Measuring the Performance of the Philippine Scientific Enterprise System

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Abstract

This study demonstrates three metrics for measuring the performance of the Philippine scientific enterprise system. The system consists primarily of institutions, agencies, and organizations in the country that are directly involved in the generation of new scientific knowledge and in the training of future Filipino scientists and researchers in science, technology, engineering, and mathematics (STEM). The national budget in 2014 was 1.59 times larger than that in 2009 consistent with the steady growth of the gross domestic product during said period. Consequently, the budgets for the state universities and colleges (SUCs) and the Department of Science and Technology (DOST) also grew by 61.53 percent and 115.11 percent, respectively. The DOST is a major source of research and development (R&D) grants and scholarships for STEM students, while the country's higher education institutions (HEIs) form the backbone of the enterprise system. Peer-reviewed technical publications and PhD graduates are considered to be tangible outputs of an institution that is engaged in scientific R&D activities.

The performance indices are: *Academic Productivity Index* (API), *Science Productivity Index* (SPI), and the *PhD Production Efficiency Index* (PPEI). The API score of an HEI is given by the ratio of the (geometric) product

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of the number of SCOPUS publications and PhD graduates produced in a given year, and that of its corresponding budget allocation and number of faculty members. The SPI score is computed as the ratio of the product of the number of SCOPUS publications and PhD graduates, and that of the number of faculty members and their time to do research. A PhD program gets a high PPEI score if it graduates many PhD students within the shortest possible completion time. An institution gets a zero API or SPI score if it does not produce a PhD graduate even if its faculty members are publishing. Two or more units perform uniformly well when their corresponding index scores are comparatively high. The geometric product places equal importance to the institutional output (PhD graduates) and the individual accomplishment (peer-reviewed publications). Because the possible outputs are calibrated to the inputs, an index score would track the response (absorption capacity) of an institution or program to temporal variations in resources invested in it.

The use of scientific measures that align institutional output with individual performance is recommended in faculty and staff promotion and in the selection of administrators, as well as in assessing the possible impact and long-term consequences of programs and administrative policies. Prudent application of data-driven analytics promotes transparency, predictability, fairness, and meritocracy in the scientific enterprise system. It motivates stakeholders to work together for a common purpose that is larger than the sum of their own individual aspirations.

Keywords: Philippine scientific enterprise system, higher education institutions, Department of Science and Technology, measures of scientific output and productivity

Introduction

The gross domestic product (GDP) of the Philippines grew steadily at an average rate of 8.9 ± 2.54 percent per annum from 2005 to 2015, and it enabled the Philippine government to finance the cost of implementing its socio-economic programs as well as expanding their coverage. From 2006 to 2016, the yearly national expenditure program (NEP) that is submitted by the Department of Budget and Management for scrutiny by the Philippine Congress has been equivalent to 19.3 ± 1.32 percent of the GDP in the previous fiscal year.[1]

The version of the NEP that is jointly passed by the House of Representatives and the Senate becomes the General Appropriations Act when signed into law by the Philippine president. The Act contains the specifics of the national budget for a given fiscal year. A growing Philippine economy implies more revenues for the government and the availability of more resources at the disposal of the executives, administrators, and managers in the Philippine bureaucracy.

Here the impact of additional investments on the performance of the Philippine scientific enterprise system is measured. The system consists primarily of institutions, agencies, and organizations in the country that are directly involved in the generation of new scientific knowledge and in the training of future Filipino scientists and researchers in science, technology, engineering, and mathematics (STEM).

The national budget in 2015 was 1.59 times larger than that in 2009, resulting in an increase in the budget allocations for the 112 state universities and colleges (SUCs) and the Department of Science and Technology (DOST) by 61.53 percent and 115.11 percent, respectively. The DOST is a major source of research and development (R&D) grants and scholarships for STEM students, while the degree-granting higher education institutions (HEIs) form the backbone of the enterprise system. Peer-reviewed scientific publications and PhD graduates are considered tangible outputs of a scientific institution that is engaged in scientific R&D activities.

The DOST organized the Engineering Research and Development for Technology (ERDT) and the Accelerated Science & Technology Human Resource Development (ASTHRD) programs in 2007 and 2009, respectively, for the purpose of increasing the number of PhD and MS graduates.[3] The University of the Philippines System (UP) is one of four SUCs in the nine HEIs that qualified to participate in the said programs.

More than 99.5 percent of the 1,935 HEIs accredited by the Commission on Higher Education (CHED) are incapable of offering tenable PhD degree programs in STEM due to a lack of qualified faculty members. According to CHED, only 12.54 percent of all HEI faculty members had PhD degrees during academic year (AY) 2014-15, which is just 3.3 percent more than the number in AY 2003-04.[2] A PhD degree is a research degree that is granted to a student who has been able to contribute an original, novel, and significant piece of scientific knowledge. Only PhD faculty members are qualified to mentor and supervise PhD students. A distinctive requirement for the awarding of a PhD degree is the publication of the dissertation results in a refereed journal, with the concerned PhD student serving as the first or corresponding author.

The number of peer-reviewed SCOPUS-indexed publications from the Philippines is growing at an average rate of 136 ± 66.43 papers per year from 2009 (with 1,196) to 2015 (2,014), with UP accounting for 35.57 percent of the total number (11,676).[4] It should be pointed out that UP has been receiving 27.36 + 1.32 percent of the annual SUC budget allocation in the last eleven years, ending 2016. From 2009 to 2014, the number of SCOPUS publications rose by 68.4 percent, while the combined allocation for SUCs and DOST increased by 110 percent, with the UP budget increasing by 91.7 percent. Evidently, UP plays a defining role in the functioning of the Philippine scientific enterprise system.

A proper performance analysis shall consider the output relative to the input that is given into an institution. The use of the following indices is demonstrated to determine the comparative performance of HEIs and doctoral programs: (1) *Academic Productivity Index* (API), (2) *Science Productivity Index* (SPI), and (3) *PhD Production Efficiency Index* (PPEI).

The API score of an HEI is given by the ratio of the (geometric) product of the number of SCOPUS publications and PhD graduates that it produces in a given year, and that of its corresponding budget allocation and assigned number of faculty items. On the other hand, the SPI score is computed as the ratio of the product of the number of SCOPUS publications and PhD graduates, and that of the assigned faculty items and faculty research workload. A PhD program gets a high PPEI score if it graduates many PhD students within a short average completion time. An institution with no PhD graduate gets a zero API or SPI score even if its faculty members are publishing scientific papers. Moreover, two or more units perform comparatively well when their corresponding index scores are both high and close to each other.

The indices employ the geometric product to align the institutional output (PhD graduates) with individual accomplishment (peer-reviewed publications) instead of treating them separately as a sum. When calculated over a sufficient period of time, an index would track the response of an institution to changes in the resources that are invested in it.

The use of indices that couple institutional output with individual performance, in faculty and staff promotion and in the appointment of school officials and administrators, is recommended. They are also highly suitable for determining the long-term impact and effectiveness of programs and administrative policies. The prudent application of analytics promotes greater transparency, predictability, fairness and meritocracy in the scientific enterprise system particularly in the SUCs. It motivates the various stakeholders to work together for a common purpose that is larger than the sum of their own individual aspirations.

The presentation for this paper proceeds as follows: In Section II, the Philippine scientific enterprise system is characterized in terms of its ability to generate new scientific knowledge and to train the next generation of Filipino scientists and researchers. The said capability is calibrated with respect to the resources that are invested in the enterprise. Section III defines the API, SPI, and PPEI formulas and applies them to rate the performance of the three largest constituent universities of UP, constituent units of the College of Science, UP Diliman, and the doctoral programs of UP Diliman. The presentation ends with a set of recommendations for improving the performance of the HEIs in the country.

Basic Information about the Philippine Scientific Enterprise System

Publications Per Capita and GDP Per Capita

The Philippines is one of the six major ASEAN economies, together with Singapore, Malaysia, Thailand, Indonesia, and Vietnam. Its population is the second largest behind that of Indonesia among the ten ASEAN member-states, and the Philippine GDP per capita (in current US dollars) is the sixth largest since 2009.[5] In terms of SCOPUS-indexed publications, the Philippines produced the smallest number among the six major ASEAN economies.[6]

Figure 1 plots the publication per capita versus the GDP per capita of the ten ASEAN countries for 2015. Publication per capita is obtained by dividing the number of SCOPUS publications with the country population. Singapore produces the highest publication per capita (2.954109×10^{-3}) and GDP per capita (USD52,888.7), while Myanmar (2.39534×10^{-6}) and Cambodia (USD1,158.7) have the lowest publication per capita and GDP per capita, respectively. The Philippines is ranked eighth in publication per capita (1.85602×10^{-5}) and sixth in GDP per capita (USD2,899.4).

The GDP per capita and the publications per capita are strongly correlated with each other for countries with a GDP per capita of more than USD5,800 (Singapore, Malaysia, and Thailand). For the said countries, increasing national prosperity is accompanied by an improving scientific productivity of the population. On the other hand, no such correlation is observed for the remaining five countries that are characterized by a GDP per capita of less than USD5,000 (Indonesia, Philippines, Vietnam, Lao PDR, Myanmar and Cambodia). The lack of correlation implies that differences in GDP per capita are not accompanied by proportional changes in the publication per capita.

The case of Brunei Darussalam is an outlier in Figure 1. It has the smallest population (423,188) but the second highest GDP per capita (USD36,607) among ASEAN countries. A similar case was previously found for Luxembourg (569,700 population), with its high GDP per capita but low publication citation intensity count in a 2004 study involving 31 countries.[7]

The plot behavior in Figure 1 for 2015 is also displayed in corresponding plots for 2009 and 2015. In the ASEAN region at least, the symbiotic relation between the capability of a country to generate new scientific knowledge and national prosperity is not detected below a GDP per capita threshold.

The Philippine Higher Education System

Figure 2 plots the number of CHED-accredited HEIs in the country.[2] From AY 2003-04 to AY 2014-15, the number increased by 25.65 percent, with private schools accounting for 24.51 percent of the growth. Meanwhile, the Philippine population increased by 21.66 percent in the aforementioned period.

Classified as public HEIs are the SUCs that are operated using yearly allocations from the national budget and the local universities and colleges (LUCs) that rely on financial support from local government units. Figure 2 shows a 1.14 percent increase in the number of public HEIs since 2003, due primarily to the establishment of additional LUCs.

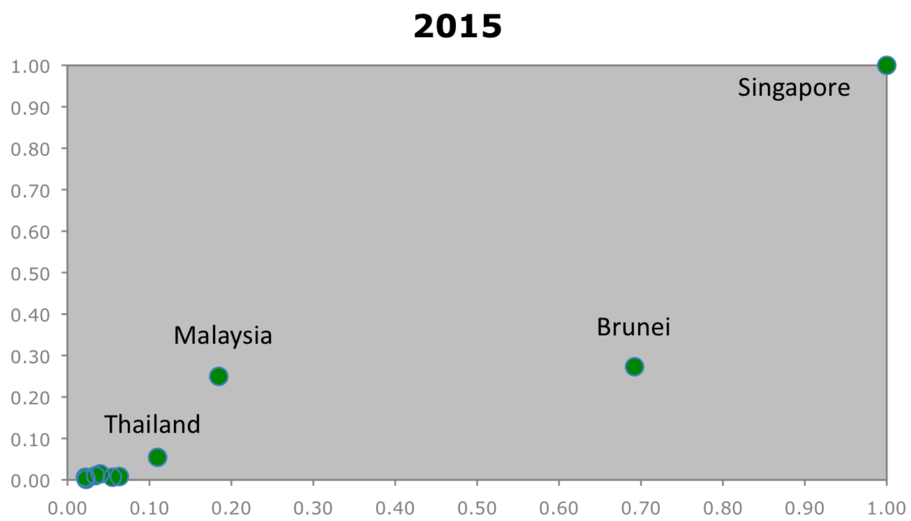


Figure 1. Plot of normalized publications per capita (y-axis) versus normalized GDP per capita of ten ASEAN countries for 2015.
Singapore produced the highest publication per capita (2.954109 x 10-3) and GDP per capita (USD52,888.7) while Myanmar (2.39534 x 10-6) and Cambodia (USD 1,158.7) had the lowest publication per capita and GDP per capita, respectively. The ten ASEAN member states in the order of population size are: Indonesia, Philippines, Vietnam, Thailand, Myanmar, Malaysia, Cambodia, Lao PDR, Singapore and Brunei Darussalam.

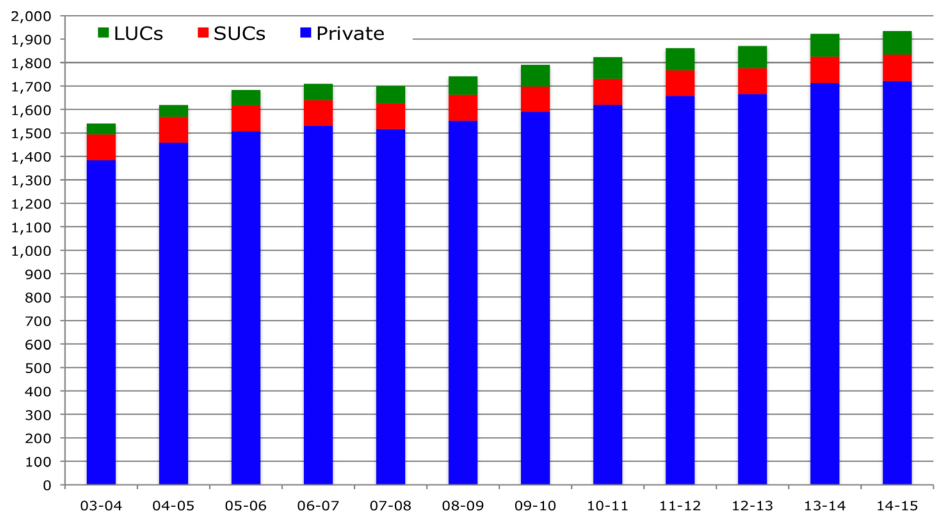


Figure 2. Number of HEIs from AY 2003-04 to AY 2014-15. Of the 1,935 HEIs operating in AY 2014-15, more than 88 percent were private and 213 were publicly-funded, including 112 SUCs.

Figure 3 presents the percentage distribution of HEI faculty members according to their highest educational attainment. In AY 2003-04, more than 60 percent of the faculty members only had baccalaureate degrees and were not qualified to teach graduate degree programs. By AY 2014-15, that number was reduced to 47 percent, with those having master's degrees increasing to 41 percent from 30 percent in AY 2003-04. The corresponding number of faculty members with PhD degrees increased by only 3.3 percent, from 9.24 percent in AY 2003-04. More than 99 percent of HEIs today are incapable of offering tenable PhD degree programs in STEM due to the lack of qualified faculty members.

Figure 4 plots the year-to-year percentage change of undergraduate enrolment from AY 2004-05 to AY 2014-15. In 2003 there were a total of 2.42 million undergraduates, with 34.25 percent enrolled in public HEIs. By 2014 the number increased to 3.81 million, with 44.25 percent studying in public institutions.

Undergraduate enrolment in CHED priority disciplines was 1.527 million, representing 63.1 percent of the total enrolment in 2003. In 2014, it increased

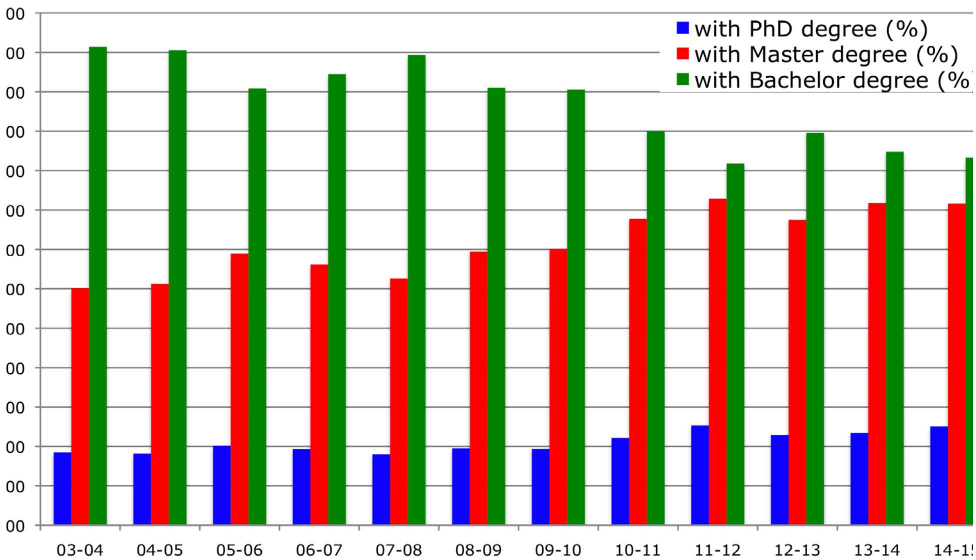


Figure 3. Percentage distribution of faculty members according to their highest educational attainment.
Number of faculty members with PhDs increased only by 3.3 percent from AY 2003-04 to AY 2014-15.

to 2.232 million—that is equivalent to 58.6 percent of the total enrollment, representing a 4.5 percent decrease over 12 years. The CHED priority disciplines are: Sciences (18.6 percent of total enrolment in 2014); Maritime, Medicine and Health, Engineering and Technology (20.8 percent); Agriculture-related and Veterinary Medicine, Teacher Education, Information Technology-related, and Mathematics (1.8 percent); and Architectural and Town Planning.

Figure 5 plots the year-to-year percentage change in graduate school enrolment from AY 2004-05 to AY 2014-15. During AY 2003-04, there were 0.3882 million graduate students, with 36.5 percent of them studying in public HEIs. By AY 2014-15, the number increased to 0.647 million, with 46.2 percent of them in public institutions. Public institutions are absorbing a higher percentage of graduate students in AY 2014-15 than they were ten years previously.

Graduate school enrolment in the priority disciplines was 0.231 million, representing 59.44 percent of total enrolment in 2003. It became 0.371 million, or 57.2 percent, of total enrolment in 2014. The graduate enrolment in CHED priority disciplines in 2014 was: Sciences (1.9 percent of total enrolment); Maritime, Medicine and Health, Engineering and Technology (17.7 percent), Agriculture-related and Veterinary Medicine, Teacher Education, Information Technology-related, and Mathematics (0.77 percent), and Architectural and Town Planning.

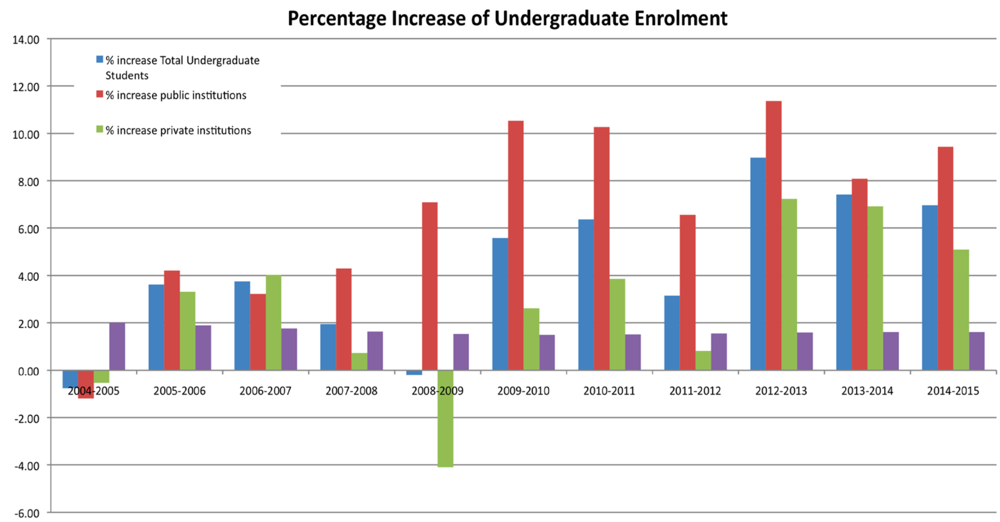


Figure 4. Year-to-year percentage change of undergraduate enrolment from AY 2004-05 to AY 2014-15.

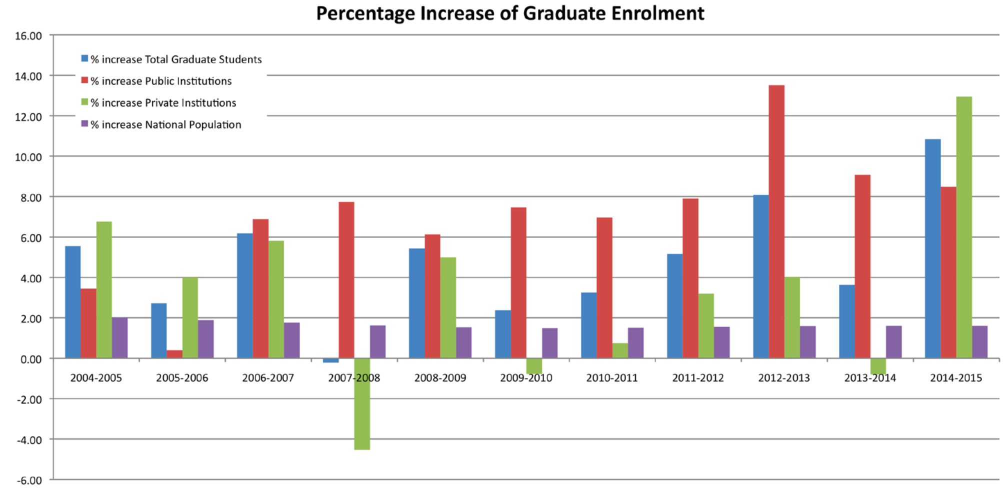


Figure 5. Year-to-year percentage change in graduate school enrolment. Enrolment in all fields increased by 67.12 percent, with enrollment in STEM growing at a slower rate of 38.53 percent from AY 2003-04 to AY 2014-15.

Budgetary Allocations for the DOST and SUCs

Figure 6 presents the annual budget allocations of the DOST and SUCs from 2006 to 2016. The 2016 DOST budget is 115.11 percent more than it was in 2006, while the allocation for the 112 SUCs in 2016 is 61.53 percent higher. On average, UP receives 27.36 ± 1.32 percent of the annual SUC budget. In 2006, the UP budget was 1.93 times larger than that of DOST (PhP2.781B), but it is only 0.63 times that of DOST (PhP18.137B) in 2016.

In terms of total student enrolment, the largest SUC in the country is the Polytechnic University of the Philippines (with 79,762), followed by UP (72,339) and the Mindanao State University System (62,501) in AY 2013-14. Only 14.4 percent of the 47,145 regular faculty members in the SUCs had PhD degrees, with UP (3,165) having the highest ratio of 28.72 percent.

A strong correlation (correlation coefficient: 0.988) is observed between graduate school enrolment E_G (in units of 100,000) and GDP (in trillions of PhP) from 2003 to 2015: $E_G = 3.29GDP - 7.99$. The corresponding undergraduate enrolment E_{UG} correlates with GDP according to (coefficient: 0.974): $E_{UG} = 0.54GDP - 7.57$. The GDP grew steadily at an average rate of 8.9 ± 2.54 percent per annum from 2005 to 2015, and it has allowed more Filipinos to pursue graduate studies at a rate that is faster than the corresponding increase in undergraduate enrolment with GDP.

Overall graduate enrolment in all fields increased by 67.12 percent, with enrollment in STEM growing at a slower rate of 38.53 percent from AY 2003-04 to AY 2014-15. Because the number of PhD faculty increased by only 3.3 percent, a majority of these graduate students would encounter considerable difficulty in getting a PhD degree due to the lack of qualified mentors.

The DOST first established the ERDT and the ASTHRD programs in 2007 and 2009, respectively, in order to increase the number of PhD and MS graduates in STEM by coordinating the services of qualified PhD faculty and improving access to existing R&D facilities across the country. The Science Education Institute of the DOST evaluated the capabilities of the various HEIs and found that only nine were able to offer a tenable PhD degree program in STEM and qualify to participate in either program.[8,9]

UP is one of three SUCs that qualified to participate in both programs. Together, the nine ASTHRDP institutions are known as the National Science Consortium. As of summer 2015, only 19.75 percent (47) and 9.61 percent (22) of the ERDT and ASTHRD PhD scholars, respectively, were able to graduate, with 62.32 percent (43) receiving their technical training from UP. UP Diliman (with 32) and UP Los Baños (9) produced the most number of PhD graduates in the ERDT and ASTHRD programs, respectively.

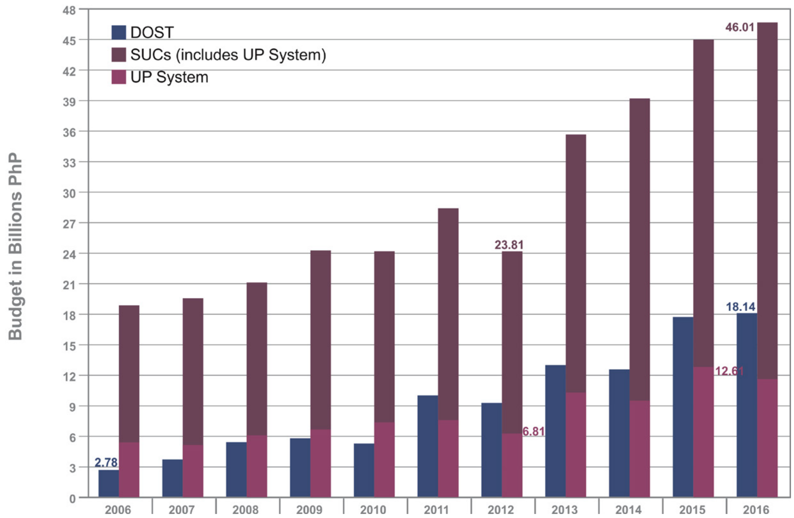


Figure 6. Yearly budget allocations of DOST and the SUCs.
The 2016 DOST budget is 115.11 percent more than it was in 2006, while that of SUCs is 61.53 percent higher. On average, UP receives 27.36 ± 1.32 percent of the annual SUC budget. The 2006 UP budget was 1.93 times larger than that of DOST (PhP2.781B). In 2016 the entire SUC budget is only 0.63 times that of DOST (PhP18.137B).

Generation of New Scientific Knowledge

The ability of an institution or organization to generate new scientific knowledge that improves the accuracy of the understanding of natural phenomena is usually measured in terms of the number of peer-reviewed publications produced. Simply put, a commonly accepted indicator of a successful research endeavor is the publication of its research results in a refereed journal that is widely read by the scientific community.

Figure 7 presents the number of SCOPUS-indexed publications that have been produced by the Philippines, UP and UP Diliman respectively, from 2009 to 2015. The number of publications from the Philippines increased steadily at a rate of 136 ± 66.43 per year, unlike that of UP, which tapered off after 2012. UP accounts for 35.57 percent of the total number, with UP Diliman contributing 51.77 percent of all UP publications. The number of UP publications peaked in 2012 at 648, decreasing to 618 in 2015.

The number of Philippine publications in 2015 was 68.4 percent higher than in 2009. On the other hand, the combined DOST-SUC budget in 2015 was 110 percent more than it was in 2009. The UP budget increased by 91.7 percent in the aforementioned years.

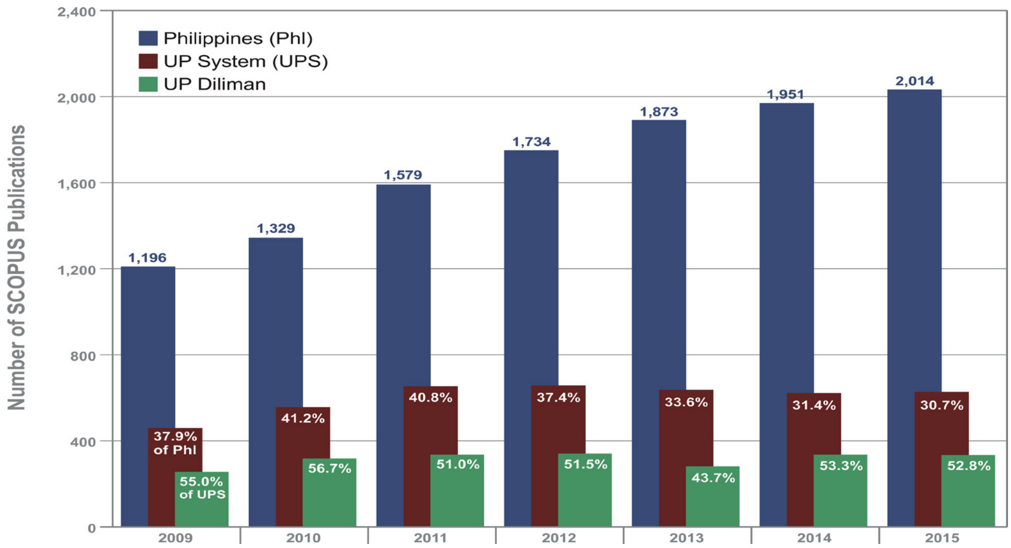


Figure 7. Number of SCOPUS-indexed publications from the country, from UP, and from UP Diliman.
Counted as publications are articles, reviews and conference papers published by a journal in the three previous years (selected year documents are excluded).

Figure 8 shows the number of SCOPUS-indexed publications that were produced by the different constituent universities (CUs) of UP from 2009 to 2015. UP Diliman accounted for 51.77 percent of the total number produced by UP, followed by UP Manila (23.43 percent) and UP Los Baños (14.74 percent). The remaining CUs contributed 10.06 percent of the total. In April 2011, UP Diliman (43.6 percent), UP Manila (16.4 percent), and UP Los Baños (24 percent) together employed 84 percent of all regular UP faculty members.

Figure 9 compares the number of SCOPUS-indexed publications from UP Diliman and the College of Science that accounted for 58.93 percent of all UP Diliman publications from 2009 to 2015. The publication number for UP Diliman peaked in 2012 at 334, while that for the College of Science was highest in 2013 at 210.

In January 2013 the College of Science employed 20.6 percent of all regular UP Diliman faculty, followed by the College of Engineering (15 percent), College of Arts and Letters (12.7 percent) and the College of Social Science and Philosophy (11.2 percent). As of November 2012, the abovementioned colleges together with the School of Economics employed a total of 444 regular PhD faculty members, and 36.94 percent of them were aged 56 years old and above. More than 31 percent (31.23 percent) of the 1,503 regular faculty members in UP Diliman are PhD (or equivalent) degree holders.

Figure 10 compares the number of SCOPUS-indexed publications from the ten constituent units of the College of Science, namely: Institute of Biology (IB), Institute of Chemistry (IC), National Institute of Geological Sciences (NIGS), Institute of Environmental Science and Meteorology (IESM), Marine Science Institute (MSI), Institute of Mathematics (IM), National Institute of Molecular Biology and Biotechnology (NIMBB), National Institute of Physics (NIP), Materials Science and Engineering Program (MSEP), and the Natural Science Research Institute (NSRI). All units offer graduate degree programs, except the NSRI.

The MSI and the NIP are consistent top producers of SCOPUS publications. Their production, however, does not show steady growth from 2009 to 2015.

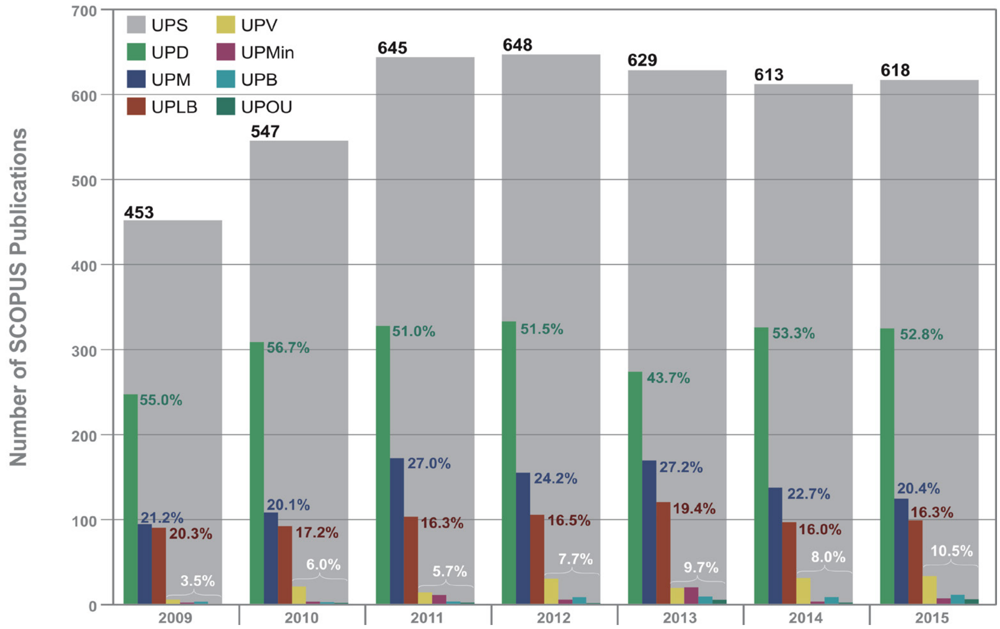


Figure 8. Number of SCOPUS-indexed publications from UP.
Its constituent universities are UP Diliman (UPD), UP Manila (UPM), UP Los Baños (UPLB), UP Visayas (UPV), UP Mindanao (UP Min), UP Baguio (UPB), and UP Open University (UPOU).

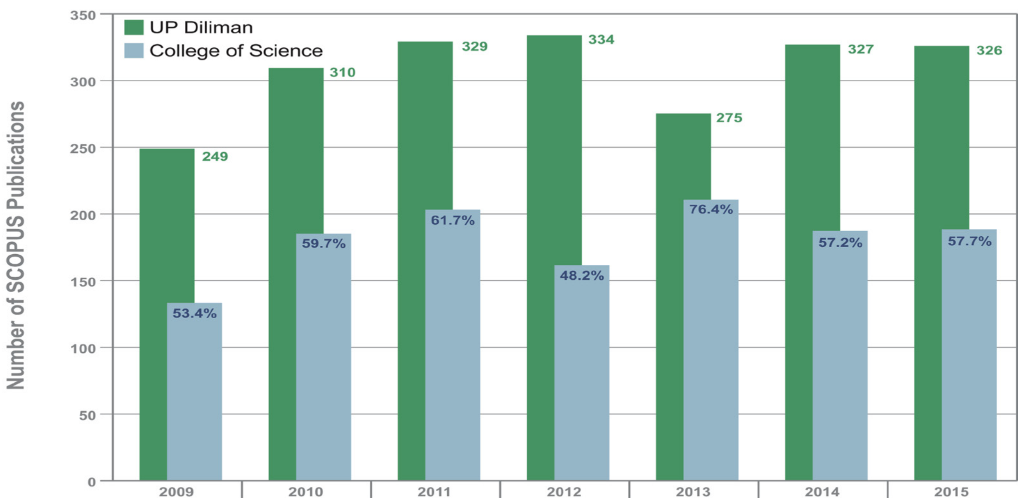
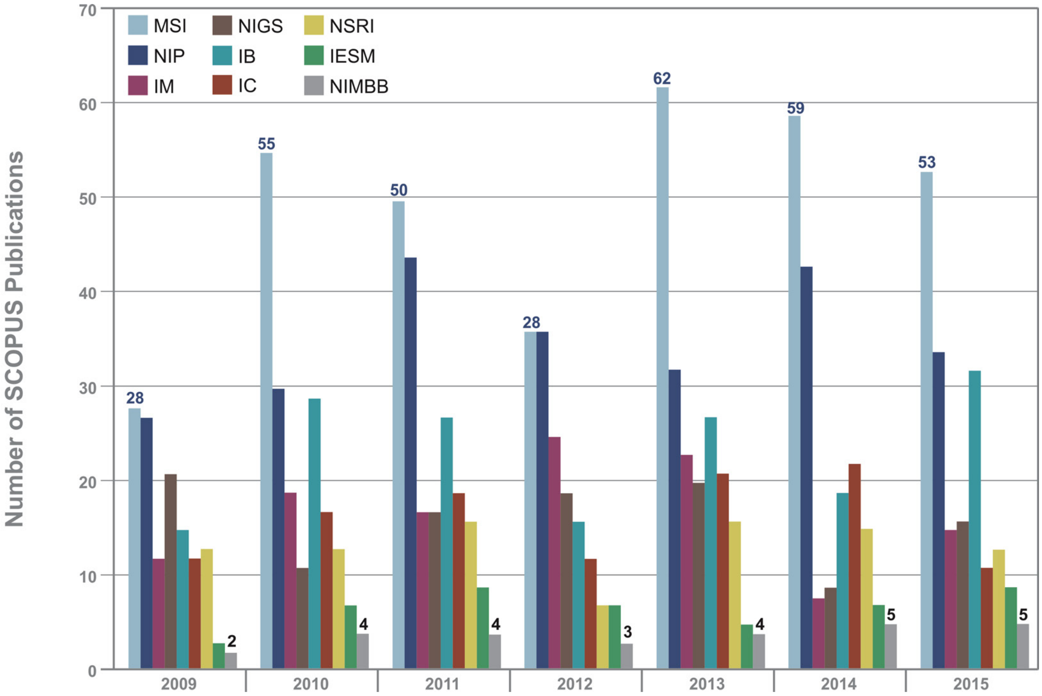


Figure 9. Number of SCOPUS-indexed publications from UP Diliman and the College of Science.
The College of Science employed 20.6 percent of all regular UP Diliman faculty in January 2013.



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Production of PhD Graduates in UP Diliman, UP Los Baños, and UP Manila

Figure 11 shows the number of PhD graduates that was produced by the three main CUs of UP from AY 1999-2000 to AY 2013-14.[10] Every year, UP Diliman produced an average of 68.47 ± 10.51 PhD graduates, followed by UP Los Baños (53.80 ± 9.32), and UP Manila (1.73 ± 1.62). Annual PhD production strongly fluctuated (greater than 10 percent variation from year to year) and did not show an increasing trend for UP Diliman and UP Los Baños. In April 2011, UP Diliman (43.6 percent), UP Los Baños (24 percent) and UP Manila (16.4 percent) employed 84 percent of all regular UP faculty members.

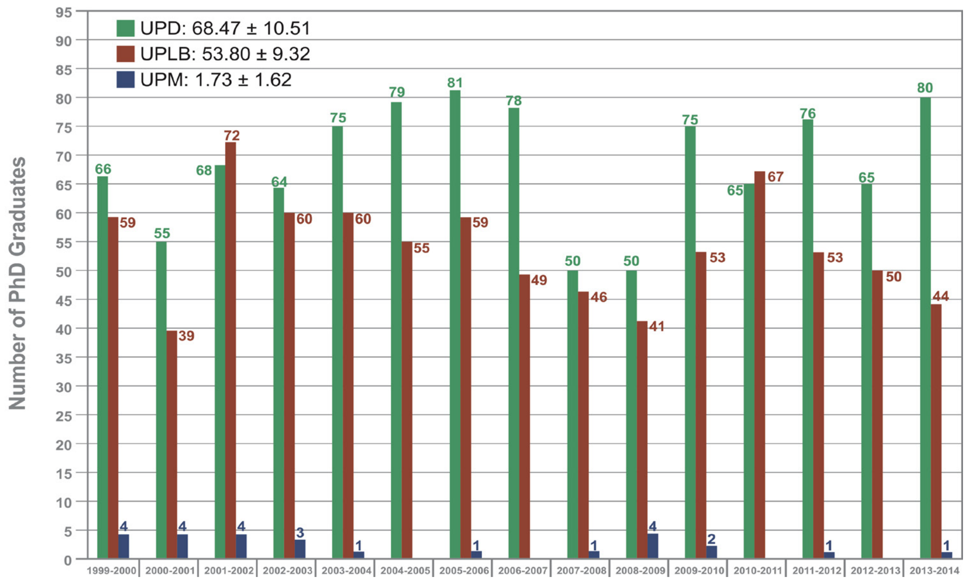


Figure 11. Number of PhD graduates produced by the three main CUs of UP from AY 1999-2000 to AY 2013-14.
Every year UP Diliman produced an average of 68.47 ± 10.51 PhD graduates, followed by UP Los Baños (53.80 ± 9.32), and UP Manila (1.73 ± 1.62).

Figure 12 tabulates the average number of PhD graduates that is produced annually by the various colleges of UP Diliman from AY 1990-91 to AY 2014-15.[10] The top five producers of PhD graduates were: College of Education (16.36), College of Science (12.56), College of Social Science and Philosophy (7.68), College of Arts and Letters (5.76), and College of Engineering (4.32). UP Diliman produced an average of 64.12 ± 16.20 PhD graduates per year over the said 25-year period.

Figure 13 plots the number of PhD graduates that was produced annually by College of Engineering (4.32 ± 5.05) and the College of Science (12.56 ± 3.87) of UP Diliman (64.12 ± 16.2) from AY 19-1991 to AY 2014-15.[10] The number of PhD graduates per year did not increase steadily for either UP Diliman or the College of Science. The number of PhD graduates from the College of Engineering has been growing since AY 2007-08, which is likely due to the implementation of the ERDT program.

In December 2015, 30.9 percent (154) and 14.66 percent (73) of all PhD faculty members of UP Diliman were affiliated with the College of Science and the College of Engineering, respectively.

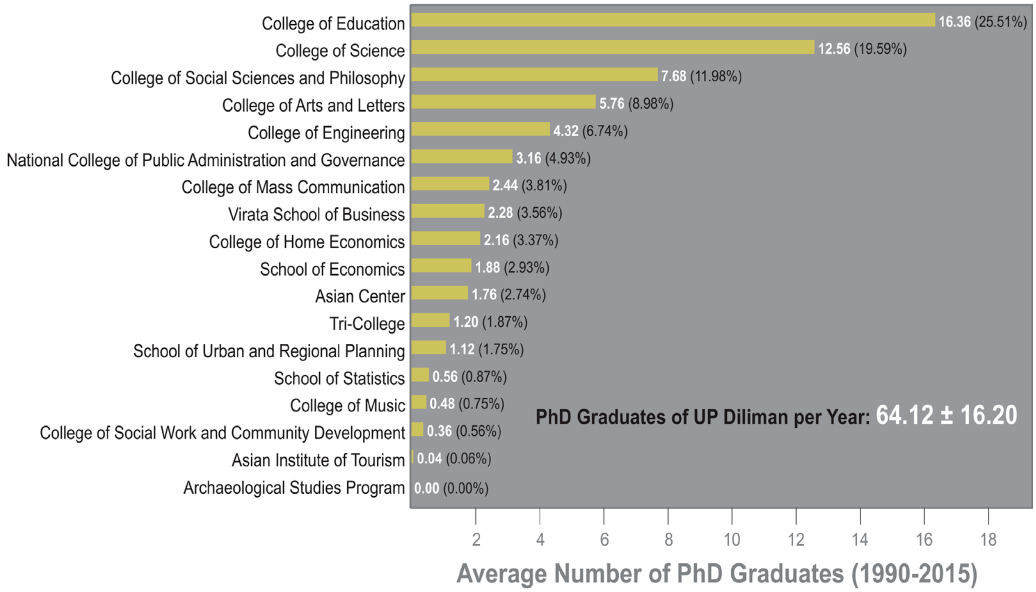


Figure 12. Average number of PhD graduates produced yearly by the various colleges of UP Diliman from AY 1990-91 to AY 2014-15.

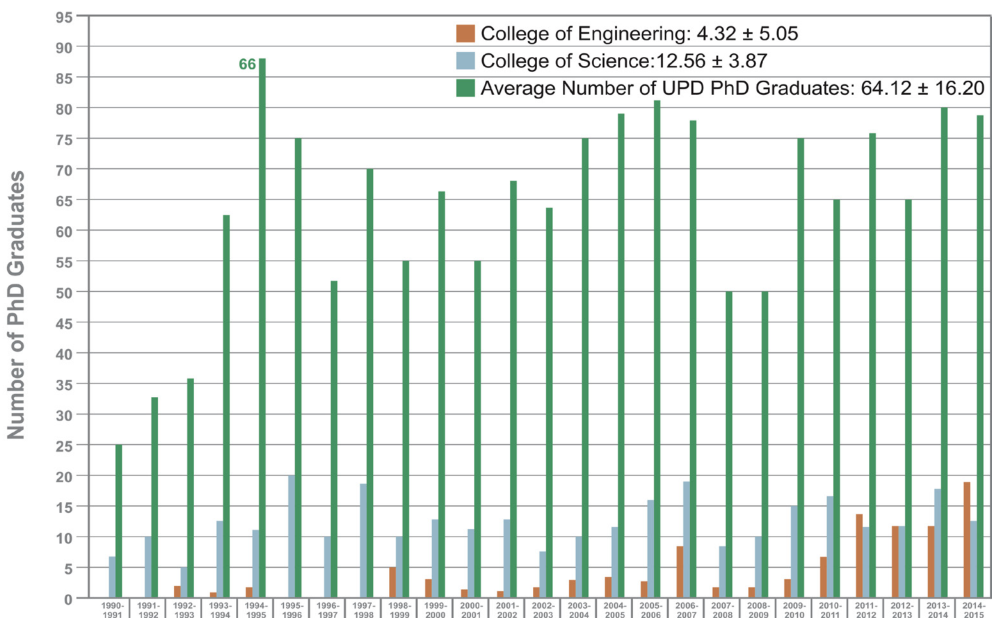


Figure 13. No. of PhD graduates produced annually by College of Engineering (4.32 ± 5.05) and the College of Science (12.56 ± 3.87) of UP Diliman (64.12 ± 16.2) from AY 1990-91 to AY 2014-15.

Figure 14 plots the average number of PhD graduates that is produced by the Institute of Biology, National Institute of Physics, Institute of Mathematics, and the Marine Science Institute. From AY 1983-84 to AY 2014-15, the College of Science produced an average of 13 ± 4.1 PhD graduates per year. The said 32-year average annual PhD production rate is broken down in the following manner: Institute of Biology (2.94, or 22.58 percent), National Institute of Physics (2.68, or 20.60 percent), Institute of Environmental Science and Meteorology (2.48, or 19.11 percent), Institute of Mathematics (2.45, or 18.86 percent), Institute of Chemistry (0.94, or 7.2 percent), Marine Science Institute (0.84, or 6.45 percent), National Institute of Molecular Biology and Biotechnology (0.52, or 3.97 percent), National Institute of Geological Sciences (0.10, or 0.74 percent) and Materials Science and Engineering Program (0.06, or 0.5 percent).

The National Institute of Physics consistently increased its PhD production rate from an average of 0.83 PhD graduates per year in the five-year period covering 1984 to 1990 to 5.8 in 2011 to 2015. On the other hand, the Institute of Biology was the top producer in the 1980s and 1990s, but its production rate dropped by more than 60 percent going into the period 2011 to 2015. The Marine Science Institute steadily increased its production rate during the 15 years from 2001 to 2015. The overall production rate of the College of Science fluctuated, since the production rates of its constituent units are not in synchrony with each other.

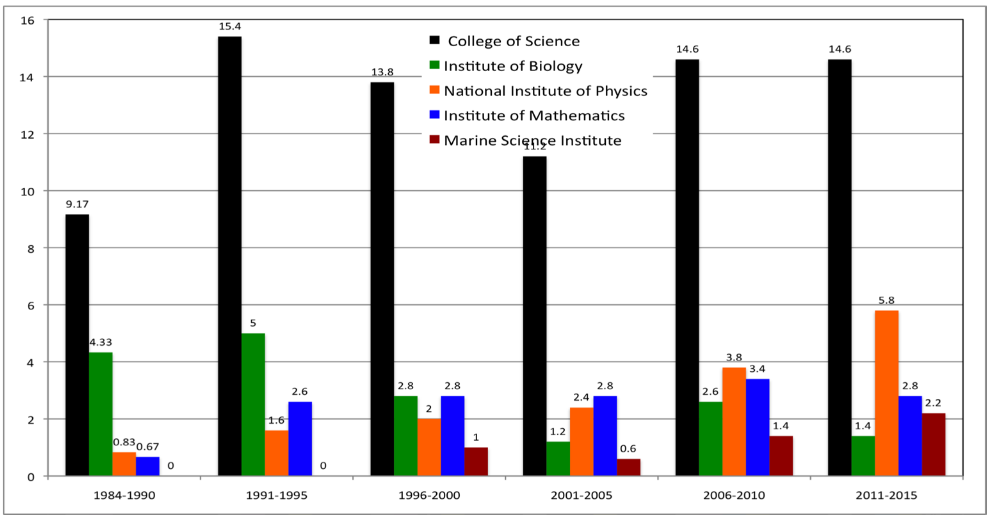
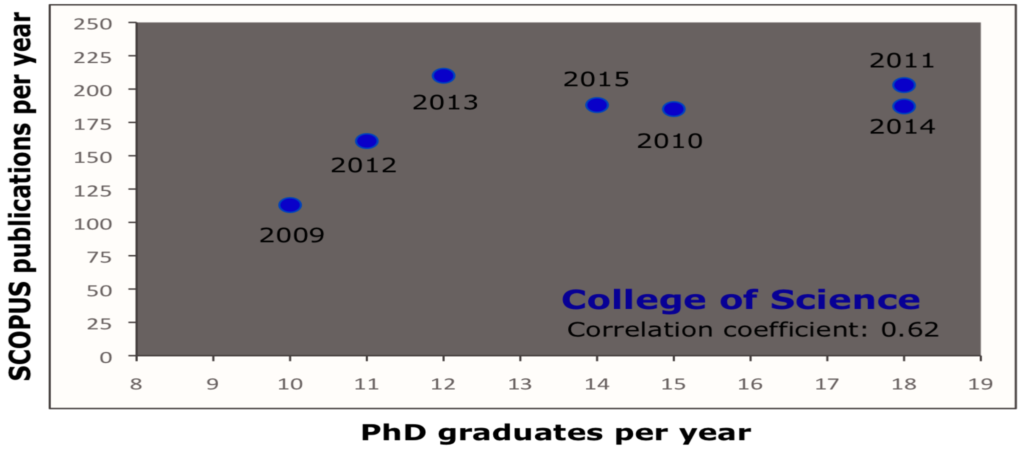


Figure 14. Average number of PhD graduates produced per year by the College of Science Institute of Biology, National Institute of Physics, Institute of Mathematics, and the Marine Science Institute.

Figure 15 plots the number of SCOPUS-indexed publications versus the corresponding number of PhD graduates that were produced for a given year (2009 to 2015) by the College of Science and UP Diliman. The correlation between peer-reviewed publication and PhD graduate production is stronger in UP Diliman (correlation coefficient: 0.84) than in the College of Science (0.62). The number of SCOPUS publications reached a plateau and became unmatched with PhD graduate production for the College. The National Institute of Geological Sciences has been able to publish consistently on a yearly basis, but failed to produce even one PhD graduate from 2009 to 2015.



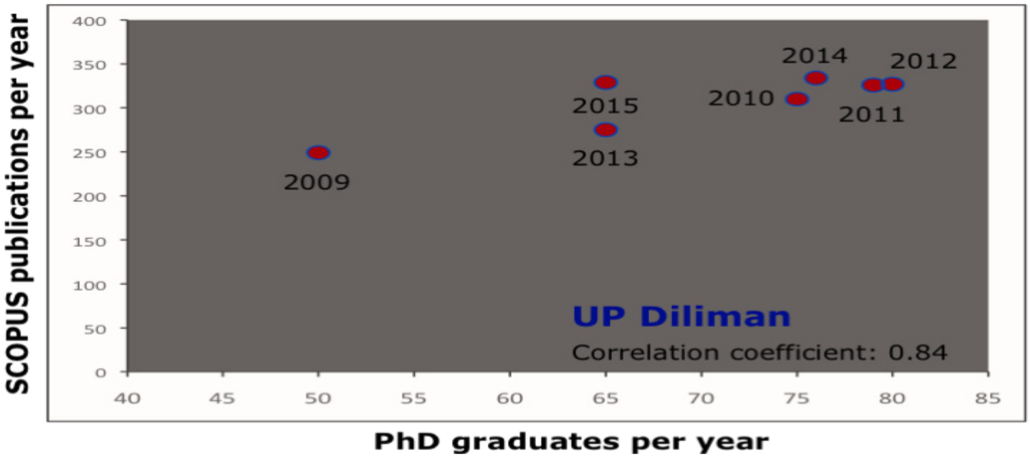


Figure 15. Number of SCOPUS-indexed publications versus number of PhD graduates produced for a given year (2009 - 2015) produced by the College of Science (top) and UP Diliman (bottom).

Duration of PhD Study in UP Diliman

The performance of 835 doctoral graduates from 59 degree programs at UP Diliman between AY 2003-04 and AY 2014-15 is examined in this section. The graduates spent an average of 7.88 ± 1.57 years to complete their academic requirements. Figure 16 presents a histogram of the number of PhD graduates and the corresponding duration of their PhD study.

A student with the prerequisite master's degree who is then admitted into the PhD program is required to complete 24 units of academic courses plus four additional units of seminar and colloquium courses. He or she is required to pass the PhD candidacy examination and successfully defend his or her dissertation work. A full-time PhD student with a pre-requisite MS degree could graduate within three years after admission. On the other hand, a PhD student that is admitted straight after completing his pre-requisite BS degree could finish within five years.

The following is the average number of years needed by PhD students to graduate, calculated per college (the second number is the actual number of PhD graduates per college): College of Social Work and Community Development (4.542 years; 8 PhD graduates), College of Engineering (5.51; 85), College of Science (6.924; 167), Virata School of Business (7.278; 18), College of Mass Communication (7.4; 40), College of Public Administration and Governance (7.717; 46), College of Arts and Letters (7.833; 60), School of Statistics (8.067; 5), College of Education (8.307; 177), College of Social Science and Philosophy (8.625; 96), College of Home Economics (8.768; 23), Tri-College (9.258; 75), School of Economics (9.487; 13), and School of Urban and Regional Planning (10.65; 22).

Table A-1 in the Appendix lists the completion times (in years) of the 835 PhD graduates according to their degree programs. The Computer Science program produced two graduates who completed their requirements in the shortest duration of 3.3 ± 0.94 years, while the longest is 11.8 ± 0.69 years for three Food Science graduates. The top five producers of PhD graduates are: Philippine Studies (75), Physics (52), Public Administration (46), Communication (40), and Educational Administration (38).

No correlation (correlation coefficient: -0.068) is apparent between the number of PhD graduates produced by a college (among the 14 colleges considered) and the corresponding average completion time. For the constituent units of the College of Science, however, the number of PhD graduates correlates fairly well (coefficient: -0.669) with completion times: NIP

(52 graduates and 3.942 years), IM (34 graduates and 7 years), IB (22 graduates and 7.47 years), MSI (17 graduates and 9.235 years), IESM – Environmental Science (16 graduates and 10.5 years), IC (9 graduates and 8.96 years), NIMBB (9 graduates and 9 years), IESM – Meteorology (6 graduates and 9.222 years) and NIGS (0). Constituent units (e.g., NIP and IM) that graduate students more quickly also produce the most number of PhD graduates.

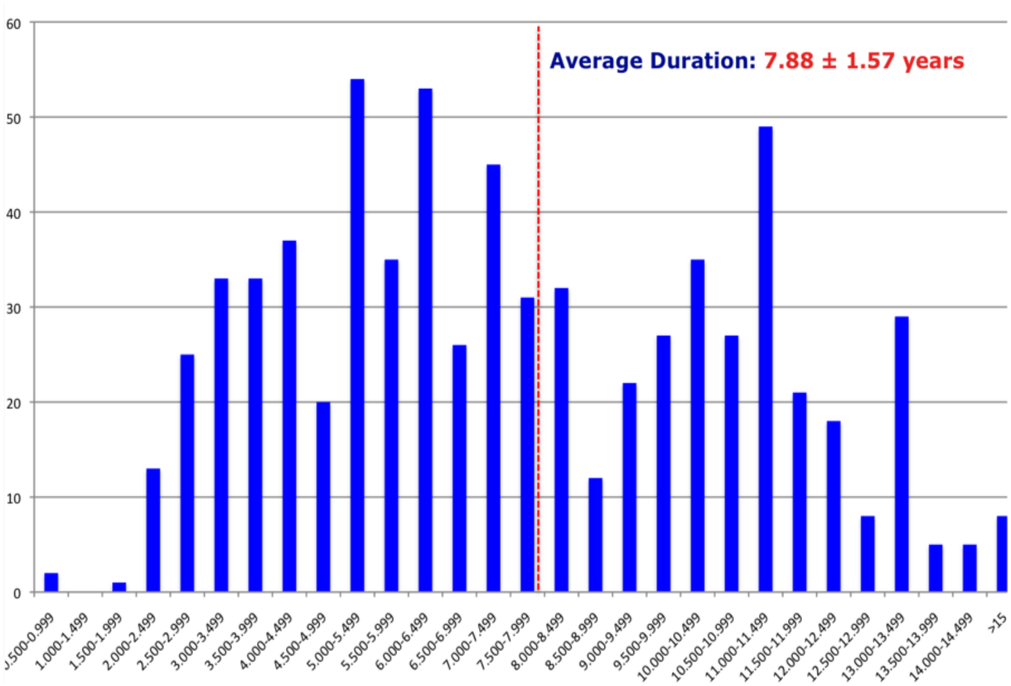


Figure 16. Number of PhD graduates (vertical axis) and their corresponding duration (in years) of study. Histogram involves a total of 835 doctoral graduates from 59 degree programs of UP Diliman between AY 2003-04 and AY 2014-15.

Metrics for Measuring the Performance of a Higher Education Institution

A more accurate measurement of the performance of an academic institution or program is to measure its outputs (in terms of PhD graduates and peer-reviewed publications) relative to the resources put into that unit. Among the possible inputs that may be applied are budget allocation, number of faculty, and faculty workload for research. For evaluating a PhD program, the possible input is the duration of PhD study.

Academic Productivity Index

The *Academic Productivity Index* (API) compares the relative performance of an institution among its peers in a cohort. The annual API score of an institution is computed as:

$$\mathrm{API} = (P \times G)^{1/2} / (F \times B)^{1/2} \qquad (1)$$

where P is the normalized number of publications per year ($0 \le P \le 1$), G is the normalized number of PhD graduates per year ($0 \le G \le 1$), F the normalized number of faculty items per year ($0 \le F \le 1$) and B is the normalized budget allocation per year ($0 \le B \le 1$). The API considers the SCOPUS publications and PhD graduates produced per year as outputs and the corresponding budget and number of faculty items as inputs.

When comparing a group of N institutions, the Gn value for the nth institution is computed as: $G_n = (g_n - g_{min}) / (g_{max} - g_{min})$, where g_n is the number of PhD graduates that it produces and g_{min} and g_{max} are the minimum and maximum PhD production values found in the group. Hence, $G_n = 1$ when $g_n = g_{max}$. The corresponding values for P_n, F_n, and B_n are computed in a similar manner. In the general case where J (> 2) input variables $\{I_j\}$ are considered, the geometric numerator product in Equation (1) becomes: $(I_1 \times I_2 \times \dots \times I_J)^{1/J}$. Similar formulation applies to the output variables that form the geometric product in the denominator.

A desirable case when comparing the performance of institutions is for them to yield comparably high API scores. In computing for the API, the output (numerator) of an institution is interpreted as a geometric product of the P and G values instead of being a sum to impose the equal importance of producing PhD graduates and generating new scientific knowledge. The API formula in Equation (1) aligns institutional production (PhD graduates) with individual faculty accomplishment (authorship of publication). An institution that does not produce a PhD graduate gets a zero API score even if its faculty members are able to publish. On the other hand, the input (denominator) is given by the geometric product of the F and B values to indicate the equal role of financial support (for capital outlay, maintenance, operation and other expenses, salaries, etc.) and human resource allocation. A high API score that is obtained with the least possible input value describes desirable performance.

At this point, the API is employed to rate the performance of the three biggest CUs of UP: UP Diliman, UP Los Baños, and UP Manila. Figure 8 presents the annual SCOPUS-indexed publication output of the three CUs while Figure

11 shows the number of PhD graduates that they produce each year. In April 2011, UP Diliman (43.6 percent), UP Los Baños (24 percent) and UP Manila (16.4 percent) employed 84 percent of all regular UP faculty members (3,430). Figure A-1 (Appendix) presents the yearly UP budget (2008 – 2015) and the corresponding budget allocations for the different CU.[11]

Figure 17 plots the yearly API scores of UP Diliman, UP Los Baños, and UP Manila from 2009 to 2015. The average API score of UP Diliman (0.99 ± 0.182) is 2.69 times larger than that of UP Los Baños (0.37 ± 0.115), and 8.59 times that of UP Manila (0.12 ± 0.118). The API score (1.222) of UP Diliman was highest in 2012. The significant differences in the API scores indicate a disparate degree of performance among the three CUs. The API scores do not reflect the sustained increases in the UP budget during the indicated period. Interestingly, the API scores were highest during the year that the UP budget was at its lowest (2012).

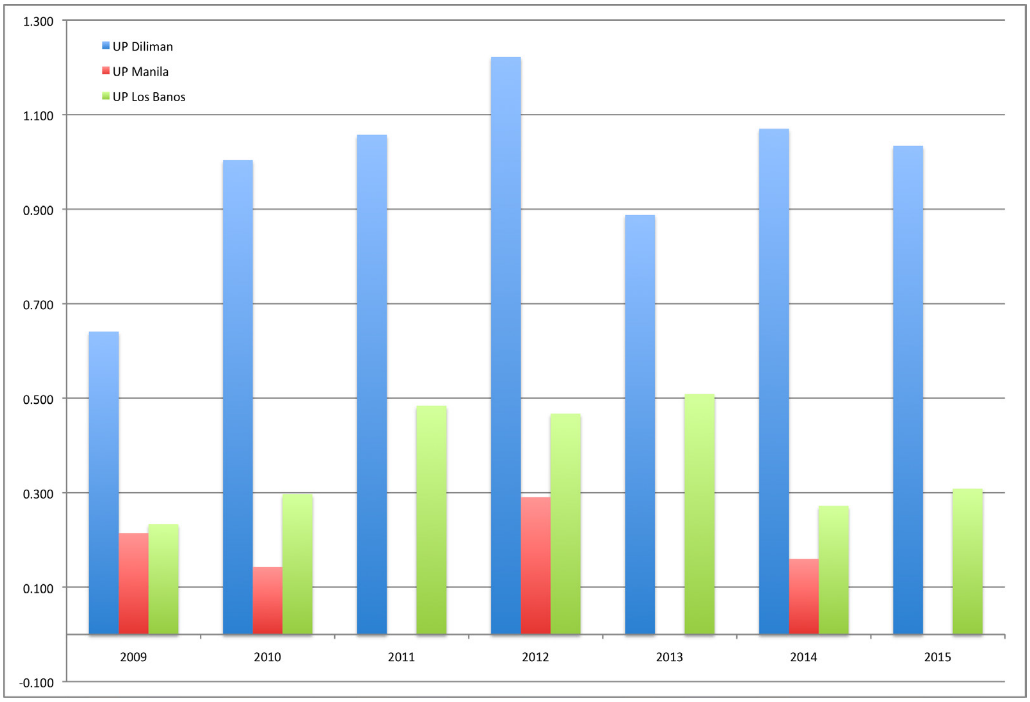


Figure 17. Yearly API scores of UP Diliman, UP Los Baños, and UP Manila. Average API scores are: UP Diliman (0.99 ± 0.182), UP Los Baños (0.37 ± 0.115), and UP Manila (0.12 ± 0.118).

Scientific Productivity Index

Another metric that can be used to rate the relative performance of academic institutions when the pertinent budget information is difficult to ascertain—which is the case for colleges and institutes that share common expenses— is the *Scientific Productivity Index* (SPI). The SPI score is calculated as follows:

$$SPI = (P \times G)^{1/2}/(F \times R)^{1/2} \qquad (2)$$

where R is the normalized research load granted to a faculty ($0 \leq L \leq 1$). In UP, for example, the regular faculty workload is 12 units per semester, comprising his or her teaching, research, and administrative load assignment.

The SPI is employed to rate the constituent units of the College of Science. Figure 10 presents the number of SCOPUS-indexed publications produced by the units, while Figures 13 and 14 show the corresponding PhD production rates. Table A-2 (Appendix) presents the regular faculty complement of the constituent units.[12] The PhD faculty members of the College are each granted a research load credit of three units (out of a total workload of twelve per semester), except for those at MSI who are given six, which means less time for teaching and more for research.

Figure 18 plots the yearly SPI scores (2008 – 2015) of the constituent units. It reveals that no unit is able to produce an annual SPI score that is increasing steadily through time. The SPI score of NIP was highest (2.323) in 2014 while MSI scored highest (1.543) in 2013.

The following are the average SPI scores: NIP (1.491), MSI (1.028), IM (0.529), IB (0.786), IESM (0.325), IC (0.204), NIMBB (0.152), and NIGS (0). The MSEP is excluded because it does not have its own faculty items, while NIGS did not produce a single PhD graduate within the period considered. The SPI scores are widely distributed, indicating varying degrees of performance—the SPI score of NIP is 9.8 times larger than that of the NIMBB.

Figure 19 plots the average SPI score against the percentage of PhD degree holders, tenured faculty, and faculty with local PhD degree on the faculty roster of a constituent unit. About fifty percent (49.7 percent) of the regular faculty members (310) of the College of Science have the required PhD degrees, while 27.4 percent (85) of them have permanent (tenured) appointments. Moreover, 36 percent (56) of the PhD faculty members obtained their degrees from UP.

The Institute of Mathematics (regular faculty: 83), Institute of Chemistry (71), National Institute of Physics (53), and the Institute of Biology (32) have large faculty rosters that include instructors who are still pursuing their graduate degrees. These institutes offer service courses to undergraduate students from other colleges in UP Diliman.

Figure 19 shows that the API scores do not correlate with the relative number of PhD faculty members and percentage of tenured faculty. More than 85 percent of the faculty of MSI (100 percent), IESM (100 percent), and the NIMBB (85.7 percent) have PhD degrees, but their SPI scores are all lower than that of NIP with only 39.6 percent. A certain level of correlation exists between API score and the percentage of PhD faculty who obtained their degrees from UP. The NIP has the highest percentage (81 percentage) and API score (1.491),

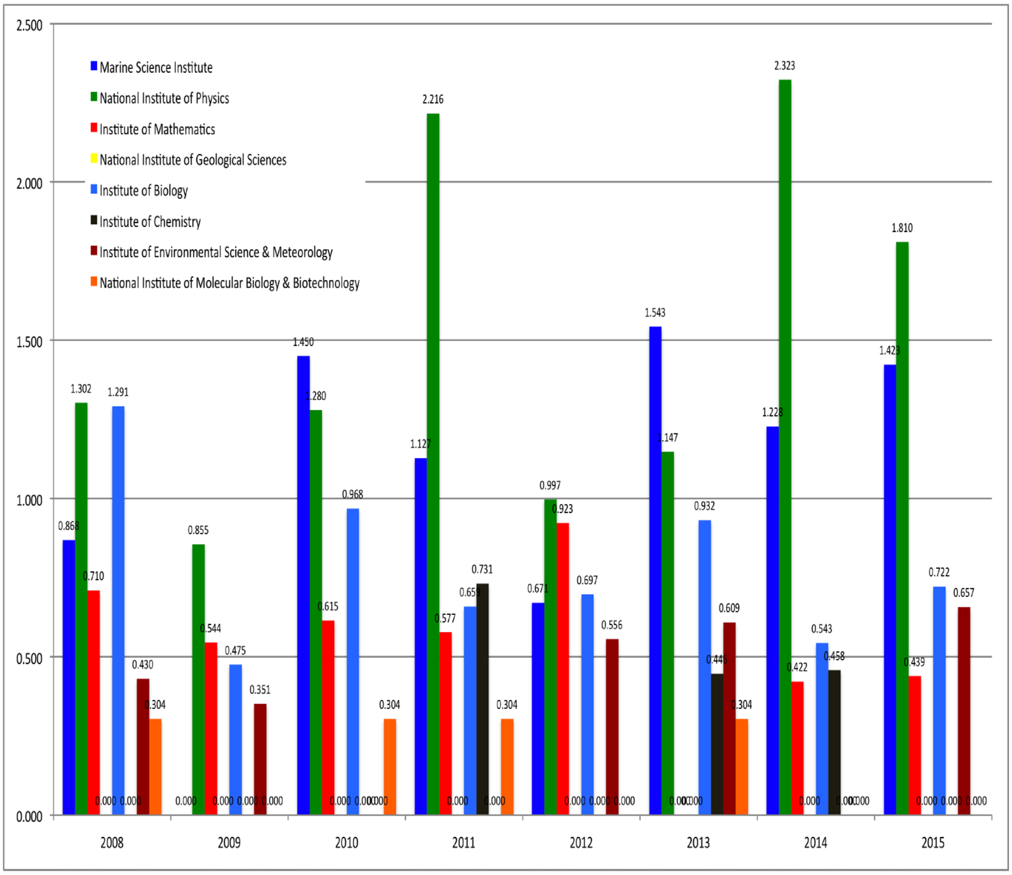


Figure 18. SPI scores (2008 - 2015) of the constituent units of the College of Science.

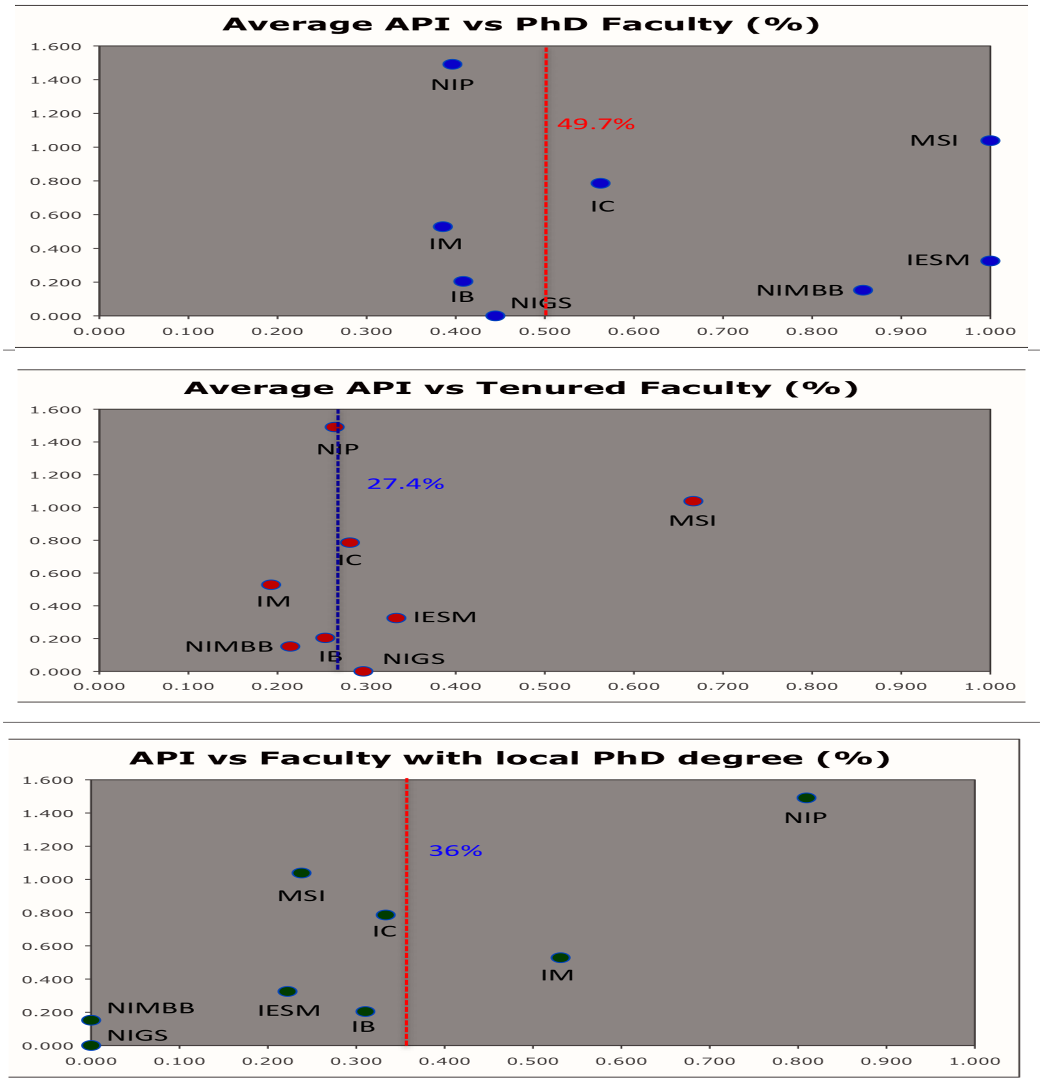


Figure 19. Average API score versus the percentage of PhD degree holders (top), tenured faculty (middle), and faculty with local PhD degree (bottom) on the faculty roster of the Institute of Biology (IB), Institute of Chemistry (IC), National Institute of Geological Sciences (NIGS), Institute of Environmental Science and Meteorology (IESM), Marine Science Institute (MSI), Institute of Mathematics (IM), National Institute of Molecular Biology and Biotechnology (NIMBB), and the National Institute of Physics (NIP). The Natural Science Research Institute (NSRI) and the Science and Society Program are non-degree granting units, while the Materials Science and Engineering Program (MSEP) has no assigned faculty items. The dotted lines indicate the values for the entire College of Science.

while NIMBB and NIGS with all foreign-trained PhD faculties have the lowest API scores among the constituent units.

PhD Production Efficiency Index

The *PhD Production Efficiency Index* (PPEI) is a possible metric for evaluating a doctoral degree program:

$$PPEI = \frac{\left(\frac{N_{PhD\min}}{N_{PhD\max}}\right) + \left(\frac{(N_{PhD} - N_{PhD\min})}{N_{PhD\max} - N_{PhD\min}}\right)}{1 + \left(\frac{N_{year(ave)} - N_{year(ave)\min}}{N_{year(ave)\max} - N_{year(ave)\min}}\right)} \tag{3}$$

where: N_{PhDmin} and N_{PhDmax} are the minimum and maximum number of PhD graduates produced in the group of programs to be evaluated, N_{PhD} the number of PhD graduates for a particular program, $N_{\mathrm{year(ave)}}$ the average duration needed to complete a program, and $N_{\mathrm{year(ave)min}}$ and $N_{\mathrm{year(ave)max}}$ are minimum and maximum average durations, respectively.

A doctoral degree program achieves a high PPEI score if it produces many PhD graduates in the shortest possible time. Programs that do not produce at least one graduate get a score of PPEI = 0. The following doctoral programs obtained the highest PPEI scores: Physics (0.656), Philippine Studies (0.594), Environmental Engineering (0.432), Public Administration (0.409), and Communication (0.364). The lowest non-zero PPEI score is 0.007.

Figure 20 plots the average SPI scores against the number of regular faculty members, the percentage of PhD faculty, and the percentage of tenured faculty with local PhDs in the College of Science (CS), College of Social Science and Philosophy (CSSP), and the College of Engineering (CoE). Tables A-3 and A-4 (Appendix) present the pertinent information for regular faculty rosters of the constituent units of the CSSP [13] and the CoE.[14]

In terms of PPEI per faculty, which is obtained by dividing the PPEI with the number of regular faculty items assigned to an institute or department offering the doctoral program, the following scores were obtained for the CS units: NIP (0.012), IESM (0.011), MSI (0.006), IB (0.006), NIMBB (0.005), IM (0.004), IC (0.001), and NIGS (0). The following are the PPEI per faculty scores that were calculated for the CoE units: Chemical Engineering Department

(0.006), Electrical and Electronics Engineering Institute (0.002), Institute of Civil Engineering (0.002) and Computer Science Department (0.001). The following are corresponding PPEI per faculty scores for the CSSP departments: Psychology (0.011), Anthropology (0.0085), History (0.0083), Linguistics (0.0033), Sociology (0.0032), Political Science (0.0020) and Philosophy (0.0003).

Doctoral programs (e.g., Material Science and Engineering, Energy Engineering, and Environmental Engineering) that are jointly administered by multiple institutes and departments are not rated. The following PPEI per faculty scores are calculated when the comparison is limited only to the three colleges that offer PhD programs in STEM: College of Science (0.00335), College of Engineering (0.00185) and College of Social Science and Philosophy (0.00209).

It is observed that the PPEI scores are not correlated with the number of tenured faculty. Having a high percentage of tenured faculty members does not guarantee a high PPEI score. The same can be said of the correlation between PPEI score and percentage of PhD faculty. The PPEI score of NIP is 0.656, while the percentage of faculty with tenure and PhD is 26 percent and 40 percent, respectively. It is 0.135 for MSI, where the percentage of faculty with tenure and PhD is 67 percent and 100 percent, respectively. The PPEI score of the Psychology Department is 0.263, while the percentage of faculty with tenure and PhD is 87.5 percent and 41.7 percent, respectively.

Discussion

The study has found that differences in the GDP per capita of Indonesia, Philippines, Vietnam, Cambodia, Myanmar, and Lao PDR do not translate to proportional variations in their corresponding publication per capita. The GDP per capita needs to reach a threshold (around USD5000) before it starts correlating with publication per capita, which is the case for Singapore, Malaysia, and Thailand. The Philippines needs a faster GDP growth and a slower rate of population increase in order to surpass the GDP threshold.

Instead of funding so-called big-ticket research programs to keep up with its more prosperous ASEAN neighbors, the Philippines should focus its attention on areas that directly improve the general quality of life of Filipinos. Meaningful success in this regard means the palpable presence of a responsive, competent, and honest government; a national-scale infrastructure network that promotes the efficient and reliable transport of people, goods, services, and information; a widely-accessible education system that builds up the human capital value of

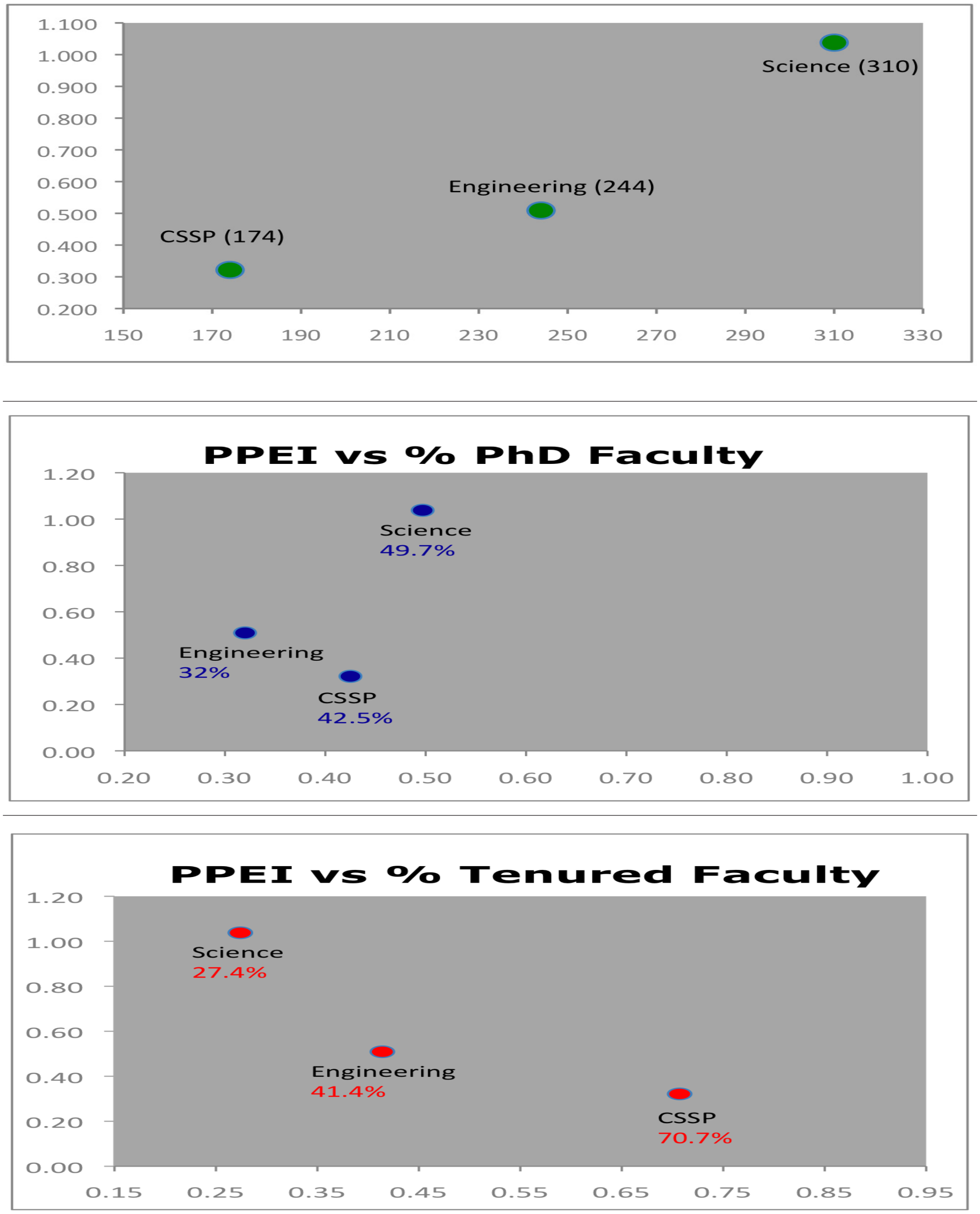


Figure 20. Average SPI scores versus number of regular faculty members (top), percentage of PhD faculty (middle), and percentage of tenured faculty with local PhD degree (bottom) in the College of Science (CS), College of Social Science and Philosophy (CSSP), and the College of Engineering (CoE).

students; an affordable and comprehensive health care service; and the earnest implementation of initiatives that effectively arrest and reverse the rising income inequality in Philippine society. Big science projects that consume billions of pesos would likely underperform or fail because their success is strongly dependent on an established culture of operational excellence and on the sustained participation of thousands of Filipino scientists and researchers – elements that simply do not fully exist in the country today.

The national budget is equivalent to 19.27 ± 1.32 percent of the GDP in the previous year (2006 – 2016). The 2014 budget allocations for SUCs and the DOST were higher by 61.5 percent and 115.1 percent with respect to their corresponding values in 2009. The 2015 GDP per capita is 57.8 percent higher than it was in 2009, while graduate enrollment rose by 34.8 percent from AY 2009-10 to AY 2014-15, with the corresponding enrollment in STEM growing by 36.4 percent. The increases in the SUC and DOST budgets are critical since graduate enrollment in the public HEIs grew from 36.5 percent in AY 2003-04 to 46.2 percent in AY 2014-15. Because the corresponding number of HEI faculty members with PhDs increased by only 3.3 percent, the increase in graduate enrollment is unlikely to result in more PhD graduates, given that most of PhD faculty members are also incapable of producing one PhD graduate per year.

UP is allotted 27.36 ± 1.32 percent of the total yearly budget for the operations of the 112 SUCs in the country. In 2006 and 2016, respectively, the DOST budget was 0.52 and 1.58 times that of UP. The ASTHRDP program produced an average of 7.3 PhD graduates per year (2010 – 2012), while the ERDT yielded 6.7 PhD graduates (2008 – 2015). Completion rate among DOST-funded PhD scholars is below 30 percent. It is worth mentioning that 56.7 percent of the PhD faculty members participating in the ASTHRDP were 51 years old or older in October 2010. The compulsory retirement age in public and private HEIs is 65 and 60 years old, respectively. A rapidly aging PhD faculty is compounding the lack of qualified PhD faculty members to handle PhD degree programs in STEM.

The API scores of UP Diliman (0.99 ± 0.182), UP Los Baños (0.37 ± 0.115), and UP Manila (0.12 ± 0.118) differ widely from each other, indicating disparate levels of performance. Moreover, their API scores are also not increasing with time—the API score of UP Diliman peaked in 2012 at 1.222.

In the 25-year period ending AY 2014-15, UP Diliman produced an average of 64.12 PhD graduates per year, with the College of Education (CoEd), College of Science (CS), College of Social Sciences and Philosophy (CSSP), and the

College of Engineering (CoE) contributing 16.36, 12.56, 7.68, and 4.32 graduates, respectively. In the 12-year period ending SY 2014-15, UP Diliman graduates (sample size: 835) took an average of 7.88 ± 1.57 years to complete doctoral degrees, with those from the CoE, CS, CoEd, and CSSP needing 5.51, 6.92, 8.31, and 8.62 years, respectively. The number of PhD graduates per college did not correlate with the average completion time.

For CS units, however, the number of PhD graduates correlates (coefficient: -0.669) with the completion times: Institutes that train PhD students more efficiently also produce the most number of graduates. On average, PhD students in NIP finish within 3.942 years after admission, the fastest among doctoral programs in UP Diliman. The NIP also yields the highest SPI score of 1.491, followed by MSI with 1.028.

For CS (with 310 regular faculty items), CoE (224), and CSSP (174), size matters in terms of PPEI scores: CS (1.038), CoE (0.509), and CSSP (0.322). At the institute or department level, however, faculty size does not correlate with the corresponding PPEI score. For example, the Institute of Mathematics (83) and IC (71) are the two largest CS units in terms of faculty number but rank only second (0.320) and sixth (0.076), respectively, among eight CS units. On the other hand, the PPEI score of CoE benefits from the strong contribution of its interdisciplinary Environmental Engineering (0.432) program. Among nine CSSP units, the highest score (0.263) is garnered by the Department of Psychology (24), which only has the fourth largest faculty size.

Among 59 doctoral programs in UP Diliman with at least one graduate, the following are the best performing in terms of PPEI scores: Physics (0.656), Philippine Studies (0.594), Environmental Engineering (0.432), Public Administration (0.409), and Communication (0.364). The lowest non-zero PPEI score is 0.007.

For CS (1.038), CSSP (0.322), and CoE (0.509), PPEI scores are not linked with the percentage of tenured faculty in the college. The CSSP (with 70.7 percent) has the highest percentage of permanent faculty members, but its PPEI is the lowest among the three. The same could be observed between PPEI score and the percentage of faculty with PhDs, CSSP with 42.5 percent yields a lower PPEI score than Engineering with 32 percent.

At this point, a reasonable production target is for a PhD faculty to produce (at least) one PhD graduate every three years. For CS, with its 154 PhD faculty members, this should mean the yearly graduation of about 50 PhD students, which is about four times the current rate of 13 ± 4.1 (1984 – 2015). For the CSSP with its 44 PhD faculty members, it means a yearly production increase to about 25 PhD graduates from its current average of 7.68 (1990 – 2015). For CoE with its 78 PhD faculty members, it implies a yearly production increase to about 25 PhD graduates from its current average of 4.32 (1990 – 2015).

Recommendations

This paper's analysis of the Philippine scientific enterprise system has led to the following set of recommendations[15]:

1. For the country's political leaders, decision makers, and socioeconomic managers to become fully aware that the symbiotic closed-loop (feedback) relationship between scientific productivity (publications per capita) and national prosperity (GDP per capita) that holds in the three most prosperous ASEAN economies (Singapore, Malaysia, and Thailand) and in other developed countries is not observed in the other six ASEAN countries, where the GDP per capita is below a certain threshold.
2. For the DOST to provide full PhD scholarships to qualified students in the social sciences and economics, while sustaining its current support to those taking PhD degree programs in STEM. The Philippines is confronted with complex challenges (e.g., climate change, income inequality, inefficient distribution of people, public services, goods, and information) that are best addressed by the interdisciplinary collaboration of experts. A significant percentage of the increases in the year-to-year DOST budget is best spent on human capital generation in the form of student scholarships from high school to STEM PhD students to postdoctoral fellows.
3. For the DOST to offer postdoctoral fellowship awards to qualified PhD graduates from Philippine universities, thereby enabling them to carry out postdoctoral research work in leading foreign research laboratories in the United States, Europe, Japan, South Korea, etc. The said fellowship program shall not require applicants to have current employment affiliation with public institutions and government agencies. The only return-service-obligation is for the fellows to return and work in the country for at least three years for every year spent abroad. The postdoctoral fellowship awards will attract additional young Filipino talents to pursue PhD studies and help build the scientific infrastructure of the country.
4. For the DOST and UP to formulate jointly a separate procurement system governing the use of public funds in scientific R&D activities. It would feature a separate Implementing Rules and Regulations of Republic Act

9184 – The Government Procurement Reform Act, which was first signed into law in January 2003. The aforementioned procurement system shall include a depreciation formula for research facilities, equipment, devices, and components. It shall allow the direct importation of equipment and technical services from internationally-recognized and established manufacturers and service providers free of tax and custom duties. In addition, imported products that are for R&D use shall be brought directly to the research laboratory without initial storage in the Bureau of Customs. The concerned foreign manufacturers will not be required to have local distributors and representatives. The permission applies only to publicly-funded R&D projects that are performed in an ERDT and ASTHRDP member institution. The procurement system shall also feature a clear-cut procedure for regularly adjusting the price ceiling for shopping and small-value procurement that considers possible variations in inflation rate, consumer price index, and foreign exchange rate. A responsive procurement system is essential in the proper operations and maintenance of research laboratories and even university campuses.

5. For the public HEIs—especially UP, being the national university—to develop and apply performance measures that align institutional output (PhD graduate production) with the individual accomplishments (publications, citations, patents, etc.) of faculty and staff. Data-driven analytical tools (e.g., API, SPI, PPEI) shall be used to accurately track the ability of an HEI or academic program to respond optimally to increases in the amount of resources that is given to it. The coupling of institutional output with individual productivity will ensure sustained institutional growth by attracting young talent to join the organization and work together toward a shared institutional goal. NIGS is a case in point—it has produced only three PhD graduates since AY 1984-85 (32 years) and none since 2000, even though its faculty members have been able to publish an average of 15 SCOPUS-indexed papers a year since 2009.
6. For UP and the other SUCs to employ analytics in recognizing and promoting faculty members and staff. Scientific measures of excellence are crucial in building an enabling and nurturing ecosystem that is founded on transparency, predictability, fairness, and meritocracy. Their use will motivate the faculty, staff, and administrators to work together for a common purpose.
7. To rely extensively on analytics in choosing officials and administrators of SUCs. A candidate who underperforms as a department head is unlikely to become a successful CEO of a more complex organization like a college

or a university. Performance metrics that distinguish the output from the input variables would minimize, if not eliminate, the trivialization of excellence and the perpetuation of mediocrity in the academe. UP, being a recipient of almost a third of the entire SUC budget, should serve as a role model of effective governance and a veritable source of best practices in the country.

8. For public HEIs to invest seriously in building a culture of excellence in campus operations, which includes the availability of a reliable data gathering and management system. An HEI that cannot maintain a clean, safe, and secure campus is likely incapable of operating research laboratories and programs that produce cutting-edge scientific results.
9. For UP to allocate a sufficient regular budget for the maintenance and operation of the National Science Complex in UP Diliman, and to complete the construction of the Engineering Complex in UP Diliman that was started in 2007.
10. To decouple salary grade increase from academic (and administrative) rank promotion in UP and the other SUCs. Decoupling would allow the prompt promotion of an individual faculty or staff who has been duly recognized for his or her work without waiting for a DBM allocation. Such a policy would also allow salary grade increases to faculty members with the academic rank of Professor 12, as well as to deserving administrative personnel who are already occupying the highest salary grade level in their assigned administrative item (*sagad*).

Acknowledgement

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Notes

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9. ERDT participating institutions: University of the Philippines, Central Luzon State University, Mindanao State University-Iligan Institute of Technology, Ateneo de Manila University, De La Salle University, Mapua Institute of Technology and the University of San Carlos.
10. Sources: UP Diliman (Office of the University Registrar), UP Los Baños (Yearly Commencement Programs) and UP Manila (Graduate Office).
11. Source: Office of the UP Vice-President for Finance.
12. Sources: Office of the College of Science Dean, UP Diliman Human Resource Development Office.
13. Source: Office of the Dean, College of Social Science and Philosophy, UP Diliman.
14. Source: Office of the Dean, College of Engineering, UP Diliman.
15. Additional details are available at http://cids.up.edu.ph/can-ph-improve-science-enterprise/.

Annex

Table A-1. Completion times (in years) of 835 PhD graduates by doctoral degree program (No. of programs: 59); Period: First semester, AY 2003-04 – Midyear 2015.

Doctoral Program	Average Duration (Years)	No. of Graduates
Food Science	11.8	3
Urban and Regional Planning	10.7	22
Sociology	10.5	7

Table A-1. Completion times (in years) of 835 PhD graduates by doctoral degree program (No. of programs: 59); Period: First semester, AY 2003-04 – Midyear 2015.

Doctoral Program	Average Duration (Years)	No. of Graduates
Environmental Science	10.5	16
Creative Writing	10.3	1
Political Science	10.3	8
Education (Anthropology and Sociology of Education)	10.0	9
Education (Reading Education)	10.0	17
Education (Research and Evaluation)	9.9	15
English Studies: Language	9.7	2
Linguistics	9.6	5
Economics	9.5	13
Energy Engineering	9.4	4
Philippine Studies	9.3	75
Anthropology	9.2	15
Marine Science	9.2	17
Meteorology	9.2	6
Molecular Biology and Biotechnology	9.0	9
English Studies: Anglo-American Literature; Creative Writing; Language	9.0	19
Home Economics	8.5	19
Education (Educational Administration)	8.5	38
Education (Special Education)	8.5	15
Education (Social Studies Education)	8.4	4
Education (Physics Education)	8.3	2
Chemistry	8.3	9
Psychology	8.3	31
Education (Curriculum Studies)	8.1	7
Statistics	8.1	5
English Studies: Creative Writing	8.0	1
Education (Educational Psychology)	7.9	23
Public Administration	7.7	46
Chemical Engineering	7.7	19
History	7.7	29

Table A-1. Completion times (in years) of 835 PhD graduates by doctoral degree program (No. of programs: 59); Period: First semester, AY 2003-04 – Midyear 2015.

Doctoral Program	Average Duration (Years)	No. of Graduates
Biology	7.5	22
Communication	7.4	40
Filipino: Istruktura ng Wikang Filipino; Malikhaing Pagsulat, Pagpaplano sa Wikang Filipino, Pagsasalin, Panitikan)	7.4	25
Education (Language Education)	7.4	14
Education (Mathematics Education)	7.3	15
Business Administration	7.3	18
Mathematics	7.0	34
Materials Science and Engineering	7.0	8
Comparative Literature: Comparative Literary Theory; Literary Translation; Philippine Literature in English; Popular and Folk Literatures; Regional and National Literatures	6.9	8
Education (Biology Education)	6.8	4
Education (Chemistry Education)	6.7	1
Material Science Engineering	6.5	2
Hispanic Literature: Spanish American Literature; Spanish Filipino Literature; Spanish Peninsular Literature	6.5	2
Education (Educational History and Philosophy)	6.1	6
Education (Guidance)	6.0	7
Philosophy	5.7	1
Filipino: Panitikan	5.3	1
Civil Engineering	4.9	8
Nutrition	4.7	1
Social Development	4.5	8
Electrical and Electronics Engineering	4.4	8
Filipino: Pagsasalin	4.3	1
Environmental Engineering	4.1	35
Physics	3.9	52
Chemical Engineering	3.3	1
Computer Science	3.3	2

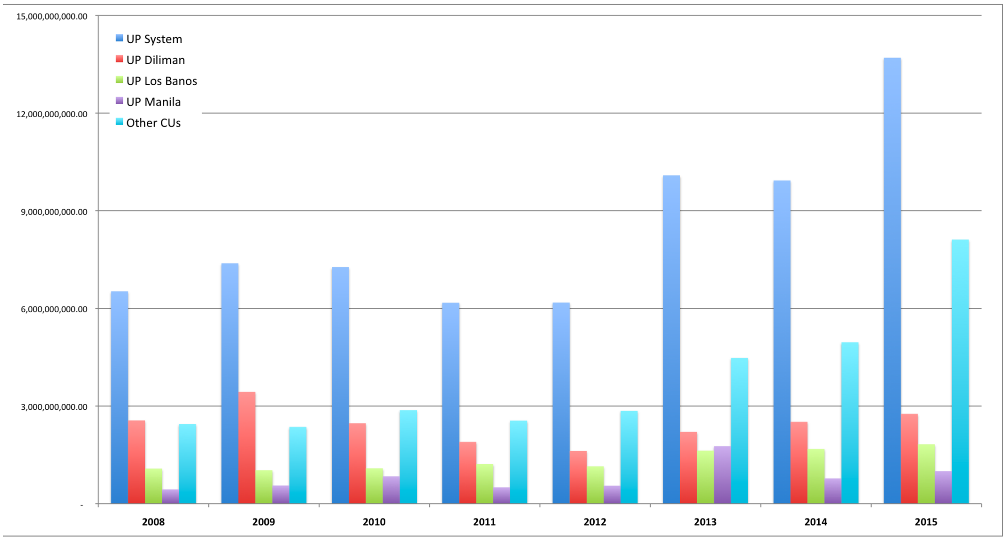

Figure A-1. Annual UP budget and corresponding allocations to constituent units (2008 - 2015).
In 2008 the percentage allocations were: UP Diliman (39.22 percent), UP Los Baños (16.51 percent), UP Manila (6.71 percent), Office of the UP President (2.99 percent), and other CUs (37.55 percent). In 2015 the percentage allocations were: UP Diliman (20.14 percent), UP Los Baños (13.32 percent), UP Manila (7.3 percent), Office of the UP President (6.54 percent), and other CUs (59.24 percent).

Table A-2. Regular faculty distribution in the constituent units of the College of Science, UP Diliman

CS Unit (as of December 2015)	Regular faculty	PhD faculty	With PhD deg from UP	With tenure
MSI	21	21	5 (24%)	14
NIP	53	21	17 (81%)	14
IM	83	32	17 (53%)	16
NIGS	27	12	0	8
IB	32	18	6 (33%)	9
IC	71	29	9 (31%)	18
IESM	9	9	2 (22%)	3
NIMBB	14	12	0	3
NSRI		(3)	0	
TOTAL	310	154 (49.7%)	56 (36%)	85 (27.4%)

Table A-2. Regular faculty distribution in the constituent units of the College of Science, UP Diliman

Note: The constituent units consist of: Institute of Biology (IB), Institute of Chemistry (IC), National Institute of Geological Sciences (NIGS), Institute of Environmental Science and Meteorology (IESM), Marine Science Institute (MSI), Institute of Mathematics (IM), National Institute of Molecular Biology and Biotechnology (NIMBB), National Institute of Physics (NIP), and the Natural Science Research Institute (NSRI). The NSRI and the Science and Society Program are non-degree granting, while the Materials Science and Engineering Program (MSEP) has no assigned faculty items.

Table A-3. Regular faculty distribution of the constituent departments of the College of Social Sciences and Philosophy, UP Diliman

CSSP Department (December 2015)	Regular faculty	PhD faculty	Tenured Faculty
Anthropology	14	7	8
Geography	9	5	5
History	31	13	20
Linguistics	12	4	7
Philosophy	30	10	25
Political Science	30	12	22
Psychology	24	10	21
Sociology	16	7	9
Population Institute	8	6	6
TOTAL	174	74 (42.5%)	123 (70.7%)

Table A-4. Regular faculty distribution in departments of the College of Engineering, UP Diliman

Engineering Unit (December 2015)	Regular faculty	PhD faculty	Tenured faculty
Electrical & Electronics Eng'g Institute	47	18	16
Institute of Civil Engineering	48	19	24
Department of Chemical Engineering	29	11	11
Department of Computer Science	32	8	17
Department of Geodetic Engineering	18	4	6
Department of Industrial Engineering & Operations Research	22	6	10
Department of Mechanical Engineering	19	4	8
Department of Mining, Metallurgical & Materials Engineering	29	8	9

Table A-4. Regular faculty distribution in departments of the College of Engineering, UP Diliman

Energy Engineering Program			
Environmental Engineering Program			
Total	244	78 (32%)	101 (41.4%)