

# The Indigeneity Trend in Philippine Research from 2012 to 2021

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## ABSTRACT

Using the Scopus database, this paper examines the indigeneity trend of the Philippine research outputs, as represented by its top four comprehensive universities, from 2012 to 2021. The researchers adapted the indigeneity metric of Siddiqi et al. (2016) in bibliometric analysis, which is defined by the domesticity of a given publication's corresponding author and is equated with the rootedness of a given publication on the capacities and concerns of the publication's domicile country and is further equated with such domicile country's potential to compete against the knowledge-based powers of Euro-American countries. From 2012 to 2021, in as far as the case studies of this paper are concerned, the Philippines' Scopus-indexed papers grew at an annual average rate of 13.43%. The country's growth rate of indigenous Scopus-indexed papers, at 13.87%, is growing slightly faster than its total number of Scopus-indexed papers. This trend suggests to the country's policymakers and research managers that with the expected increase of the country's total Scopus-indexed papers, driven by the new graduate studies publication requirement and the tighter promotion requirement within the state universities, there is a

need to constantly monitor the percentage increase of the country's indigenized papers so that the country can more tightly connect its research activities and productions with the vision of building its competitive advantage.

## INTRODUCTION

Research production is now recognized as one of the key elements in building or maintaining the competitive edge of any given industrialized country. Developing countries are now imbibing this principle and are trying to step up their research productions. The Philippines, for example, produced only 1,564 Scopus-indexed papers in 2012, a figure that was multiplied almost four times in 2021 with its 6,014 Scopus-indexed papers for that year.

In the 2022 Global Innovation Index (GII) report, the Philippines was ranked 59th out of 132 economies, a decrease of eight places from its 2021 ranking. Nonetheless, the country remained among the top 40% of economies covered by the survey, which is still an improvement from being within the top 60% in 2018 with its erstwhile 73rd rank.

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## KEYWORDS

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The ranking of the country in the aforementioned report pertinent to pillar 1, institutions, decreased both by political and regulatory environment. Nevertheless, the business environment improved by 7 points to 87th from 94th in 2022 and 2021 respectively. The business environment indicator assesses the government policies and entrepreneurship conditions of the country. As regards human capital and research, education and higher education sub-pillars dropped to 112th and 59th place, respectively. In comparison, the R&D sub-pillar showed a marginal improvement from 74th to 63rd place.

In comparison with 2021, the Philippines Investments sub-pillar showed a 47 percentage point improvement to 55th place in 2022. The ease of protection for the investors index as an indicator is part of the sub-pillar. From the 119th position in 2021 to 115th by 2022, improvements have also been noted within the credit sub-pillar. On the other hand, trade has fallen to 22nd in 2022 from 21st in 2021, which is a drop of one point. Both knowledge workers and knowledge absorption sub-pillars under business sophistication, dropped in rankings in 2022, while innovation linkages jumped by three notches to 91st in 2022 from 94th in 2021.

It is notable that, in 2022, the rankings for all knowledge and technology outputs sub-pillars - knowledge creation, knowledge impact, and knowledge absorption, decreased. Among the three, knowledge creation fell by 14 percentage points. More so, the GII report has always emphasized measuring creativity as part of its innovation output sub-index due to the role of creativity in innovation which remained largely unmentioned in the debate on innovation measurement and policy. Intangible assets and online creativity improved to become 56th of the list as compared to 2021, while creative goods and services fell 23 places.

While the Philippines declined in its overall rank, it nonetheless maintained its 5th spot among the ASEAN member states. In fact, the World Intellectual Property Organization (WIPO) recognized the Philippines as one of the middle-income economies with the fastest innovation catch-up. Evidently, it performs above the lower-middle-income group average in all GII pillars and above the regional average in knowledge and technology outputs. This was due to its improvement in research as one of the determinants of the country's innovation capacity, from the 74<sup>th</sup> to 63<sup>rd</sup> spot. It must be noted though that the United Nations Educational, Scientific and Cultural Organization (UNESCO) Institute of Statistics suggests a ratio of 380 scientists per every million population. This means that the Philippines needs 19,000 more scientists to be a significant force in research and development.

In 2020, graduates in science and engineering were equal to 22.8% of tertiary graduates, down by 4 percentage points from the year prior and equivalent to an indicator rank of 52. Philippines performs better in innovation outputs than innovation inputs (Sarmiento, et al 2021). In 2021, the Philippines ranks 72nd in innovation inputs, lower than last year but higher than 2019. As for innovation outputs, the Philippines ranks 40th. This position is higher than both 2020 and 2019. These may be attributed to the Philippines' firm commitment to improve human capital and the science, technology, and innovation sectors which were previously attested by the National Economic and Development Authority (2017) as the country's contribution to help bridge the IR4.0 phenomenon.

The aforementioned scenarios have even led educational authorities to step up efforts in order to improve the quality of STEAM education, trusting that it will contribute to the country's economic success. It is also a challenge for the government and the private sector to prioritize innovation given

that the Philippines has been ranked in the most recent Global Innovation Index. As the country further capitalizes on its strengths and increases capacity for industry 4.0 technologies, the Department of Science and Technology (DOST) fully supports efforts to make our local industry successful by investing in S&T equipment and lab networks with a view to supporting their productivity.

DOST funded R&D facilities and laboratories with an active nationwide network for the development of industry and programs for digitalization, allowing industry for a more streamlined and efficient process. While the lower rank in 2022 was largely due to decreased performance scores in knowledge and technology outputs which are mainly a function of knowledge creation, knowledge impact, and knowledge diffusion, this brings a challenge for an increased indigeneity of papers and enhanced researchers capacity for innovation.

Meanwhile, there is a handful of literature on research and the building of the Philippines' competitiveness. Symaco's 2013 article "Education in the Knowledge-Based Society: The Case of the Philippines" studies the central government's responses to the changing demands on higher education within the context of knowledge-based economic competition. Symaco's 2012 article "Higher Education in the Philippines and Malaysia: The Learning Region in the Age of Knowledge-Based Societies" studies the same Philippine central government's responses against the backdrop of the Malaysian central government's more planned and aggressive responses. Cororato's 2003 monograph, "Research and Development and Technology in the Philippines," looks at the gaps in the central government's efforts to intensify research for the purpose of improving the Philippine economy. But for research production to have a more profound impact on the competitive edge of any given country, such production must ideally be rooted in the capacities and context of that same country.

This paper adapts the notion of indigeneity in bibliometric analysis from Siddiqi et al. (2016) as laid down in the article "Scientific Wealth in Middle East and North Africa: Productivity, Indigeneity, and Specialty in 1981–2013," which is defined by the domicile country of a given publication's corresponding author, and is equated with the rootedness of a given publication on the capacities and concerns of the publication's domicile country, and is further equated with such domicile country's potential to compete against the knowledge-based might of the Euro-American countries.

The notion of indigeneity provides an alternative metric in analyzing scientific output by taking into account the domicile country of a publication's lead author. Siddiqi et al. (2016) assumed that these corresponding authors played a crucial role in the research production. They suggested that indigeneity reflects the location of scientific activity and partially represents the local absorptive capacity (Siddiqi et al. 2016). Utilizing indigeneity and the more common productivity metric can provide insights in understanding the impact of scientific production as these are valuable indicators to assess the strength or fragility of national research ecosystems (Siddiqi et al. 2016). There are two clusters of literature on Philippine bibliometrics. The first one is composed of disciplinary bibliometrics, such as the articles of Fernandez, Tolentino, Miranda, Guanlao, and Sac (2022) in human kinetics; Cuaton and Delina (2022) in rice research; Kulsum, Nurmandi, Muallidin, Loilatu, and Kurniawan (2022) in open government; Roxas, Imperial, and De La Cruz (2021) in natural language processing; Bringula, Racelis, and Rodriguez (2020) in information technology; Gravoso, Navarrete, and Gahoy (2016) in development communication; and Vinluan (2012) in education and psychology. This present paper deviates from these disciplinary

bibliometric studies by taking a more panoramic bibliometric look at Philippine research production.

The second cluster of literature on Philippine bibliometrics is composed of HEI-centered bibliometrics, such as the articles of Rogayan and Corpuz (2021) that looked at the research production profile of a state university in Central Luzon; Regla and Ballera (2021) that also looked at the research production profile and research collaboration network of a private technological HEI in Metro Manila; Mala and Canencia (2021) that looked if ethnicity and campus location are significant factors in the research production of the chartered university in Mindanao; and Regadio and Tullao (2015) that compared the efficiency of research fund utilization of selected state universities and private HEIs. None of these studies pursued the category of indigeneity. In fact, Siddiqi, Stoppani, Anadon, and Narayanamurti's notion of indigeneity in bibliometric analysis has never been replicated in any other country or region so far.

From 2012 to 2021, the Philippines' Scopus papers grew at an annual average rate of 13.43%. This paper specifically looked at the indigeneity trend in relation to the increasing number of Scopus papers in the country. Using the strategy of case studies, this paper addressed the main problem: What is the indigeneity trend in Philippine research, as represented in the Scopus data of its top four comprehensive universities (CUs), and relative to the gross annual Scopus data from these same CUs from the year 2012 to 2021? This main problem was divided into the following sub-problems: 1) What are the indigeneity trends in the research productions of each of the four representative CUs?; 2) Is there a statistically significant difference on the indigeneity trends in research productions of these four representative CUs?; 3) What countries have significant influence on the research productions of each of these four representative CUs?; and 4) What countries have significant influence on the combined research productions of these four representative CUs?

This paper is significant in conveying the information to the country's policymakers and research managers that with the expected increase of the country's total Scopus-indexed papers, driven by the graduate programs' publication requirement as mandated by the Commission on Higher Education starting 2019 and the tighter promotion requirements within the state universities as specified by a joint policy by the Commission on Higher Education and the Department of Budget and Management starting 2022, there is a need to constantly monitor the percentage increase of the country's indigenized papers so that the country can more tightly connect its research activities and productions with the vision of building its competitive advantage.

## MATERIALS AND METHODS

**Data Gathering:** As already mentioned, this paper used the strategy of case study so that by looking at the Scopus data of the Philippines' top four CUs, some generalizations about the whole country's Scopus data can be gleaned. After all, in 2021, the Scopus-indexed papers of these four CUs constituted 38% of the country's total Scopus-indexed papers. These four CUs are anonymized as CU1, CU2, CU3, and CU4. All of these four CUs are located in the National Capital Region. CU1 is the flagship autonomous unit of a state university, while the other three CUs are private HEIs owned and managed by religious orders. All the four CUs are over a century old, but CU4 is the oldest, while CU2 is the newest. CU1 and CU2 are explicit in their positioning as research universities.

The 2012 to 2021 Scopus data of these four CUs were downloaded in the third week of November 2022. The specific

information taken from each Scopus-indexed publication are 1) the title, 2) the author/s, 3) the year of publication, and 4) the affiliation/s of the corresponding author/s. The domicile country of each publication was identified based on the affiliation/s of the corresponding author/s. The identified domicile country of the corresponding author/s ascertained the publication's indigeneity.

**Treatment of Data:** In addressing the first sub-problem, "What are the indigeneity trends in the research productions of each of the four representative CUs?," the annual indigeneity percentages (number of indigenous papers/total number of papers) were plotted across the decade for each of the four CUs. Then, the trendline of these annual indigeneity percentages was automatically generated using Microsoft Excel, with their corresponding slopes,  $r^2$  value, and p-value noted for each of the four CUs. In addressing the second sub-problem, "Is there a statistically significant difference on the indigeneity trends in research productions of these four representative CUs?," the one-way ANOVA statistical test was done on the annual indigeneity percentages of the four CUs. This was followed by the Tukey's Honest Significant Difference Test.

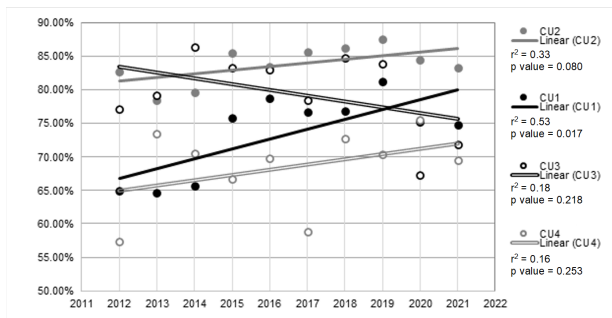
In addressing the third sub-problem, "What countries have a significant influence on the research productions of each of these four representative CUs?," the top five most recurrent domicile countries of the corresponding authors of the non-indigenous papers were identified for each of the four CUs. In addressing the fourth sub-problem, "What countries have a significant influence on the combined research productions of these four representative CUs?," the top five most recurrent domicile countries of the corresponding authors of the combined non-indigenous papers were identified.

Finally, in addressing the main problem of this paper, "What is the indigeneity trend in Philippine research, as represented in the Scopus data of its top four comprehensive universities (CUs), and relative to the gross annual Scopus data from these same representative comprehensive universities (CUs) from the year 2012 to 2021?," the combined annual indigeneity percentages (number of indigenous papers/total number of papers) were plotted across the decade, then its trendline was automatically generated using Microsoft Excel while noting its slope and  $r^2$  value.

**Ethical Consideration:** This research did not involve human participants and relied purely on the data from Scopus, which are accessible to subscribers. The identities of the four CUs were anonymized to protect their reputations. Furthermore, a research ethics clearance was secured from the home institution of one of the research team members. This research project did not receive any funding from any organization. Although four research team members are professionally connected with one of the representative CUs, no possible conflict of interest was reasonably identified.

## RESULTS AND DISCUSSION

**Indigeneity Trends in the Four CUs:** Figure 1 presents the indigeneity trends of the research productions of the four representative CUs. Figure 1 is based on the values contained in the Appendix A.



**Figure 1: Indigeneity Percentages of the Research Productions of the Four CUs from 2012 to 2021**

CU2's indigeneity trend is at the topmost, from the lowest point of 78.53% to the highest of 87.57%. It has a moderate positive slope with an  $r^2$  of 0.33, but its p-value of 0.080 signifies that its increasing trend is not statistically significant. CU3's indigeneity trend is at second from the top, from the lowest point of 67.27% to the highest of 86.32%. It has a weak negative slope with an  $r^2$  of 0.18, but its p-value of 0.218 signifies that its decreasing trend is not statistically significant. CU1's indigeneity trend is third from the top, from the lowest point of 64.18% to the highest of 79.97%. It has a moderate positive slope with an  $r^2$  of 0.53, and its p-value of 0.017 signifies that its increasing trend is statistically significant. CU4's indigeneity trendline is at the bottom, from the lowest point of 57.35% to the highest of 75.49%. It has a weak positive slope with an  $r^2$  of 0.16, and its p-value of 0.253 signifies that its increasing trend is not statistically significant.

Since CU2 and CU4's increasing indigeneity trends are not statistically significant, and since CU3's decreasing indigeneity trend is also not statistically significant, it can be stated that for these three CUs, their indigeneity rates are keeping up with the annual increase of their total Scopus papers. Only CU1's indigeneity trend can be stated to be increasing faster than its total annual Scopus papers.

CU2 and CU3's indigeneity trend's positions at the top of the chart, and CU1's statistically significant increasing indigeneity trendline, could be reflections of these three CUs' commitment to research as a pathway for excellence as manifested by their rigorous research output-based promotion system and publication incentive system, items that are wanting in the case of CU4. CU4's indigeneity trendline's position at the bottom of the chart could be a reflection of its preoccupation with medical research that both attracts and necessitates foreign research collaborators.

These four indigeneity trends drawn by this paper are lower compared to the 2000 to 2013 indigeneity slopes drawn by Siddiqi, Stoppani, Anadon, and Narayanamurti for their

reference country Turkey, South Korea, and China that moved from a low of about 84.00% to a high of about 93.00%; but higher compared to the combined indigeneity slope of the Middle East and North African countries, that moved from a high of about 73.00% to a low of about 53.00%. Turkey, South Korea, and China's indigeneity slopes are not increasing, but the combined indigeneity slope of the Middle East and North African countries are actually decreasing.

The findings presented in the passage provide valuable insights into the indigeneity trends and research output of four academic institutions (CUs) compared to reference countries and regions. The implications of these findings and the potential insights the researchers can draw from them:

**Indigeneity Trends:** The indigeneity trends of the four CUs show varying degrees of increase in the proportion of research authored by domestic researchers. CU1 demonstrates a statistically significant increase, indicating a strong commitment to indigenous research. CU2 and CU4 show moderate and weak positive slopes, respectively, but their trends are not statistically significant. CU3 exhibits a weak negative slope, but it is also not statistically significant, implying that the indigeneity rates are stable for these three CUs.

**Commitment to Research:** CU2 and CU3's positions at the top of the chart, along with CU1's statistically significant increasing trend, may suggest that these institutions prioritize and invest in research. Their research output-based promotion and publication incentive systems may be encouraging researchers to publish more, leading to higher indigeneity rates.

**CU4's Focus on Medical Research:** The lower indigeneity trendline of CU4 may indicate that the institution is heavily focused on medical research, which often involves collaborations with foreign researchers. This focus on international collaboration could explain why its indigeneity rate is not increasing significantly.

**Comparison to Reference Countries:** The comparison of indigeneity trends with reference countries (Turkey, South Korea, and China) and the Middle East and North African countries reveals interesting differences. The CUs' indigeneity trends are lower than those of the reference countries but higher than the decreasing trend in the Middle East and North African countries.

**Comparison of the Indigeneity Trends in the Four CUs:** Table 1 presents the one-way ANOVA statistical test results on the indigeneity trends of the research productions of the four representative CUs.

**Table 1: Results of the ANOVA Statistical Test on the Four Indigeneity Trends**

	Sum of Squares	df	Mean Square	F	p-value
<b>Between-treatments</b>	0.1344	3	0.0448	15.13803	.001
<b>Within-treatments</b>	0.1065	36	0.003		
<b>Total</b>	0.2409	39			

The one-way ANOVA revealed that there is a statistically significant difference in the indigeneity trends between the mean Indigeneity Indices of the CUs ( $F(3, 36) = [15.13803]$ ,  $p < .001$ ). To further investigate the nature of these mean differences, a post hoc test using Tukey's Honest Significant

Difference Test was employed. Table 2 presents the Tukey post-hoc multiple comparisons.

**Table 2: Results of the Post-Hoc Tukey HSD Statistical Test on the Four Indigeneity Trends**

Pair	Difference	SE	Q	Lower CI	Upper CI	Critical Mean	p-value	Statistical Significance
CU1-CU2	0.1026	0.0172	5.9635	0.03707	0.1681	0.06552	0.00088	Yes
CU1-CU3	0.06049	0.0172	3.5162	-0.005033	0.126	0.06552	0.07923	No
CU1-CU4	0.0497	0.0172	2.889	-0.01582	0.1152	0.06552	0.19159	No
CU2-CU3	0.0421	0.0172	2.4472	-0.02342	0.1076	0.06552	0.32327	No
CU2-CU4	0.1523	0.0172	8.8525	0.08677	0.2178	0.06552	0.00000	Yes
CU3-CU4	0.1102	0.0172	6.4053	0.04467	0.1757	0.06552	0.00036	Yes

Table 2 more specifically attests that there are statistically significant differences between the indigeneity trendlines of CU1 and CU2 ( $p = 0.001$ , 95% C.I. = [0.037, 0.168]), between CU2 and CU4 ( $p = 0.000$ , 95% C.I. = [0.087, 0.218]), and between CU3 and CU4 ( $p = 0.000$ , 95% C.I. = [0.045, 0.176]). The same table attests that there are no statistically significant differences between the indigeneity trendlines of CU1 and CU3 ( $p = 0.079$ , 95% C.I. = [-0.005, 0.126]), between CU1 and CU4 ( $p = 0.192$ , 95% C.I. [-0.016, 0.115]), and between CU2 and CU3 ( $p = 0.323$ , 95% C.I. = [-0.023, 0.108]).

**Countries with Significant Influence on the Research Productions of the Four CUs:** Table 3 presents the countries that exert significant influence on the research productions of

each of the four representative CUs. It has been noted that CU1's research is significantly influenced by the United States, three Asian countries, and Australia; CU2's research by four Asian countries and the United States; CU3's research by the United States, Australia, an Asian country, and two European countries; while CU4's research by the United States, a European country, and three Asian countries. The United States and Japan recur as top influencing countries in all four CUs; Taiwan in three CUs; Australia, Germany, and Malaysia in two CUs each; while China, South Korea, and the United Kingdom only occur in one CU each. No two CUs have the same profile of influencing countries.

**Table 3: Top Five Countries with Significant Influence on the Research Productions of the Four CUs from 2012 to 2021**

Influencing Country	CU1			CU2			CU3			CU4		
	Freq.	%	Rank	Freq.	%	Rank	Freq.	%	Rank	Freq.	%	Rank
Australia	105	2.07%	4.0				39	2.11%	2.5			
China				55	1.16%	5.0						
Germany							18	0.97%	5.0	57	3.79%	2.0
Japan	212	4.18%	2.0	101	2.14%	3.0	39	2.11%	2.5	32	2.13%	5.0
Malaysia				118	2.50%	1.0				44	2.93%	4.0
South Korea	86	1.70%	5.0									
Taiwan	150	2.96%	3.0	105	2.22%	2.0				49	3.26%	3.0
United Kingdom							20	1.08%	4.0			
United States	306	6.04%	1.0	92	1.95%	4.0	163	8.81%	1.0	80	5.32%	1.0

**Countries with Significant Influence on the Combined Research Productions of the Four CUs:** Table 4 presents the countries that exert significant influence on the combined research productions of the four representative CUs. The significant influence of the United States on the combined research productions of the four CUs would not be surprising considering the colonial and neo-colonial ties of the Philippines with this powerful Western country. Given that the Philippines and Japan had imperial and post-World War II links, it would also not be surprising if this strong Asian nation came in second place behind the United States on the same list. However, it is a little unexpected that Taiwan, a small region with a debatable country status, came in after Japan on this list. Taiwan's influence on the research production of the four CUs is concentrated in chemistry and allied disciplines. Australia's presence in the list could be a result of its assistance and commitment to the Philippines as well as the graduate studies scholarships that this country provided to a number of Filipinos. Malaysia's presence on the list is another surprise finding. Its influence is concentrated in the disciplines of engineering.

CU1's positive and statistically significant indigeneity trend suggests that its research policies and support mechanisms are effective in promoting domestic research output. Other institutions looking to boost indigenous research could potentially learn from CU1's practices.

CU2 and CU3's high positions in the chart, despite not having statistically significant trends, may indicate a stable research output that keeps up with the increase in overall research papers. This stability could be seen as positive, but there might be potential for further growth if these institutions invest more in research promotion.

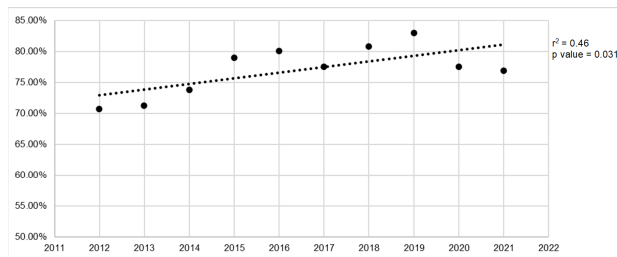
CU4's focus on medical research and its lower indigeneity trendline could raise questions about the balance between international collaborations and promoting domestic research output. The institution might benefit from strategies to incentivize and support indigenous research.

**Table 4: Top Five Countries with Significant Influence on the Combined Research Productions of the Four CUs from 2012 to 2021**

Influencing Country	Freq.	%	Rank
United States	641	4.93%	1.0
Japan	384	2.95%	2.0
Taiwan	304	2.34%	3.0
Australia	202	1.55%	4.0
Malaysia	162	1.25%	5.0

**Combined indigeneity trend of the research productions of the four representative CUs:** Figure 2 presents the combined indigeneity trend of research outputs from four representative comprehensive universities, with a view to addressing the main

problem presented in this paper. The values set out in Appendix B form the basis for this content.



**Figure 2: Indigeneity Percentages of the Combined Research Productions of the Four CUs from 2012 to 2021**

The combined indigeneity trend of the four CUs shows a lowest point of 70.65% to a highest point of 82.52%. While the Philippines was regarded as one of the middle-income economies with the fastest innovation catch-up performing above the lower-middle-income group average in all GII pillars and above the regional average in knowledge and technology outputs, it needs to remain firm in achieving 19,000 more scientists to be a significant force in research and development. It needs to remain committed to improve human capital and the science, technology, and innovation sectors. Educational authorities need to continuously step up efforts not just to help bridge the IR4.0 phenomenon and improve the quality of STEAM education, but also to reassert research indigeneity.

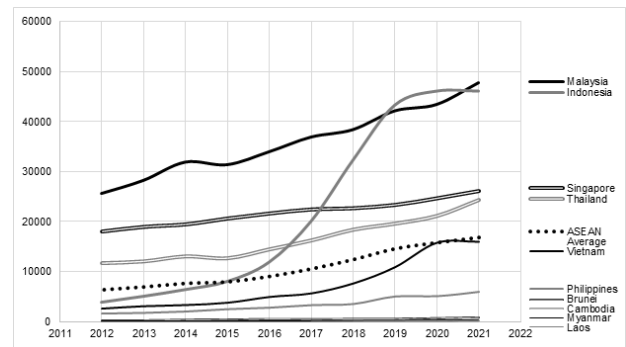
## CONCLUSION

The paper looked at the indigeneity trend of the Philippine research outputs, as represented by its top four comprehensive universities, from 2012 to 2021. Overall, the four CUs analyzed for this study have strong indigeneity trends. However, these are lower compared to the 2000 to 2013 indigeneity slopes drawn by Siddiqi, Stoppani, Anadon, and Narayanamurti for their reference country Turkey, South Korea, and China but higher compared to the combined indigeneity slope of the Middle East and North African countries.

A closer look at the home countries of the affiliations of their corresponding collaborator shows that the United States, Japan, Taiwan, Australia, and Malaysia have significant influence on the combined research productions of the four CUs. The United States and Japan recur as top influencing countries in all four CUs; Taiwan in three CUs; Australia, Germany, and Malaysia in two CUs each; while China, South Korea, and the United Kingdom only occur in one CU each. No two CUs have the same profile of influencing countries.

The main problem addressed by this paper is “what is the indigeneity trend in Philippine research, as represented in the Scopus data of its top four CUs, and relative to the gross annual Scopus data from these same CUs from the year 2012 to 2021?” In as far as these four representative CUs are concerned, the Philippine indigeneity trend is very promising. Appendix C shows that the indigeneity trend is growing annually at an average of 13.87%, compared with gross Scopus papers which are growing annually at an average of 13.47%. In as far as the four CUs are concerned the indigeneity trend is growing slightly faster than its Scopus papers production trend. But the country's policymakers and research managers should not be complacent about this and expect immediate results in the country's

competitiveness as the bulk research production of the Philippines is still far from being remarkable. Figure 3 shows how the bulk research production of the Philippines, in terms of Scopus-indexed papers, still lags below the ASEAN average.



**Figure 3: Comparison of the Annual Bulk Research Productions, in Terms of Scopus-indexed Papers, of the Ten ASEAN Countries**

Malaysia and Indonesia's stellar rise in research production are caused by their central governments' conscious efforts and policy changes. As mentioned, from 2012 to 2021, the Philippines' Scopus-indexed papers have grown at an annual average rate of 13.43%. But this pace could not keep up with the ASEAN average trendline unless the Philippine central government will belatedly undertake conscious efforts and policy changes similar to those of Malaysia and Indonesia.

Despite this bleak forecast, the Philippines' number of Scopus-indexed papers will continue to rise as this will be driven by the graduate studies publication requirement as mandated by the Commission on Higher Education Memorandum Order 15, Series of 2019, the tighter promotion requirements within the state universities that started with their 2019 cycle, and the conscious efforts of CU1 and CU2 to complete their more than a decade old projects of transitioning from teaching universities into functional research universities. Thus, there is a need to constantly monitor that the current promising status of the country's indigeneity trend can keep up with the pace of its expected research growth. With the growth of the number of scholars embracing indigenized research in Philippine HEIs, there is an urgent need to mentor and ensure the growth of more Filipino researchers taking leadership roles in international collaborative projects. In light of the new post-pandemic sustainability agenda, joint efforts are urgently required to develop and implement suitable initiatives to empower Filipino researchers and loop back their findings for policy-making and developmental undertakings to make these knowledge producers truly active agents of change. Mechanisms, incentivization, and programs that will sustain the motivation of researchers in engaging in indigenized projects must also be set in place. Furthermore, education agencies in the Philippines may provide ways and means to empower HEIs and basic education institutions to promote and strengthen mentoring, collaboration, and internationalization that will enable Filipino educators to take leadership roles in conducting collaborative research projects.

The increase in research indigeneity can positively impact on the following GII factors in the coming years: number of researchers, under Pillar 2; university-industry R&D collaborations, and research talent percentage in businesses, under Pillar 5; patents by origin, and utility models by origin, under Pillar 6; and cultural and creative services exports, creative goods exports, and mobile apps creation, under Pillar 7.

This research is of importance as this is the first attempt to replicate Siddiqi, Stoppani, Anadon, and Narayanamurti's notion of indigeneity in bibliometric analysis. The authors also intend

to make a related paper that would compare the indigeneity of Philippines' Scopus-indexed papers across the disciplinary clusters of humanities, social sciences, and science-technology. Future researchers may compare the indigeneity trend of Philippine HEIs to the trends of selected ASEAN HEIs. Investigating the indigeneity of Philippine research can be significantly enriched by triangulating these with qualitative investigations among university administrators, faculty members, and key researchers. It will be interesting also to make a finer application of Siddiqi et al.'s bibliometric analysis on countries with high GII to determine in which specific disciplines research indigeneity matters. It would be equally interesting to determine the percentage of PhDs in the total number of corresponding authors in each of the four CUs as well as their corresponding fields.

Furthermore, while the indigeneity trends of the four CUs are impressive, the challenge in indigenous research rooted in cross-cultural methodologies, propagating cultural sensitivity and appropriateness within the social sciences as defined by Enriquez (1997), can also be an interesting topic to be pursued. Thus, future researchers may sharpen the notion of the indigeneity of Siddiqi, Stoppani, Anadon, and Narayanamurti. As presented in this paper, the growing number of indigenous research projects in the Philippines can be a starting point for developing research projects that are more rooted in the perspectives, experiences, and concerns of Filipino researchers and, more truly, for the Filipino people.

#### STATEMENT ON CONFLICT OF INTEREST

The authors declare no conflict of interest.

#### CONTRIBUTIONS OF INDIVIDUAL AUTHORS

All authors contributed to the data gathering, analysis of the results, and the writing of the manuscript.

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**Appendix A: Indigeneity Percentages of the Research Productions of the Four CUs from 2012 to 2021**

Years	CU1			CU2			CU3			CU4		
	Total Scopus Papers	Indigenized Papers	%	Total Scopus Papers	Indigenized Papers	%	Total Scopus Papers	Indigenized Papers	%	Total Scopus Papers	Indigenized Papers	%
2012	271	176	64.94%	151	125	82.78%	96	74	77.08%	68	39	57.35%
2013	311	201	64.63%	163	128	78.53%	96	76	79.17%	49	36	73.47%
2014	341	224	65.69%	266	212	79.70%	117	101	86.32%	85	60	70.59%
2015	423	321	75.89%	298	255	85.57%	120	100	83.33%	99	66	66.67%
2016	521	410	78.69%	452	377	83.41%	141	117	82.98%	116	81	69.83%
2017	541	415	76.71%	469	402	85.71%	176	138	78.41%	194	114	58.76%
2018	544	418	76.84%	471	406	86.20%	197	167	84.77%	147	107	72.79%
2019	708	575	81.21%	756	662	87.57%	280	235	83.93%	196	138	70.41%
2020	652	491	75.31%	695	587	84.46%	275	185	67.27%	253	191	75.49%
2021	756	565	74.74%	869	724	83.31%	352	253	71.88%	296	206	69.59%
<b>Total</b>	<b>5068</b>	<b>3796</b>	<b>74.90%</b>	<b>4590</b>	<b>3878</b>	<b>84.49%</b>	<b>1850</b>	<b>1447</b>	<b>78.22%</b>	<b>1503</b>	<b>1038</b>	<b>69.06%</b>

**Appendix B: Indigeneity Percentages of the Combined Research Productions of the Four CUs from 2012 to 2021**

Years	CU1		CU2		CU3		CU4		Combined		
	Total Scopus Papers	Indigenized Papers	Total Scopus Papers	Indigenized Papers	Total Scopus Papers	Indigenized Papers	Total Scopus Papers	Indigenized Papers	Total Scopus Papers	Indigenized Papers	%
2012	271	176	151	125	96	74	68	39	586	414	70.65%
2013	311	201	163	128	96	76	49	36	619	441	71.24%
2014	341	224	266	212	117	101	85	60	817	597	73.07%
2015	423	321	298	255	120	100	99	66	947	742	78.35%
2016	521	410	452	377	141	117	116	81	1231	985	80.02%
2017	541	415	469	402	176	138	194	114	1390	1069	76.91%
2018	544	418	471	406	197	167	147	107	1369	1098	80.20%
2019	708	575	756	662	280	235	196	138	1951	1610	82.52%
2020	652	491	695	587	275	185	253	191	1884	1454	77.18%
2021	756	565	869	724	352	253	296	206	2307	1748	75.77%

**Appendix C: Percentage Growths in Combined Total Scopus Papers and Indigenized Papers from 2012 to 2021**

Years	Total Scopus Papers	Percentage Growth	Indigenized Papers	Percentage Growth
2012	586		414	
2013	619	5.33%	441	6.12%
2014	817	24.24%	597	26.13%
2015	947	13.73%	742	19.54%
2016	1231	23.07%	985	24.67%
2017	1390	11.44%	1069	7.86%
2018	1369	-1.53%	1098	2.64%
2019	1951	29.83%	1610	31.80%
2020	1884	-3.56%	1454	-10.73%
2021	2307	18.34%	1748	16.82%
<b>Average</b>	<b>1310.10</b>	<b>13.43%</b>	<b>1015.80</b>	<b>13.87%</b>