Documenting the Correlation between Average Life Expectancy and the Gross Domestic Product of a Country

A study in data correlations between the years 2000 and 2015

Introduction

Throughout history, there has been a connection made between wealth and happiness. While happiness is difficult to measure or even quantify, it is possible to show a correlation between a country's overall economic health and a higher lifespan of the population. There has been a great deal of research done to try and determine if wealth can, in fact, increase quality of life within a country.

This study is focused in on 6 separate countries in an attempt to draw tangible correlations between the global economic health of a country and average life expectancy rates of the population.

Study Background Information

The countries included in this study are China, Germany, Zimbabwe, Chile, Mexico, and the United States. The data includes the Average Life Expectancy at Birth and the GDP for each country between the year 2000 and 2015.

The GDP of a country is its Gross Domestic Product value, or a measure of the market value of all goods and services produced within a country during a given time period. This study uses years as the time reference, but often GDP is measured quarterly as well. While a country's GDP is used as an at-a-glance indicator of the overall economic health of that region, a high GDP does not always equate to a high level of happiness within that country.

Data Sources

The GDP data was provided by the World Bank's national accounts data, and the OECD National Accounts data files. The Life Expectancy data was provided by the World Health Organization.

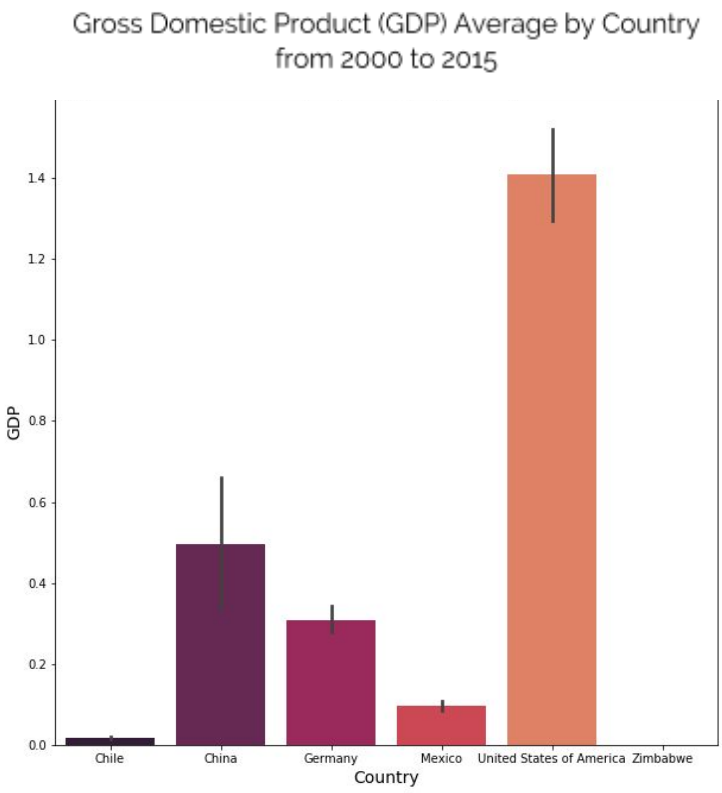
Other sources that were consulted for this study were:

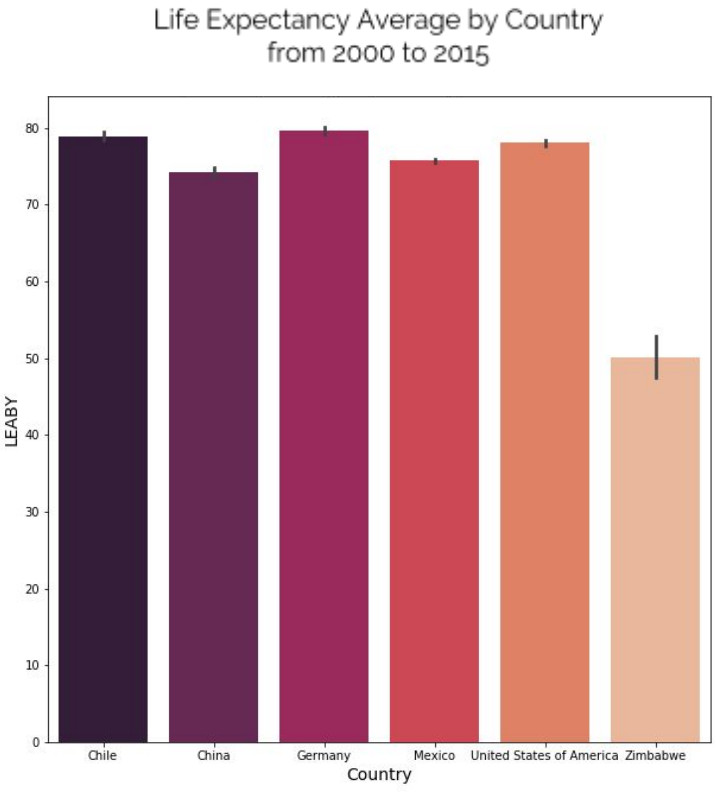
Murwirapachena, Genius & Mlambo, Courage. (2015). *Life Expectancy In Zimbabwe: An Analysis Of Five Decades*. International Business & Economics Research Journal (IBER). 14. 417. 10.19030/iber.v14i3.9207.

OECD Data site documenting GDP can be found here: httpps://data.oecd.org/gdp/gross-domestic-product-gdp.htm

Dayanikli, Gokare and Kincaid. (2015). *Effect of GDP Per Capita on National Life Expectancy*. Georgia Tech SMARTech Library. https://smartech.gatech.edu/bitstream/handle/1853/56031/effect_of_gdp_per_capita_on_national_life_expectancy.pdf

GDP and Life Expectancy Averages by Country





The above bar charts show the mean values, or averages, for both the GDP and the Average Life Expectancy by country.

Just glancing at these charts, you can see that there is a dramatic difference in average GDP values between countries. The United States has a significantly higher average than even China, with Zimbabwe's average being so low in comparison that it can barely be seen on this chart.

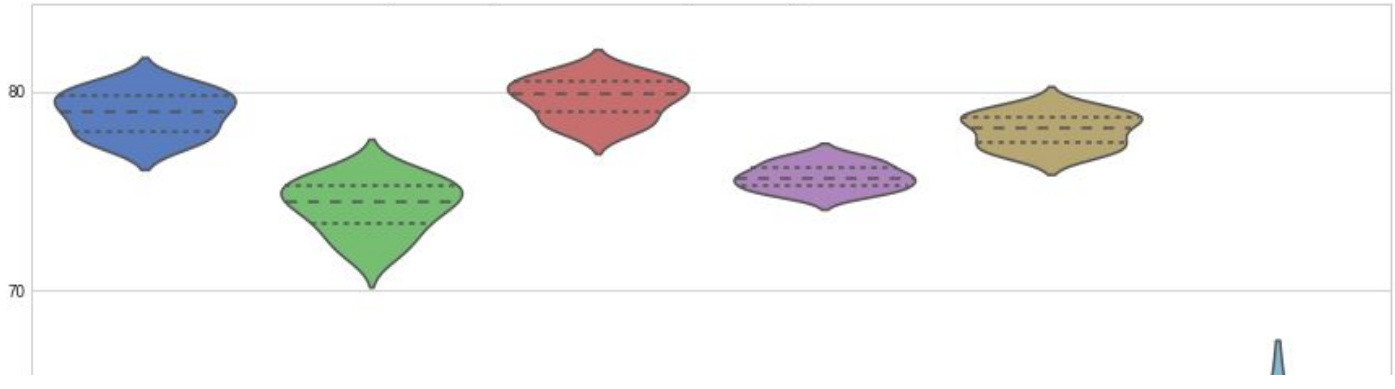
Average Life Expectancy by Country

Chile	78.94
China	74.26
Germany	79.66
Mexico	75.72
United States of America	78.06
Zimbabwe	50.09

Average Life Expectancy doesn't have as dramatic of a distribution, however you can see that Zimbabwe again trails the rest of the country's averages by a long shot.

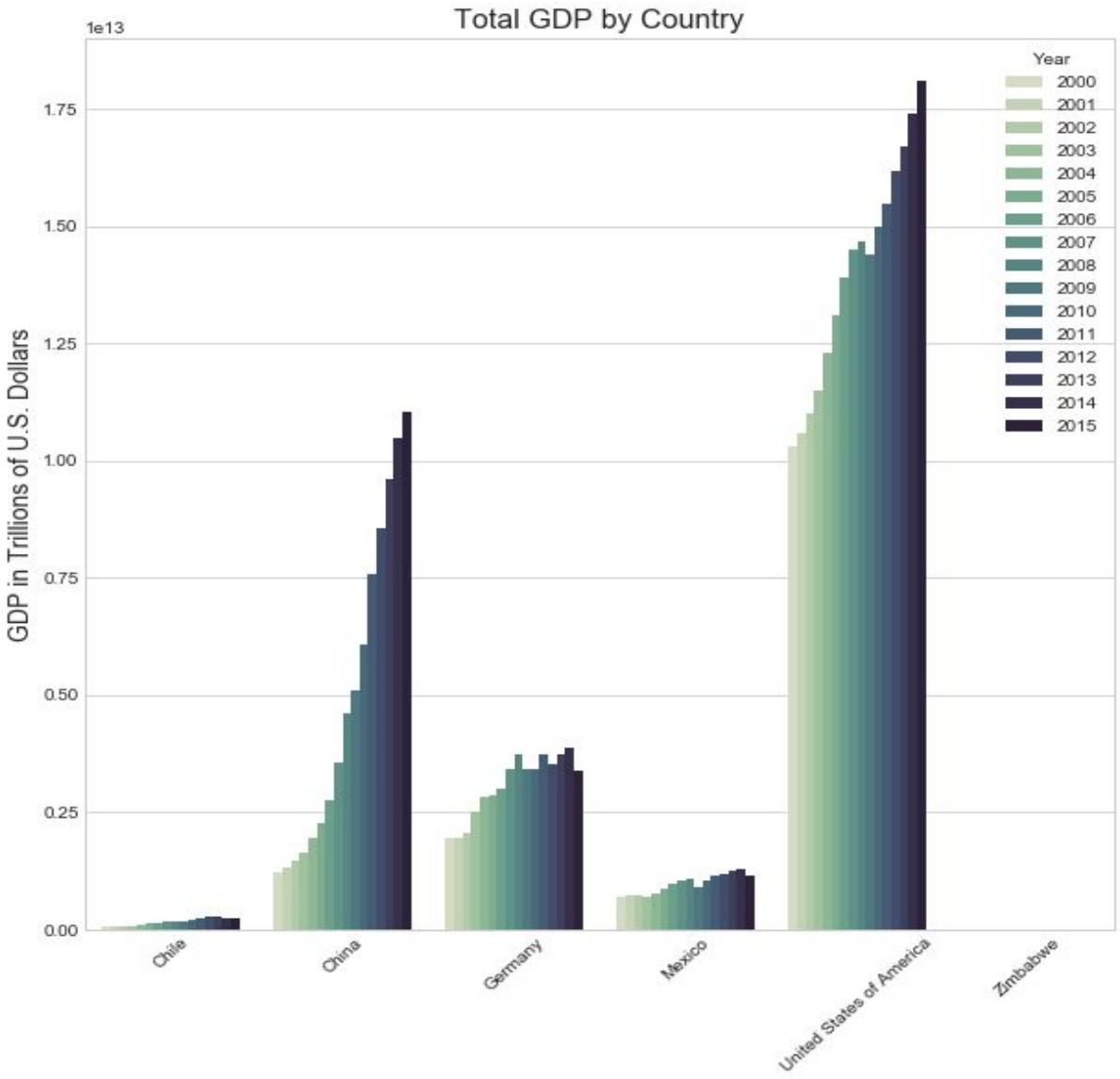
To further this point, the following violin plot shows the life expectancies of each country as a distribution, with the median value being the middle-dashed line, and the interquartile range denoted by both the upper and lower dashed line:

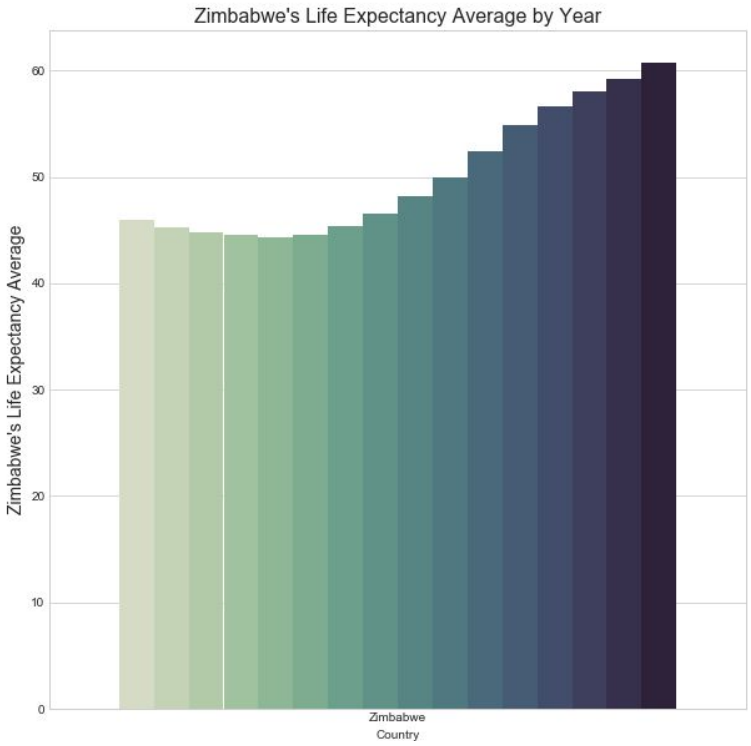
Life Expectancy Distribution by Country between 2000 and 2015

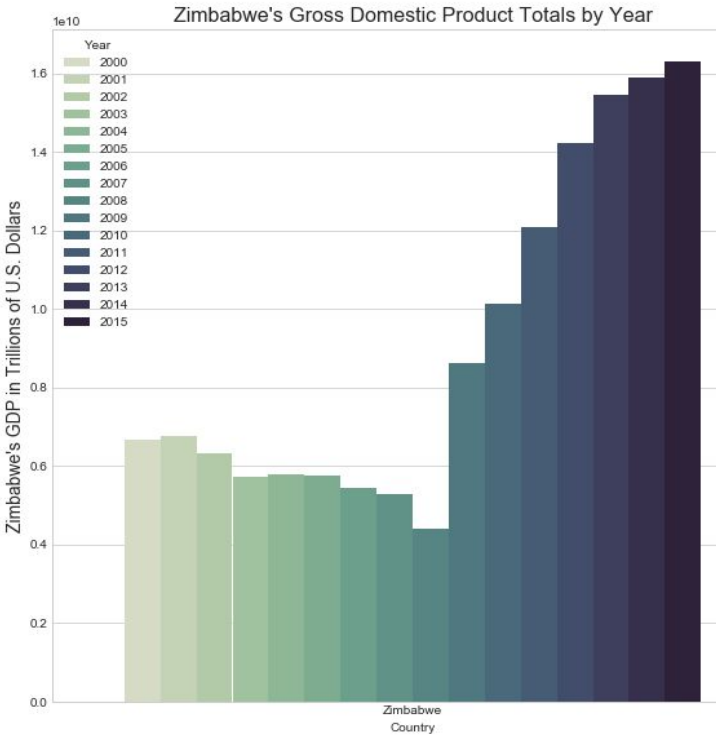


The data points on this plot are all located within the violin shape, which is essentially a distribution plot that has been turned on it's side and mirrored. The wider points of each shape are where there is a heavier distribution of values, and a higher probability factor. Most of the country's violin plots hover between the 70 and 80 year range, with very similar shape distributions. Zimbabwe is the obvious outlier, with a large quartile range, showing that 50% of the values have a much wider distribution than any of the other countries; this also shows that Zimbabwe's average life expectancy has fluctuated dramatically during the data's year ranges.

In the charts below, the Total GDP is shown by country and by year, to give a better view of how each country's GDP total fluctuated from year to year. This gives a better overview of the differences between years as well as insight into the rise and fall of values, versus just looking at each country's overall average.


Total GDP by Country
1e13
GDP in Trillions of U.S. Dollars
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
Year
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Chile
China
Germany
Mexico
United States of America
Zimbabwe


Zimbabwe's Life Expectancy Average by Year
Zimbabwe's Life Expectancy Average
0
10
20
30
40
50
60
Zimbabwe
Country

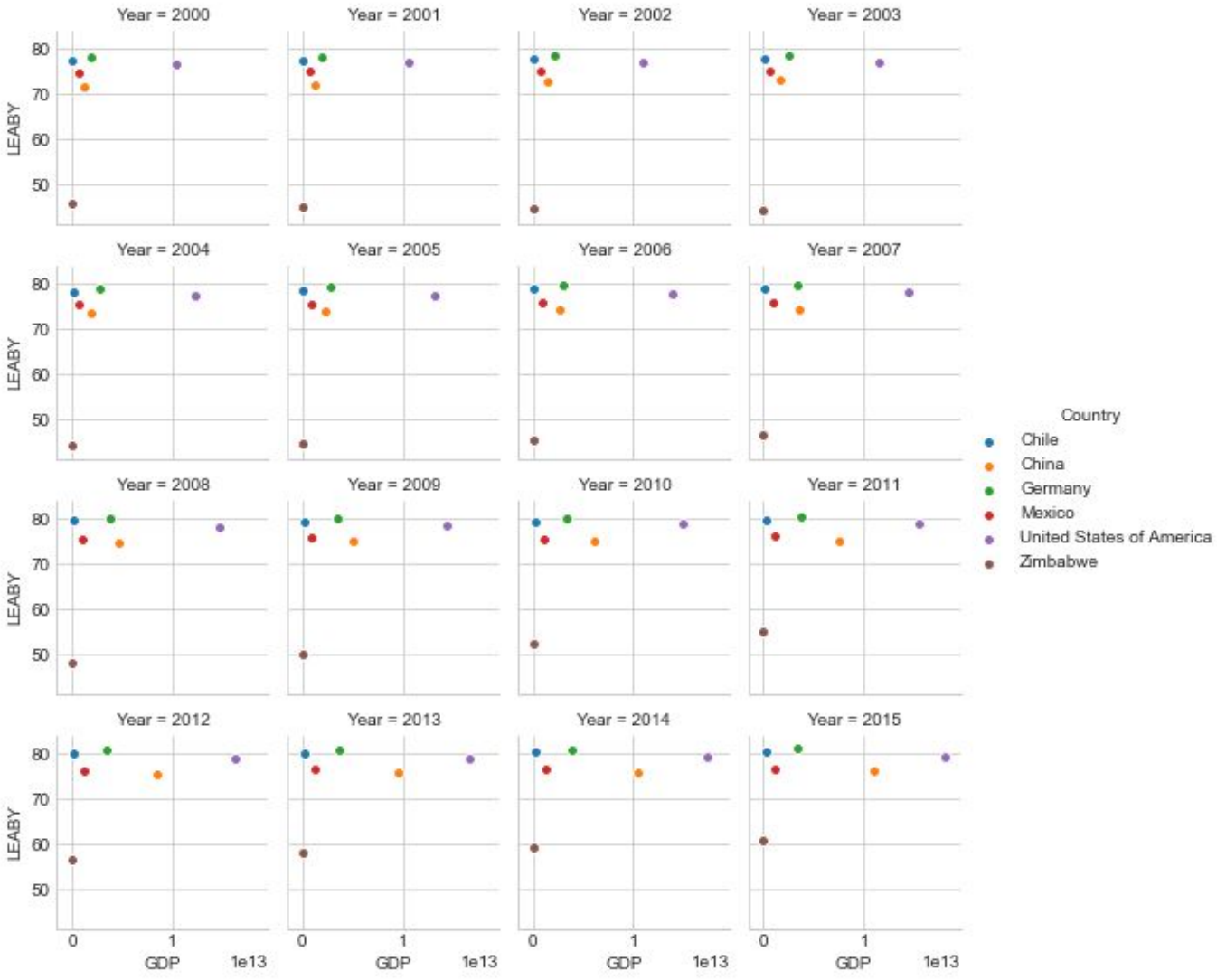

Zimbabwe's Gross Domestic Product Totals by Year
1e10
Zimbabwe's GDP in Trillions of U.S. Dollars
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
Year
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Zimbabwe
Country

Also included in the charts above are individual views of Zimbabwe: both the GDP and the Life Expectancy Average by year. Since Zimbabwe's data is so much smaller in comparison to the other country's data, it is difficult to see the distribution shapes of the data when grouped with much larger values. In the two charts, you can see a shape correlation between the rise and fall of the GDP along with the Life Expectancy values.

In both charts, the data values are in a declining pattern from 2000 to around 2007. GDP takes a dramatic turn for the better in 2009, according to the research presented in the study Life Expectancy in Zimbabwe: An Analysis of Fife Decades, due to multiple factors. While the rest of the world was seeing an increase in Life Expectancy values, Zimbabwe's was in a steep decline due to the prevalence of HIV, the AIDs epidemic, deteriorating economic activity and a lack of accessible medical facilities, as well as a massive spread of poverty affecting the nation. Women's life expectancy average was lower than that of men in Zimbabwe, which goes against the patterns seen in other countries where women typically outlive men by at least a few years.

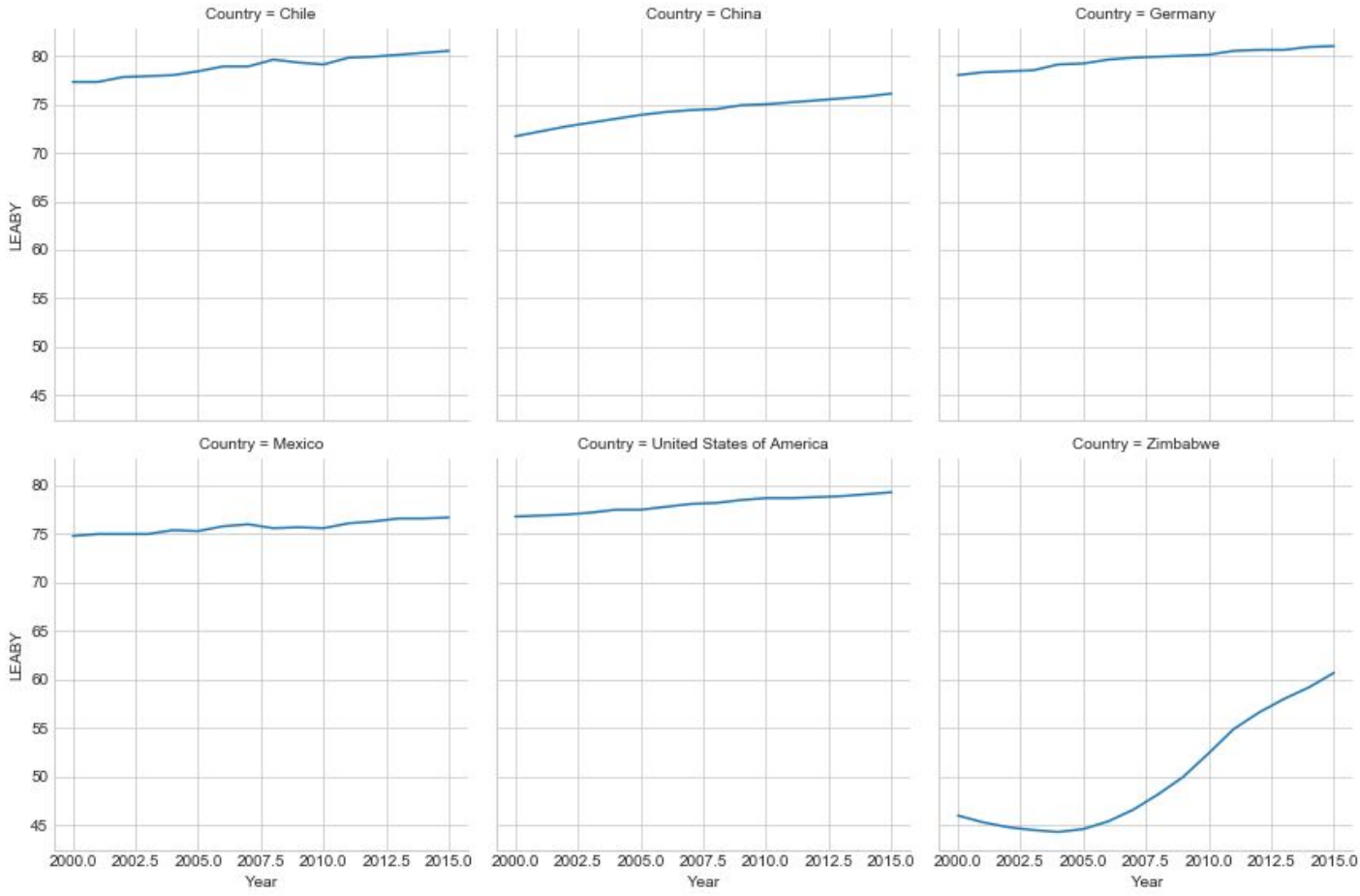
In 2010, a new united government was formed in Zimbabwe, which introduced national stability to the country. It allowed the use of multiple foreign currencies to be used, which jump-started the decaying economy, and allowed for state hospitals to reopen, leading to more jobs, better healthcare accessibility, and an overall decrease in mortality rates.

GDP as it Relates to Average Life Expectancy – Grouped by Year



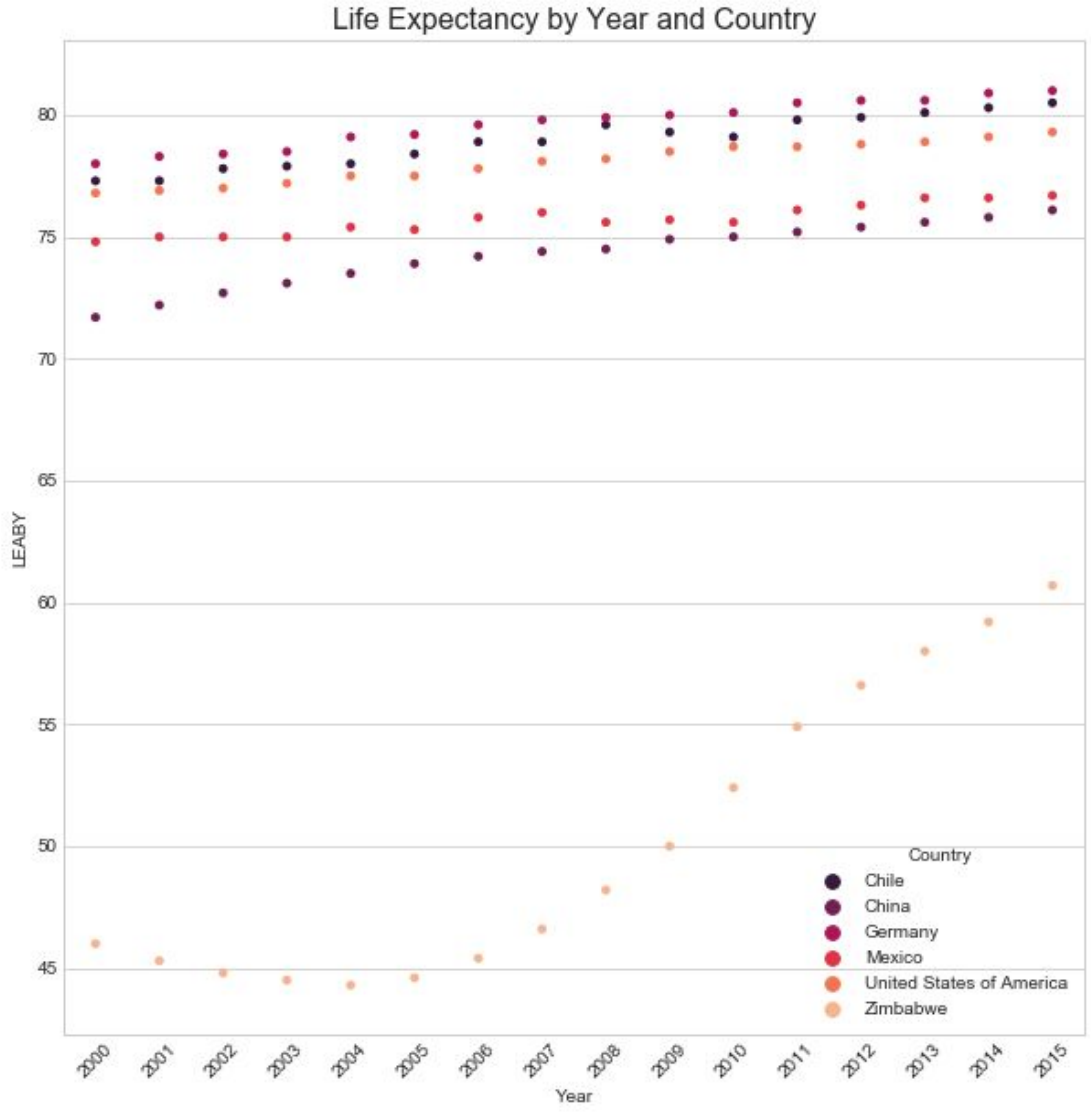
The grouping of grids above is called a Faced Grid, and it is an ideal way of showing multiple plots for comparison, and to show how data moves in relation to multiple variables. The x-axis is the GDP of a country, and the y-axis is the average life expectancy for each country by year. With this visualization, it is easier to see that there is a possible correlation between a country's GDP and the Average Life Expectancy of the population. It is especially interesting to follow Zimbabwe's movements throughout the 15-year span.

Average Life Expectancy by Country

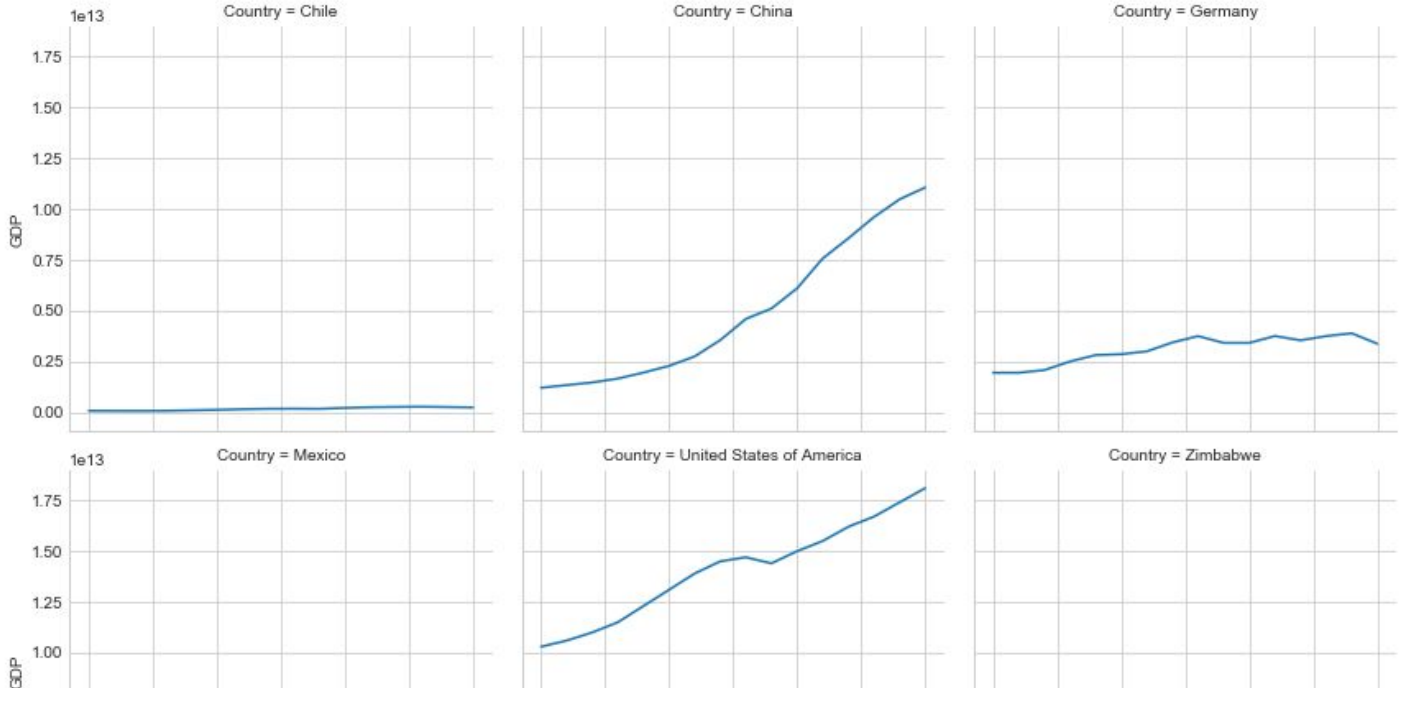


This collection of graphs above shows the movement of the average life expectancy values through time. While \Chili and Mexico do have a small decline that can be seen around the year 2010, the first 5 countries show an increasing average value over time. Zimbabwe's average plummets around 2004, which is easily seen in this line graph.

The Life Expectancy scatter plot below just reinforces the conclusions stated above: most countries have a very obvious upward trend, and Zimbabwe is the outlier at the very bottom of the plot.



Gross Domestic Product by Country



The collection of graphs above does the best job at showing the movement of each country's GDP over time in relation to each other. While Zimbabwe's individual GDP chart by year showed a dramatic fall and rise of the GDP, in relation to the other countries, the overall GDP of Zimbabwe is very small. It is also interesting to see the dip in the United State's chart as well around 2009, which is when the recession occurred.

Conclusion

While there is clearly a strong correlation between the rise and fall of a country's GDP and the overall life expectancy average of the citizens, it begs the question as to what other variables could be affecting the average lifespan of country.

The data used for this analysis leaves out the fact there are other macroeconomic indicators of a country's state: overall access to healthcare, government expenditures towards technological advancements, infrastructure spending, or the overall "happiness" of the population.

In addition, the data set simply had one average life expectancy value per country per year, without dividing the data by sex to allow for further comparisons to be made. In the case of Zimbabwe, this data would have been useful to see that during the drastic decline of life expectancy between 2000 and 2004, men were on average outliving women, which is unusual and could use further discovery and analysis.