An Economic Rationalization Framework for Higher Education

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Abstract

The marginal rate of returns (MRR) of higher education programs affect a country's economy. It is in this light that the current study primarily intends to determine which higher education programs the state should fully subsidize and which programs the private education service providers should take charge of. The net effect of this identification is to rationalize the supply side of the economy. Quantitative non-experimental retrospective explanatory design and data mining techniques were used. Consequently, based on the programs' marginal rate of returns, indeed there are certain higher education services that bring about public good while some others do not. Agriculture, services, humanities and arts, sciences, health and welfare, engineering, manufacturing and construction, and education programs demonstrate greater public good while social sciences, business, and law generally promote greater private returns to the individuals rather than to the society.

Keywords: rationalization framework, HEIs, subsidy, data mining

1.0 Introduction

While basic education is universally-accepted as a state responsibility, tertiary education is sometimes argued as a state function but may also be viewed otherwise. The determination of who should shoulder the cost of higher education is dependent on how the state sees higher education as a good: as a public good or as a private good. Proponents of the public good nature of higher education (Shaw, 2010; Kocaqi, 2015; Pham & Briller, 2015) point to the direct link of higher education to the national economy. Citizens, equipped with higher education and training, stimulate productivity, promote innovation and technology, and contribute substantially to the national development, in general (Asian Development Bank, 2014). For these reasons, the state should provide for and support higher education.

Meanwhile, Schoenenberger (2005) argues that higher education is the responsibility of the individual citizens because it mainly enhances private good. An individual who obtains a college degree increases his chances of enriching himself but contributes little to societal economic welfare. Thus every citizen desiring to improve his lot should invest personally in higher education and training. Consequently, the state's responsibility for education ceases at the basic education level.

These aforementioned points ignore the details of higher education and view it as a single commodity in the education market. The danger of such an appreciation of higher education lies in the possibility of a wholesale overgeneralization of the services. It is like saying that "All Filipinas are beautiful with a heart" and, yet, find a specific instance of a "Filipina who is neither beautiful nor with a heart". Hence this study hopes to demonstrate that certain higher education services bring about greater public good while some other services do not.

The philosophy adopted by the higher education sector directly impacts on the higher education service providers: public or private. This philosophy also defines the nature of the education market in the country. Viewing higher education as a public good implies the preponderance of state-funded colleges and universities and defines a monopolistic market economy. In such a monopolistic environment, quality depends heavily on the magnitude of public investment in higher education. Chen (2013) averred that highly-developed economies benefit the most in terms of quality through a monopolistic public higher education system. On the other hand, less developed economies that adopt a public higher education system are unable to fully sustain and suffer the backlash of mediocre quality (Shaw, 2010).

A state that advocates a "private good" view of higher education encourages the participation of the private sector in service delivery. A free-market economy is characterized by competition. Classical economics (Smith, 1776) predicts that for such a market structure, quality increases and reaches certain equilibrium. The long-run quality of higher education of a private-led economy is, thus, primarily defined by the equilibrium condition. Economic studies about market equilibrium (Nash, 1953) also predict that the equilibrium quality occurs at the "average": the norm set by society.

In most countries of the world (Unites States, Great Britain, France, Japan, including the Philippines), a mix of public and private higher education service providers exists. The existence of these two (2) types of economic players in the market is neither founded on the "public good" philosophy nor the "private good" belief. Consequently, the state-funded higher education service providers are viewed as competitors by the private ones. According to Puno (2005), the competition, however, is not the type that enhances quality but a competition that is labeled as unfair because the "playing field is not even". He further mentions the need to make public service more private and for the private sector to be more public. However, since a higher education market framework for a mix of public-private sector players is non-existent, a way to rationalize the market operatives has not been defined.

This academic undertaking also argues that a market structure that optimizes quality in the context of mixed public-private economic providers can be formulated anchored on a "level playing field" concept where both supply (higher education services) and demand (the students) are differentiated and targeted.

This study focuses on the marginal rate of returns of the various higher education programs to the country's economy. Its primary purpose is to determine which higher education programs the state should fully subsidize and which programs the private sector should take charge of. The net effect of this identification is to rationalize the supply side of the economy.

The Economic Higher Education Rationalization

Framework (EHER) is an essential input for higher education policy. The 21st century has seen a tremendous expansion of higher education globally. In Southeast Asia, East Asia, and the Pacific, higher education enrollment rose twelve-fold from 1970 to 2007 (from 3.9 M in 1970 to 46.7 M in 2007), as noted by the Asian Development Bank (2012). No substantial increase in government support for higher education has been pointed out despite the huge enrollment increase. In the Philippines, public expenditure for higher education was only 0.273% of the GDP in 2009 (Department of Budget and Management, 2016) compared to the 2% expenditure in more developed economies (Altbach, 2009). The magnitude of public expenditure on higher education reflects the philosophical stance of government leaders: those who believe that higher education is a public good will invest more while those who do not will invest less.

When the state fails to substantially invest in higher education amidst strong demand for the service, the vacuum is filled in by the private sector. Underinvestment in public higher education adversely affects quality in state-funded higher education institutions. This quality, nonetheless, becomes the equilibrium quality target for most of the private sector service providers. Consequently, the overall quality of higher education becomes less than satisfactory for both the state and the international community (Shaw, 2010).

Although there are already existing higher education frameworks, an economic higher education rationalization framework that stimulates healthy competition among the economic players in the developing countries raises the overall equilibrium quality condition. For this reason, the development of such a framework is urgently needed in the Philippines when the country is poised to join the much broader ASEAN economies.

2.0 Methodology

This study utilized the quantitative, non-experimental, retrospective explanatory research design to explain the relationship between GDP and percentage of graduates per higher education program as basis for the rationalization framework. Data mining techniques were used to determine the patterns that emerge out of the data plots of GDP versus the percentage of graduates per higher education program. This paper considered the problem of defining and quantifying the rate at which each graduate of a higher education program contributes to the national economy and how such programs (treated as service commodities) may be assigned to the state and the private sector. The researcher tacitly assumed that a program that produces graduates with higher contributions to the national economy has greater public good than one which is not. Those programs with lower contributions to the national economy are programs that promote private returns to the individuals rather than to the society as a whole.

The study focused on the analysis of selected Asian economies with more or less similar situations: developing or underdeveloped economies, the participation of the private sector in higher education, and democratic societies. The most recent available data from eighteen (18) Asian economies on their 2014 higher education programs were obtained from reliable internet sources (United Nations Educational, Scientific and Cultural Organization Institute for Statistics, 2016) (Note: this paper was finished January 2017). These graduates who joined the countries' labor force within the year and contribute to the Gross

Domestic Product (GDP) were thoroughly compiled in a reliable internet database (International Monetary Fund, World Economic Outlook Database, 2015). From the list of all Asian countries, only those with complete information on both their 2014 percentage of graduates per program and 2015 GDP for a total of eighteen (18) countries (roughly 40% of all Asian countries) were included. These countries are Azerbaijan, Japan, Lao People's Democratic Republic, Malaysia, Mongolia, Nepal, Philippines, Sri Lanka, Vietnam, Indonesia, Afghanistan, Armenia, India, Bangladesh, Georgia, Bhutan, Kyrgyzstan, and Kazakhstan. Even though these Asian coutries have commonalities, one limitation of this study is the fact that there are still varying levels in terms of their economies and the extent or proportion of private and public higher education institutions in each country.

The higher education courses were grouped into eight (8) programs based on the 2011 International Standard Classification of Education or ISCED (UNESCO, 2011). The multi-disciplinary programs were classified according to a majority rule (in the field in which students spent most of their time). These are agriculture (Ag), education (Ed), engineering, manufacturing and construction (Eng), health and welfare (HW), humanities and arts (HA), sciences (Sci), services (Serv), and social sciences, business, and law (SocSci).

Agriculture (Ag) program includes courses such as agriculture, forestry, and fishery agriculture, crop and livestock production, agronomy, animal husbandry, horticulture and gardening, forestry and forest product techniques, natural parks, wildlife, fisheries, fishery science and technology, veterinary medicine and veterinary assisting.

For education (Ed), it includes teacher training and education such as science teacher training for pre-school, kindergarten, elementary school, vocational, practical, non-vocational subject, adult education, teacher trainers, and disabled children. General and specialized teacher-training programs in education science such as curriculum development in non-vocational and vocational subjects; and educational assessment, testing, and measurement, educational research, other education science.

Engineering, manufacturing, and construction (Eng) include engineering and engineering trades (such as engineering drawing, mechanics, metal work, electricity, electronics, telecommunications, energy and chemical engineering, vehicle maintenance, surveying), manufacturing and processing, architecture and building, and civil engineering.

Health and welfare (HW) comprise of health medicine, medical, dental services, social services, and social work.

Humanities and arts (HA) include fine arts, performing arts, graphic and audio-visual arts as well as craft skills. Humanities, religion and theology, foreign languages and cultures, native languages, and other humanities are also included.

Science (Sci) comprises life sciences, physical sciences (astronomy and space sciences, physics, other allied subjects, chemistry, other allied subjects, geology, geophysics, mineralogy, physical anthropology, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, marine science, volcanology, paleoecology. Mathematics, statistics, and computing are also included.

Services (Serv) include personal, transport, environmental, and security services.

Social sciences, business, and law (SocSci) comprise of social and behavioral science, ethnology, futurology, psychology, geography (except physical geography), peace and conflict studies, human rights), journalism and information (journalism; library technician and science; technicians in museums and similar repositories; documentation techniques; Archival sciences), business and administration (retailing, marketing, sales, public relations, real estate), finance, accounting (auditing, bookkeeping), management (public administration, institutional administration, personnel administration, secretarial and office work), and law local magistrates.

Data mining techniques were utilized to determine the patterns that emerged out of the data plots of GDP versus the percentage of graduates per higher education program. It is assumed that hidden in the plots are the relationship of the form:

$$\text{lo gGDP} = \text{f (percentage of graduates/ program)} + \text{noise} \quad \textbf{(1)}$$

The goal is to explain the relationships between GDP and the percentage of graduate per program with due consideration of any deviance of the data. Minimizing and, or eliminating "deviances" or "outliers" will highlight the true relationship of GDP and the percentage of graduate per program, which can be done by polynomial regression techniques. It can be inferred that the relationship obtained in (1) is "acceptable" whenever the R^2 X 100% value exceeds 80% (R^2 is a statistical measure of how close the data are to the fitted regression line):

Acceptability criterion: R^2 X 100% ≥ 80% **(2)**

Equivalently, we can use the signal-to-noise ratio (SNR) as a criterion:

$$\text{SNR} = \frac{SSR}{\frac{SSE}{n-2}} = \frac{\text{variance explained by the model}}{\text{variance of the error/noise}} = f \quad \textbf{(3)}$$

The marginal rate of return (MRR) of a higher education program is defined as the change in GDP per unit change in the percentage of graduates in the programs:

$$\text{MRR} = \frac{\text{change in GDP}}{\text{Change in the \% of graduates}} = \frac{\partial(\text{GDP})}{\partial(\text{percentagegraduates})} \quad \textbf{(4)}$$

Evaluated at the current percentage of graduates, the interpretation of MRR is as follows:

$$\begin{gathered} MRR\ (x - Xo) = positive, greater\ public\ good \\ MRR\ (x - Xo) = negative,\ greater\ private\ returns \end{gathered} \quad \textbf{(5)}$$

The MRR of a higher education program per type of higher education institution (public or private) is defined as the change in GDP per unit change in the percentage of graduates in the programs per type of HEI (public or private HEIs).

$$\text{MRR} = \frac{\text{change in GDP}}{\begin{array}{c}\text{Change in the percentage of}\\ \text{graduates per HEI type}\end{array}} = \frac{\partial(\text{GDP})}{\partial(\%\text{graduates})\text{per HEI type}} \quad \textbf{(6)}$$

The optimal percentage of graduates per program is the point at which the program contributes the highest in the GDP of the country. It is derived by equating the slope to point 0.

Taking into consideration the overall MRR, current and optimal percentage of graduates per program in both public and private HEIs and MRR of both public and private HEIS, the criteria for the decision making will be the following (7) :

Decision 1: Program for PUBLIC HEI Offering ONLY

1.1 If overall MRR is > 0;

1.2 Optimal percentage of graduates is > 2014 Philippine total percentage of graduates;

1.3 Percentage of graduates in public HEIs ALONE warrants attainment of optimal percentage of graduates in the program

Decision 2: Program for PUBLIC and PRIVATE HEI Offering (by percentage)

2.1 If overall MRR is > 0;

2.2 Optimal percentage of graduates is > 2014 Philippine total percentage of graduates;

2.3 Percentage of graduates in public HEIs ALONE can't achieve the optimal percentage of graduates in the program

Decision 3: Program not anymore Suitable for Public Investment

3.1 If overall MRR is < 0;

3.2 Optimal percentage of graduates is < 2014 Philippine total percentage of graduates;

Table 1. *2014 Percentage of Graduates per Program And 2015 GDP Country Data*

Country	2015 GDP	Agriculture	Education	Eng'g	Health & Welfare	Humanities	Sciences	Services	Social Sciences
Azerbaijan	6576	0.835	0.835	17.589	8.133	12.179	4.433	0.233	30.147
Japan	33223	2.587	7.740	16.587	13.984	14.273	3.079	8.612	26.174
Lao	1816	8.748	7.741	10.940	6.470	11.347	6.413	3.376	44.964
Malaysia	10654	1.424	7.521	26.547	7.797	6.724	10.627	3.820	35.420
Mongolia	4195	2.626	15.648	13.462	7.979	8.384	6.015	6.026	39.858
Nepal	763	0.425	34.635	3.486	3.898	19.176	8.590		29.586
Philippines	3037	2.389	16.791	11.606	8.630	1.914	13.924	5.814	34.138
Sri Lanka	3818	3.152	3.297	6.378	6.014	42.510	13.571		25.076
Viet Nam	2233	5.669	24.372	22.399	5.025	4.346		4.311	33.877
Indonesia	3511	3.411	27.871	9.160	12.126	1.829	11.333	2.254	32.015
India	1,808	0.490	17.750						
Afghanistan	673	9.990	9.927	8.246	4.261	12.725	5.988		38.285
Armenia	2819	4.706		4.940	10.133	34.738	9.198	3.757	20.162
Bangladesh	1284	1.321	3.775	4.427	1.664	34.625	11.106		43.081
Bhutan	2884	9.515							
Georgia	3087	1.916	2.617	7.507	11.701	17.395	9.187	5.405	44.272
Kazakhstan	11488	2.587	20.755	10.493	3.513	4.343	15.212	3.679	39.417
Kyrgyzstan	1298	0.999							

3.0 Results and Discussions

The most recent available data from eighteen (18) Asian economies on their 2014 higher education programs are obtained from reliable internet sources (UNESCO Institute for Statistics, 2016). These graduates who join the countries' labor force within the year and contribute to the Gross Domestic Product (GDP) are thoroughly compiled in a reliable internet database (International Monetary Fund, 2015). From the list of all Asian countries, only those with complete information on both their 2014 % of graduates per program and 2015 GDP for a total of eighteen (18) countries (roughly 40% of all Asian countries) were included. These countries are Azerbaijan, Japan, Lao People's Democratic Republic, Malaysia, Mongolia, Nepal, Philippines, Sri Lanka, Vietnam, Indonesia, Afghanistan, Armenia, India, Bangladesh, Georgia, Bhutan, Kyrgyzstan, and Kazakhstan.

Marginal Rates of Return for Agriculture Program

Figure 1 shows the plot of GDP versus the percentage of graduates of agriculture programs of eighteen (18) Asian countries:

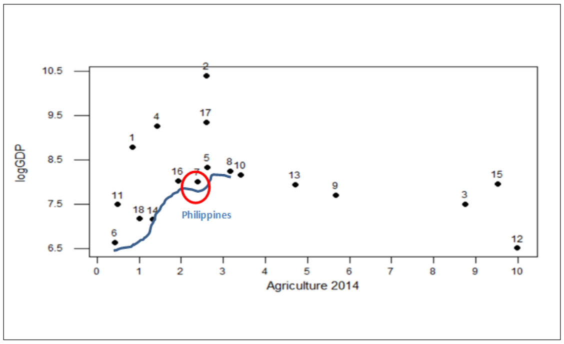


Figure 1. *Log(GDP) versus Agriculture*

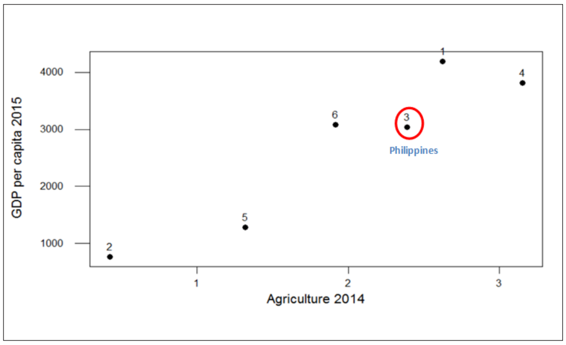


Figure 2. *Plot of Log(GDP) versus Agriculture*

The scatter of points appears to be random at first glance (R2= 5.4 %), but a closer look at the scatterplot reveals a third-degree polynomial graph when the "noise" is removed. Figure 2 shows the "cleaned" data plot. This pattern can be represented by the model:

$$\text{Log (GDP)} = a + b\,(\%\text{ of graduates}) + c\,(\%\text{ of graduates})2 + \text{error} \quad \textbf{(7)}$$

The regression fit for (7) yields:

$$\text{Log (GDP)} = 6.06 + 1.25\text{ Ag} - 0.167\text{ Ag}^2$$
$$R^2\text{ X}100\% = 93.6\% \quad \textbf{(8)}$$

The marginal rate of return for agriculture is, therefore: $\text{d (LogGDP)/d Ag}=1.25\text{- }.334\text{Ag} = 45$, which shows that after the optimal value of $\text{Ag}=1.25/.334=3.74\%$, the contribution of producing more agriculturists to the national economy becomes negative. That is, as the economic base of a nation moves from agricultural to industrial, building more agriculturists becomes a counterproductive strategy. These countries include Mongolia, Nepal, Philippines, Sri Lanka, Bangladesh, and Georgia.

Majority of the countries that deviated from the model are industrialized economies such as Azerbaijan, Japan, Malaysia, Indonesia, India, Armenia, and Kazakhstan. Mostly, petroleum and petroleum products are the drivers of the economy like Azerbaijan, Malaysia, Indonesia, and India. At the same time, Japan, Armenia, and Kazakhstan are more commonly known to produce technologically advanced vehicles, equipment, and machine tools.

Unexpectedly, there are countries like Lao, Vietnam, Bhutan, and Kyrgyzstan that are basically agricultural-based economies and are continually producing agriculturists yet turned out to be different in a sense that the contribution of agriculture to the national economy is still limited. Common reasons include the type of terrains, which are mostly rugged, and mountainous, and current environmental issues such as difficulty to access water, deforestation, soil erosion, and unexploded ordnance, specifically in Lao. These impediments severely affected agricultural production. Hence, these countries are not recommended to produce more agriculturists in the future but rather to prioritize in addressing these environmental challenges instead (Central Intelligence Agency, 2016).

In the Philippine context, the percentage of graduates in agriculture is 2.39% (14,468 graduates) as of 2014, which is still way below, with the optimal proportion of 3.74% (22,641 graduates). Hence, producing more agriculture graduates can potentially contribute to the national economy of the country (Canadian International Development Agency-Philippines-Canada Local Government Support Program, 2003). Based on 2014 actual graduates, the Philippines is still in need of 8,173 more agriculturists to boost its effect on the national economy.

Marginal Rates of Return for Education Program

Figure 3 shows the plot of GDP versus the percentage of graduates of Education programs in fifteen (15) Asian countries:

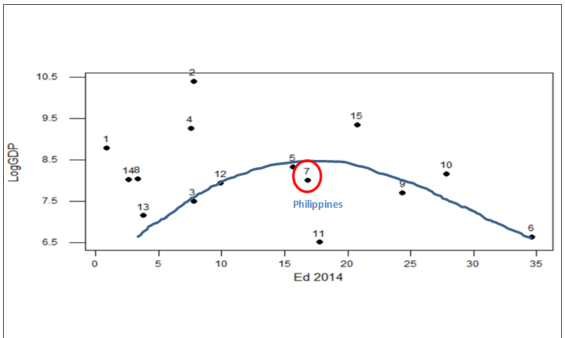


Figure 3. *Log (GDP) versus Education*

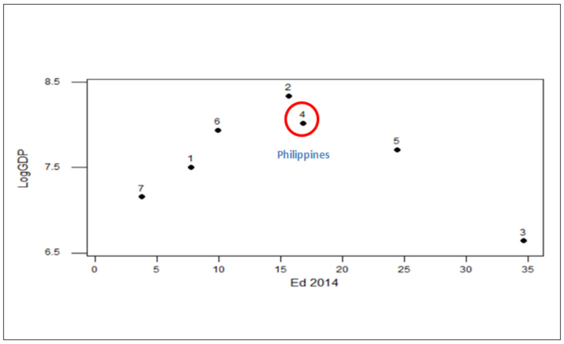


Figure 4. *The Plot of log(GDP) versus Education*

Initially, the data points seem to be arbitrarily scattered (R^2= 14.9%), but a closer look at the scatterplot reveals a parabolic shape when the "noise" is removed. Figure 4 shows the "cleaned" data plot. The model can represent the parabolic curve:

$$\text{Log (GDP)} = a + b\,(\text{percentage of graduates}) + c\,(\text{percentage of graduates})^2 + \text{error} \quad \textbf{(9)}$$

The regression fit for (9) yields:

$$\text{Log (GDP)} = 6.56 + 0.179\,Ed - 0.00515\,\text{Ed}^2$$
$$R^2 \text{ X100\%} = 93.7\% \quad \textbf{(10)}$$

The marginal rate of return for education is, therefore: $(d(\text{logGDP}))/(d\,Ed) = 0.179 - .01030\,Ed$ is 0.00605, which shows that after the optimal value of Ed= 0.179/0.01030 =17.38%, the contribution of producing more educators to the national economy becomes negative. That is, as the oversupply of educators in the country increases, the lower is its absorptive capacity, which can further lead to underemployment or even unemployment. This is the case of Afghanistan and Nepal, where many educators were produced already, yet its contribution to GDP is still low.

Japan, however, has a low percentage of graduates in education yet a very progressive economy. Japan is among the world's largest and most technologically advanced producers of motor vehicles, electronic equipment, machine tools, steel and nonferrous metals, ships, chemicals, textiles, and processed food. On the other hand, as shown in the data plot, countries like Azerbaijan, Georgia, Malaysia, and Sri Lanka can still invest more in producing educators to promote economic growth potentially (Central Intelligence Agency, 2016).

In the Philippines, the percentage of graduates in education is 16.79 percentage (101,642 graduates) as of 2014, which is still below as compared with the optimal rate of 17.38% (105,214). Hence, producing more education graduates can potentially contribute to the national economy (Education Encyclopedia, 2016). Based on 2014 actual graduates, the Philippines is still in need of 3,571 more educators to optimize its effect on the national economy.

Marginal Rates of Return for Engineering, Manufacturing and Construction Programs

Figure 5 shows the plot of GDP versus the percentage of graduates of Engineering, Manufacturing, and Construction programs in fifteen (15) Asian countries:

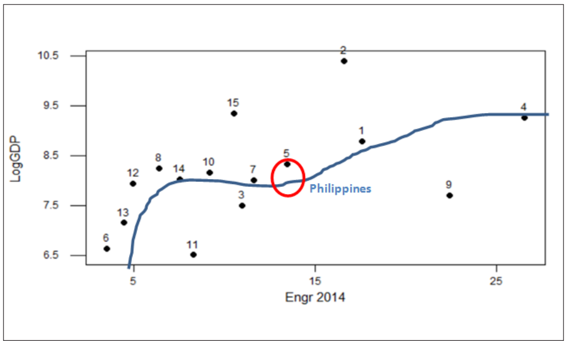


Figure 5. *Log(GDP) versus Engineering, Manufacturing and Construction Programs*

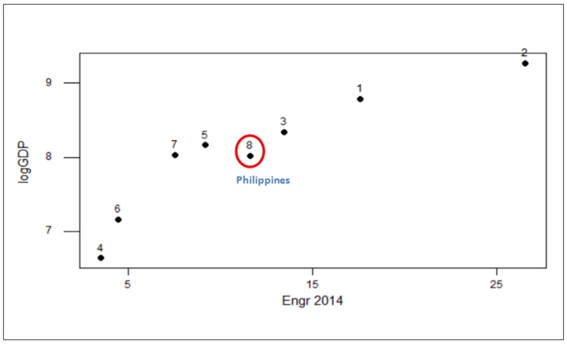


Figure 6. *The Plot of log(GDP) versus Engineering, Manufacturing and Construction Programs*

The scatter of points appears to be random at first glance (R^2= 37.3%), but a closer look at the scatterplot reveals a third-degree polynomial diagram when the "noise" is removed. Figure 6 shows the "cleaned" data plot:

The model can represent this pattern:

Log (GDP) = a + b Eng + c Sqrt (Eng) **(11)**

The regression fit for (11) yields:

Log (GDP) = 4.23 – 0.129 Eng + 1.63 SqrtEng
R2 X100% = 94.7% **(12)**

The marginal rate of return for engineering, manufacturing and construction is therefore: (*d* (*logGDP*))/*d Eng*)= -0.129 + .815/(*sqrt Eng*)=0.11, which shows that after the optimal value of *Eng*= .815/(-.129)=39.91%, the contribution of producing more engineers and other related courses to the national economy becomes negative. That is, as the oversupply of engineers, manufacturers, and construction workers in the country increases, the lower is its absorptive capacity, which can further lead to underemployment or even unemployment. This is the case of Indonesia and Sri Lanka, where lots of engineers were produced already, yet its effect on GDP is still limited (Central Intelligence Agency, 2016).

In highly industrialized countries like Japan and Kazakhstan, the effects of engineers are optimized. Japan is among the world's largest and most technologically advanced producers of motor vehicles, electronic equipment, machine tools, steel and nonferrous metals, ships, and textiles. In Kazakhstan, the major industries include petroleum and natural gas, coal, iron ore, lead, zinc, gold, silver and steel, tractors and other machinery, electric motors, and construction materials (Central Intelligence Agency, 2016).

In the Philippines, the percentage of graduates in engineering and related courses is 11.61% (70,284 graduates) as of 2014, which is still way below the optimal proportion, which is 39.91% (241,786). Hence, producing more engineers can potentially contribute to the national economy. Based on 2014 actual graduates, the Philippines is still in need of more 171, 502 engineers to boost its effect on the national economy. According to the Global Competitiveness Report (2015), it seems Filipino engineers are not valued enough, much less paid — so it should not be a surprise that the country does not produce them enough. There are demand and supply side fixes that need urgent attention.

Marginal Rates of Return for Health and Welfare

Figure 7 shows the plot of GDP versus the percentage of graduates of Health and Welfare programs in fifteen (15) Asian countries:

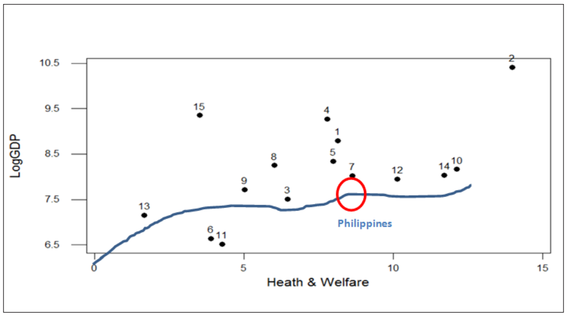


Figure 7. *Log(GDP) versus Health and Welfare*

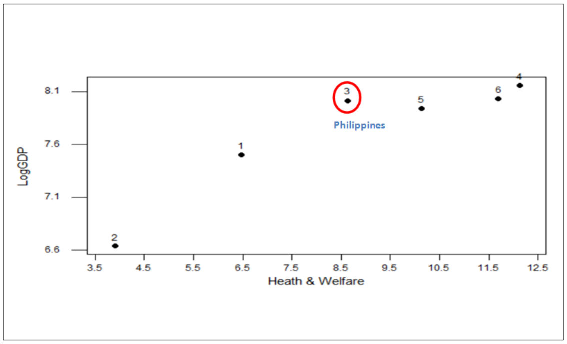


Figure 8. *The Plot of log(GDP) versus Health and Welfare*

The scatter of points appears to be random at first glance (R^2= 31.1%), but a closer look at the scatterplot reveals a third-degree polynomial graph when the "noise" is removed. Figure 8 shows the "cleaned" data plot.

The model can represent the pattern:

$$Log\ (GDP) = a + b\ HW + c\ Sqrt\ (HW) \qquad \textbf{(13)}$$

The regression fit for (13) yields:

$$Log\ (GDP) = 0.20 - 0.658\ HW + 4.56\ Sqrt\ HW$$
$$R^2\ X100\% \quad = 98.2\% \qquad \textbf{(14)}$$

The marginal rate of return for health and welfare is, therefore: *(d(logGDP))/(d HW)= -.658 + 2.28/sqrtHW= 0.12*, which shows that after the optimal value of *HW= 2.28/.658= 3.465 squared= 12.01%*, the contribution of producing more health and welfare graduates to the national economy becomes negative. As the oversupply of health and welfare graduates in the country increases, the lower is its absorptive capacity, which can further lead to underemployment or even unemployment. This can be the case of Nepal and Afghanistan, where lots of health care graduates were produced already, yet its effect on GDP is still low. This can also be attributed to the fact that health care providers in these countries are not being prioritized.

On the other hand, Japan has been very supportive of producing graduates in line with the provision of health and welfare to the society. Reasons may include the evident aging (inverted pyramid) population, the current environmental issue on air pollution from power plant emissions resulting in acid rain, and its susceptibility to natural hazards such as active volcanoes, occasional earthquakes, yearly tsunamis, and typhoons. Japan is even one of the countries in the world that spend a considerable percentage of GDP on health-related expenditures (Central Intelligence Agency, 2016).

As illustrated in the data plot, countries such as Azerbaijan, Mongolia, Malaysia, Sri Lanka, and Kazakhstan are recommended to produce more graduates on health and welfare courses to enhance its national economy potentially.

In the Philippines as well, the percentage of graduates in health and welfare is 8.63% (52,243 graduates) as of 2014, which is still way below the optimal rate which is 12.01% (72,705). Hence, producing more health care providers can potentially contribute to the national economy (Health Care Asia, 2017). Based on 2014 actual graduates, the Philippines is still in need of more 20, 461 health care providers to maximize its effect on the national economy.

Marginal Rates of Return for Humanities and Arts

Figure 9 shows the plot of GDP versus the percentage of graduates of Humanities and Arts programs in fifteen (15) Asian countries:

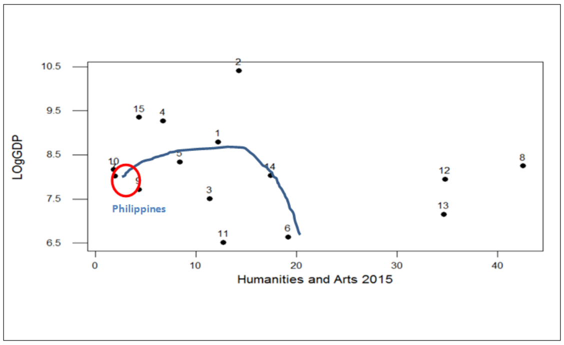


Figure 9. *Log(GDP) versus Humanities and Arts*

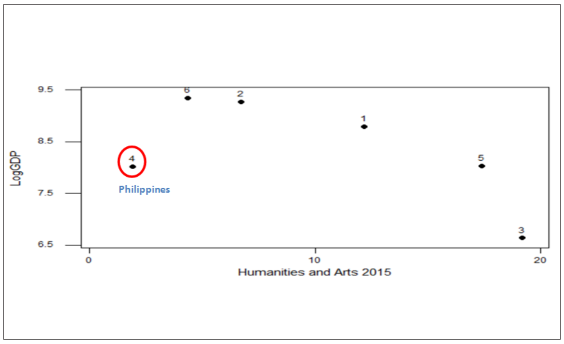


Figure 10.*The Plot of log(GDP) versus Humanities and Arts*

The scatter of points appears to be random at first glance (R^2=6.9%), but a closer look at the scatterplot reveals a parabolic shape when the "noise" is removed. Figure 10 shows the "cleaned" data plot.

The model can represent the parabolic curve:

$$Log(GDP) = a + b\ (\%\ of\ graduates) + c\ (percentage\ of\ graduates)^2 + error \qquad (15)$$

The regression fit for (15) yields:

$$Log\ (GDP) = 7.50 + 0.430\ Hum - .0242\ Hum^2$$
$$R^2\ X100\% = 89.4\% \qquad (16)$$

The marginal rate of return for humanities and arts is, therefore: $(d\ (logGDP))/(d\ Hum)= 0.430 - .0484\ Hum=0.34$, which shows that after the optimal value of $Hum= .430 - .0484\ Hum= 8.88\%$, the contribution of producing more graduates in humanities and arts to the national economy becomes negative. That is, as the economic base of a nation moves from entertainment-based industry to another, producing more artists becomes noncontributory.

In a country wherein the entertainment industry is not braced by the community, the nonproduction of artists is not that relevant to national development. In Japan, for instance, the industry is centered on motor vehicles, electronic equipment, machine tools, steel and nonferrous metals, ships, and textiles production. Furthermore, more production of artists even is not substantial such as in the case of Armenia, Bangladesh, and Sri Lanka (Central Intelligence Agency, 2016).

The Philippines is one of the countries where the entertainment industry is continually booming. Yet, the percentage of graduates in humanities and arts is only 1.91% (11,562) as of 2014, which is still way below the optimal proportion of 8.88% (53,757) of total graduates. Hence, producing more artists can potentially contribute to the national economy (Edralin, 2000). Based on 2014 actual graduates, the Philippines is still in need of 42, 194 more graduates to boost its effect on the national economy.

Marginal Rates of Return for Sciences

Figure 11 shows the plot of GDP versus the percentage of graduates of Sciences programs in fourteen (14) Asian countries:

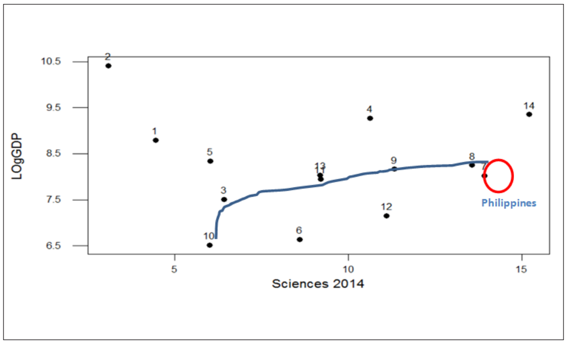


Figure 11. *Log(GDP) versus Sciences*

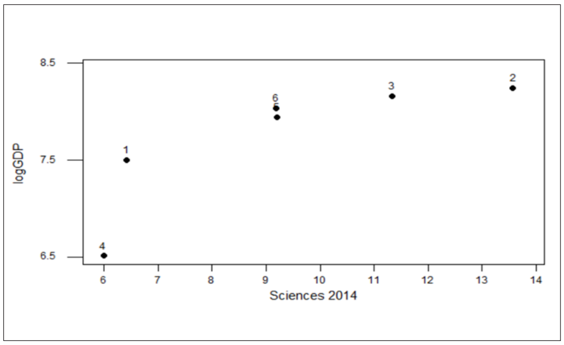


Figure 12. *The Plot of log(GDP) versus Sciences (Sci noise removed)*

The scatter of points appears to be random at first glance (R^2= 42.6%), but a closer look at the scatterplot reveals an increasing pattern when the "noise" is removed. Figure 12 shows the "cleaned" data plot.

The model can represent the linear pattern:

$$Log(GDP) = a + b\ (percentage\ of\ graduates) + c\ (percentage\ of\ graduates)^2 + error \quad \textbf{(17)}$$

The regression fit for (17) yields:

$$Log\ (GDP) = 5.17 + 0.338\ Sci - 0.0056\ Sci^2$$
$$R^2\ X100\% = 81.3\% \quad \textbf{(18)}$$

The marginal rate of return for sciences is, therefore: $(d\ (logGDP))/(d\ Sci) = .338 - .0112 = .18$, which shows that after the optimal value of $Sci = .338/.0112 = 30.18\%$, the contribution of producing more scientists to the national economy becomes negative. This implies that further production of scientists beyond this percentage would not anymore warrant increase in the GDP in the country.

In growing economies like Azerbaijan and Japan, they have noticeably high GDP even with fewer scientists. This is because their prime drivers for national development are not primarily affected by the presence of scientists. In the case of Japan, the major industries are the production of advanced motor vehicles, electronic equipment, machinery, steel, and other textiles, while that of Azerbaijan, natural resources include petroleum and petroleum products, natural gas, equipment, cement, iron ore, and other petrochemicals (Central Intelligence Agency, 2016).

In contrast, Nepal and Bangladesh have increased the number of scientists, yet its contribution to the national economy is still low (refer to Table 1 and Figure 11). These countries are still developing, and discoveries and inventions of scientists may not be appropriately supported to maximize innovations in the country level.

The Philippines is considered as noise in this model and hence removed on the final model to determine the exact effect of science in the country. It is noticeable that the number of scientists in the Philippines is increasing, yet its impact on GDP is declining (refer to Figure 11). Filipino scientists continue to find discoveries, but because of the lack of opportunities in the country, some scientists opted to look for a better future in more progressive countries around the world. This is the brain drain phenomenon wherein the country loses its best scientists since they are attracted by higher rates and better working conditions in other developed economies (Philippine Journal of Science, 2019).

Based on the Asian model above, although the percentage of graduates in sciences is increasing, yet 13.92% (84,268) as of 2014 is still way below the optimal rate, which is 30.18% (182,702). Hence, producing more scientists can potentially contribute to the national economy. Based on 2014 actual graduates, the Philippines is still in need of 98, 433 more graduates to boost its effect on the national economy. Furthermore, there is also an urgent need for the country to explore ways on how to make its scientists stay and substantially contribute to the nation's economy.

Marginal Rates of Return for Services

Figure 13 shows the plot of GDP versus the percentage of graduates of Services programs in eleven (11) Asian countries:

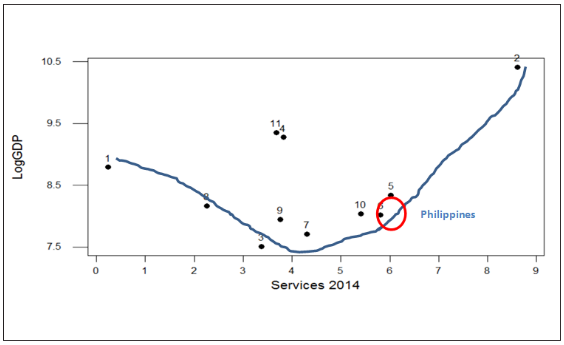


Figure 13. *Log(GDP) versus Services*

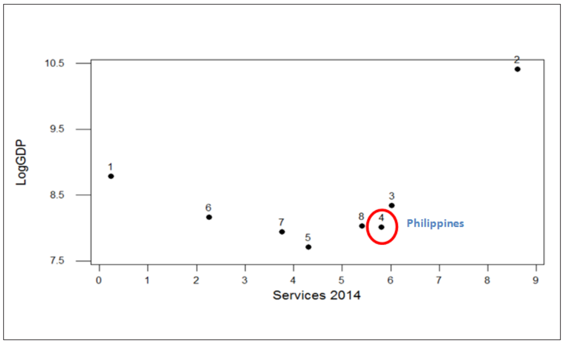


Figure 14. *The Plot of log(GDP) versus Services*

The scatter of points appears to be random at first glance (R^2= 46.9%), but a closer look at the scatterplot reveals a concave parabolic shape when the "noise" is removed. Figure 14 shows the "cleaned" data plot.

The model can represent the parabolic curve:

Log (GDP)= a + b (percentage of graduates) + c (percentage of graduates)^2 + error

(19)

The regression fit for (19) yields:

Log (GDP) = 9.07 - .784 Serv + .103 Serv^2

R^2 X100% = 96.6%

(20)

The marginal rate of return for services is, therefore: *(d (logGDP))/(d Serv)= -0.784 + .206 Serv = 0.45*, which shows that if the percentage of graduates would reach at least 5% of the total graduates, the contribution of producing more graduates in service degrees starts to elevate. This is particularly true in Japan, Mongolia, the Philippines, and Georgia.

In the case of Azerbaijan, on the other hand, there was a limited number of graduates in servicing courses, yet the national economy is still progressive. This is because Azerbaijan's economy is driven by natural resources like petroleum and petroleum products, iron ore, and nonferrous metals and not by tourism and other production industries which need the presence of service degree graduates (Central Intelligence Agency, 2016).

In the Philippines where the tourism industry and transportation services such as seamanship are flourishing, producing more graduates is beneficial (Richter, 2016). Based on Figure 14 above, the percentage of graduates in services is 5.81% (35,172) as of 2014 is still way below the actual maximum proportion of Japan graduates, which is 8.6% (52,062). Hence, producing more graduates under service programs can potentially contribute to the national economy. Based on 2014 actual graduates, the Philippines is still in need of 16,890 more graduates to boost its effect on the national economy.

Marginal Rates of Return for Social Sciences, Business, and Law

Figure 15 shows the plot of GDP versus the percentage of graduates of Social Sciences, Business, and Law programs in sixteen (16) Asian countries:

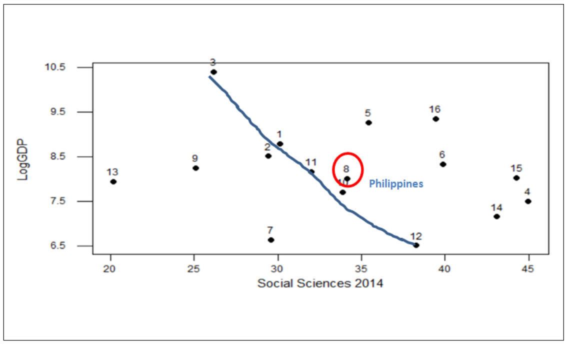


Figure 15. *Log(GDP) versus Social Sciences, Business, and Law*

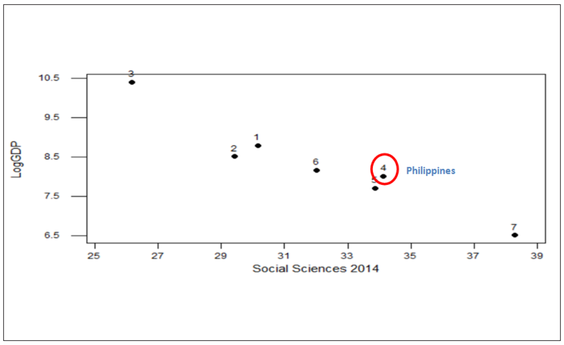


***Figure 16.** The Plot of log(GDP) versus Social Sciences, Business, and Law*

The scatter of points appears to be random at first glance (R^2= 7.4%), but a closer look at the scatterplot reveals a linear pattern when the "noise" is removed. Figure 16 shows the "cleaned" data plot.

The model can represent the linear configuration:

$$Log\ (GDP) = a + b\ SocSci \quad \textbf{(21)}$$

The regression fit for (21) yields:

$$Log\ (GDP) = 17.6 - .291\ SocSci$$
$$R2\ X100\% = 92.8\% \quad \textbf{(22)}$$

The marginal rate of return for social sciences, business, and law are therefore: $(d\ (logGDP))/(d\ SocSci) = -0.291SocSci = -9.90$, which shows that there is already an excess of behavioral scientists, journalists, and accountants. Hence, it is already not contributing to the national development such as in the case of Lao, Bangladesh and that of Georgia (Central Intelligence Agency, 2016).

In the context of the Philippines, producing more graduates under this program is not recommended since the country has far exceeded the percentage of 34.14% (206,675) as compared to that of 26.17% (158,426) optimal rate. Producing more can negatively affect the national economy. As of 2014, the Philippines has 48, 248 excess numbers of graduates from this program.

Table 2 presents the derivation of the optimal portions of graduates per program based on the final Asian models. The percentages are the points at which the contributions of the programs to GDP are at their peak. In the Philippine context, this implies that if the optimal rate of graduates in a specific program is reached, e.g., 3.74percentage of graduates in agriculture and related courses in a year, then that program contributes to the national economy in its maximum capacity. That is, translated into 22,641 agriculture graduates.

Noticeably, the total percentage of the eight (8) programs in Table 2 is more than 100%. This is because in the services (Serv) and social sciences, business, and law (SocSci) programs, the optimal percentage cannot be derived from the model since the direction of the slopes is negative as shown in the data plot implying that in most of the countries identified, there was excess production of the said professionals. Thus, the actual data of the highest-ranking country in terms of GDP (Japan) as a proxy measure for optimal percentage for both programs are taken.

The following table shows the overall MRR of the programs, the GDP multiplier effect of public and private HEIs, and an optimal percentage per program vis a vis the ability of the public and private HEIs to produce graduates per program.

Table 2. *Summary of Optimal Percentage of Graduates per Program*

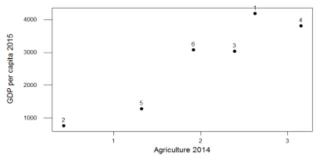
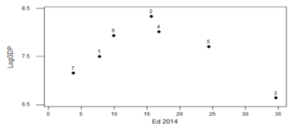
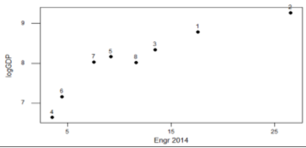
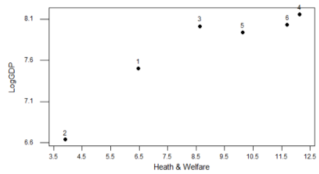
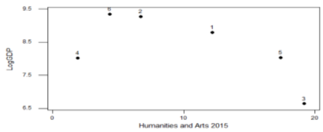
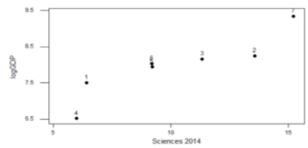
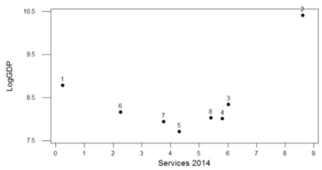
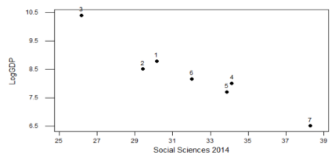
Program	Derivative/Slope	Optimal percentage	Data Plot
Agriculture (Ag)	1.25 – (2).167 Ag = 0 1.25 - .334 Ag = 0 Ag = 1.25/.334 = 3.74%	**3.74%**	
Education (Ed)	0.179 – (2) .00515 Ed = 0 0.179 - .01030 Ed = 0 Ed = .179/.01030 = 17.38%	**17.38%**	
Engineering, Manufacturing and Construction (Eng)	-.129 + (1.63)(1/2)*(1/sqrtEng) = 0 -.129 SqrtEng + .815 = 0 SqrtEng = .815/.129 = 6.32^2 = 39.9149%	**39.91%**	
Health and Welfare (HW)	-.658 + (4.56)(1/2)*(1/SqrtHW)=0 -.658sqrt(HW)+ 2.28= 0 SqrtHW = 2.28/.658 = 3.46505^2 12.0065%	**12.01%**	
Humanities and Arts (Hum)	.430 - .(2) .0242Hum=0 .430-.0484Hum = 0 Hum = .430/.0484 = 8.88430%	**8.88%**	
Sciences(Sci)	0.338 – (2) 0.0056Sci=0 0.338 - .0112 Sci= 0 Sci = .338/.0112 = 30.18%	**30.18%**	
Services (Serv)	Actual data max at 8.6% by GDP of 10.4110 (Japan)	**8.6%**	
Social Sciences, Business and Law (SocSci)	Actual Data max at 26.1740 % by GDP of 10.4110 (Japan)	**26.17%**	

Table 3. *Summary of Marginal Rate of Returns of Higher Education Services*

Higher Education Program	Derivation/ Slope for Overall MRR	Overall MRR	Derivative per Type of HEI	GDP Multiplier Effect		Optimal % of grad/ pro-gram	2014 Total % of Gradu-ates	2014 % of Grad (Public HEIs)	2014 % of Grad (Private HEIs)
				Public HEI	Private HEI				
Agriculture (Ag)	MRRAg = 1.25- .334(2.39) = .45	.45	1.25 - (2).167 Ag 1.25 - .334 Ag MEPubAg = 1.25 - .334 Pub% = 0.945117 PriAg = 1.25-.334 Pri = 0.756760	0.945	0.76	3.74%	2.39%	0.91%	1.48%
Education (Ed)	MRREd = 0.179-.01030 (16.79) = .00605	.0060	0.179 - (2) .00515 Ed 0.179 - .01030 Ed ME-PubEd = .179 - .01030 Pub%= 0.112933 MEPriEd = .179 - .01030 Pri = 0.0721172	0.113	0.072	17.38%	16.79%	6.41%	10.38%
Engineering, Manufacturing and Construction (Eng)	MRREng = -.129+.815/ Sqrt (11.61)= 0.11	0.11	-.129 + (1.63)(1/2)*(1/ sqrtEng) - .129 SqrtEng + .815 PubSqrtEng = -1.29 + .815/sqrtPub = PriSqrtEng = -1.29 + .815/sqrtPri =	0.516	0.433	39.94%	11.61%	4.43%	7.17%
Health and Welfare (HW)	MRRHW = -0.658+2.28/ sqrt(8.63) =	**0.12**	-.658 + (4.56) (1/2)*(1/SqrtHW) - .658sqrt(HW)+ 2.28SqrtHW = 2.28*.658 = Pub = .658 + 2.28/2* 1/sqrtPubHW	1.286	1.152	12.01%	8.63%	3.30%	5.33%
Humanities and Arts (Hum)	MRRHA = .430- .0484(1.91) = 0.34	**0.34**	.430 - .(2) .0242Hum.430 - .0484Hum MEPubHum = .430 -.0484 * 0.73112126 = 0.394614 PriHum = .430 - .0484 * 1.18280874 = 0.372752	0.395	0.373	8.88%	1.91%	0.73%	1.18%
Sciences (Sci)	MRRSci = .338 - .0112 (13.92) = 0.18	**0.18**	0.338 – (2) 0.0056Sci 0.338 - .0112 Sci Sci = .338-.0112 PubSci = .338-.0112 Pub = 0.28 PriSci = .338-.0112 Pri = 0.24	0.28	0.24	30.18%	13.92%	5.32%	8.60%
Services (Serv)	MRRServ = -.741 + .206 (5.81) =	.45	-0.741 + (2)0.103 Serv -0.741 + .206 Serv PubServ = -0.741 + .206 Pub = -0.283453 PriServ = -0.741 + .206 Pri = -0.0007804	-0.283	-0.0007	8.6%	5.81%	2.22%	3.59%
Social Sciences, Business and Law (SocSci)	MRRSocSci = -0.291(34.14) =	-9.90	-0.291 Pub = -0.291 Pub = Pri= -0.291Pri=	-3.795	-6.14	26.17%	34.14%	13.04%	21.1%

Note (Table 3):

Overall MRR	*- the change in GDP/unit change in the percentage of graduates*
Optimal percentage	*- maximum percentage reached where GDP is at its peak*
2014 Total percentage	*- Total percentage of graduate per program in the year 2014*
2014 total grad	*- 605,375 (CHED 2014)*
2014 Pub percentage	*- Public HEI percentage share of 2014 graduates*
2014 Pri percentage	*- Private HEI percentage share of 2014 graduates*

Table 3 illustrates the overall MRR of eight (8) higher education programs, which indicate the effect to GDP per percentage of graduates per program. All programs except for social sciences, business, and law demonstrate a positive impact to the national economy. They hence can be the programs to be prioritized by state-funded higher education institutions. According to their degree of contribution from highest to lowest, these programs are agriculture (0.45), services (0.45), humanities and arts (0.34), sciences (0.18), health and welfare (0.12), engineering, manufacturing and construction (0.11), and education (.00605).

For the marginal rate of returns of Philippine higher education programs as categorized into public and private higher education institutions, it can be seen that for six (6) programs on agriculture (0.94 vs. 0.76), education (.113 vs. .072), engineering, manufacturing and construction (.52 vs. .43), health and welfare (1.28 vs. 1.15), humanities and arts and sciences (.39 vs. .37), public HEIs contribute more to GDP than private HEIs.

The next section presents the recommendations for Philippine higher education programs. The first criterion (on economic growth and development aspect) is to determine the overall MRR per program, and if overall MRR > 0, programs shall be prioritized by the state. Secondly, the state-funded higher education institutions' ability to produce graduates is taken into consideration to ensure the quality of graduates. In determining this, all available annual percentage of graduates per program for six years (2003, 2010, 2011, 2012, 2013, and 2014) of the Philippines was culled out from UNESCO Institute for Statistics (2016). The Coefficient of variation (CV) is then computed to describe the amount of variability/dispersion of data points (percentage of graduates) relative to the mean. To determine the variability of graduates produced per type of HEI, the CV is multiplied the current number of graduates per program:

$$\textit{CV of graduates produced} = \textit{2014 no of grad in Pub or Pri HEIs} * CV \quad \textbf{(8)}$$

Finally, it is deemed necessary to calculate for the average capacity to produce graduates of a sector (public or private higher education institutions) in a specified program. Current (2014) number of graduates and an optimal number of graduates are used:

$$\text{Ability to produce (Public or Private)} = \frac{\text{current no.of graduates}}{\text{optimal no.of graduates}} * 100\% \quad \textbf{(9)}$$

Table 4. *Coefficient of Variation of Public and Private HEIs Graduates*

Program	Coefficient of variation (CV)	2014 % of Grad (Public)	Equivalent number of students	CV*PUB no. of grads	2014 % of Grad (Private)	Equivalent no. of students	CV*Private no. of graduates
Agriculture (Ag)	24%	0.91	5509	1322	1.48	8960	2150
Education (Ed)	15%	6.41	38805	5821	10.38	62838	9426
Engineering, Manufacturing and Construction (Eng)	6%	4.43	26818	1609	7.17	43405	2604
Health and Welfare (HW)	48%	3.30	19977	9589	5.33	32266	15488
Humanities and Arts (Hum)	10%	0.73	4419	442	1.18	7143	714
Sciences (Sci)	14%	5.32	32206	4509	8.60	52062	7289
Services (Serv)	17%	2.22	13439	2285	3.59	21733	3695
Social Sciences, Business and Law (SocSci)	7%	13.04	78941	5526	21.1	127734	8941

For ***agriculture program***, since the distribution is fractal, therefore, CV = 0.564/2.300 =24%, which indicates that for public, CV for Public= 5509*24% = 1322 and for private CV for Private = 8960*24% = 2160. This implies that the Public' s Ability to produce = 5509/22641*100% = 24.33% of the optimal percentage.

For ***education program***, since the distribution is non-fractal, therefore, CV = 2.095/13.960 = 15% which indicate that for public, CV for Public = 38805*15% = 5821 and for private CV for Private = 62838*15% = 9426. This implies that Public's Ability to produce = 38805/105214 *100% = 36% of the optimal percentage.

For ***engineering, manufacturing and construction program***, since the distribution is non-fractal, therefore, CV = 0.650/11.267 = 6 percentage which indicate that for the public, CV for Public = 26818*6% = 1609 and private CV for Private = 43405*6% = 2604. This implies that the Public's Ability to produce = 26818/241787 *100% = 11% of the optimal percentage.

For ***health and welfare program***, since the distribution is non-fractal, therefore, CV = 7.04/14.42 =4 8% which indicates that for the public, CV for Public = 19977* 48% = 9689 and for private CV for Private = 32266*48% = 15488. This implies that the Public's Ability to produce = 19977/72706 *100% = 27% of the optimal percentage.

For ***humanities and arts program***, since the distribution is non-fractal, therefore, CV = 0.2137/2.0833 = 10%, which indicates that for the public, CV for Public = 4419* 10% = 442 and for private CV for Private = 7143*10% = 714. This implies that the Public's Ability to produce = 4419/53757 *100% = 8% of the optimal percentage.

For ***science program***, since the distribution is non-fractal, therefore, CV = 1.781/13.050 = 14%, which indicates that for the public, CV for Public = 32206*14% = 4509 and for private CV for Private

= 52062*40% = 7289. This implies that the Public's Ability to produce = 32206/182702 *100% = 17% of the optimal percentage.

For ***services program***, since the distribution is fractal, therefore, CV = 0.795/4.55 = 17%, which indicates that for the public, CV for Public = 13439*17% = 2285 and for private CV for Private = 21735*17% = 3695. This implies that the Public's Ability to produce = 13439/52062 *100% =2 5.8% of the optimal percentage.

For the reason that the overall MRR of ***social sciences, business, and law programs*** is < 0, then subsequently, there is no need to further calculate for public HEIs' ability to produce graduates in this cluster.

Based on the decision-making criteria mentioned earlier (1. Overall MRR per program; and 2. Public Higher education sector's average ability to produce graduates per program) table 5 below summarizes the appropriate recommendations made for the Philippine higher education programs:

Table 5. *Recommendations per Program*

Program	Basis for percentage Recommendation (table 4)	Recommendations		Total Predicted Graduates	Optimal No. of Grads/prog
		Public Offering	Private Offering		
(Ag)	Public: 5509/22641*100% = 24.33%	Public 25 % = 5660 ±1322 =4338 to 6982	Private 75% = 16981 ± 2150 = 14,831 to 19,131	19,169 to 26,113	22,641
(Ed)	Public = 38805/105214*100% = 0.36882%	Public 35 % =36825 ± 5821 =31,004 to 42,646	Private 65% = 68389 ± 9426 = 58,963 to 77,815	89,967 to 120,461	105,214
(Eng)	Public = 26818/241,787*100% = 0.11092 Or 11%	Public 10 % = 24,179 ± 1609 = 22,570 to 25,788	Private 90 % = 217,608 ± 2604 = 215,004 to 220,212	237,574 to 246,000	241,787
(HW)	Public = 19,977/72,706*100% = 0.27476 Or 27%	Public 25 % =18177 ± 9589 =8,588 to 27,766	Private 75 % = 54,530 ± 15488 = 39,042 to 70,018	47,630 to 97,784	72,706
(Hum)	Public = 4419/53,757*100% = 0.0822 Or 8%	Public 8 % =4301 ± 442 =3859 to 4743	Private 92 % = 49456 ± 714 = 48742 to 50170	52601 to 54913	53,757
(Sci)	Public = 32206/182,702*100% = 0.17628 Or 17%	Public 15 % =27405 ± 4509 =22896 to 31914	Private 85 % = 155297 ± 7289 = 148,008 to 16,2586	170904 to 194500	182,702
(Serv)	Public = 13,439/52,062*100% = 25%	Public 25 % =13016 ± 2285 =10,731 to 15,301	Private 75% = 39047 ± 3695 = 35,352 to 42,742	46,083 to 58,043	52,062
(SocSci)	Not suitable for public investment		Private 100%	158,427	158,427
GRAND TOTAL					**889,296**

It can be gleaned in Table 5 that all programs (except for social sciences, business, and law programs) can be offered by both public and private institutions with suggested proportions. The primary basis for the proposed sharing scheme is the state-funded higher education institutions' ability to produce graduates for the past years rounded off for more comfortable distribution of percentage per program. Ranges are provided per type of HEI utilizing the CV as reflected in the previous table to guarantee the production of an optimal number of graduates per higher education sector per program. It is important to note though the limitations among the public higher institutions' absorptive capacity.

4.0 Conclusion and Recommendations

This study validates that indeed there are certain higher education services that bring about public good while some others do not based on the programs' marginal rate of returns. Agriculture, services, humanities and arts, sciences, health and welfare, engineering, manufacturing and construction, and education programs demonstrate greater public good. At the same time, social sciences, business, and law generally promote higher private returns to the individuals rather than to the society.

All seven (7) programs will be taken care of in the public sector alone. However, a deterioration of graduates' quality can be foreseen. This can be attributed to the fact that state-funded institutions are expected to produce three times more graduates (such as in education program) to twelve times more graduates (such as in the humanities program).

Recognizing the significance of ensuring the quality of graduates in this framework, the state-funded higher education institutions' ability to produce graduates is considered. In effect, the optimum capacity of the public HEIs per program is utilized while allowing the private HEIs to assist with its spillover. Subsequently, all seven (7) programs with greater public good are proposed with the respective proportions with corresponding quota (based on Table 5) between public and private HEIs.

Furthermore, a mechanism can also be devised so that the programs with greater public good that are offered by the private HEIs can also be subsidized by the government through various modes such as, but not limited to, scholarship grants, tertiary education subsidy (TES) program and voucher method.

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