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*Society for Research
into Higher Education*

UK's International Research Collaborations in the Post-Brexit Era

Research report

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Disclaimer: The views expressed in this report are the authors' and do not necessarily reflect those of the Society for Research into Higher Education

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I extend my special thanks to Professor Marek Kwiek, who was appointed by SRHE as a critical friend. I am grateful for his comments and advice.

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The emerging findings of this study were presented at the SRHE conference in December 2023. I am grateful to the conference organisers and audience for their helpful feedback.

Executive Summary

This project examined the UK's international research collaborations (IRC) in the post-Brexit era by investigating the available bibliometrics data from 2010-2022, corresponding to the six years before and after the Brexit vote. While the UK research system has accumulated significant talent and capacity that gained a global reputation over the last decades, the uncertainties brought by Brexit and the loss of brokering power through decreased network centrality have the potential to diminish UK research.

The project findings demonstrate four broad patterns for the UK's IRC in the post-Brexit era. First, the share of collaborations with EU researchers and their first authorships in the UK's global collaborations is decreasing. The pattern changes seem to align strongly with the Brexit milestones, i.e. voting and implementation years. This finding is also an indication that EU researchers, along with UK researchers, experience the negative consequences of Brexit as well. A decreased collaboration with the EU research system is not good news for the UK since EU countries have relatively mature research systems and have been central in the UK's IRC networks.

Secondly, first authorship data is usually associated with initiative and leadership in research collaborations. The findings demonstrate that UK researchers' first authorship in international collaborations is decreasing. The decrease is sharper among the funding-reporting publications. This trend has started even before the Brexit uncertainties. The UK has been losing its leadership in IRCs since 2010, the study's earliest observation point.

Thirdly, funded research collaborations with China-based researchers are visibly increasing *with funding from China's side*. China-based researchers are increasingly in leading first-author positions in these publications. This pattern demonstrates the opposite of what is happening in the IRC with the EU, as we observe increased funding coming from China, and China-based researchers increasingly lead collaborative papers by being first authors. These indicate how tables are turning: a country traditionally positioned as Global North (UK) increasingly receives research funding from a country traditionally positioned as Global South (China).

Lastly, non-funded IRC is increasing with certain other regions, specifically Western Asia, North Africa and Southern Asia. While increasing collaborations with other parts of the world can be seen as a good development, this should not be considered a zero-sum game with the EU collaborations. There is no need to enter a downward course with the EU research system to increase collaborations with others.

Uncertainties continue. The UK has very recently rejoined the Horizon Europe programme, the EU's largest research funding scheme, in January 2024. This may lead to positive developments in the UK's collaborations with the EU, but it is too early to draw conclusions.

Main report

Introduction

Global challenges require collaboration to seek answers. Advancement in cutting-edge research and science occurs through authoritative collective judgement and international research collaborations.

The United Kingdom is one of the leading research-producing countries globally (Marginson, 2020). However, the UK's productive research system has not been an individual endeavour in the increasingly interconnected global research (Wagner, 2018): it used to be strongly embedded into the European scientific infrastructure. Being embedded in a union of science systems that are highly collaborative with each other has been an important factor in this success and productivity (Kwiek, 2021).

Nevertheless, the UK decided to leave the European Union (EU) in 2016 with a nationwide referendum, which was called the Brexit referendum. With this referendum, the UK research enterprise effectively stopped being part of the EU research system. Brexit left all existing deals and funding arrangements, such as the massive Horizon funding scheme, in jeopardy (Highman et al., 2023b). The very recent developments of UK rejoining the upcoming Horizon Europe Programme (January 2024, the submission month of this report) is relatively good news (*UK Joins Horizon Europe under a New Bespoke Deal*, 2023), but the ongoing uncertainties may have already affected the large collaboration patterns of the UK, with the EU and other research systems globally.

Against this backdrop, it is worth investigating the UK's scientific connectedness with other regions and countries globally. This SRHE-funded project started as the analysis of the UK's research connectivity with the EU and the Middle Eastern and North African (MENA) regions (UK's closest neighbouring region beyond Europe). However, as the project progressed, it became clearer that a global analysis of all regions of the world would bring deeper insights. Therefore, the purpose of the project is to investigate the changing patterns in the UK's global research collaborations with regions of the world in the post-Brexit era.

UK's International Research Collaborations and Brexit

UK research has been punching above its weight. The UK is the sixth largest spender on research globally, but its research has the third highest impact after the US and China. According to Scopus data, research papers produced between 2019-2021 had 3.9% of all authors from UK, but 10.4% of all citations were to papers authored by UK-based researchers (Highman et al., 2023a). Universities UK (2022) reports that 9.3% of papers published in UK were ranked in the top 5% of their respective fields based on citations.

Much of this success is also related to the highly connected research system of the UK. UK had a high network centrality in global research connectivity, which may change after Brexit (Highman et al., 2023a). More than half of all UK publications included an author from another country. UK researchers collaborated intensely with the EU and the Anglophone countries (National Science Board, 2021). Despite the chronic underfunding of UK higher education sector, the research system of the UK has been a success story.

However, this success story is now in jeopardy, which is well put by Highman, Marginson and Papatsiba (2023a):

“All of these outcomes derive from a complex policy context and everchanging patterns of internal capacity, opportunity and incentive, in which the UK's links with higher education and science in Europe have been formative and until 2016 were increasingly central. The trajectory of UK higher education and research was and is highly vulnerable to Brexit, with negative effects that were widely predicted in 2016 and are now becoming apparent.” (p. 3)

The Brexit may specifically impact the UK's research system through research funding and international research collaboration. Specifically, the EU's Horizon programme is the largest international research funding scheme globally. Prior to Brexit, UK had been the leading recipient nation for the highly sought-after ERC grants of the Horizon Programme, which is not the case anymore (European Research Council, 2024). There were also other funding sources which has been important to UK's research sector, including the European Regional Development Fund and the European Social Fund.

While the UK has a significant accumulation of research expertise and talent, its modern-day research has been highly connected to the EU research. According to the European Commission report published in 2017, UK had achieved the highest level of centrality among the collaboration networks in EU before Brexit. Such gains in centrality among the productive research systems of the EU are also at risk after Brexit.

Methodology

This study used bibliometrics data to address its research purpose. The collected data covers the UK's all internationally collaborated papers globally, in the selected categories as codified in Web of Science (WoS) database. No database is perfect, WoS is no exception. Non-English-speaking papers are less included, and Global South journals may have less representation.

The collected data includes six years before the referendum and six years afterwards. Hence, the analyses of this study included data from 2010 to 2022, the latter being the latest fully available data year. In total, 87,753 papers were analysed in this project.

Bibliometrics data are used to describe large patterns. The affiliation of the authors was coded into regions and subregions. The study followed the United Nations geoscheme sub-regions (M49) to group the countries into subregions (United Nations Statistics Division, 1999). Ordinary least square models were used to predict each region of collaboration by year and funding, controlling for number of authors and journal fixed effects.

To keep the analysis feasible, all available WoS research categories with high IRC numbers were reviewed. Research categories that tend to include an ultra-high number of co-authors per paper, such as 'Astrophysics' and 'Materials Science Multidisciplinary', are not included in the analyses since they may distort the conclusions. Eventually, nine WoS research categories were selected. This was necessary to help the analyses of a large number of papers. The list of research categories is included in the appendix.

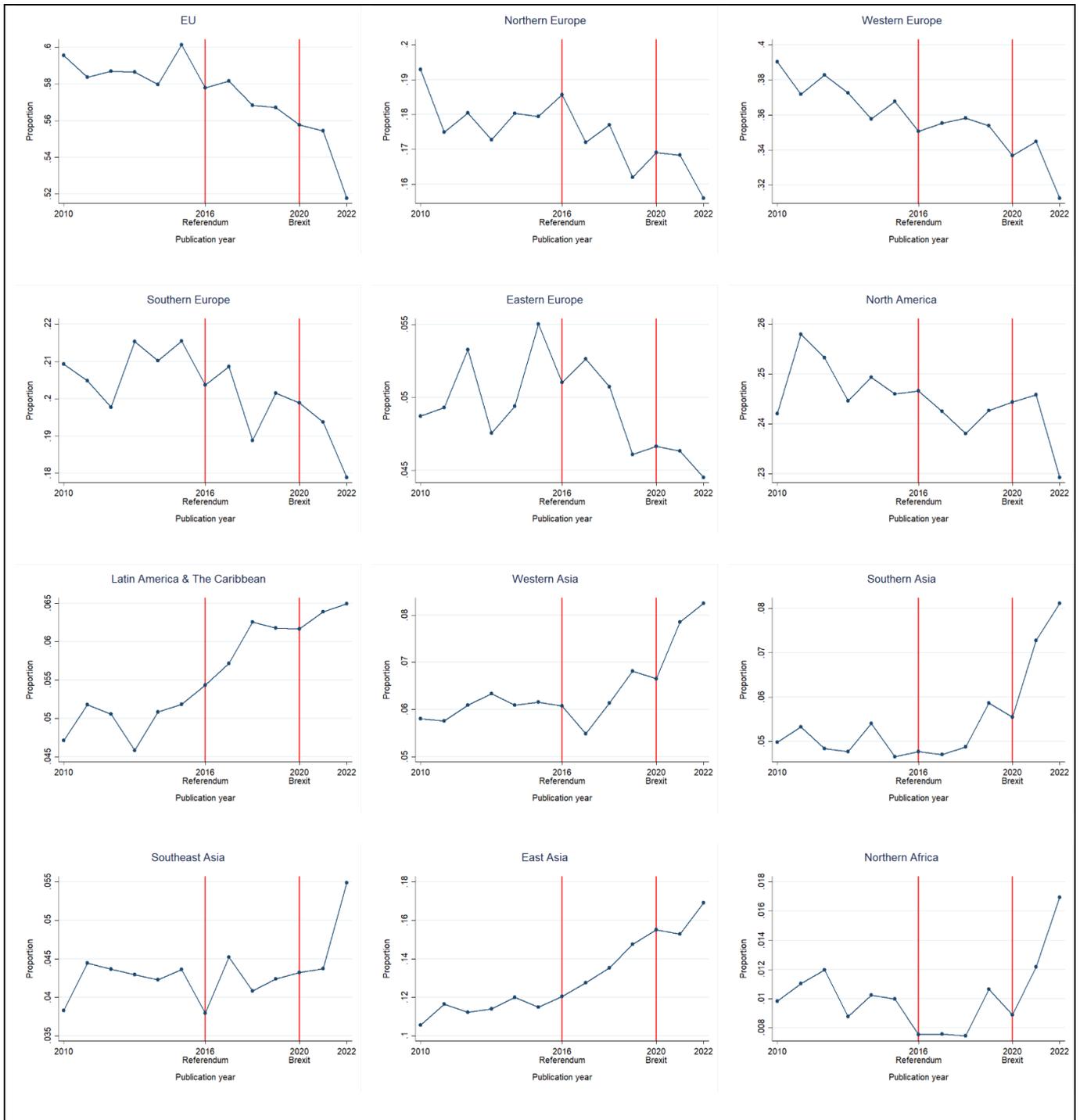
Findings

Describing the UK's research collaborations with global regions

In this section, the UK's research collaboration trends with global regions are analysed. The Brexit referendum and implementation years are highlighted. As Figure 1 highlights, there is a clear trend between the UK's IRC with EU overall and all its subregions. The IRC volume between the UK and EU countries stayed relatively similar before the Brexit referendum, but with the uncertainties starting in 2016, the trend visibly changed, causing a downturn that was further exacerbated after the Brexit implementation year. This downturn trend is reflected in the subregions of the EU. What had been a strong IRC partnership is now on a downward pattern.

There is a downward trend with the IRC with Australia and New Zealand as well, but the change is not as big in proportionate terms.

Interestingly, the UK's IRCs are now on an increasing trend with all Asian regions, including Western Asia, which was the initial area of interest in this project. There is a clear increasing trend in the IRC with Latin America and the Caribbean, Northern Africa and sub-Saharan Africa as well.



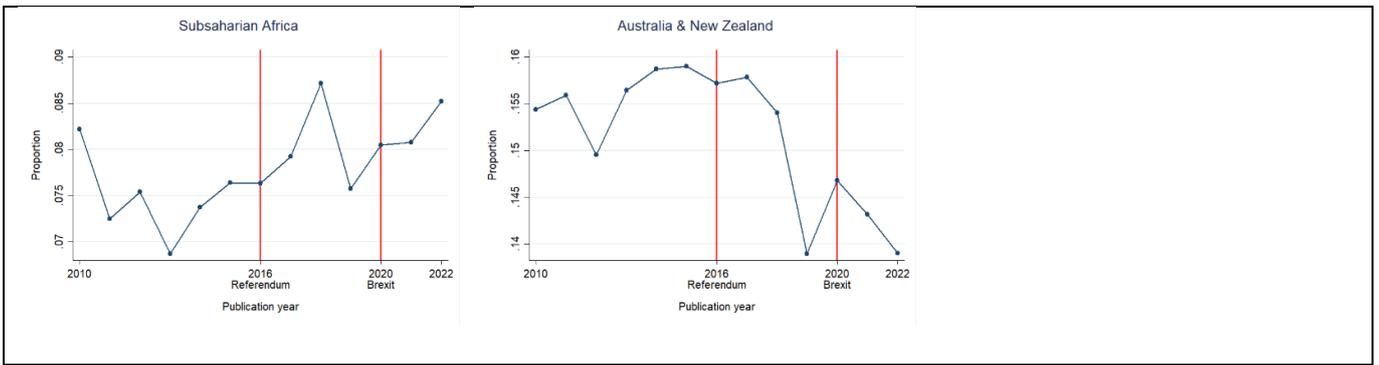
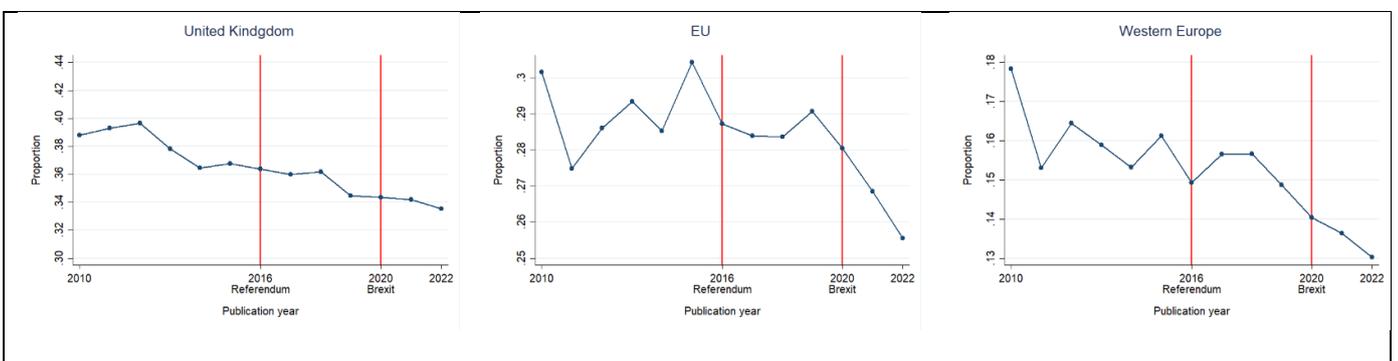


Figure 1. Proportion of collaboration with different regions.

First authorship is an important indicator that may provide insights about initiative and responsibility in a collaborative paper. Also, the co-author who has the funding may tend to have a more leadership position and be the first author (see Lee & Haupt, 2020; Oldac, 2023). Building on this, the visualisation of our analyses provided in Figure 2 indicates that UK-based scholars are decreasingly taking the first authorship roles in their IRC globally.

Among the internationally collaborated papers of the UK-based scholars, the most visible decrease is those first-authored by EU-based scholars. The changes in trends for the IRC between the UK and EU largely align with the milestones of Brexit, but a causal relationship cannot be claimed since IRC is a complex phenomenon and there are other factors. Subregions of the EU also show the same decreasing trend, although one of them -Eastern Europe- shows variation with a small proportionate increase (0.8%). North America-based scholars are also decreasing proportionately in the UK's IRCs.

By contrast, data indicates that first authorship of researchers based in all of Asia, Latin America and the Caribbean, and North Africa have clear increasing patterns. Among these, the increasing IRC pattern with Eastern Asia-based researchers seems to be the highest.



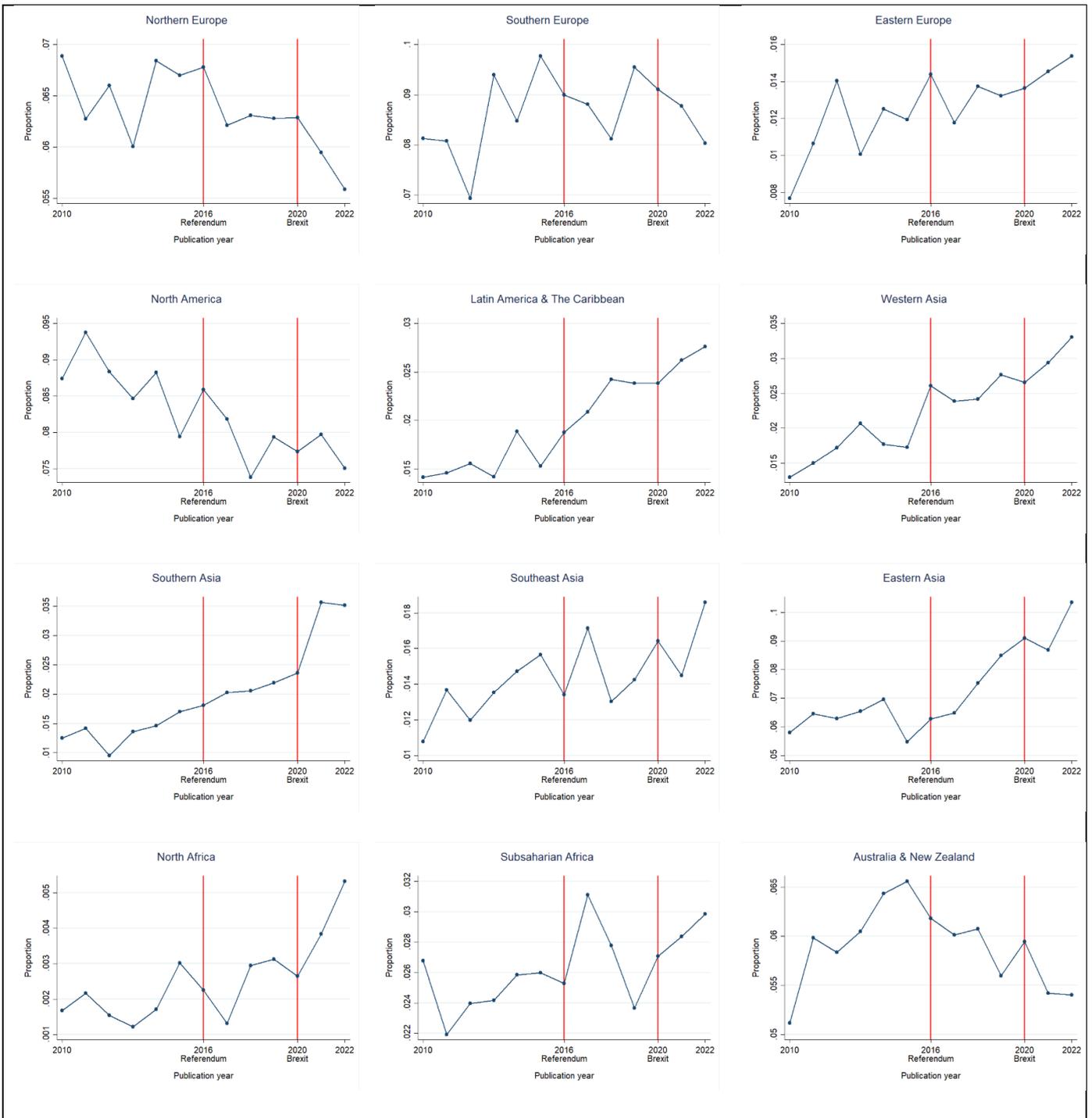
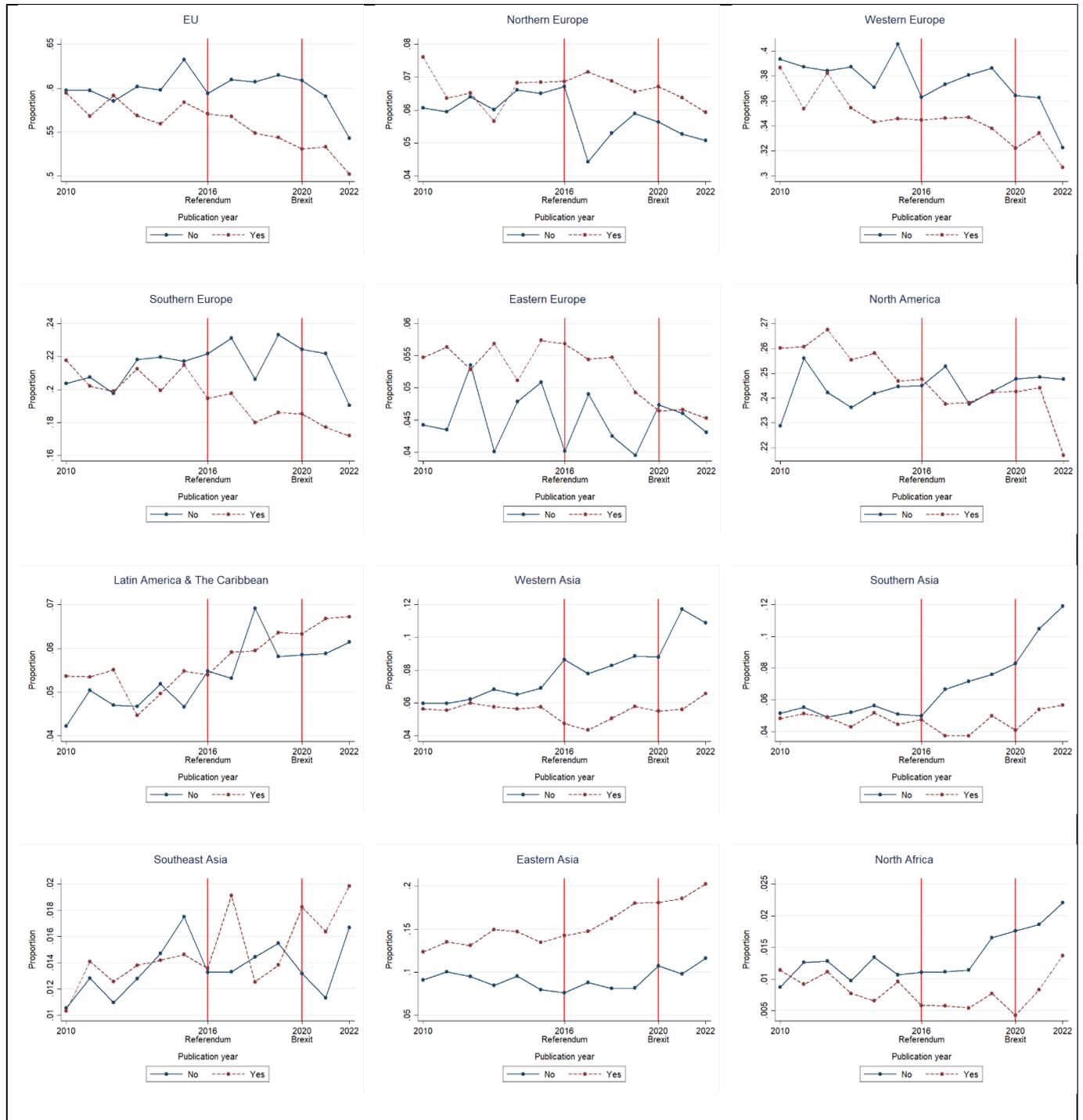


Figure 2. First authorship by region.

Reported funding in UK's research collaborations with global regions

This section provides an analysis of the role of reported funding on the UK's global IRC trends. Funding is an important matter when discussing major trends before and after Brexit. As discussed earlier, UK-based researchers got into great uncertainty about EU funding programmes with Brexit. Therefore, an expectation would be that the UK's funding-reporting collaborative papers with the EU decrease. Indeed, the findings confirm

a significant 10% decrease, as visualised in Figure 3. Interestingly, collaborated publications with no reported funding have also started decreasing after the implementation year, though the former pattern is stronger than the latter.



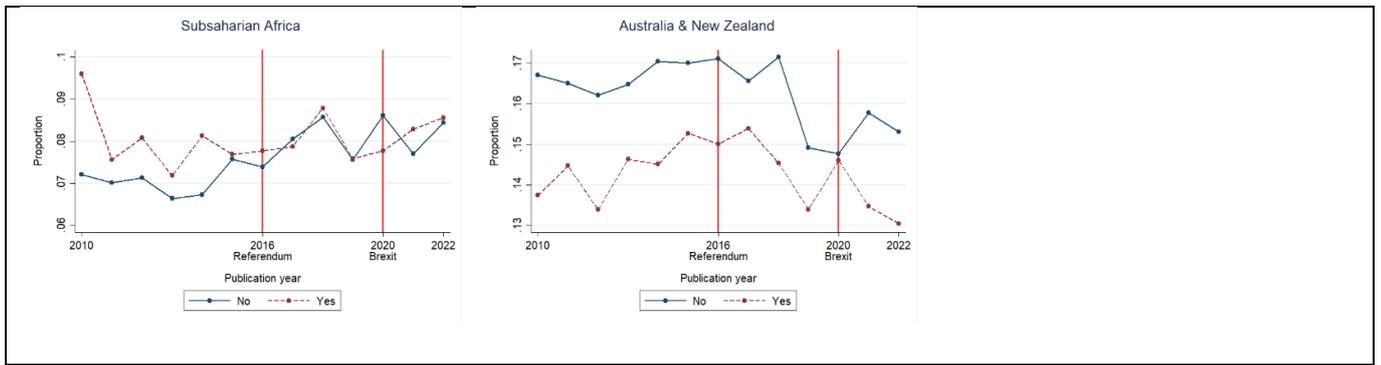


Figure 3. Collaboration by region and reported funding.

By contrast, there is a broad trend of increase in non-funding-reporting collaborative papers with most other world regions, including Western Asia, Southern Asia, North Africa. An interesting pattern here is the UK’s IRC with Eastern Asia, which has seen a visible increase in collaborated publications with reported funding. The latter trend differs from the other parts of the world, and it is the opposite of the pattern observed with EU-UK IRC.

The interesting pattern in the IRC between UK and East Asia could be a result of increased funding coming from the East Asian side, specifically China. To check this speculation, I collected data on the number of collaborative papers with reported funding from China, summarised in Figure 4. There is a close to sixfold increase in the UK’s IRC funded by China-based funders.

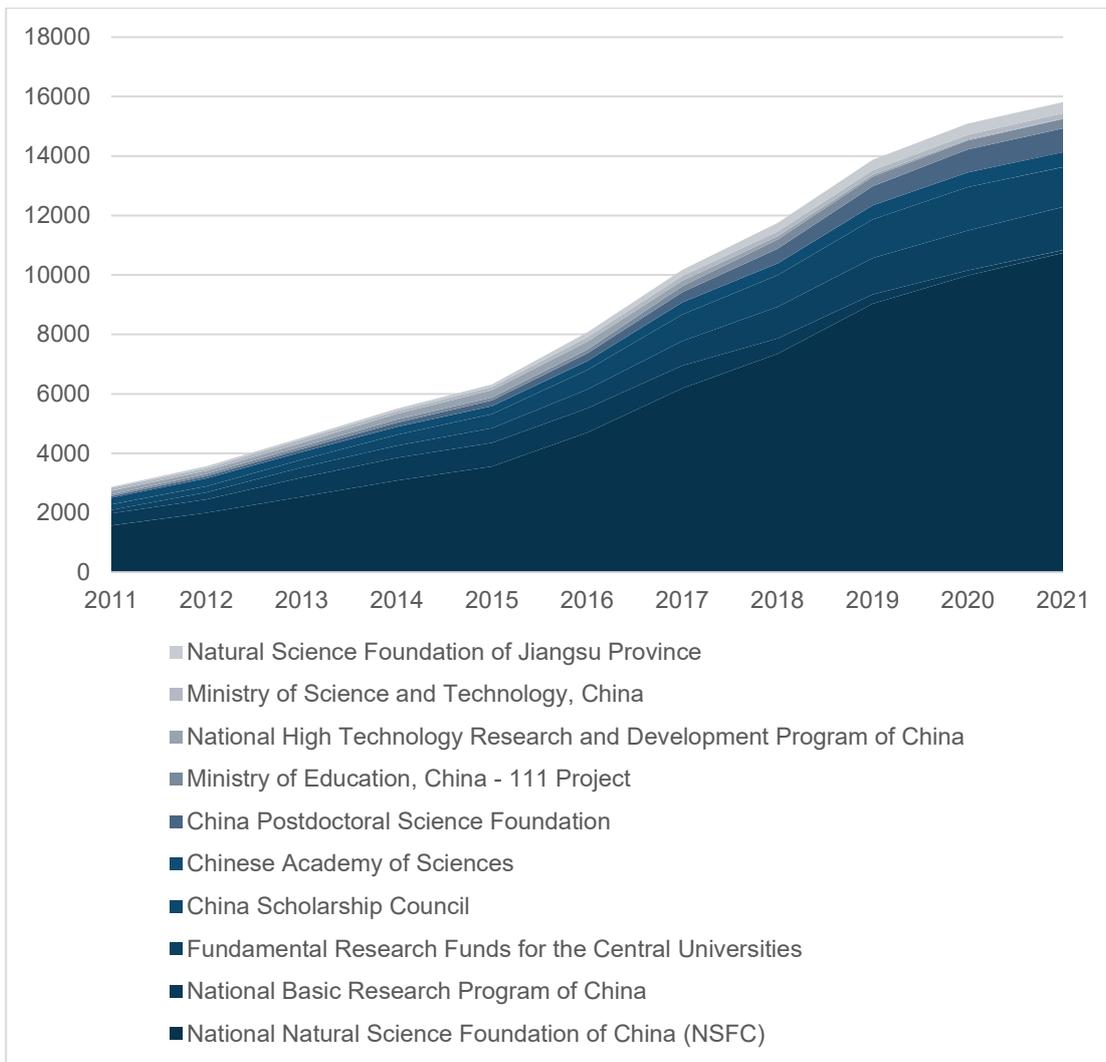


Figure 4. UK IRC funded by China-based funders (Top 10).

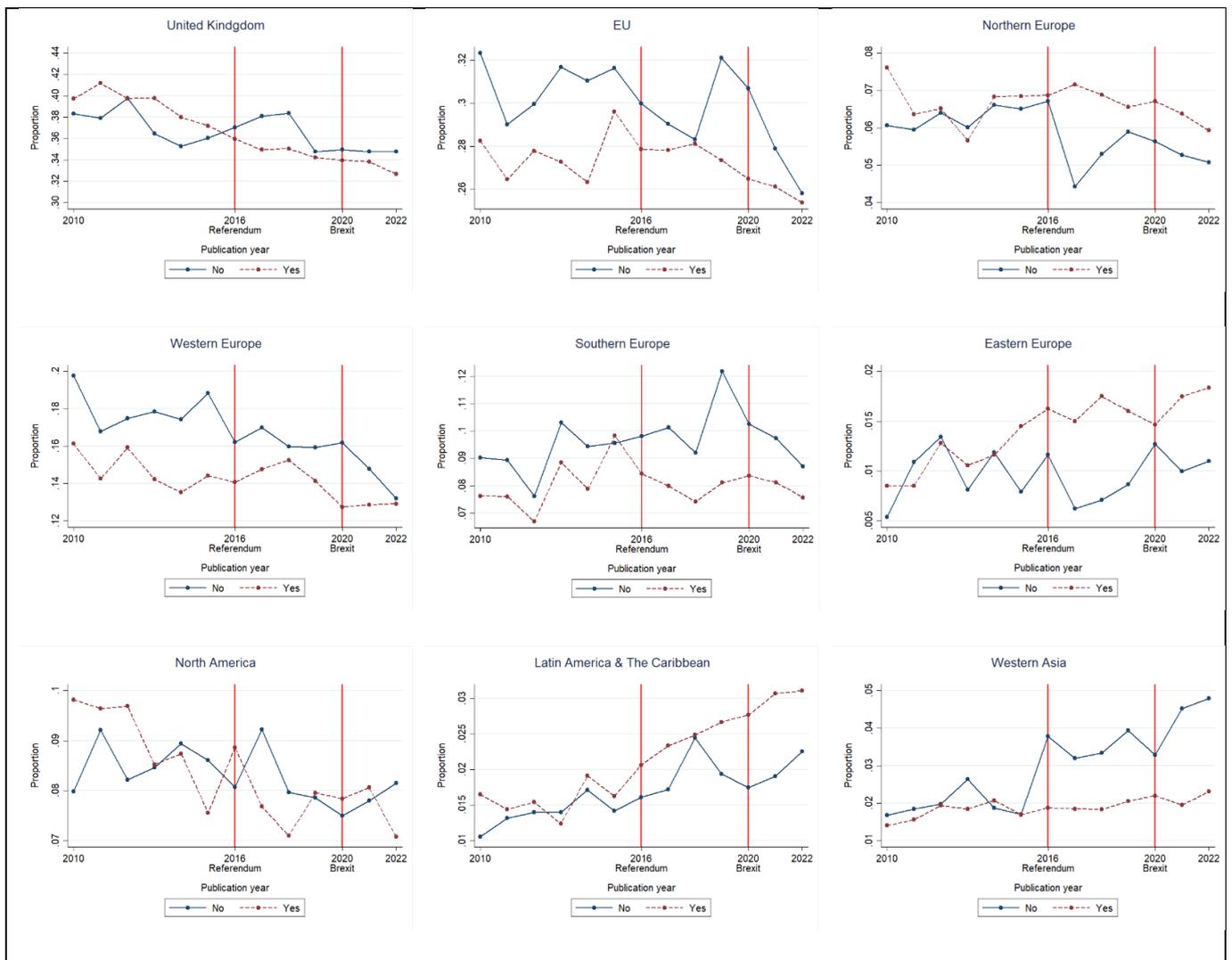
Source: Includes all indices and ESCI, 30+ authorship excluded.

Furthermore, Figure 5 demonstrates whether the UK-based researchers' first authorship changes over time based on reported funding. Findings demonstrate a decreasing pattern on the UK-based researchers' first authorship in their IRCs, especially for papers reporting research funding. This pattern has been visible since 2010, which indicates that the downward trend started before the Brexit uncertainties.

In addition, the IRC between the UK and the EU region have started seeing significant changes after the referendum and before the implementation year. Non-research-reporting collaborative papers peak just before the implementation year, and the pattern visibly decreases starting with the implementation year. Research-funding-reporting collaborative papers start demonstrating a downward trend with the referendum year. There is a strong alignment of Brexit milestone years.

Interestingly, the first authorship patterns between UK-based researchers in their collaborations with Western Asia, North Africa and Southern Asia demonstrates an increased trend for non-funding-reporting papers. Researchers from these regions use their agency to collaborate, even when there is no funding, and lead these collaborative publications as first authors.

Unlike the previous paragraph, IRC with East Asia-based researchers follow a different pattern as they increasingly lead the research-funding-reporting papers. Non-funding-reporting papers stay relatively the same. This pattern follows the previously highlighted argument that the funding is now increasingly coming from the East Asian side, especially China. Figure 6 below summarises the UK's IRC with China specifically.



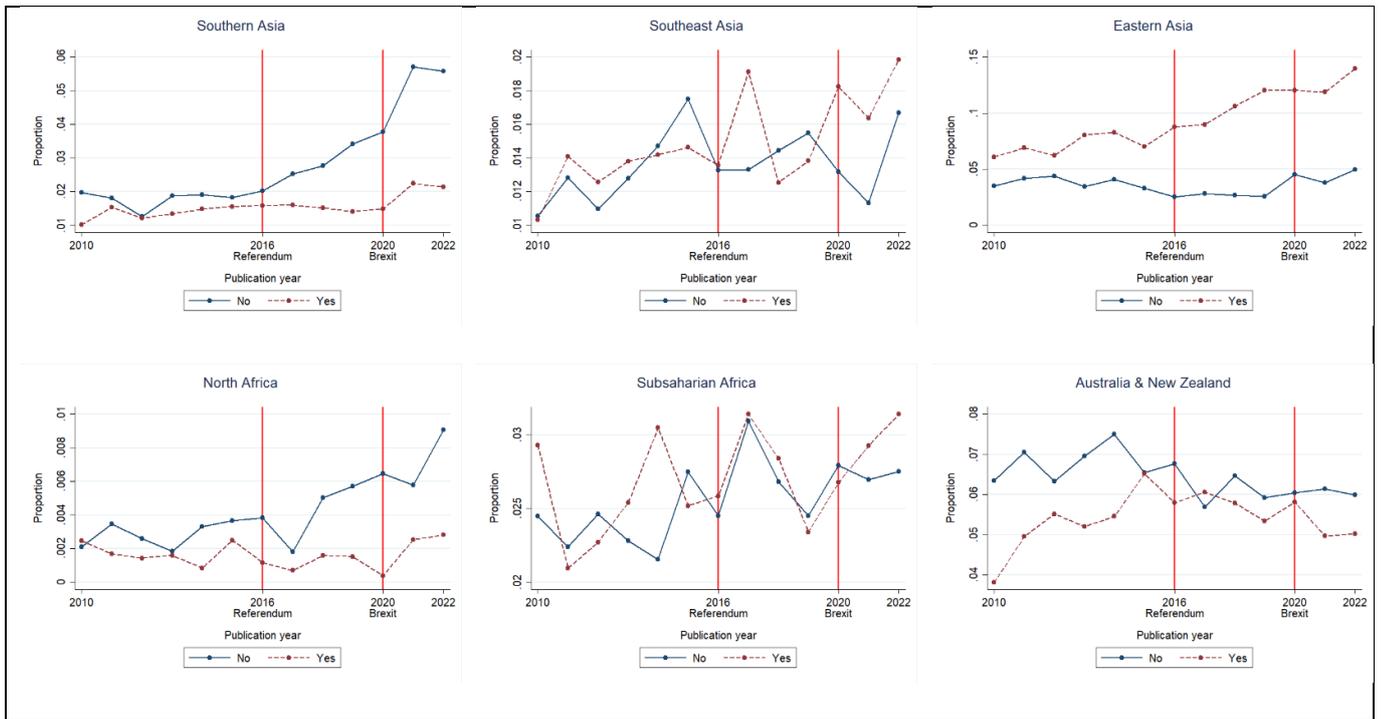


Figure 5. First authorship by region and reported funding.

Note: Predicted values from OLS models with journal fixed effects. Covariates assumed at means.

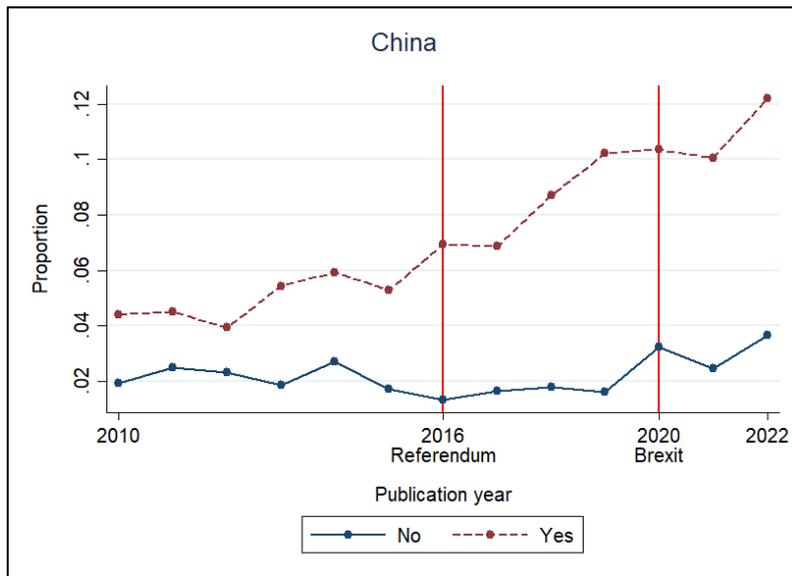


Figure 6. Chinese first authorship by reported funding.

Note: Predicted values from OLS models with journal fixed effects. Covariates assumed at means.

Concluding remarks

This research started as an exploration of IRC patterns of the UK, the EU, and the Middle East and North Africa regions after the uncertainties surrounding Brexit. However, as the research progressed, it has become clear that the changing patterns are more global than the highlighted regions. The findings provided in this report are testimonies to this.

The UK has an established research system that is reputed globally. However, as Highman, Marginson and Papatsiba (2023a) argue, while reputation takes decades to build, the increased uncertainties and loss in the brokering power through decreased network centrality in IRC can lead to a diminishing of the UK research system.

Four patterns are specifically highlighted in the concluding remarks section. First, UK's first authorship in international collaborations is decreasing. The decrease is sharper among the funding-reporting publications. First authorship is usually associated with initiative and leadership in research collaborations (Lee & Haupt, 2020; Oldac, 2023). This trend has started even before the Brexit uncertainties. The UK has been losing its leadership in IRCs in proportionate terms since 2010, the study's earliest observation.

Further, the share of EU-based researchers' first authorships and overall collaborations in the UK's global collaborations is decreasing. Here, there seems to be a strong alignment with the Brexit milestones in the pattern changes, which are turning downwards. However, no causation can be claimed, as there could be other factors. This shows that the EU research may also be left with the negative consequences of Brexit, along with the UK's research system. A decreased collaboration with the EU research system is not good news for the UK since EU countries have relatively mature research systems and have been central in the UK's IRC networks (Kwiek, 2021)

Moreover, funded research collaborations with China-based researchers are visibly increasing, *with funding from China's side*. China-based researchers are increasingly in leading first-author positions in these publications. A whole different but important pattern. This is a strong indication of how tables are turning: now a country traditionally positioned as Global North (UK) is increasingly receiving funding from a country traditionally positioned as Global South/East (China).

Lastly, non-funded IRC is on the increase with certain other regions, specifically Western Asia, North Africa and Southern Asia. While increasing collaborations with other parts of the world can be seen a good development, this should not be positioned as a zero-sum game with the EU collaborations. There is no need to take a downward course with the EU-based researchers to increase collaborations with others.

To conclude with a positive note, the UK has very recently rejoined the Horizon Europe programme, the EU's largest research funding scheme, in the month of the submission of

this report (*UK Joins Horizon Europe under a New Bespoke Deal*, 2023). This may lead to positive developments in the UK's collaborations with the EU. However, it is too early to draw conclusions.

Project Outcomes:

Journal article:

Oldac, Y.I. & Olivos, F. (analyses completed, close to submission) UK is losing, EU is losing, China is winning: UK's International Research Collaborations in the Post-Brexit era.

Conference presentation:

Oldac, Y.I. (2023, December). *International Research Collaborations in the Post-Brexit era: Implications for the scientific connectivity between the UK, EU and MENA countries*. Paper presented at Society for Research into Higher Education (SRHE) International Conference on Research into Higher Education, Birmingham, UK.

A webinar will be proposed to a highly regarded international research platform.

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Appendices

List of Web of Science research categories included in the analyses: Environmental Studies, Environmental Sciences, Business, Psychology experimental, Management, Public environmental occupational health, Psychiatry, Economics, Neurosciences