

Does GDP Raise Life Expectancy? Empirical Study from 6 Countries

/ Capstone Project of Data Visualization in the Codecademy

People intuitively think wealthy people live longer. In 1975, a striking empirical study conducted by Samuel Preston had discovered a relationship between life expectancy and income, called the Preston Curve. The curve displays that at a low level of income, a farther growth of income is related to increase in life expectancy; however, at a high level of income, the influence of raised income on life expectancy is pretty limited. Preston believed that better medical technology, enhanced public health services, and improved nutrition are the reasons for increased life expectancy. Nevertheless, a recent research from Wolfgang Lutz and Endale Kebede states that better education results in upgraded cognition of body care and better decisions for health-related behavior. Hence, there is no unified answer to the relationship between GDP and life expectancy in the academic world. After all, this article examines how life expectancy and GDP have shifted in recent years, and I have selected greatly diverse six countries to observe their similarities and differences.

GDP and Life Expectancy

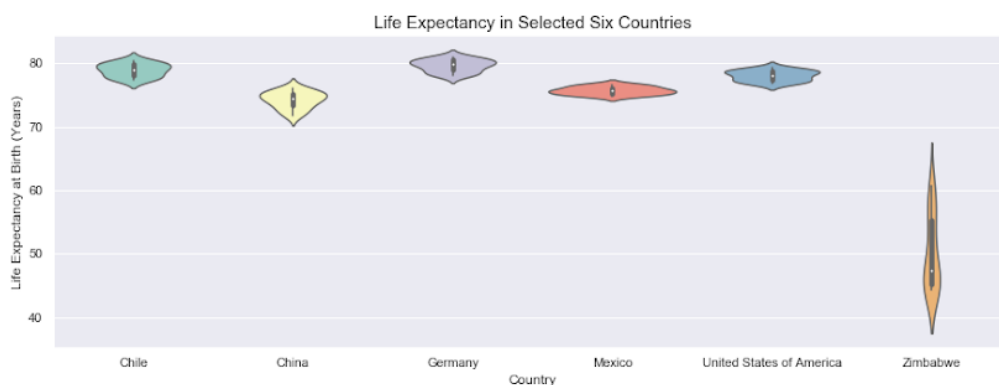
This essay explores the relationship between GDP and life expectancy and indirectly analyzes the relationship between national income and national health. GDP (Gross Domestic Product) is a measure of the market value of all the final goods and services produced over a period of time; namely, an indicator of the economic performance of a whole country. As reported by IMF (International Monetary Fund), global average GDP is 79,870 billions of U.S. dollars. Life expectancy is a measure of the average time a person is expected to live, based on the year of his/her birth; namely, an indicator of the health level of a whole country. According to WHO (World Health Organization), global life expectancy has increased by 5 years in recent fifteen years. Global life expectancy in 2015 was 71.4 years (73.8 years for females and 69.1 years for males).

In this article, the national data on 2000-2015 collected from the World Bank, IMF, and WHO. Furthermore, I have investigated recent studies about the connection between GDP and life expectancy and corresponded their findings with the data. These studies have been cited at the end of the essay.

Empirical View

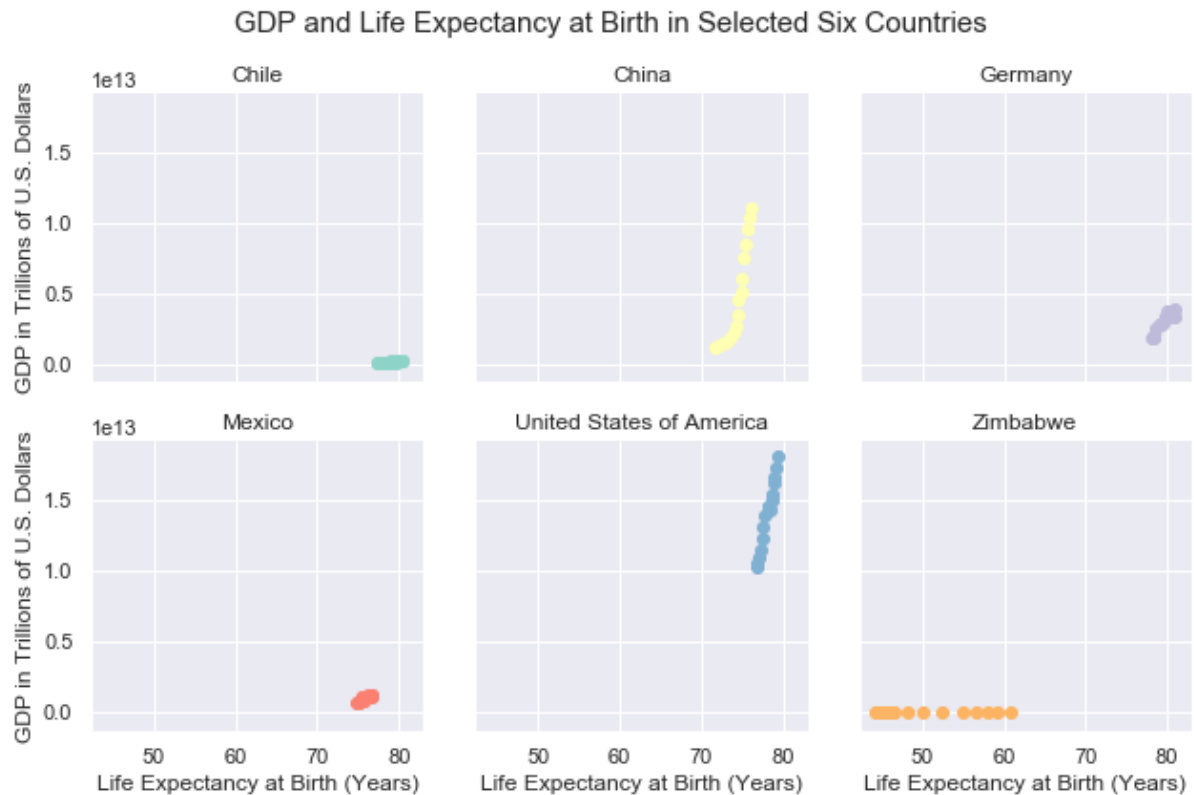
1. Life expectancy distribution: major inequalities persist among countries

The six countries are distributed on different continents. Chile located in South America; China located in Asia; Germany located in Europe; Mexico and the United States of America located in North America; Zimbabwe located in Africa. Chile, Germany and the United States have the higher life expectancy at birth, around 80 years, while China and Mexico have the quite lower life expectancy, around 75 years. Surprisingly, Zimbabwe has the lowest life expectancy and the median is below 50 years. Below violin chart is a combination of a box plot and a density plot and easier to see the distribution via the figure shape. Zimbabwe has the widest distribution of the life expectancy which implies the health condition has drastically changed in the past fifteen years. Conversely, Mexico has the narrowest distribution of the life expectancy which indicates the health condition is relatively stable but not that good. Though most people in Mexico have access to health services, the life expectancy is still stagnant. According to the Max Plank Institute for Demographic Research (MPIDR), the increase in male mortality was due to the uncommon rise in homicides. The homicide rates in Mexico doubled between 2005 and 2010, which caused a loss of life expectancy in some areas and affected to the life expectancy of a whole country. The distribution among Chile, China, Germany and the United States is quite similar which means the life expectancy did alter but not that much.



2. GDP and life expectancy: some are positively related and some are not related

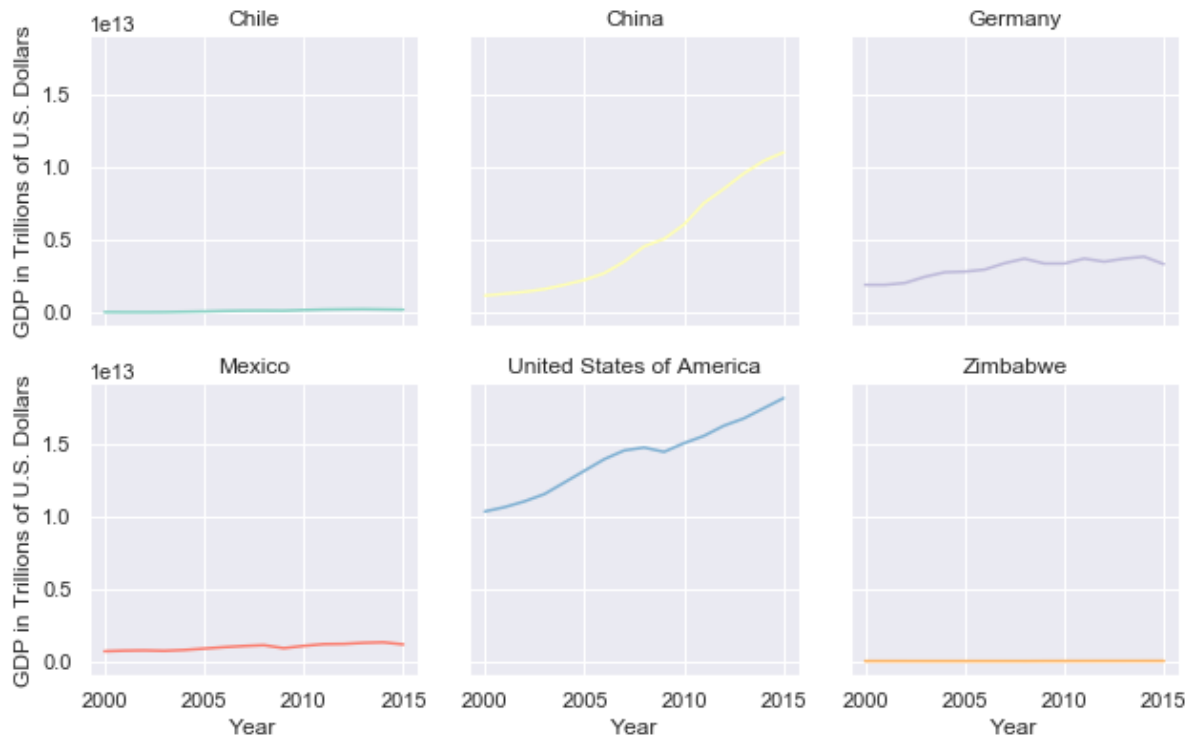
In the past fifteen years, Chile, Mexico, and Germany have a steady economic condition and life expectancy, and the scattered dots are concentrated in the lower right corner as below chart. In contrast, the GDP of China and the United States has dramatically raised up. There are two ways to increase GDP overtime: increase inputs (investment, government expenditure and so on) or to increase productivity, which is the main driver of economic growth in these two countries. In the nineteenth century, the Industrial Revolution greatly improved the productivity of labors and made the United Kindom as a leading country in the world. In the twenty-first century, the development of the Internet has become the next Industrial Revolution and created economic success in China and the United States in the past fifteen years. Another key point, Zimbabwe has endured a lagging economic situation but its life expectancy is getting better.



3. GDP trend: China and the United States are the main forces of the economy

From 2000 to 2015, Chile, Mexico, and Zimbabwe's economy are poor and stagnant. Germany's GDP has moderately raised up in the last fifteen years. As reported by IMF, Germany was the largest national economy in Europe and accounted for 28% of the euro area economy. Thanks to cross-border cooperation, Germany was the world's largest exporter from 2003 to 2008 and is a founding member of the EU, the G8 and so on. As described above, China and the United States have experienced rapid economic growth in the past decades. As stated in the World Bank, the top two largest economies by the average value of GDP in 2015 was the United States, with 18,036 billions of U.S. dollars, and China, with 11,226 billions of U.S. dollars. Moreover, the United States has kept the first place since 1960.

GDP in Selected Six Countries, 2000-2015



4. Life expectancy trend: some have grown steadily, but not in the undeveloped country

The life expectancies in Chile, China, Germany, Mexico and the United States of America have grown steadily. Notably, the life expectancy in Chile is as high as Germany and much higher than in the U.S. Mentioned by the World Bank, Chile has a life expectancy of 81.75 since 2016. According to Dr. Enrique Paris, a former chairman of the Chilean Medical Association, Chileans probably have genetic factors that protect them, and those are not related with the Europeans, which was much more resistant to diseases. Gene might be part of reasons, yet the development of general infrastructure, the increase in the health care coverage and the decrease in child mortality are also credited with the high-level life expectancy. On the other hand, the life expectancy in Zimbabwe has experienced reduction and rapid growth, though it still stays at a low level. During 2000 to 2005, life in Zimbabwe was shorter than anywhere else in the world, and the women had an average life expectancy of only 34 years, according to WHO report. The main reasons for the decline are poverty and deaths from Aids. Zimbabwe's economy has fallen off in many years under President Robert Mugabe. However, the life expectancy in Zimbabwe has increased in recent years. The increase was driven by improvements in child survival and expanded access to the treatments of HIV.

Life Expectancy in Selected Six Countries, 2000-2015



5. GDP and life expectancy percentage change

As foregoing charts, there were shifts in GDP and life expectancy, and I would like to zoom in to see the relationship between GDP quantity and the shifts in life expectancy. The life expectancy percentage changes in Germany, China, and the United States have slightly upward and downward, but all changes were positive. It seems the same as Preston Curve, which implies that when a country has achieved a certain level of economic development, increase in GDP is weakly associated with the increase in life expectancy. In the last fifteen years, Mexico and Chile have endured mild declines in life expectancy. Zimbabwe has experienced dramatical shifts of life expectancy but the GDP stayed the same level. Therefore, I can reasonably infer that the increase in life expectancy in Zimbabwe might not be associated with GDP but with the financial and medical aids from developed countries.



6. How GDP change affected on life expectancy change

The previous paragraph is to examine the relationship between GDP quantity and the shift in life expectancy, while it is worth investigating the relationship between the shift in GDP and life expectancy. I use **lmplot()** in seaborn to draw a scatterplot of these two variables, fit the regression model, and then plot the resulting regression line and a 95% confidence interval for that regression. In Chile, Mexico, Germany and the United States, GDP change is slightly related to life expectancy change. Interestingly, there is a negative relationship between GDP change and life expectancy change in China, which means that higher income change does not always lead to higher life expectancy change. The GDP change in Zimbabwe is positively related to the life expectancy change, which implies that higher income change might have beneficial effects on life expectancy change.



Does economic growth raise up life expectancy?

After all, in developed countries, such as Germany, the United States, and Chile, the GDP seems marginally related to the life expectancy. As Preston Curve discovered, in a higher level of income, the beneficial effects on life expectancy will shrink. There are other reasons to drive the increase in life expectancy in developed countries: technology, medical care policy and so on. In developing countries, like China and Mexico, the relationship between GDP and life expectancy seems similar to developed countries; however, every country has its own problem. In Mexico, homicide is rampant, which has the unfavorable influence on the growth of life expectancy. In China, the relationship between GDP change and life expectancy change seems moderately negative, revealing the disadvantage of accelerated income growth. In an undeveloped country, like Zimbabwe, there is a positive relationship between GDP change and life expectancy change, which is consistent with the conclusion of Preston Curve. At a low level of income, the benefit of GDP change to life expectancy change is notable. Therefore, it is really hard to unify conclusion in different countries. Yet, in general, the results follow the Preston Curve.

Limitation of the research

- **GDP is not a proper indicator:** After examining the updated studies about this topic, many scholars use *per capita GDP (PPP)* as the income indicator. The per capita GDP is a measure of dividing GDP by the number of people in that country, which is especially useful to show the relative performance of the countries and proper to evaluate the income level of the people.
- **Lack of longitudinal evidence:** This research only covers sixteen years of data, which means that it holds for a sample of countries taken at a particular point in time.

- **Lack of mining more reasons:** The essay only considers the relationship between GDP and life expectancy and ignores other possible factors, such as healthcare expenditure, technology improvement and so on.

Further research

- **Conduct a model explaining the story:** Before starting analyzing data, it would be better to recognize and exhaust all possible factors through literature. Then, eliminate factors and conduct a model explaining the mechanism behind a country's income and life expectancy.
- **More data from different angles to test the story:** Use longer data to comprehensively examine the relationship. Moreover, adding more countries and different categories of data related to this topic might be helpful to test the mechanism.
- **Use more statistical techniques:** With a proper model and numerous data, it would be more rigorous to conduct statistical tests.

Reference

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2. [*Economic Growth and Life Expectancy – Do Wealthier Countries Live Longer?, Audre Biciunaite, Euromonitor International*](#)
3. [*Preston curve, wikipedia*](#)
4. [*Life Expectancy, Max Roser, Our World in Data*](#)
5. [*Economic Growth, Max Roser, Our world in Data*](#)