 2021 to 10,649 in 2024, a decline of 14.6% over this period, while Croatia's output remained relatively stable, declining slightly to 6,540.

Interrupted Time Series Estimates for National Output

Table 1 shows that both countries had strong positive publication trends before 2014. Ukraine experienced a significant acceleration in output after 2014, followed by a significant reversal in trend after 2022, while Croatia showed only a smaller post-2014 increase and no significant post-2022 change.

Disciplinary Composition and Field-specific Disruptions

Analysis of research output by discipline showed that Physical Sciences and Engineering & Technology were the most productive fields, both exhibiting significant pre-2022 growth rates of + 123 and + 71 articles per year, respectively ($P<0.001$) (Figure 2). Physical Sciences output increased sharply in the early post-independence years, surpassing 2,000 annual publications by 1993 before settling into sustained growth. Engineering & Technology followed a similar pattern, with an early surge from a lower baseline. Other fields, Life Sciences (+51/year), Social Sciences (+66/year), Clinical, Pre-Clinical & Health (+32/year), and Arts & Humanities (+23/year), remained at lower levels.

Following the annexation of Crimea in 2014, growth patterns shifted. All scientific fields accelerated, except Physical Sciences, which began to plateau, fluctuating around its peak rather than continuing a strong upward trend.

The COVID-19 pandemic (2020–2021) coincided with declines in Physical Sciences, while Engineering & Technology maintained growth, and other fields remained relatively stable. This period is described for context and was not

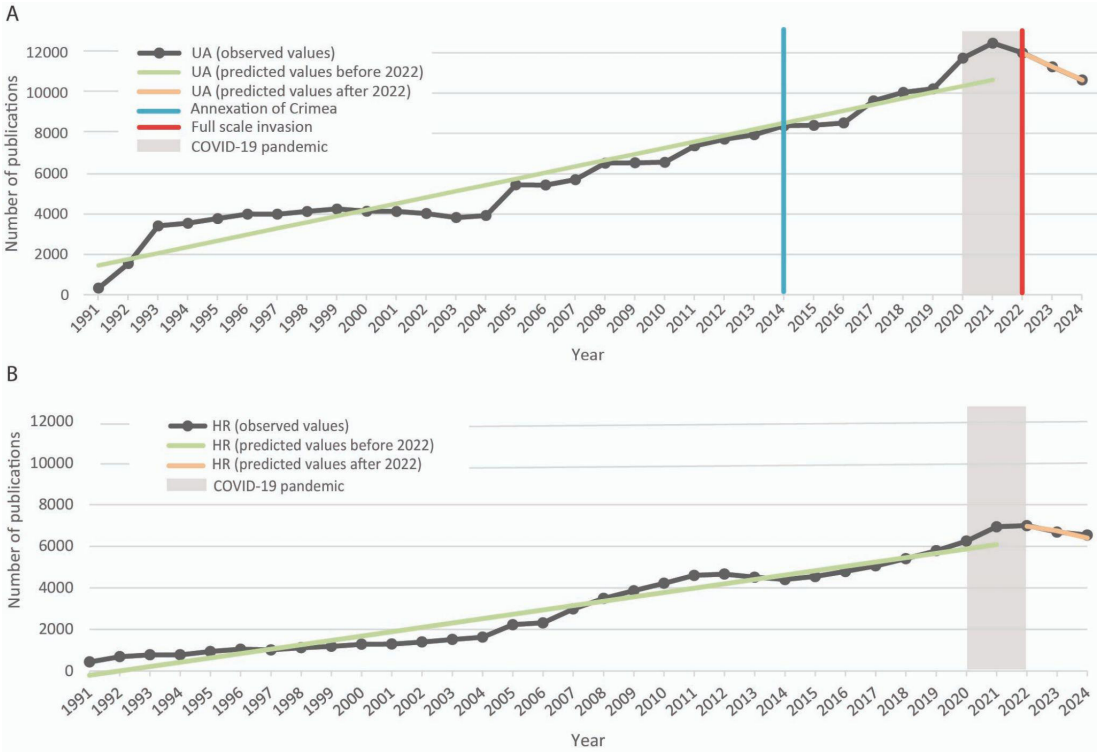

Figure 1. Interrupted time series analysis of scientific publication output in A) Ukraine and B) Croatia (1991–2024), with breakpoints at 2014 (onset of the Donbas war/annexation of Crimea) and 2022 (full-scale invasion).[1]

Table 1. Segmented Interrupted Time Series (ITS) Regression Estimates for Annual WoS-Indexed Article Counts (1991–2024), with Breakpoints at 2014 and 2022

Country	Term	β	SE	CI 2.5%	CI 97.5%	P value	R^2
Ukraine	Baseline slope (pre-2014)	253.5	20.8	210.8	295.9	0	0.963
	Level change 2014	54.9	513.2	-996.2	1106	0.916	0.963
	Slope change 2014	351.7	104.1	138.5	565	0.002	0.963
	Level change 2022	-661.2	793.5	-2286.5	964.2	0.412	0.963
	Slope change 2022	-1276.1	478.5	-2256.2	-296	0.013	0.963
Croatia	Baseline slope (pre-2014)	197.8	14.1	168.9	226.7	0	0.964
	Level change 2014	-299.4	348.7	-1013.7	414.8	0.398	0.964
	Slope change 2014	154.7	70.7	9.8	299.7	0.037	0.964
	Level change 2022	-15.6	539.2	-1120	1088.9	0.977	0.964
	Slope change 2022	-578.6	325.1	-1244.6	87.5	0.086	0.964

Legend: Coefficients are from ordinary least squares segmented regression. Baseline slope is the estimated annual change in articles before 2014. Level changes represent immediate shifts in 2014 and 2022, and slope changes represent changes in annual trends after these breakpoints. β, coefficient estimate; SE, standard error; CI, 95% confidence interval; P, significance test for β = 0; R^2, model fit; N, number of annual observations was 34.

[1] The analysis starts in 1991, the year of Ukraine's independence. Pre-1991 articles from institutions in present-day Ukraine were indexed under the Soviet Union and cannot be reliably disaggregated by national affiliation. Low counts in the early 1990s therefore reflect the post-independence transition and the analytical boundary, rather than an absence of scientific activity.

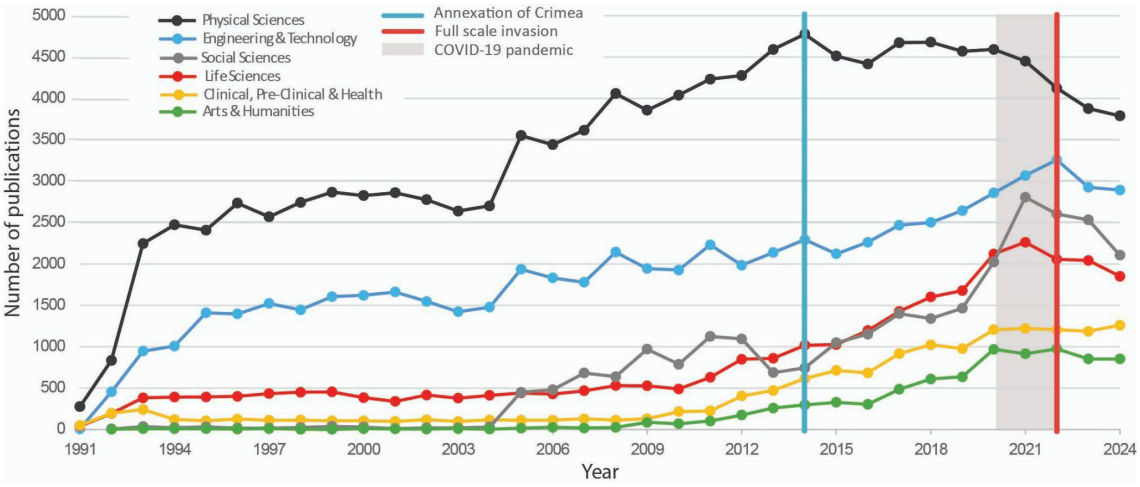

Figure 2. Annual trend in the number of scientific publications by Ukrainian researchers indexed in the Web of Science Core Collection (1991-2024) by scientific discipline.

modeled as a separate intervention because its effects overlap with war-related disruptions and are better treated as a shared background influence captured through the Croatia comparator. ITS analysis incorporating breakpoints in 2014 and 2022 (with 2014 capturing the Donbas phase and 2022 the full-scale invasion) indicated that disciplinary trajectories shifted after 2014 primarily through changes in growth rates (slope) rather than abrupt level drops, with Physical Sciences showing the clearest early flattening. The model also showed estimated post-2022 level changes in several fields, most notably Physical Sciences (–1,232 articles, P=0.014) and Social Sciences (–977, P=0.005), whereas Arts & Humanities showed an estimated increase (+408, P=0.018). Clinical, Pre-Clinical & Health remained close to pre-2022 levels in the post-invasion period. These model-based effects were larger than those visible in raw counts, underscoring the scale of disruption.

Publication Trajectories of Highly Ranked Ukrainian Universities

The publication output of highly ranked Ukrainian universities in the Shanghai (Figure 3A) and THE lists (Figure 3B) was low and fairly stable in 1991, with no institution exceeding about 150 articles (Figure 3). Most universities published fewer than 200 articles annually, and changes during the 1990s were gradual. From 2004 onward, output increased steadily across most institutions, although growth varied markedly. For instance, Ivan Franko National University of Lviv, the top Shanghai-ranked institution, reached around 450 articles (Figure 3A), less than half the output of Taras Shevchenko National University of Kyiv (Figure 3B), which recorded peaks above 1,000 articles. Growth remained modest before 2008, but from 2009 publication output rose consistently until 2022. The full-scale invasion then sharply disrupted this upward trend at nearly all universities, except Bogomolets National Medical University.

Scientific Output in Occupied Territories

The analysis of scientific production in occupied territories focused on Luhansk, Donetsk, Simferopol, and Sevastopol (Figure 4; Supplementary Tables S1 and S2). Because Donetsk and Luhansk were affected by occupation and armed conflict from 2014 onward, city-level changes were interpreted relative to the 2014 breakpoint and, where relevant, the additional 2022 breakpoint used in the same ITS framework as the national analyses. In Luhansk (Figure 4A), Ukrainian-affiliated output showed a significant level drop in 2014 (–12.7, P=0.044), followed by a slope increase after 2014 (+ 5.17/year, P<0.001), but a marked negative slope change after 2022 (–17.95/year, P=0.003). Russia-indexed

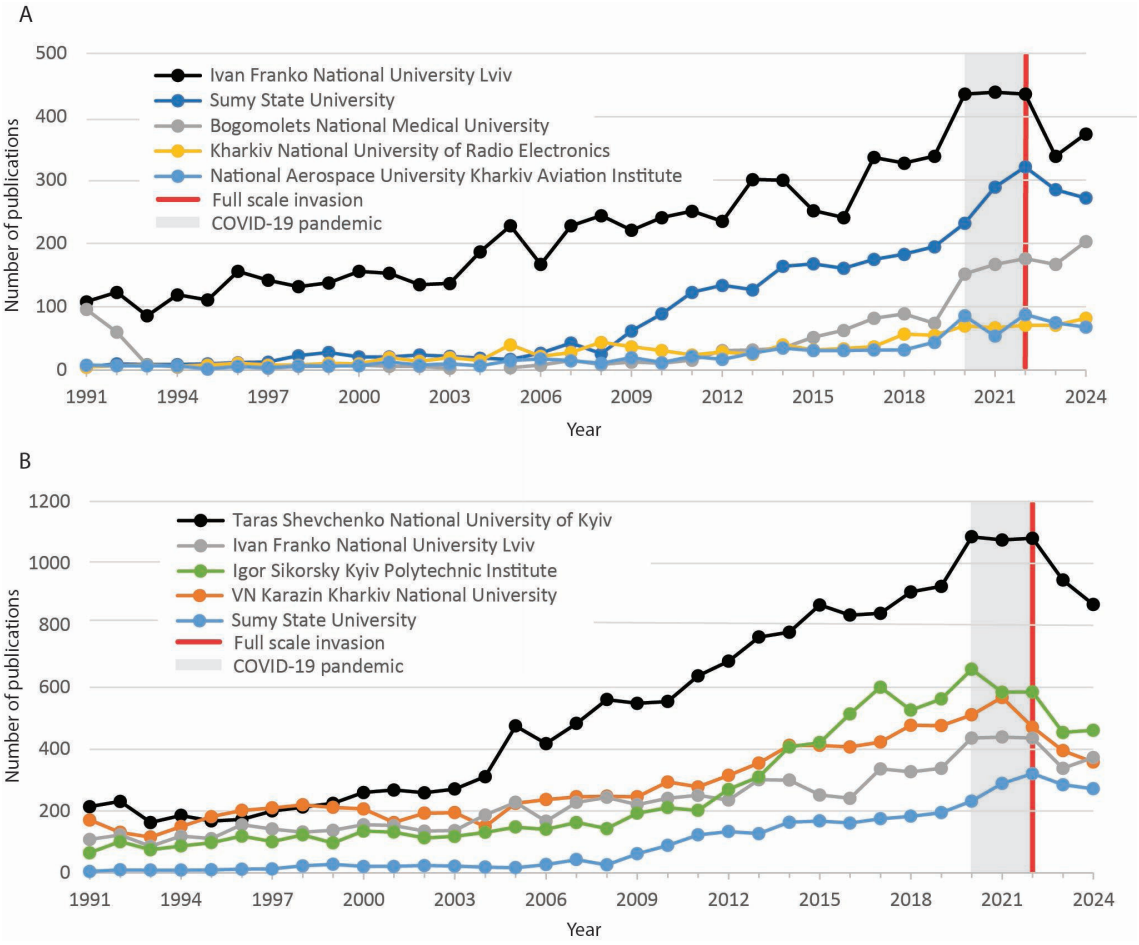

Figure 3. The annual number of publications from highly ranked Ukrainian institutions according to the (A) Shanghai and (B) Times Higher Education ranking lists.

output remained low, with only minor changes over time (Supplementary Tables S1 and S2). In Donetsk (Figure 4B), Ukrainian-affiliated output declined immediately in 2014 (–68.3, P=0.046), while Russia-indexed articles increased sharply after 2014, with both a positive level change (+17.1, P<0.001) and slope increase (+3.10/year, P<0.001). After 2022, Donetsk's Russia-indexed output showed a significant level decrease (–15.6, P=0.009), and the Ukrainian-affiliated series showed a further negative slope change (–64.81/year, P=0.043) (Supplementary Tables S1 and S2).

By contrast, Simferopol (Figure 4C) and Sevastopol (Figure 4D), the main scientific centers of Crimea, followed a different trajectory. After the 2014 annexation, Russia-indexed output rose sharply in both cities, with strong positive post-2014 slope changes (Simferopol: +32.62/year, P<0.001; Sevastopol: +32.92/year, P<0.001), indicating rapid bibliometric substitution. After 2022, these series were clearly disrupted: Simferopol showed a large negative level change (–103.1, P<0.001) and negative slope change (–41.14/year, P=0.006), while Sevastopol showed a significant negative slope change (–47.21/year, P<0.001) (Supplementary Tables S1 and S2). These patterns suggest a clear divergence between Donbas and Crimea: Donbas shows declining Ukrainian-affiliated output with only limited Russia-indexed growth, whereas Crimea shows near-complete bibliometric substitution after 2014, with Russia-indexed output replacing, and at times exceeding, pre-2014 Ukrainian levels.

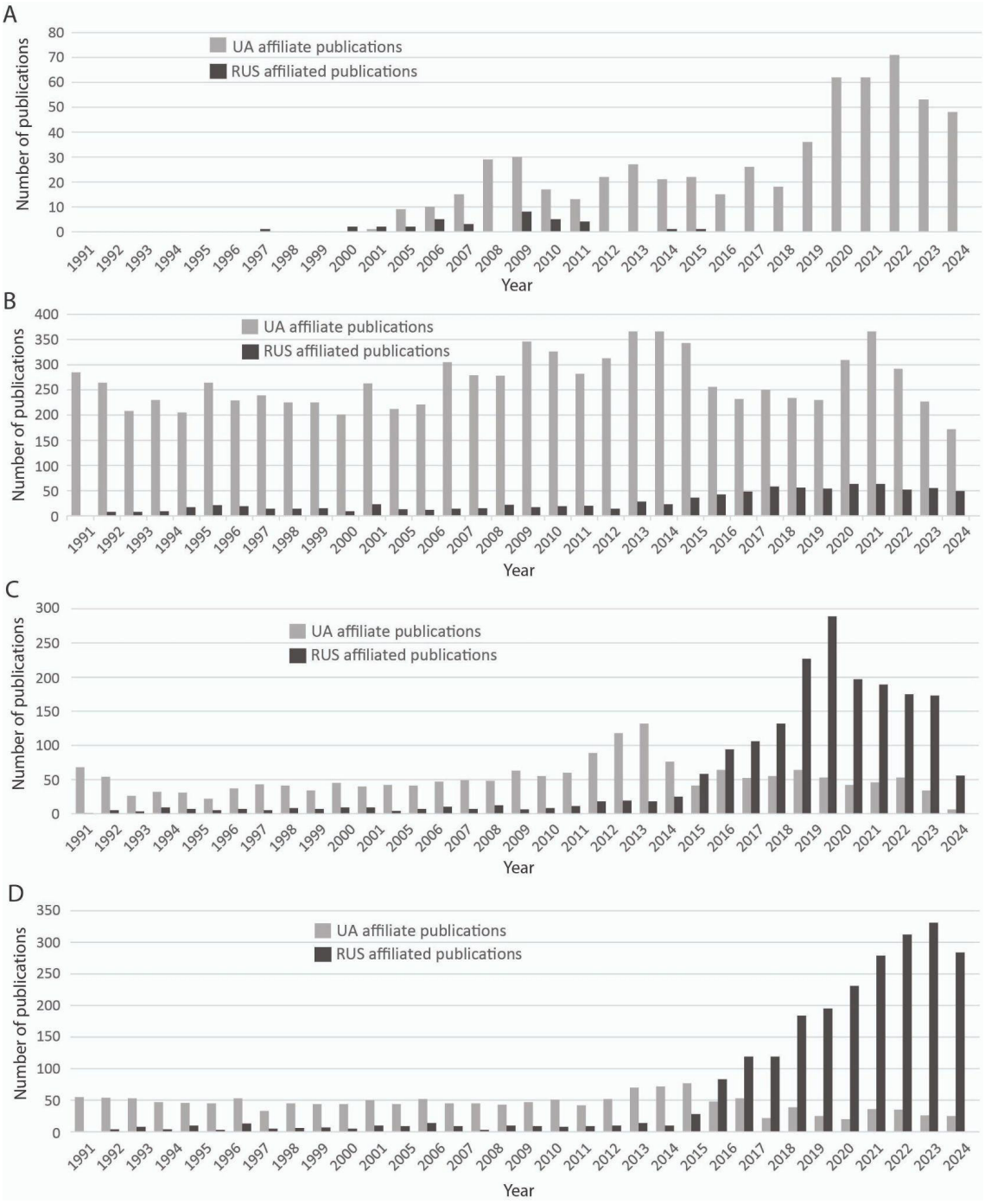

Figure 4. Annual number of publications affiliated with Ukrainian (UA) and Russian (RUS) institutions in cities of occupied territories (1991–2024): (A) Luhansk, (B) Donetsk, (C) Simferopol, (D) Sevastopol.

International Collaboration Patterns

From 1991 to 1994, international co-authored articles by Ukrainian researchers were rare, with fewer than 100 per year (Figure 5). Collaboration with Russia rose rapidly in the early 1990s and remained the largest until 2001, after which Germany and the USA became leading partners. From 2004

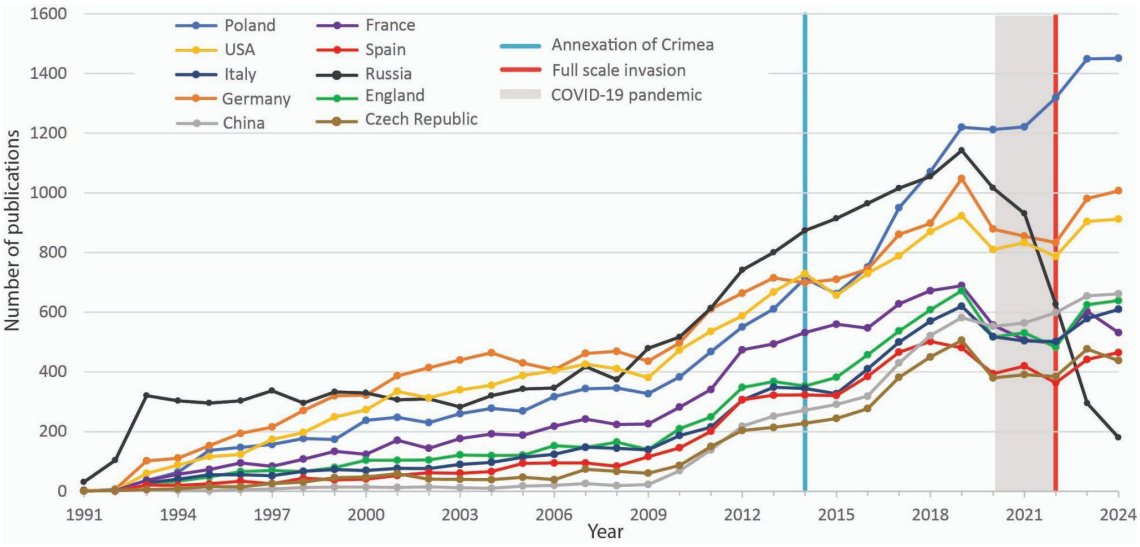

Figure 5. Trends in international research collaborations of Ukrainian scientists with key partner countries (1991–2024).[2]

onward, collaborations with most countries grew steadily. After 2014, collaboration with France, England, and China accelerated, while during COVID-19 (2020–2021), most partnerships stagnated or declined slightly, except in Poland. After 2022, collaboration with Russia fell by an average of 31% compared with the pre-2022 period, dropping from about 900 articles in 2021 to fewer than 200 in 2024. In contrast, Poland became Ukraine's largest partner, increasing by over 220% and exceeding 1,450 joint articles in 2024. Germany (+91%) and the USA (+103%) also expanded cooperation, stabilizing at about 900 to 1,000 articles per year. Other collaborations also increased, including France (+92%), Italy (+168%), England (+153%), Spain (+142%), China (+346%), and the Czech Republic (+211%).

Discussion

Our findings indicate that Russia's aggression produced phase-specific disruptions in Ukraine's research trajectory. Between 1991 and 2021, publication output increased steadily, with accelerated growth after 2014, but this trajectory changed after 2022, when output shifted into sustained decline. Although global factors such as COVID-19, indexing delays, and natural fluctuations may contribute, the timing and magnitude of the downturn are less consistent with a purely global disruption. Because Croatia experienced similar pandemic-era pressures but no war during the period corresponding to Ukraine's wartime years, this comparison suggests that war was the most probable driver. In the segmented interrupted time series analysis, Ukraine showed a significant post-2022 slope reversal, whereas Croatia exhibited only a smaller, non-significant post-2022 slowdown, consistent with war-related displacement, university relocations, infrastructure destruction, and interruption of academic work (2, 5). The ITS estimates also point to a pronounced downturn. Although statistical significance was not reached, likely due to the short post-2022 window, the direction and magnitude align with external evidence on researcher and institutional disruption (5).

The disciplinary analysis highlights both vulnerability and resilience. Fields heavily dependent on laboratories, specialized equipment, and international partnerships, such as the Physical Sciences and Life Sciences, experienced the steepest losses. By contrast, Arts & Humanities and

[2] The analysis starts in 1991, the year of Ukraine's independence. Earlier publications were indexed under the Soviet Union, limiting reliable identification of national collaboration patterns.

Clinical, Pre-Clinical & Health appeared more adaptable, possibly because some publications addressed urgent wartime health, social, and humanitarian needs.

Institutional dynamics also show uneven resilience. In the years following independence, most universities had limited research capacity because of economic hardship and systemic restructuring, with growth emerging only after 2008 during a period of relative stability and gradual modernization. The full-scale invasion reversed these gains across the system, including in Kyiv and Lviv, showing that the impact was nationwide rather than confined to frontline areas. Even leading universities such as Ivan Franko National University of Lviv and Taras Shevchenko National University of Kyiv experienced decline, although they maintained relatively high productivity. Differences between the THE and Shanghai rankings likely reflect their different weighting of publication output (18). An exception was Bogomolets National Medical University, which maintained activity, possibly aided by targeted mentoring and publication support through the Giving Voice initiative (10).

Patterns were especially stark in conflict-affected territories. City-level ITS estimates further support the two-phase pattern. Donetsk and Luhansk show clear changes beginning in 2014, while Crimea displays rapid post-2014 substitution toward Russian-indexed output, with additional disruption after 2022 (Supplementary Tables S1 and S2). In Luhansk and Donetsk, Ukrainian-affiliated publications declined sharply after 2014 and further dropped after 2022, although relocated institutions such as Donetsk National University (Vinnytsia) and Donetsk National Technical University (Pokrovsk) preserved some capacity. By contrast, Crimea displayed bibliometric substitution, as Ukrainian-affiliated output collapsed within two years of annexation while Russian-affiliated publications surged, supported by domestic funding, integration into the Russian Science Citation Index, and targeted re-equipment programs outlined in official Russian policy documents from 2014 onward (19). This divergence underscores two models of disruption: gradual attrition in Donbas versus rapid replacement in Crimea.

The war also reshaped international collaborations. Russia, once Ukraine's leading partner, had largely disappeared from co-authorship networks after 2022, falling below 200 joint papers by 2024. At the same time, partnerships with Poland expanded sharply, surpassing 1,400 publications, while collaborations with Germany, the USA, and other European countries rebounded quickly after an initial wartime dip. Even China strengthened its position. These shifts reflect both the collapse of traditional ties and stronger international support, helping prevent Ukraine's academic isolation (20).

Limitations of the Study

Several limitations should be noted. Bibliometric data are subject to publication lag, which may underestimate recent activity, particularly in 2022 and 2023. In addition, the post-2022 period currently includes only three complete publication years, from 2022 to 2024, which limits longer-term projections and the ability to detect more gradual effects. Reliance on Web of Science also underrepresents locally published work, especially in the humanities and social sciences. This study uses address-based bibliometric data and therefore captures institution- and territory-based output rather than the total productivity of Ukrainian researchers regardless of location. Publications by displaced scholars who re-affiliated abroad are not counted as Ukrainian output, so the observed declines reflect disruptions to nationally affiliated research capacity and may underestimate overall researcher activity. Institutional analysis was also confined to top-ranked universities, which may not capture trends among smaller or regionally focused institutions. Finally, the comparison between Ukraine and Croatia should be interpreted with caution because the two countries differ in the size of their scientific communities and in absolute publication volume. However, our analysis focused on temporal trends and changes in direction over time rather than absolute output levels,

which makes the comparison informative despite these structural differences.

Conclusion

In conclusion, this study demonstrates that the 2022 invasion disrupted decades of scientific progress in Ukraine, with the sharpest losses in infrastructure-dependent fields and occupied regions. Sustained international collaboration, flexible funding, and targeted support for displaced institutions will be critical to preserving Ukraine's scientific capacity and ensuring its reintegration into the global academic system during and after the war.

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Conflict of Interest: The authors declare that they have no conflict of interest.

Data availability: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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