Statistical Analysis of Literacy rate and its relationship with GDP per capita.

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Abstract

Gross domestic product per capita is a basic approximation of the economic performance of a country. It's considered to be an indicator of a country's standard of life, and is a key factor in the computation of the Human Development Index. Literacy rate is essentially the total number of literate people in a given age group, expressed as a percentage of the total population in that age group. As educated individuals are considered skilled manpower, the careers and jobs they pursue are more financially rewarding than blue-collar work. This suggests that there exists a positive correlation between these two variables, and an increase in the overall literacy population of a country should lead to an increase in the GDP per capita of a country.

Keywords: Gross domestic product, Literacy rate, Correlation

Introduction

The United Nations Educational, Scientific and Cultural Organization defines being literate as the "ability to identify, understand, interpret, create, communicate and compute, using printed and written materials associated with varying contexts" (UNESCO), or in other words a literate individual is someone who is able to read and write in their native or acquired language. The percentage of literate people in a given age group is expressed by the number of literates divide by the total population, giving the literacy rate of that age group.

Literacy rate indicates the existence of an effective primary education system and/or literacy programs that have enabled a large portion of the population to acquire the ability of using written words in daily life and to continue learning. The data for literacy rates is usually acquired from national population census along with labor and household surveys. The frequency for these are not constant and vary from country to country, causing missing points in plots. This was the rationale behind choosing the data on literacy rates of different countries till 2010. The data published by UNESCO in the Gapminder tool gives two subgroups of literacy rates for any given country. For this project the adult literacy rate is used, it's a measure of literacy among persons aged 15 years and above. This is justified because only adults would be generating substantial income.

GDP per capita is mathematically the gross domestic product divided by midyear population. The gross domestic product of a country is the sum of gross value of products produced, along with services provided by a country, plus any product taxes and minus any subsidies not included in the value of the products (The World Bank). It is calculated annually without making "deductions for depreciation of fabricated assets or for depletion and degradation of natural resources." (The World Bank). The data shown in Gapminder is GDP adjusted for

inflation, which can simply be defined as "ongoing fall in the overall purchasing power of the monetary unit." (White). GDP is calculated using the following formula:

GDP = private consumption + gross investment + government investment + government spending + (exports – imports).

Conjectures for the analysis:

A nation's economy is built by the contribution of its populace; its human capital. Skilled and literate manpower possess the intellect, skillset, competence and other attributes that are crucial for economic activity and its growth over time. A country with a high GDP per capita will be economically progressive, which leads to an increase in the standard of living and prosperity of the citizens, increasing the expenditure in services such as trade, healthcare and education. These progressive changes and the positive correlation between Human Development Index and GDP (Islam, 1995) suggests that a higher GDP would lead to an emphasis on education and thus a higher literacy rate.

Studies conducted by the World Literacy Foundation have shown that that the economic value of literacy is quite high and a population with non-zero illiteracy rate or functionally illiteracy can impact a country's economy significantly (Cree, 2015). A functionally illiterate individual is someone who can read and write simple words, but cannot apply literacy skills to everyday tasks. These factors suggest a positive correlation between the two variables.

Using Gapminder

Gapminder is a data tool with a collection of various up to date data sets along with multiple tools to help the user analyze data through visual analysis. It is very helpful in evaluating data that changes over time given its wide collection of global data and visually

effective tools. The Gapminder tool used for this project is known as a scatter plot. A scatter plot

is defined as a visual summary of two variables and their relationships or association.
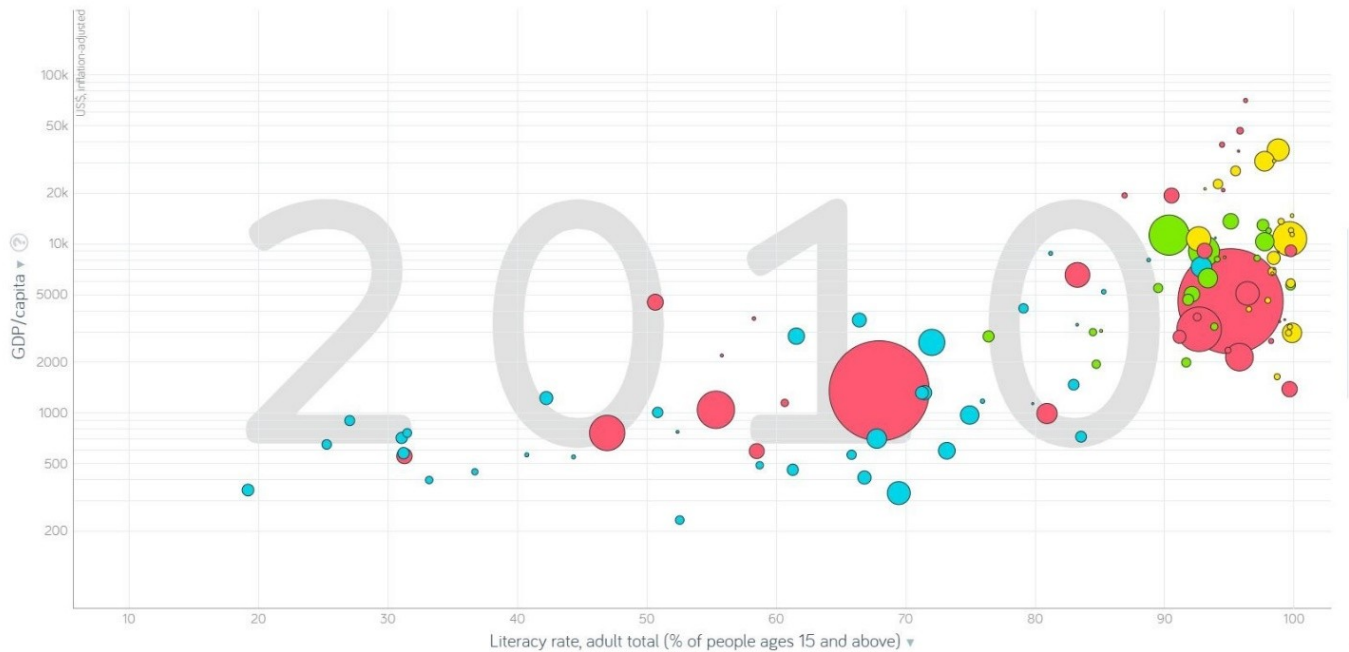

Fig (I) Gapminder plot of Literacy Rate in adults over 15 years in linear scale vs GDP

per capita in logarithmic scale for 2010.

The plot from figure one is a scatter plot that shows the GDP per capita of a country on

the y-axis and its literacy rate on the x-axis. The bubbles seen are a representation of a country's

population; the larger the area of the bubble, the higher the population. The countries shown are

color coded according to their respective continents. The x-axis ranges from 0-100 as literacy is a

ratio of the number of literate population compared to the total. The y-axis ranges from $200 to

$100,000 and is in a logarithmic scale. The countries around the world vary hugely in terms of

GDP. These large values cause the plot to look skewed, i.e. a few points are much larger than the

bulk of the data. This is why a logarithmic scale was necessary, using it will help establish a visual correlation between the two chosen variables.

The plot has a lot of countries from Africa and Asia in the mid-range in terms of literacy rate and a corresponding lower GDP per capita. The rightmost part of the plot with literacy rate of over 95% is dominated by European countries with most of the American continent around or above 90%. In terms of GDP per capita, the countries in the middle-east are at the top followed by countries from Europe. Two countries with the highest GDP per capita in the world, Switzerland and Luxembourg have missing data points and thus are not shown in the plot.

The location of the countries in the Middle East is mostly due to their booming oil based economy, while a lower literacy rate in most Asian countries could be a factor of overpopulation and lack of infrastructures and laws promoting education.
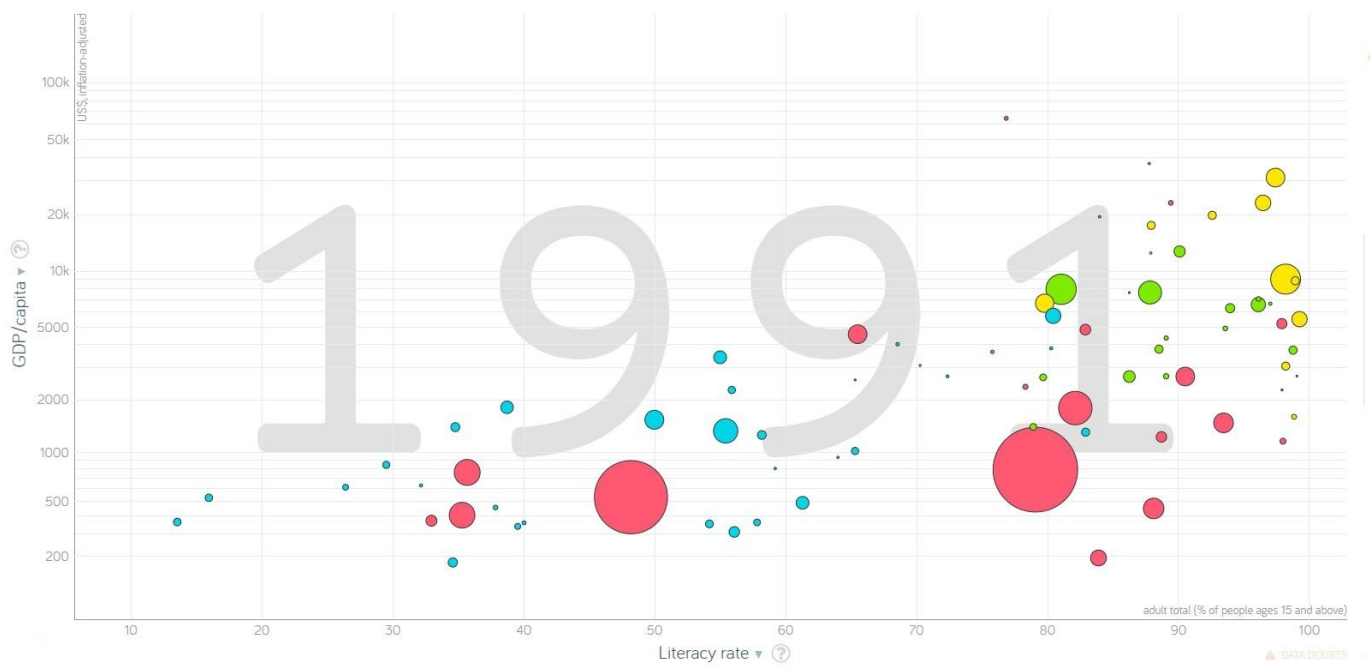

Fig (II) Gapminder plot of Literacy Rate in adults over 15 years in linear scale vs GDP per capita in logarithmic scale for 1991.

We now look at the same plot with data from about twenty years back in figure two. In this plot we do not see many Asian countries present the upper half of the plot. A possible reason behind it would be that the oil economy in the Middle East had not yet flourished. Most of the countries from Europe are still on the right side of the plot, boasting high literacy and high GDP per capita.

This is expected as during the 90's the dominant countries in terms of high GDP and equally high literacy rates were mostly the European countries. Most countries in the continent of Asia and Africa were still developing at a steady, but slow pace.

To show a better visual representation of a linear trend, a plot with the data from 1983 to 2010 of all possible countries has been plotted in figure three. Over time we can see the literacy rate and the GDP per capita for almost all countries increasing. Except for a few anomalies, a positive correlation between the literacy rate and the GDP per capita can be observed.
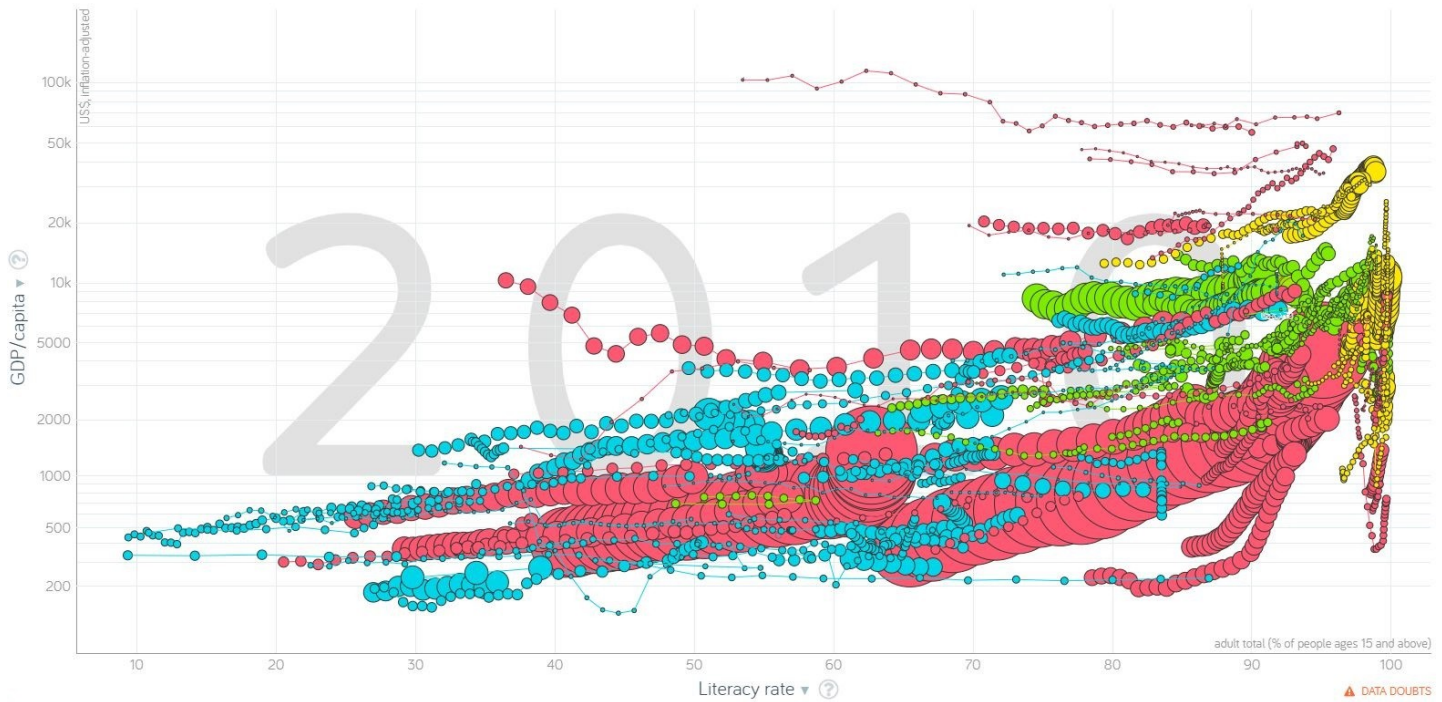
Fig (III) Gapminder plot of Literacy Rate in adults over 15 years in linear scale vs

GDP per capita in logarithmic scale, linearly shown from 1983 to 2010.

Explanation of the evaluated correlation

Literacy may not automatically guarantee socio-economic development, but it does influence a lot of factors that affect the financial state of a country. Literacy has shown to greatly influence the governance of a country, decentralization of its resources, enhancement of a country's human capital and even sustainable growth in terms of population and economy both of which affect GDP per capita. (Biao et al., 2014). Educational planning and literacy programs have shown success in some South American and African countries (Cree, A. 2015). Furthermore, literacy creates opportunities for employment and income generation, something that directly contributes to a countries GDP.

The plot in figure three had some countries that did not show a positive correlation. Some of these that were outliers to the whole plot are discussed below with potential reasoning behind why they do not follow the trend.

United Arab Emirates:

UAE is a fairly small country in western Asia with a predominantly oil dependent economy. As seen in figure four, as the literacy rate of the country increases, the total GDP per capita is seen to be decreasing. A look at UAE's economy over the past couple of decades show variations in terms of growth. While the GDP growth has been positive, the GDP per capita decreased during the turn of the century. This was mostly because of an economic crisis in Dubai, UAE's financial hub along with a steady rise in population. ("2008 Financial Crisis in the United Arab Emirates (UAE)").

Myanmar:

Myanmar or Burma is a country in Southeast Asia. According to the plot data, Myanmar followed the expected trend of an overtime increase in both the GDP per capita and the literacy rate till 1987 but went completely downwards thereafter. The country was following a socialist system of governance with a lot industries nationalized till 1987. After a military coup in 1988 however, the government was overthrown and the country's military took charge. The military rule followed totalitarian socialism and suppressed of private financial. Inflation skyrocketed and the literacy rate lowered as most educational institutes shut down. The state owned private enterprises were still active and generated revenue showing an increase in the country's GDP per capita while the lack of education amongst the younger generation decreased the literacy rate. This is clearly visible in figure four where we see Burma following the trend till 1988 and then suddenly shifting towards the left.

Iraq and Iran:

Iran and Iraq are both middle-eastern countries with an oil dominated economy. The plot shows Iran having a decrease in GDP per capita along with an increase in literacy rate to begin with while Iraq has had the same GDP per capita with decreasing literacy rate. The main reason behind this was the Iran-Iraq war, which lead to about a million casualties and over one trillion dollars in combined cost for both countries. While Iran recovered over time, Iraq was plunged into war again during the Gulf-War of 1990 and its socio-economic situation has had a hard time improving from there onwards.
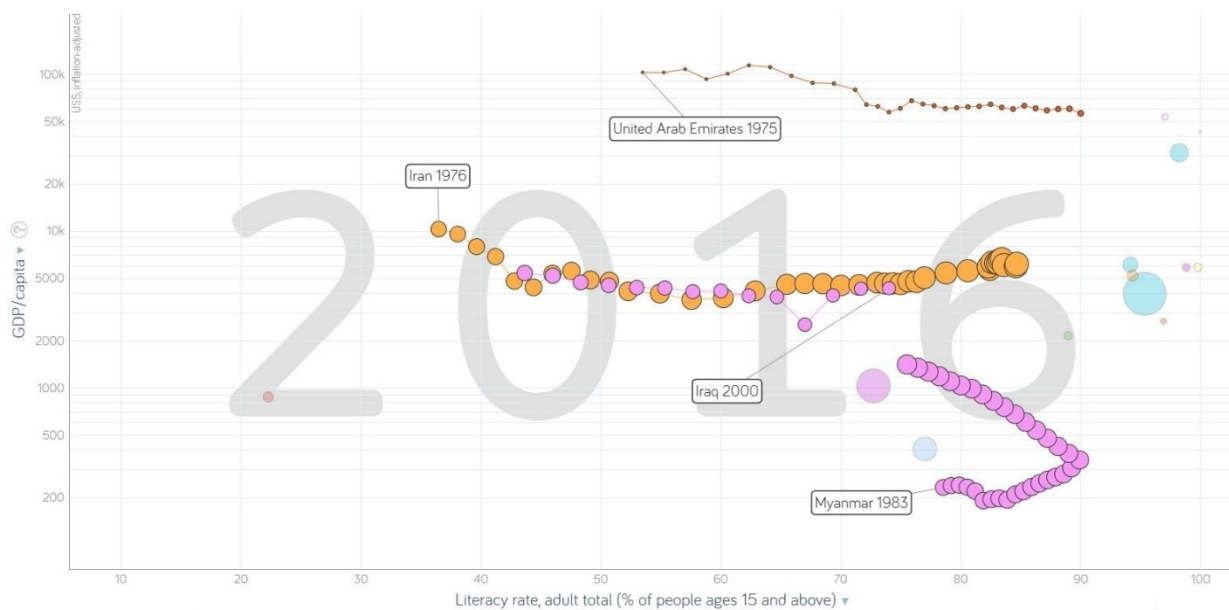

Fig (IV) Gapminder plot of Literacy Rate in adults over 15 years in linear scale vs GDP per capita in logarithmic scale of UAE, Myanmar, Iraq and Iran.

Conclusion and Afterthought:

Through high literacy rate can be deemed as an indicator of a prospering socio-economic country, it cannot be directly proved that a high literacy rate naturally means a high GDP per capita. It would however be appropriate to suggest that a high GDP per capita is a likely cause for a higher literacy rate rather than the other way around.

The literacy rate for a country only accounts for a population's ability to read and write instead of their ability to actually communicate and simultaneously gain useful knowledge, given which it would not be the best index to analyze the economic stature for a country. For example, two countries with a literacy rate of a 100% would suggest that all of the populace can read and write. One country may have citizens that simply graduated high school and joined an agrarian society, while the other may have citizens who have doctorates in highly advance fields and are employed in thriving corporations. Comparing the economic factors in between both can show drastic differences in GDP per capita even though the literacy rate remains the same.

References

2008 Financial Crisis in the United Arab Emirates (UAE). (n.d.). Retrieved April 30, 2019, from

Fanack.com website: https://fanack.com/united-arab-emirates/economy/united-arab-

emirateseconomythe-2008-financial-crisis/

Biao, I., Mogotsi, K., Maruatona, T., Raditloaneng, W., Tladi, F., Chawawa, M., & Kheru, O.

(2014). The Contribution of the Human Development Index Literacy Theory to the

Debate on Literacy and Development. *World Journal of Education*, *4*(3).

https://doi.org/10.5430/wje.v4n3p1

Cree, A. (2015). *The Economic and social cost of illiteracy: a snapshot of illiteracy in a global

context; final report - UNESCO Digital Library*. Retrieved from

https://unesdoc.unesco.org/ark:/48223/pf0000216012

Islam, S. (1995). The human development index and per capita GDP. *Applied Economics Letters*,

2(5), 166–167. https://doi.org/10.1080/135048595357537

The World Bank. (n.d.). GDP per capita (constant 2010 US$) | Data. Retrieved April 30, 2019,

from https://data.worldbank.org/indicator/NY.GDP.PCAP.KD

UNESCO. (n.d.). The Plurality of literacy and its implications for policies and programmes:

position paper - UNESCO Digital Library. Retrieved April 29, 2019, from

https://unesdoc.unesco.org/ark:/48223/pf0000136246

White, L. H. (n.d.). Inflation. Retrieved April 30, 2019, from Econlib website:

https://www.econlib.org/library/Enc/Inflation.html