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A Study of the Relation between Byline Positions of Affiliated/Non-Affiliated Authors and the Scientific Impact of European Universities in Times Higher Education World University Rankings

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Abstract: Universities have undergone a profound transformation to increase their competitiveness and research performance; evaluating their research output and scientific impact is therefore of great importance. This article aims to suggest an approach to analyze how the JIF quartile share of research articles differs among European universities in medical science, and how the byline positions of affiliated and non-affiliated authors can influence an article's scientific impact. We examined the research output of universities in the Top 5 European and Visegrad Group Countries based on the Times Higher Education (THE) World University Ranking 2022 (University of Oxford, ETH Zurich, Karolinska Institute, Charité—Universitätsmedizin Berlin, KU Leuven, Semmelweis University, Jagiellonian University, Charles University Prague, and Comenius University Bratislava). We found that the share of Q1 and the less prestigious Q3 and Q4 papers are inversely proportional when plotted against the ranks of universities. Whilst the proportion of Q1 papers is higher for the Top 5 universities, this ratio decreases with a less prominent place in the ranking. The presence of non-affiliated authors in the first, last, and corresponding author byline positions has a significantly positive effect on the Category Normalized Citation Impact, correlating with the position of the university in the ranking. Moreover, the difference in the Category Normalized Citation Impact between papers with affiliated and non-affiliated authors is also specific to university rank.

Keywords: university rank; JIF quartile; byline position; scientific impact; category normalized citation impact

Citation: Kohus, Z.; Demeter, M.; Kun, L.; Lukács, E.; Czakó, K.; Szigeti, G.P. A Study of the Relation between Byline Positions of Affiliated/Non-Affiliated Authors and the Scientific Impact of European Universities in Times Higher Education World University Rankings. *Sustainability* **2022**, *14*, 13074. https://doi.org/10.3390/su142013074

Academic Editor: Dina Zoe Belluigi

Received: 19 September 2022
Accepted: 10 October 2022
Published: 12 October 2022

1. Introduction

The use of university world rankings is a strategic tool to suggest a way to improve the overall position of a particular higher education institution. Through the measurement of their performance, the visibility of universities in world rankings is increasing globally and provides their international prestige [1]. The popularity of university rankings forces the higher education institutions to evaluate themselves regularly. The most widely used university rankings (Academic Ranking of World Universities, Times Higher Education World University Rankings, and Quacquarelli Symonds World University Rankings) primarily rank the research activities of universities and thread them as "generators" of highly cited publications [2]. The competition among higher education institutions forces university management to find ways to improve their positions in university world rankings.

According to Docampo et al. (2015) [3], it is not easy to create a world-class university. The opportunities for existing institutions to achieve better positions in world rankings are also limited. To this end, attention turns to the cooperation between existing institutions, providing access to talent, resources, and additional financial sources.

Several cross-country comparative studies have been conducted to compare universities in certain regions [4–6], but no study analyzing and comparing top European countries with other European regions has been undertaken throughout world university rankings, taking into account research output and scientific impact. Although Europe maintains a leading position in terms of its share of scientific research papers worldwide, there are significant performance differences between European Union countries [7].

As part of the transformation of higher education, the quality of scientific research has changed within the Central-Eastern European model since the 2000s, including the Visegrad Group [8]. The Visegrad Group or Visegrad Four (V4) is an alliance of four Central European Countries—the Czech Republic, Hungary, Poland, and Slovakia—founded by the Visegrad Declaration of 1991. All four countries had aspired to become members of the European Union and reached this goal in 2004. The historical, political, and cultural similarities of the V4 countries make them well suited for comparison [6]. Still, there is a need for an up-to-date comparison between the V4 higher education institutions and the top performing European ones. We accept that the shift of researchers and institutions into international networks can have a beneficial effect on university ranking; however, there are remarkable differences between a core group of collaborating and peripheral countries [9,10]. We therefore suggest that this discrepancy can also be captured at the top European and V4 institutions level.

Previous studies have shown that scientific collaboration among researchers and research institutions is vital for producing scientific knowledge [11–13]. There has been an exponential trend in the number of published papers over the last century. Moreover, the average number of authors per paper has increased more than five-fold and could reach eight authors per paper by 2034 [14]. One of the most commonly used indicators to measure university research productivity is the publication of research articles indexed in databases [15,16] and the number of citations a research paper receives [17]. The number of citations a publication receives is primarily driven by its journal placement (Journal Impact Factor quartile—JIF quartile) and citation performance. Generally, research papers in journals with higher impact factors often gain more citations [18]. Once a paper is published, both the Impact Factor (IF) and the JIF quartile, as well as the Category Normalized Citation Impact (CNCI) can be observed from the appropriate database, such as the Web of Science InCites. The value of IF, JIF quartile (Q1-Q4), and CNCI can be used to analyze publication success as a factor dependent on the extent and type of collaboration [11,19–21].

Most scientific research is performed by teams, and during the publication process scientists consider multiple factors affecting who to include as co-authors and where to place them in the byline [22,23]. Co-authorship as an indicator [24] is an accessible and accepted methodology to study the scientific collaboration of researchers, institutions, and countries at the micro-, meso-, and macro levels [25–27]. For example, co-authorship can be used to examine how researchers and institutions can benefit from non-corresponding authorship [25]. Publications, bibliometric data, and co-authorship derived from the publications are imperative and carry significant weight in evaluating the impact of internal (national) and external (international) research collaborations on the scientific performance of researchers and academic institutions. These can highlight how collaborations among researchers and research teams can contribute to expanding the university's research quality and quantity. These cooperations can increase research output numbers and consequently levels of citations, influencing the position of a given institution in different university rankings [1,2,28]. From a bibliometric perspective, allocating research papers to different countries and institutions allows us to understand the structure of scientific collaboration and dynamics [23,29,30]. Studies using co-authorship usually conclude that the contribution of individual collaborators is equal to the performed scientific work [31,32]. However,

the collaboration within a team involved in scientific implementation could be diverse [30]. Dividing credit equally among all authors is not a viable option in terms of researcher evaluation, and the author's position in the byline is more accurate when measuring author contribution [33]. Although the authorship order is not always aligned with the contribution statement, it can provide information about the scientific contributions of individuals [23]. According to the contribution-based ordering of authors, it is assumed that the first author is usually (but not necessarily) the corresponding author and the major contributor. The last and second authors follow the participation level, and the middle authors have the lowest contribution [13,32,34]. In addition, it has been shown by Yu and Yin (2021) [35] that the last authors named on a paper have also widely served as corresponding authors. Still, they suggest a fundamentally complementary meaning for the first and last author positions: while the first author is the one who has made the major contribution to the project, the last author is the research lead.

The authorship of a research paper has at least three different functions in science. First, it attributes credit to a researcher or group of researchers. Second, it assigns ownership to the abovementioned researcher or researchers. Third, it provides a reputation for both the authors and the affiliating institutions [31]. To this end, more importance is given to the first, last, and corresponding authors. In practice, the byline position can be used as a proxy to understand how national and international collaborations influence publication success and scientific impact [21].

Based on these considerations, this study aims to reveal the relationship between the byline position of authors, scientific impact, and position of higher education institutions in The Times World University Rankings by subject (Clinical and health) 2022. The following research questions are intended to guide this study:

1. What is the share in medical science of Q1–Q4 papers for the Top 5 European (University of Oxford, United Kingdom; ETH Zurich, Switzerland; Karolinska Institute, Sweden; Charité—Universitätsmedizin Berlin, Germany; and KU Leuven, Belgium) and V4 (Semmelweis University, Hungary; Jagiellonian University, Poland; Charles University Prague, Czech Republic; and Comenius University Bratislava, Slovakia) universities?;
2. What is the association between the JIF quartile share and the position of higher educational institutions in The TIMES World University Ranking by subject (Clinical and health) 2022?;
3. How does the byline position of authors influence CNCI and is this reflected in the position of selected universities in The TIMES World University Ranking by subject (Clinical and health) 2022?

In general, we find that the distribution of JIF quartiles changes with the rank of the university. Whilst the proportion of Q1 research papers increases, the portion of less prestigious Q3 and Q4 papers decreases with a more prestigious place within that ranking. The citation gain follows this trend; however, CNCI shows remarkable differences for all examined universities when analyzed for the byline positions of authors. The attribution (or non-attribution) of research papers to the analyzed university significantly affects citation impact.

2. Materials and Methods

We selected universities from the Times Higher Education World University Ranking 2022 by subject: Clinical and health (THE Ranking 2022). We used the first five European countries with the best-positioned university appearing on the list. We obtained the following order: 1. University of Oxford (United Kingdom, UK), 13. Karlolinska Institute (Sweden, SW), 32. Charité—Universitätsmedizin Berlin (Germany, GE), 43. ETH Zurich (Switzerland, CH), and 44. KU Leuven (Belgium, BE). The Visegrad Group universities extended the list based on their order in the same ranking: 176–200. Semmelweis University (Hungary, HU), 251–300. Jagiellonian University (Poland, PL), 301–350. Charles University Prague (Czech Republic, CZ), and 501–550. Comenius University Bratislava

(Slovakia, SK). Scientific output was observed from the Web of Science InCites database. We performed data collection on the 30 April 2022. During the first data search, we used the following filter settings: (1) Time: between 2011–2020; (2) Location type: individual search for all universities; (3) Research area: OECD based, Medical and Health Sciences; and (4) Document type: Article. A second InCites search resulted in a list of research papers based on the JIF Quartile (using separate excel tables for Q1, Q2, Q3, and Q4 research papers). For the third search, the Author Position filter option was used: we downloaded all research papers where the first, last, or corresponding authors were affiliated with the given institution. For each university, three different data sheets were downloaded and processed offline. The final table for each university and research article contained the following main data: JIF quartile (Q1, Q2, Q3, or Q4), Author affiliation (Affiliated or Not Affiliated), and the CNCI.

The share of research papers in JIF Quartiles was calculated and plotted against the positions of universities in THE Ranking 2022. The median value of Category Normalized Citation Impact (CNCI) was calculated for each JIF Quartile and within Q1 papers for the Affiliated and Not Affiliated groups. The results were also plotted against the ranks of universities in the THE Ranking 2022.

Before any pairwise statistical analysis, the normality distribution of individual CNCI values was calculated using the Shapiro–Wilk test. In all cases, normal distribution was rejected. The U Mann–Whitney nonparametric test was therefore used to compare pairwise groups statistically. Pearson correlation and linear regression analyses were performed by JMP® Pro (v.1989–2021, SAS Institute Inc., Cary, NC, USA) data analysis software. Data were visualized using the Origin Pro 2022 (Student Version 2022, OriginLab Corporation, Northampton, MA, USA) statistical and graphing software.

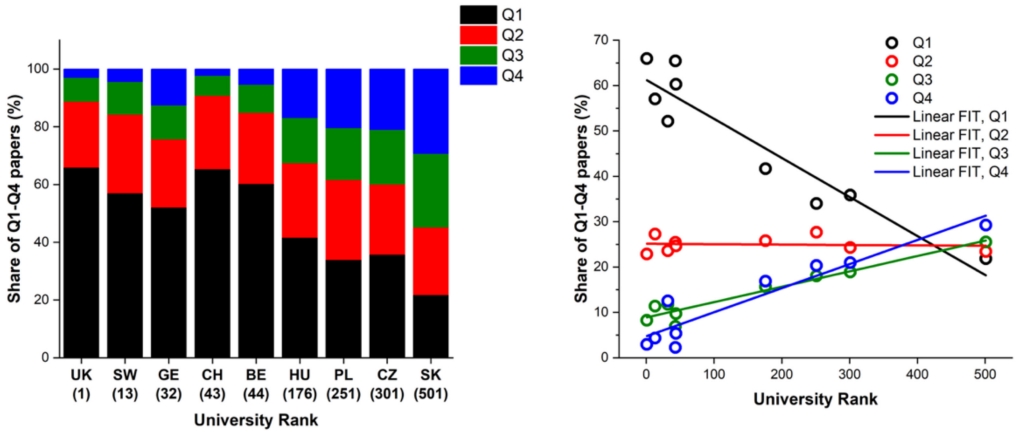
3. Results

3.1. The Share of Q1–Q4 Papers Is Specific to University Rank Position

The total count of research output and citations for a given institution is predominantly a size-dependent indicator, favoring larger institutions [25,36]. To overcome this problem and answer our first question regarding the shares of Q1–Q4 papers of selected universities, based on the total publication number of the Top 5 European and V4 institutions we calculated the publication rates for Q1–Q4 JIF quartiles for each of the nine analyzed higher education institutions (Table 1).

The results were plotted against the rank observed on THE Ranking 2022 (Figure 1A). Our data show that the share of Q1 journals for the Top 5 universities (52–66%) was higher than for the V4 institutions (21–42%). The percentage of published Q2 papers varied between 22 and 28%. On the contrary, the share of Q3 and Q4 papers showed a remarkable increase for V4 universities compared to the Top 5: from 8–12% to 15–26% for Q3, and from 2–12% to 16–30% for Q4 papers. Based on this, we can conclude that the share of JIF quartile shows university-dependent properties.

To test how the share of research papers in individual JIF quartiles is dependent on the position of higher education institutions in the THE Ranking 2022 (second question), we performed a linear regression analysis between the ranks of given institutions and publication trends (Figure 1B). This revealed a statistically significant dependence of the Q1, Q3, and Q4 paper ratio on university rank. Moreover, Pearson correlation showed a significantly negative relationship between Q1 paper share and rank position, and a significantly positive relationship between Q3 and Q4 paper ratio and rank position (Table 2). These results highlight that the share of Q1 journals decreases significantly with a less prestigious position in the THE Ranking 2022. On the other hand, we can see a significant upward trend in the share of less reputable Q3 and Q4 journals with a less prestigious position in the THE Ranking 2022.



(**A**) (**B**)

Figure 1. The distribution of research papers based on JIF quartile. (**A**) Q1–Q4 research paper share for each analyzed institution. The X axis represents the country code and the rank of the university in the Times Higher Education Ranking 2022 (in brackets). (**B**) Linear fit between the position of universities in the THE Ranking 2022 and share of Q1–Q4 research papers. UK—United Kingdom, SW—Sweden, GE—Germany, CH—Switzerland, BE—Belgium, HU—Hungary, PL—Poland, CZ—Czech Republic, SK—Slovakia.

Table 1. The total number of research articles for selected Top 5 and V4 universities and their share in Q1-Q4 JIF quartiles. UK—United Kingdom, SW—Sweden, GE—Germany, CH—Switzerland, BE—Belgium, HU—Hungary, PL—Poland, CZ—Czech Republic, SK—Slovakia.

University Name	Country Code	THE Ranking 2022	WoS Paper (N)	Research Papers by Journal JIF Quartile (%)			
				Q1	Q2	Q3	Q4
University of Oxford	UK	1	31,089	65.96	22.87	8.25	2.92
Karolinska Institutet	SW	13	40,545	57.03	27.28	11.36	4.33
Charité—Universitätsmedizin Berlin	GE	32	27,073	52.14	23.56	11.76	12.54
ETH Zurich	CH	43	5989	65.42	25.43	6.90	2.25
KU Leuven	BE	44	22,435	60.30	24.63	9.70	5.37
Semmelweis University	HU	176–200	6921	41.67	25.79	15.65	16.89
Jagiellonian University	PL	251–300	7940	33.99	27.64	18.02	20.34
Charles University Prague	CZ	301–350	12,110	35.84	24.29	18.91	20.96
Comenius University Bratislava	SK	501–550	2942	21.82	23.42	25.53	29.23

3.2. The Byline Position of Affiliated and Non-Affiliated Authors Influences the Scientific Impact of Research Papers

To reveal how institutions can benefit from the byline positions of authors (third question), research papers for all nine facilities were divided into two groups: Affiliated and Not Affiliated. The Affiliated group is represented by research papers where at least the first, last, or corresponding author is affiliated with the analyzed university. The Not Affiliated group contains those papers where the first, last, and corresponding authors have no affiliation with the selected higher education institution. Table 3 shows the total

number of research papers for each university in the Affiliated and Not Affiliated groups, the median value of CNCI, and the statistical significance of the difference between the two analyzed groups regarding CNCI.

Table 2. The results of linear regression analysis and Pearson correlation between the ranks of universities and share of Q1–Q4 papers.

	Linear Regression (R Square)	Linear Regression (F Test)	Pearson Correlation (Correlation Coefficient)	Pearson Correlation (Correlation Probability)
University rank vs. Q1 paper ratio	0.89	0.0001, ***	−0.94	0.0001, ***
University rank vs. Q2 paper ratio	0.01	0.82, NS	−0.08	0.82, NS
University rank vs. Q3 paper ratio	0.094	<0.0001, ***	0.96	<0.0001, ***
University rank vs. Q4 paper ratio	0.87	0.0003, ***	0.93	0.0003, ***

The level of significance is marked by stars: *** $p < 0.001$; NS = not significant.

Table 3. The total number of research papers, calculated CNCI for the Affiliated and Not Affiliated groups, and the significance level (Sig.) of difference between the two groups for each university. UK—United Kingdom, SW—Sweden, GE—Germany, CH—Switzerland, BE—Belgium, HU—Hungary, PL—Poland, CZ—Czech Republic, SK—Slovakia.

University Name (Country Abbreviation)	The TIMES Ranking 2022	Affiliated (N)	NOT Affiliated (N)	Affiliated (MEDIAN)	NOT Affiliated (MEDIAN)	Sig.
University of Oxford (UK)	1	17,411	13,681	0.99	1.22	***
Karolinska Institutet (SW)	13	24,613	15,935	0.77	1.04	***
Charité—Universitätsmedizin Berlin (GE)	32	16,262	10,811	0.62	1.06	***
ETH Zurich (CH)	43	3437	2555	0.95	1.04	***
KU Leuven (BE)	44	12,833	9605	0.81	1.16	***
Semmelweis University (HU)	176	4079	2845	0.43	0.95	***
Jagiellonian University (PL)	251	5348	2595	0.50	0.87	***
Charles University Prague (CZ)	301	7817	4297	0.42	1.01	***
Comenius University Bratislava (SK)	501	2062	884	0.35	0.67	*

The level of significance is marked by stars: * $p < 0.05$; *** $p < 0.001$.

Although the total number of research papers in the Affiliated group was higher than in the Not Affiliated group for each university (Figure 2A), the median value of CNCI was significantly higher for the latter one (Figure 2B). Thus, institutions generally benefit from the first, last, and corresponding byline position of non-affiliated authors in terms of scientific impact (CNCI).

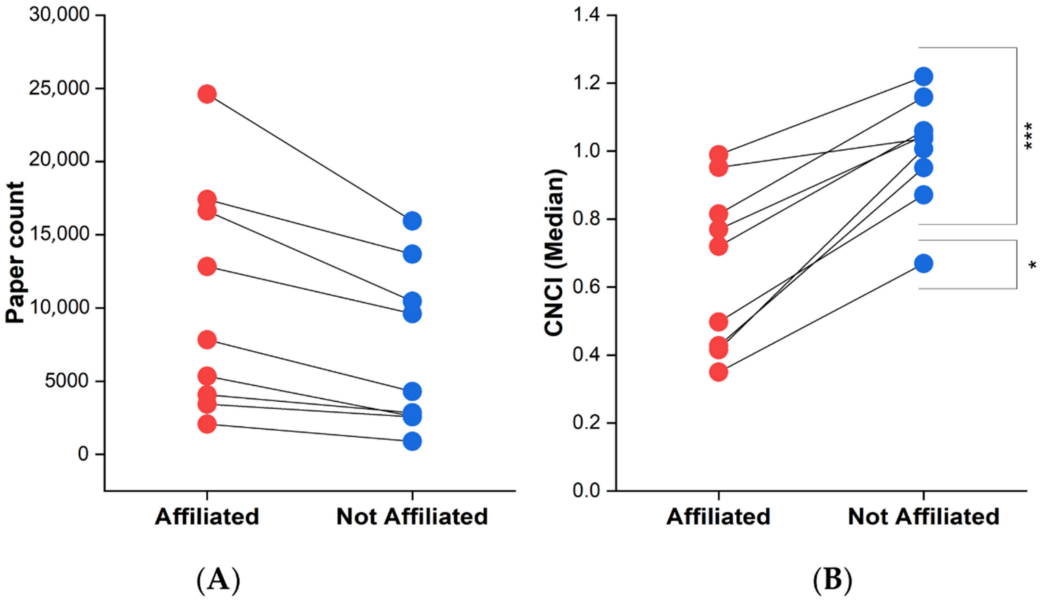
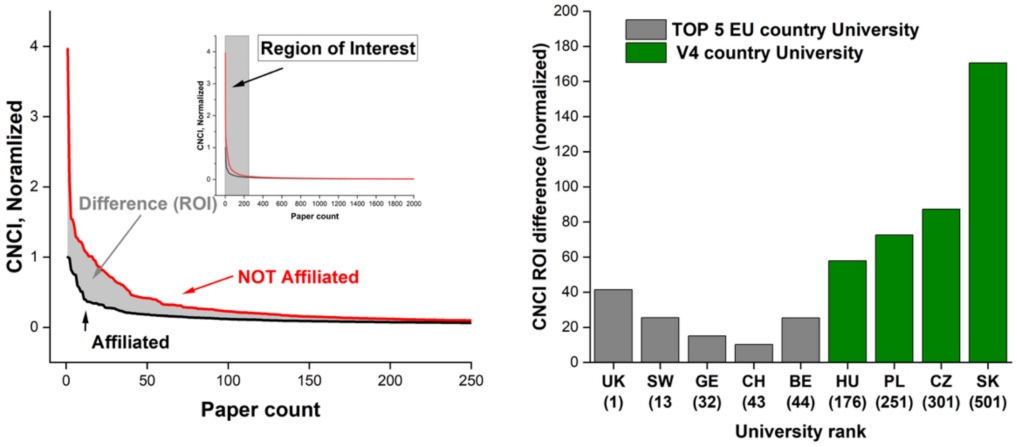


Figure 2. (**A**) The total number and (**B**) median CNCI of research papers in the Affiliated (red circles) and Not Affiliated (blue circles) groups. The total number of research papers for each university is higher for the Affiliated group. Nevertheless, the CNCI is significantly higher for the Not Affiliated group. The level of significance is marked by stars: * $p < 0.05$; *** $p < 0.001$.

While we found a significant difference in the CNCI between the Affiliated and Not Affiliated groups, we suggested that the effect of non-affiliated authors at prestigious byline positions (first, last, and corresponding author) may vary across higher education institutions as a function of position in the THE Ranking 2022. To reveal institutional differences, the normalized CNCI for all research papers in the Affiliated and Not Affiliated groups were plotted in descending order for each university. The normalization value was the highest CNCI for each university in the Author group. This enabled us to calculate the difference between two regions of interest—one for the Affiliated group and one for the Not Affiliated group—for the first 250 research papers in both groups (Figure 3A). The difference was plotted against the position observed in the THE Ranking 2022 (Figure 3B). As suggested, we found a significantly positive correlation between the university rank and the observed CNCI difference (Correlation coefficient = 0.96; Correlation probability, $p < 0.001$, ***). Moreover, the consequent linear regression revealed a significant dependence of CNCI difference on the university ranking position (R square = 0.95; F Test < 0.001, ***). Thus, although the prestigious byline position of non-affiliated authors has a positive effect on CNCI, this effect is higher for universities at lower positions in the THE Ranking 2022.

3.3. A Prestigious Byline Position of Non-Affiliated Authors Increases the CNCI for Q1 Research Papers

The total number and share of publications in the Q1 quartile can serve as an essential factor in the performance-based funding of public research [37] and has been used to compare the performance of individual researchers and institutions [38,39]. We therefore tested how the byline position of affiliated and non-affiliated authors in Q1 journals can influence CNCI. As a first step, research papers in the Affiliated and Not Affiliated groups were divided into two additional subgroups based on JIF quartile: Q1 papers and Non-Q1 papers. As suggested, the CNCI was higher for Q1 papers than for Non-Q1 papers in both Affiliated and Not Affiliated groups at all nine universities. The differences were significant except for those of Comenius University Bratislava, Slovakia in the Affiliated group (Table 4).



(**A**) (**B**)

Figure 3. Universities benefit from non-affiliated authorship. (**A**): Representative schema to calculate the difference of CNCI between Affiliated and Not Affiliated groups. For each group, the Region of Interest (ROI) was obtained and subtracted (main graph, grey background) based on the normalized value of CNCI. (**B**): The plot result of observed differences. Note the increasing difference with a less prestigious position in the THE Ranking 2022 (position in brackets). UK—United Kingdom, SW—Sweden, GE—Germany, CH—Switzerland, BE—Belgium, HU—Hungary, PL—Poland, CZ—Czech Republic, SK—Slovakia.

Table 4. The total number of research papers in Q1 and Non-Q1 journals, calculated CNCI, and the significance level (Sig.) of difference between the Q1 and Non-Q1 paper CNCI for the Affiliated and Not Affiliated groups. UK—United Kingdom, SW—Sweden, GE—Germany, CH—Switzerland, BE—Belgium, HU—Hungary, PL—Poland, CZ—Czech Republic, SK—Slovakia.

University Name	Affiliated (N)					Not Affiliated (N)				
	Paper Count (N)		Median		Sig.	Paper Count (N)		Median		Sig.
	Q1	NOT Q1	Q1	NOT Q1		Q1	NOT Q1	Q1	NOT Q1	
University of Oxford (UK)	10,979	6432	1.3	1.56	***	9526	4152	0.58	0.66	***
KU Leuven	13,223	11,389	1.099	1.44	***	9900	6033	0.53	0.63	***
Charité—Universitätsmedizin Berlin	7323	6288	1.07	1.63	***	8939	4523	0.35	0.57	***
ETH Zurich	2220	1217	1.206	1.35	***	1698	854	0.66	0.6	***
Karolinska Institutet	7208	5625	1.148	1.57	***	6321	3281	0.516	0.65	***
Semmelweis University	1244	2835	0.89	1.41	***	1640	1202	0.32	0.52	***
Jagiellonian University	1401	3947	0.85	1.49	*	1298	1294	0.39	0.5	***
Charles University Prague	1899	5917	0.901	1.67	***	2441	1853	0.337	0.49	***
Comenius University Bratislava	280	1781	0.751	1.24	NS	362	519	0.319	0.41	***

The level of significance is marked by starts: * $p < 0.05$; *** $p < 0.001$; NS = not significant.

Comparing the Affiliated and Not Affiliated groups within the Q1 research papers revealed that research papers in the Not Affiliated group had significantly higher CNCI. Moreover, as shown in Figure 4A, we found remarkable differences between the Top 5 and V4 universities. Whilst the median value of CNCI was higher than 1 for Top 5 universities; this value was below 1 for V4 universities.

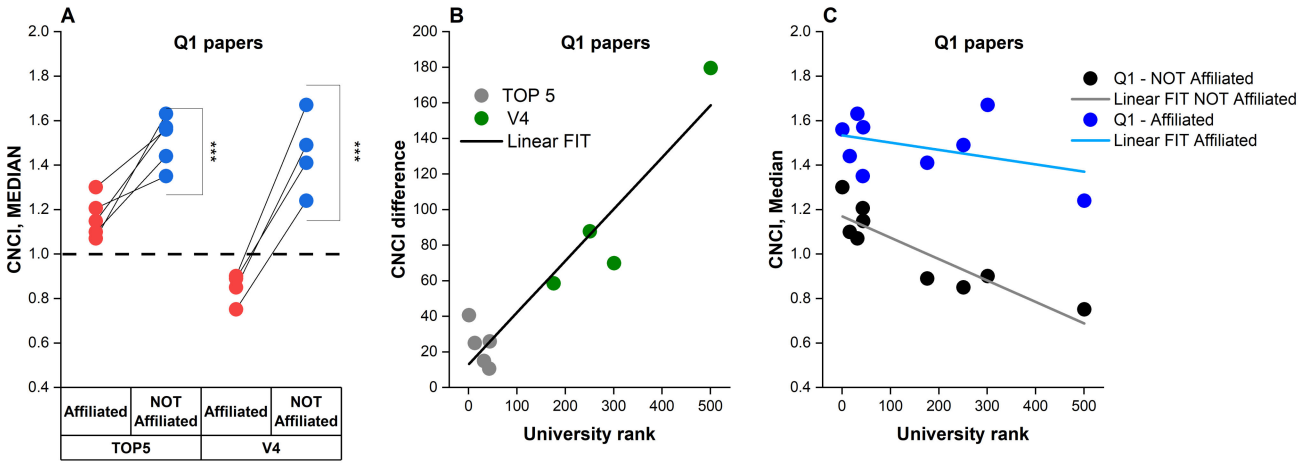


Figure 4. The difference in CNCI of Q1 papers as a factor of byline position of authors. (**A**): Plot diagram of the median CNCI values for Q1 research papers in the Affiliated (red circles) and Not Affiliated (blue circles) groups. Note the lower CNCI value for V4 countries in the Affiliated group (dashed line is at median CNCI value 1). (**B**): The difference of normalized CNCIs between the Affiliated and Not Affiliated groups plotted against the position of universities in The TIMES Ranking 2022. The black line is a linear fit used for linear regression analysis. (**C**): The median value of CNCI for the Affiliated (Blue) and Not Affiliated (Black) groups plotted against the position in The TIMES Ranking 2022. The continuous lines represent the linear fit used for linear regression analysis. See the decrease of CNCI for both Affiliated and Not Affiliated groups with a less prestigious position in the THE Ranking 2022. The level of significance is marked by stars: *** $p < 0.001$.

The quantitative difference between the Affiliated and Not Affiliated groups for Q1 papers is represented in Figure 4B. We found a significantly positive correlation between the university rank and CNCI difference (Correlation coefficient = 0.92; Correlation probability < 0.001, ***) and significant dependence of CNCI on the university ranking position by linear regression analysis (R square = 0.88; F Test < 0.001, ***). The difference in CNCI between the Affiliated and Not Affiliated groups is also visible in Figure 4C.

In the case of Q1 research papers in the Affiliated group, we found a negative but insignificant cross-correlation between the university rank and observed median CNCI (Correlation coefficient = −0.41; Correlation probability = 0.27). This non-significance was supported by the linear regression analysis (R square = 0.16; F Test = 0.27). However, we found a significantly negative correlation in case of the Not Affiliated group (Correlation coefficient = −0.86; Correlation probability = 0.002, **), supported by consequent linear regression analysis (R square = 0.75; F Test = 0.002, **). These data indicate that even in the case of Top 5 universities, the byline position of authors can significantly influence the research impact. Thus, scientific papers in research collaborations not attributed directly to the given institution have a higher CNCI. Moreover, the difference in the CNCI between the Affiliated and Not Affiliated groups shows a significantly increasing tendency for a less prestigious position in the THE Ranking 2022.

4. Discussion

This research aimed to examine the share of research papers in Q1-Q4 JIF quartiles (Questions one and two) and how the byline positions of authors can influence the research impact of published articles in medical and health science (third question) for the best-ranked universities in the Top 5 European and the top Visegrad Group country universities in the THE Ranking 2022.

Several researchers have shown that the share of research articles in JIF quartiles is an important indicator of research performance: it can be used to compare researchers and research institutions [37,38,40]. Our findings are in agreement with this recognition.

We have shown that the share of Q1, Q3, and Q4 publications is a good proxy of the position of the given university in the THE Ranking 2022. Whilst the proportion of Q1 papers decreases, the ratio of Q3 and Q4 research articles increases with a less prestigious position in the Times Higher Education Ranking 2022. However, the share of Q2 papers at all the investigated research universities did not show a dependence on the university's rank in the THE Ranking 2022. These results are in line with the findings of Orbay et al. (2020) [41], who have shown that the proportion of Q2 papers ranges between ~20–25% for Turkey, Russia, Iran, Brazil, South Korea, Germany, Spain, USA, and the United Kingdom. However, Viiu and Păunescu (2021) [42] argued 'that the singular use of JIF quartiles is a second order ecological fallacy', which is due to the intrinsic problem associated with the differences between the quartile boundary of JIF values. The pairwise absolute differences limiting JIF quartile classes are smaller for the Q1–Q2 journals than for the Q2–Q3 and Q3–Q4, and the Q1–Q2 differences cover a broader range compared to the Q2–Q3 and Q3–Q4 pairs.

Although Bornmann and Marx (2014) [43] claimed that the rate of the first quartile publication could be expected at 25%, we agree with Liu et al. (2016) that this estimation is not precise. This is true for a considerable set of research articles without considering the individual institution size and its research performance. In contrast to previous studies [40,43,44], we analyzed the research papers in different JIF quartiles at the level of individual universities and found significant dependence of the share of Q1, Q3, and Q4 papers and the rank of the analyzed institution in the THE Ranking 2022.

An institution's scientific productivity in itself does not reveal how it affects the scientific world. Being able to answer our second and third questions, we used CNCI as a proxy for scientific impact [11,45,46]. We found that universities benefit from the position of non-affiliated authors at the first, last, and corresponding positions. Moreover, the universities at the more prestigious institutions show less difference between the CNCI of research papers authored or not authored by affiliated researchers than the universities at lower positions in the THE Ranking 2022. The significant difference between the CNCI of research papers with affiliated and non-affiliated authors was also observed at the level of Q1 research papers. The difference between the two paper groups increased with a less prestigious position in the THE Ranking 2022, and the linear correlation analysis revealed a significant dependence of CNCI on the position of universities in the THE Ranking 2022 for research papers with authors not affiliated with the analyzed university. Generally, analyzed countries have substantial differences according to their position in the THE Ranking 2022. Universities with a more prestigious rank are characterized by a higher CNCI and a smaller difference between papers with or without affiliated authors compared to universities at a less prestigious place in the THE Ranking 2022.

It was noted by Grácio et al. (2020) [25] that research papers in national collaboration have a higher citation impact when published with a non-corresponding author. Still, institutions with the highest research output reach a more significant citation impact regardless of the corresponding author's affiliation. Our results contradict these findings regarding the connection between citation impact and research output. According to our results, the paper count is not only responsible for a higher CNCI at all universities; the CNCI was also significantly higher for research papers with non-affiliated authors at the first, last, and corresponding author byline positions.

From the institutional network perspective, bilateral/trilateral collaboration of research institutions with industrial players or/and other higher educational institutions can positively influence scientific performance [47]. At the level of individual researchers, there is a positive correlation between the structure of the co-authorship ego network and academic performance, suggesting that researchers with a higher publication output and impact are characterized by a larger collaboration network. Moreover, international research migrants are growing their network more efficiently than migrants from the same country [48]. These data indicate that the authors' performance and collaboration

features are also in an excellent position to influence universities' research output and scientific impact.

The results obtained in this research highlight the influence of affiliated and non-affiliated authors within the byline on the CNCI. However, this study does not consider other credits such as the Gross Domestic Product or the spending on Research and Development of the affiliated country of the first, last, or corresponding authors. Moreover, as shown by Li et al. (2013) [49], the co-authorship network from the perspective of social capital can also influence the scientific impact. There is no uniform understanding of how authorship order may influence the scientific impact of research papers. Besides the affiliation of the first, last, and corresponding authors, several other factors should be considered when interpreting and valuing the scientific impact. However, our results indicate that universities, especially those at less prestigious positions in the THE Ranking 2022, should consider the share and CNCI of Q1–Q4 papers as a potential tool to obtain a better standing. Increasing the international research network (providing 2.5% of the rank in the THE Ranking) and international collaborations (2.5% of the rank in the THE Ranking) are viable methods to influence the research output and scientific impact (accounting for 6% of the rating in the THE Ranking) and the proportion of Q1 research papers. A higher number of research papers in prestigious JIF quartiles, in turn, can be associated with a higher citation count (accounting for 30% of the rating in the THE Ranking).

The sustainable development of higher educational institutions is a critical strategy which must be embedded in the decision-making of universities. Considering the three core missions of universities (research, teaching and the third mission—e.g., technology transfer and commercialization), the increase of these indicators are in a good position to reflect an opportunity for universities to gain a reputation towards sustainable development [50]. Although valuing sustainability and sustainable development in the broader sense are scarce [51], each year the higher educational institutions monitor their position on the most prestigious global rankings with special attention to the progress compared with the previous years. We are aware that this study shows a cross-sectional picture of higher educational institutions in a specified research field based on bibliometric data; however, this could be a good start for initiating the use of longitudinal performance metrics to measure the sustainability and sustainable development of research institutions in terms of research performance. On the other hand, the first public analysis of the Sustainable Development Goal impact on higher educational institutions was released in 2020 by the Times Higher Education [52]. This impact ranking introduced a new indicator showing how universities can deliver sustainable social and economic impacts for society. The United Nations set 17 different Sustainable Development Goals to achieve a more sustainable future. These goals should be part of the major mission of universities. Thus, the sustainability and sustainable development of research institutions are permanently monitored; however, these developments require the implementation of active policies considering both internal and external factors [53]. The Sustainable Development Goals and sustainable development of universities regarding the position on global rankings based on bibliometric analysis should be a core mission of higher educational institutions. Although this study focuses on the position of universities in the THE Times Ranking 2022 and the possibility of getting a more prestigious position of higher educational institutions on this ranking, the sustainability-related rankings are also part of the THE Times Ranking.

It should be noted that the implementation of results comes with some limitations. First, this study uses the THE Ranking 2022 as a reference to compare higher educational institutions. In general, global ranking systems tend to rely on internationally accessible bibliometric databases and reputation surveys; however, the weight of individual outcomes can result in different ranking positions of universities in the different global ranking systems [54]. Second, the positive correlation between the number of co-authors and the impact factor of journals has been shown for several subject categories [55]; we did not analyze the relationship between the number of authors, scientific impact, and the position of higher educational institutions in the THE Ranking 2022. Third, the country of origin

of authors at prestigious places (first, second, and corresponding) was not investigated. In our previous work, we showed that the byline position of affiliated and non-affiliated authors, as well as the country of origin of the first, last, and corresponding authors in V4 countries, can influence the scientific impact of research papers [56]. However, this could stimulate further research analyzing the relationship between the byline position/country of origin of co-authors and the scientific impact/position of universities in prestigious global university rankings.

Author Contributions: Conceptualization, Z.K., G.P.S., K.C., E.L. and M.D.; methodology, Z.K., M.D. and L.K.; validation, Z.K., M.D. and G.P.S.; resources, Z.K. and L.K.; writing—original draft preparation, Z.K.; writing—review and editing, Z.K. and M.D.; visualization, Z.K.; supervision, K.C., E.L. and G.P.S. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by the 2019-1.2.1-EGYETEM-ÖKO_2019-00013 project implemented with the support provided by the Ministry of Innovation and Technology of Hungary from the National Research, Development and Innovation Fund, funded under the 2019-1.2.1-.EGYETEMI ÖKO funding scheme.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: There was no original, raw data generated for this manuscript. Research paper quantitative data were observed from the Web of Science InCites and Web of Science Core Collection databases. For more details on data collection, see Section 2.

Conflicts of Interest: The authors declare no conflict of interest.

Abbreviations

THE = Times Higher Education World University Ranking; THE Ranking 2022 = Times Higher Education World University Ranking 2022 by subject: Clinical & health; V4 = Visegrad Four/Visegrad Countries; JIF = Journal Impact Factor quartile; IF = Impact Factor; CNCI = Category Normalized Citation Impact.

References

1. Kivinen, O.; Hedman, J.; Artukka, K. Scientific publishing and global university rankings. How well are top publishing universities recognized? *Scientometrics* **2017**, *112*, 679–695. [CrossRef]
2. Aldieri, L.; Kotsemir, M.; Vinci, C.P. The impact of research collaboration on academic performance: An empirical analysis for some European countries. *Socio Econ. Plan. Sci.* **2018**, *62*, 13–30. [CrossRef]
3. Docampo, D.; Egret, D.; Cram, L. The effect of university mergers on the Shanghai ranking. *Scientometrics* **2015**, *104*, 175–191. [CrossRef]
4. Soh, K.C.; Ho, K.K. A tale of two cities' university rankings: Comparing Hong Kong and Singapore. *High Educ.* **2014**, *68*, 773–787. [CrossRef]
5. Taylor, P.; Braddock, R. International University Ranking Systems and the Idea of University Excellence. *J. High. Educ. Policy Manag.* **2007**, *29*, 245–260. [CrossRef]
6. Vašenda, J. Visegrad Group countries compared through world university rankings. *Int. Educ. J. Comp. Perspect.* **2019**, *18*, 100–115.
7. European Commission; Directorate General for Research and Innovation. *Science, Research and Innovation Performance of the EU, 2020: A Fair, Green and Digital Europe*; Publications Office: Luxembourg, 2020.
8. Dobbins, M. *Higher Education Policies in Central and Eastern Europe*; Palgrave Macmillan: London, UK, 2011; ISBN 978-1-349-33199-4.
9. Adams, J. The fourth age of research. *Nature* **2013**, *497*, 557–560. [CrossRef]
10. Leydesdorff, L.; Wagner, C.S. International collaboration in science and the formation of a core group. *J. Informetr.* **2008**, *2*, 317–325. [CrossRef]
11. Adams, J.; Gurney, K.A. Bilateral and Multilateral Coauthorship and Citation Impact: Patterns in UK and US International Collaboration. *Front. Res. Metr. Anal.* **2018**, *3*, 12. [CrossRef]
12. Lee, C.; Kogler, D.F.; Lee, D. Capturing information on technology convergence, international collaboration, and knowledge flow from patent documents: A case of information and communication technology. *Inf. Processing Manag.* **2019**, *56*, 1576–1591. [CrossRef]
13. Lu, C.; Zhang, C.; Xiao, C.; Ding, Y. Contributorship in scientific collaborations: The perspective of contribution-based byline orders. *Inf. Processing Manag.* **2022**, *59*, 102944. [CrossRef]

14. Aboukhalil, R. The rising trend in authorship. *Winnower* **2014**, *2*, e141832. [CrossRef]
15. Albers, S. What Drives Publication Productivity in German Business Faculties? *Schmalenbach Bus. Rev.* **2015**, *67*, 6–33. [CrossRef]
16. Armijos Valdivieso, P.; Avolio Alecchi, B.; Arévalo-Avecillas, D. Factors that Influence the Individual Research Output of University Professors: The Case of Ecuador, Peru, and Colombia. *J. Hisp. High. Educ.* **2021**, *21*, 450–468. [CrossRef]
17. Aksnes, D.W.; Langfeldt, L.; Wouters, P. Citations, Citation Indicators, and Research Quality: An Overview of Basic Concepts and Theories. *SAGE Open* **2019**, *9*, 215824401982957. [CrossRef]
18. Lozano, G.A.; Larivière, V.; Gingras, Y. The weakening relationship between the impact factor and papers' citations in the digital age. *J. Am. Soc. Inf. Sci Technol* **2012**, *63*, 2140–2145. [CrossRef]
19. Ioannidis, J.P.A. Measuring Co-Authorship and Networking-Adjusted Scientific Impact. *PLoS ONE* **2008**, *3*, e2778. [CrossRef]
20. Khor, K.A.; Yu, L.-G. Influence of international co-authorship on the research citation impact of young universities. *Scientometrics* **2016**, *107*, 1095–1110. [CrossRef]
21. Smith, M.J.; Weinberger, C.; Bruna, E.M.; Allesina, S. The Scientific Impact of Nations: Journal Placement and Citation Performance. *PLoS ONE* **2014**, *9*, e109195. [CrossRef]
22. Marušić, A.; Bošnjak, L.; Jerončić, A. A Systematic Review of Research on the Meaning, Ethics and Practices of Authorship across Scholarly Disciplines. *PLoS ONE* **2011**, *6*, e23477. [CrossRef]
23. Sauermann, H.; Haeussler, C. Authorship and contribution disclosures. *Sci. Adv.* **2017**, *3*, e1700404. [CrossRef]
24. Katz, J.S.; Martin, B.R. What is research collaboration? *Res. Policy* **1997**, *26*, 1–18. [CrossRef]
25. Grácio, M.C.C.; de Oliveira, E.F.T.; Chinchilla-Rodríguez, Z.; Moed, H.F. Does corresponding authorship influence scientific impact in collaboration: Brazilian institutions as a case of study. *Scientometrics* **2020**, *125*, 1349–1369. [CrossRef]
26. Lancho Barrantes, B.S.; Guerrero Bote, V.P.; Rodríguez, Z.C.; de Moya Anegón, F. Citation flows in the zones of influence of scientific collaborations. *J. Am. Soc. Inf. Sci.* **2012**, *63*, 481–489. [CrossRef]
27. Lancho-Barrantes, B.S.; Guerrero-Bote, V.P.; de Moya-Anegón, F. Citation increments between collaborating countries. *Scientometrics* **2013**, *94*, 817–831. [CrossRef]
28. Li, H.; Yin, Z. Influence of publication on university ranking: Citation, collaboration, and level of interdisciplinary research. *J. Librariansh. Inf. Sci.* **2022**, *2022*, 096100062211061. [CrossRef]
29. Haeussler, C.; Sauermann, H. Division of labor in collaborative knowledge production: The role of team size and interdisciplinarity. *Res. Policy* **2020**, *49*, 103987. [CrossRef]
30. Lu, C.; Zhang, Y.; Ahn, Y.; Ding, Y.; Zhang, C.; Ma, D. Co-contributorship network and division of labor in individual scientific collaborations. *J. Assoc. Inf. Sci. Technol.* **2020**, *71*, 1162–1178. [CrossRef]
31. Birnholtz, J.P. What does it mean to be an author? The intersection of credit, contribution, and collaboration in science. *J. Am. Soc. Inf. Sci.* **2006**, *57*, 1758–1770. [CrossRef]
32. Yang, S.; Wolfram, D.; Wang, F. The relationship between the author byline and contribution lists: A comparison of three general medical journals. *Scientometrics* **2017**, *110*, 1273–1296. [CrossRef]
33. Mattsson, P.; Sundberg, C.J.; Laget, P. Is correspondence reflected in the author position? A bibliometric study of the relation between corresponding author and byline position. *Scientometrics* **2011**, *87*, 99–105. [CrossRef]
34. Perneger, T.V.; Poncet, A.; Carpentier, M.; Agoritsas, T.; Combescure, C.; Gayet-Ageron, A. Thinker, Soldier, Scribe: Cross-sectional study of researchers' roles and author order in the Annals of Internal Medicine. *BMJ Open* **2017**, *7*, e013898. [CrossRef] [PubMed]
35. Yu, J.; Yin, C. The relationship between the corresponding author and its byline position: An investigation based on the academic big data. *J. Phys. Conf. Ser.* **2021**, *1883*, 012129. [CrossRef]
36. Yegros-Yegros, A.; Rafols, I.; D'Este, P. Does Interdisciplinary Research Lead to Higher Citation Impact? The Different Effect of Proximal and Distal Interdisciplinarity. *PLoS ONE* **2015**, *10*, e0135095. [CrossRef]
37. García, J.A.; Rodriguez-Sánchez, R.; Fdez-Valdivia, J.; Martinez-Baena, J. On first quartile journals which are not of highest impact. *Scientometrics* **2012**, *90*, 925–943. [CrossRef]
38. Bornmann, L.; Williams, R. Can the journal impact factor be used as a criterion for the selection of junior researchers? A large-scale empirical study based on ResearcherID data. *J. Informetr.* **2017**, *11*, 788–799. [CrossRef]
39. Chinchilla-Rodríguez, Z.; Zacca-González, G.; Vargas-Quesada, B.; de Moya-Anegón, F. Benchmarking scientific performance by decomposing leadership of Cuban and Latin American institutions in Public Health. *Scientometrics* **2016**, *106*, 1239–1264. [CrossRef]
40. Miranda, R.; Garcia-Carpintero, E. Comparison of the share of documents and citations from different quartile journals in 25 research areas. *Scientometrics* **2019**, *121*, 479–501. [CrossRef]
41. Orbay, K.; MiRanda, R.; Orbay, M. Invited Article: Building Journal Impact Factor Quartile into the Assessment of Academic Performance: A Case Study. *Particip. Educ. Res.* **2020**, *7*, 1–13. [CrossRef]
42. Viiu, G.-A.; Păunescu, M. The lack of meaningful boundary differences between journal impact factor quartiles undermines their independent use in research evaluation. *Scientometrics* **2021**, *126*, 1495–1525. [CrossRef]
43. Bornmann, L.; Marx, W. How to evaluate individual researchers working in the natural and life sciences meaningfully? A proposal of methods based on percentiles of citations. *Scientometrics* **2014**, *98*, 487–509. [CrossRef]
44. Liu, W.; Hu, G.; Gu, M. The probability of publishing in first-quartile journals. *Scientometrics* **2016**, *106*, 1273–1276. [CrossRef]

45. Bornmann, L. Does the normalized citation impact of universities profit from certain properties of their published documents—Such as the number of authors and the impact factor of the publishing journals? A multilevel modeling approach. *J. Informetr.* **2019**, *13*, 170–184. [CrossRef]
46. Ravenscroft, J.; Liakata, M.; Clare, A.; Duma, D. Measuring scientific impact beyond academia: An assessment of existing impact metrics and proposed improvements. *PLoS ONE* **2017**, *12*, e0173152. [CrossRef]
47. Chen, K.; Zhang, Y.; Zhu, G.; Mu, R. Do research institutes benefit from their network positions in research collaboration networks with industries or/and universities? *Technovation* **2020**, *94–95*, 102002. [CrossRef]
48. Paraskevopoulos, P.; Boldrini, C.; Passarella, A.; Conti, M. The academic wanderer: Structure of collaboration network and relation with research performance. *Appl. Netw. Sci.* **2021**, *6*, 31. [CrossRef]
49. Li, E.Y.; Liao, C.H.; Yen, H.R. Co-authorship networks and research impact: A social capital perspective. *Res. Policy* **2013**, *42*, 1515–1530. [CrossRef]
50. Bautista-Puig, N.; Orduña-Malea, E.; Perez-Esparrells, C. Enhancing sustainable development goals or promoting universities? An analysis of the times higher education impact rankings. *Int. J. Sustain. High. Educ.* **2022**, *23*, 211–231. [CrossRef]
51. Diaz-Sarachaga, J.M.; Jato-Espino, D.; Castro-Fresno, D. Is the Sustainable Development Goals (SDG) index an adequate framework to measure the progress of the 2030 Agenda? *Sustain. Dev.* **2018**, *26*, 663–671. [CrossRef]
52. Veidemane, A. Education for Sustainable Development in Higher Education Rankings: Challenges and Opportunities for Developing Internationally Comparable Indicators. *Sustainability* **2022**, *14*, 5102. [CrossRef]
53. Blasco, N.; Brusca, I.; Labrador, M. Drivers for Universities' Contribution to the Sustainable Development Goals: An Analysis of Spanish Public Universities. *Sustainability* **2020**, *13*, 89. [CrossRef]
54. Çakır, M.P.; Acartürk, C.; Alaşehir, O.; Çilingir, C. A comparative analysis of global and national university ranking systems. *Scientometrics* **2015**, *103*, 813–848. [CrossRef]
55. Abramo, G.; D'Angelo, C.A. The relationship between the number of authors of a publication, its citations and the impact factor of the publishing journal: Evidence from Italy. *J. Informetr.* **2015**, *9*, 746–761. [CrossRef]
56. Kohus, Z.; Demeter, M.; Szigeti, G.P.; Kun, L.; Lukács, E.; Czakó, K. The Influence of International Collaboration on the Scientific Impact in V4 Countries. *Publications* **2022**, *10*, 35. [CrossRef]