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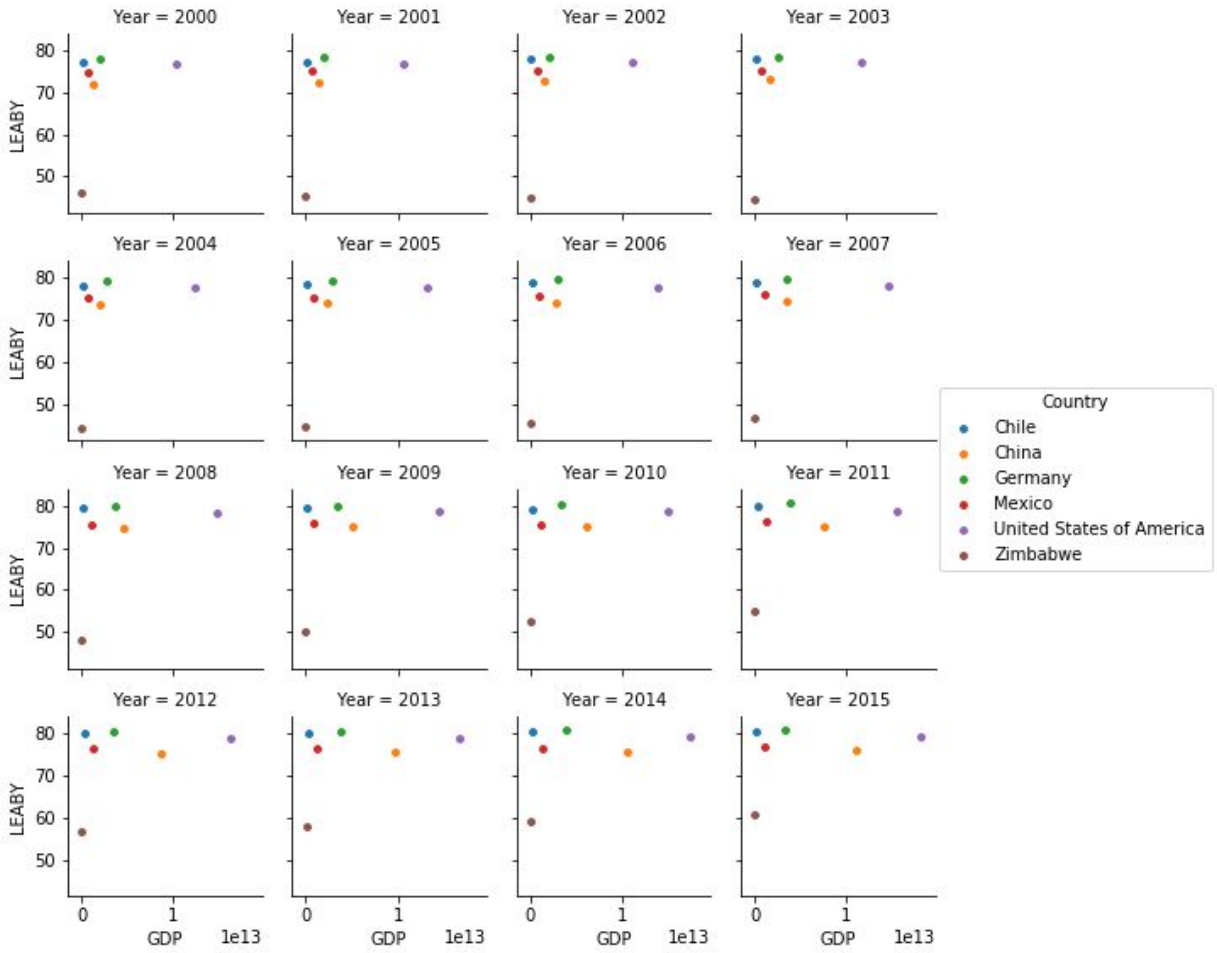
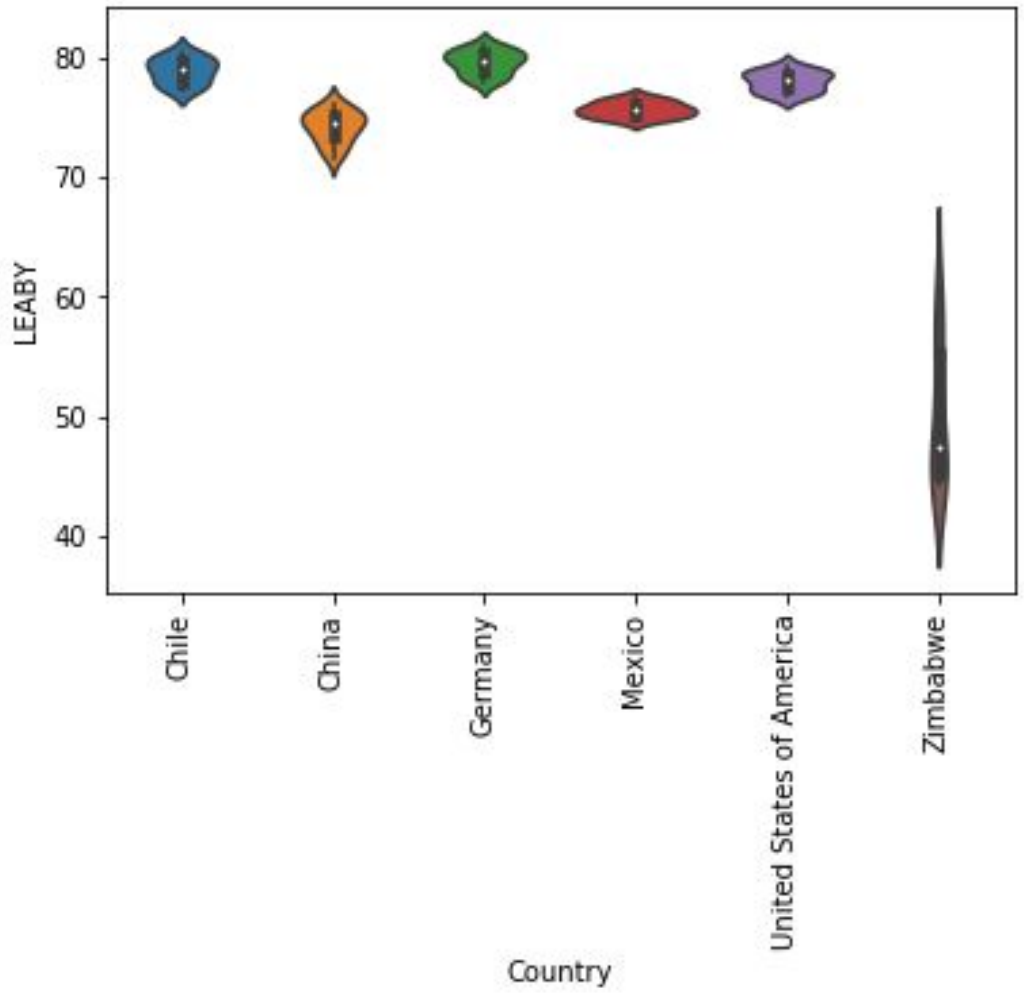
Money Can't Buy Everything: Measuring the Relationship between GDP and Life Expectancy

What determines how long the average person lives? Happiness? Availability of resources? Access to a robust healthcare system? There are a variety of factors that come to mind, but one particularly popular term comes to the forefront of the discussion: gross domestic product (GDP). GDP, or the measurement of a country's economic productivity based on the goods or services produced within its domestic purview, is often equated to a measurement of a country's success. If a high GDP is widely touted as a gold standard for a country and its standard of living, then one would assume that it would correlate with a higher life expectancy. However, life expectancy is a tricky metric that is influence by a multitude of variables (obesity rates, access to healthcare, suicide rates, substance use trends, etc), so the connection is not as straightforward as one would believe. In order to clarify this relationship, this blog post will examine six countries over the course of 16 years (2000 - 2015) to see if GDP serves as an indicator of life expectancy at birth in years (referred to as LEABY). By mapping out the data with three different yet complementary graph types - scatter plot, violin plot, and a set of facet grids - it will become clear that the strength of a country's economy does not necessarily dictate the longevity of its people.

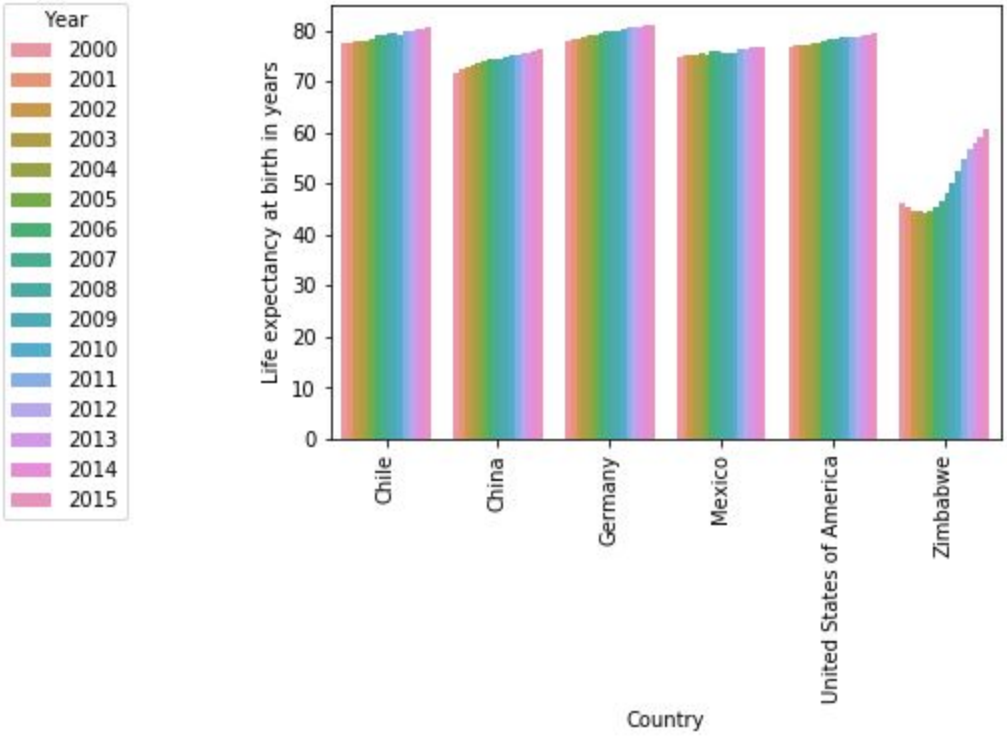


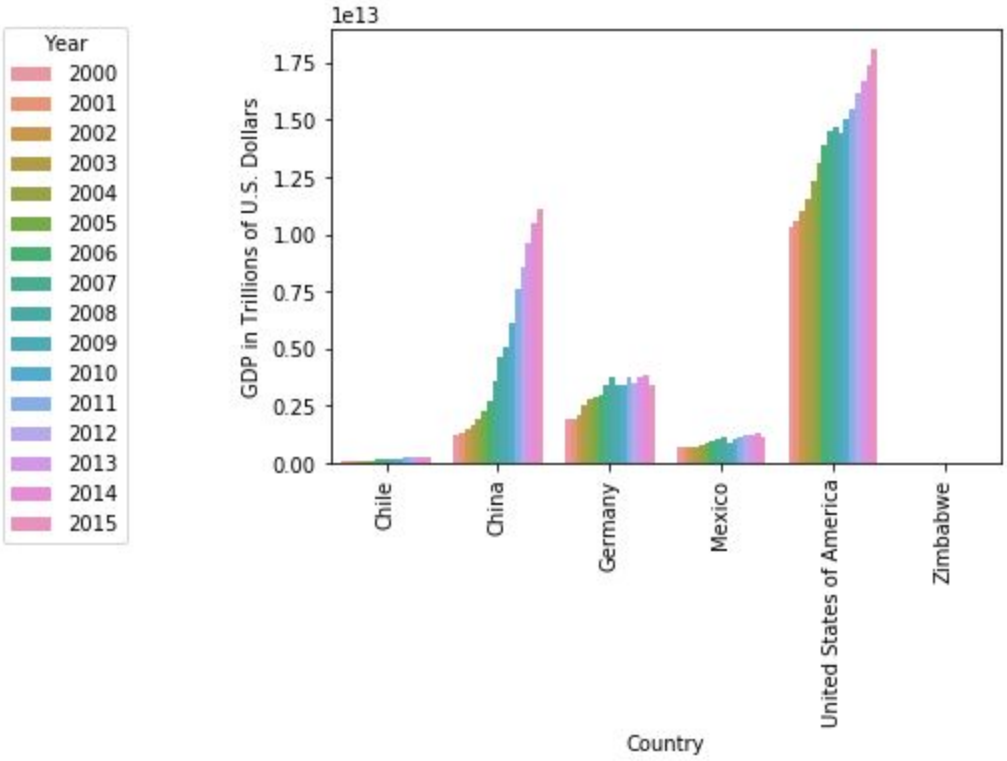
The graphs above depict the relationship between LEABY (y-axis), GDP (x-axis), trended over the course of 16 years (separated into 16 distinct scatter plots, one for each year). This collection of scatter plots achieves the goal of charting out three separate variables in a 2D space, but it does so in a rather inelegant way. Having 16 plots side-by-side sacrifices ease of trend identification since visual real estate is limited, so one must look closely to gather any intelligence from the data. With enough examination, one can identify trends such as Zimbabwe's increasing LEABY despite stagnating GDP growth, and China's lagging LEABY compared to its counterparts even though the country experienced explosive GDP growth, but it is difficult to come to these conclusions without close scrutiny. Superficially, it can be determined that GDP is not an accurate indicator since GDP growth in China is not matched by growth in LEABY, but this is difficult to determine. Though this set of scatter plots has value in its depiction of three variables and the relationships between them, it is hard to digest quickly and easily, meaning that additional data visualizations are needed before coming to a conclusion.



Consolidating the data into one chart rather than 16 separate graphs, this violin plot measures a country's LEABY and the frequency associated with each age (effectively measuring time since each year within a country has a LEABY tied to it). Unlike the scatter plot, this violin graph is limited to two variables: LEABY and year. With that said, it is much easier to spot out trends. Like the scatter plot, we can determine that Zimbabwe underwent a dramatic change in LEABY (it is worth noting that there are no directional indicators and we can't tell whether the LEABY is rising or falling, but it is reasonable to infer that it is trending upwards). Additionally, a few more trends are immediately visible: Mexico has undergone few changes in its LEABY (as indicated by the plots short height), and China has experienced a modest increase in LEABY and looks like it will soon overtake Mexico. Subsequently, there is value in

this graph in that it is much easier to compare and contrast different countries versus the scatter plot. However, because the goal is to determine how GDP influences LEABY, this graph does not meet expectations, creating a need for another visualization.

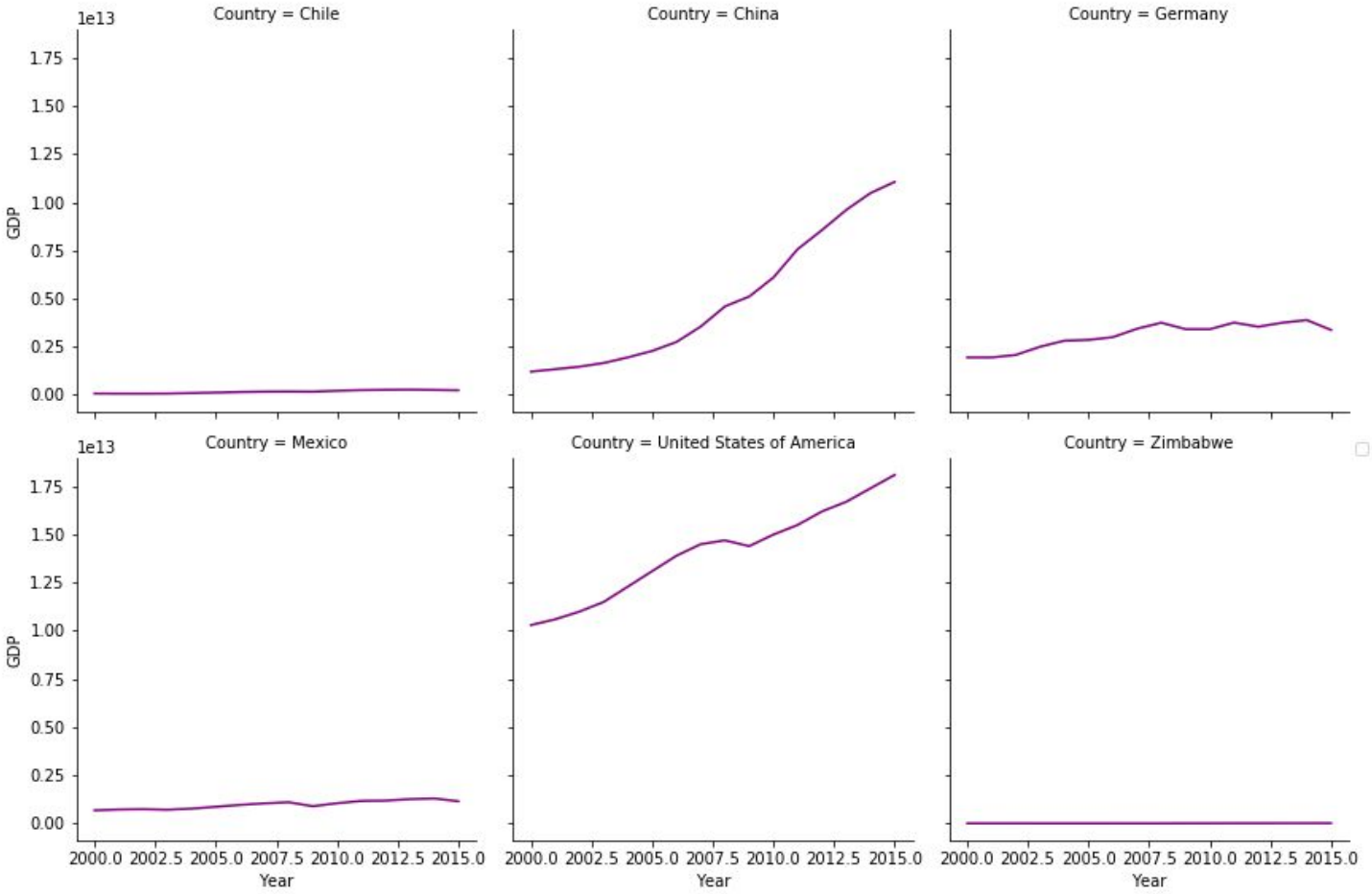




Finally, we come to the set of facet grids: one measuring LEABY growth, and the other measuring GDP growth. This set of charts is a happy marriage best components of the violin plot and the scatter plot - it measures all three variables while still being easy to read. It is also easy to spot all of the trends found in the previous graphs. We can see rapid growth in LEABY for Zimbabwe, stagnance for Mexico's LEABY, and explosive GDP growth for China. We can even tell that there is a distinct *dip* in Zimbabwe's life expectancy in the early 2000's, which is something that is completely left out in the violin graph, and hard to determine from the scatter plot. Lastly, it is evident that GDP is a poor indicator of LEABY. Chile, a country with an extremely small GDP, boasts a very high life expectancy. The USA has a very high GDP, yet has a life expectancy comparable to Mexico, which has a fraction of the economic clout. Evidently, GDP is not a leading indicator of LEABY, and these graphs show it clearly. Though not as concise as the violin plot and not as detailed as the scatter plot, these charts strike a happy medium between the two and give the insight needed to come to a more concrete conclusion.

It took a handful of data visualizations to prove the point, but it is safe to assume that LEABY isn't necessarily linked to GDP. One might think that the more productive a country's economy is, the better the quality of life would be for its citizens. However, GDP does not take into account population - a country that is considered prosperous but has a small population (Luxembourg and Singapore come to mind) would have a comparatively small GDP compared to countries with robust economies and large populations (USA and Japan). GDP alone cannot serve as an indicator of LEABY, and the facet grids prove that point. Unless another variable is added to the mix, such as population for calculating GDP per capita, GDP simply serves as a signal that mapping out LEABY growth isn't as straightforward as it might seem.

Appendix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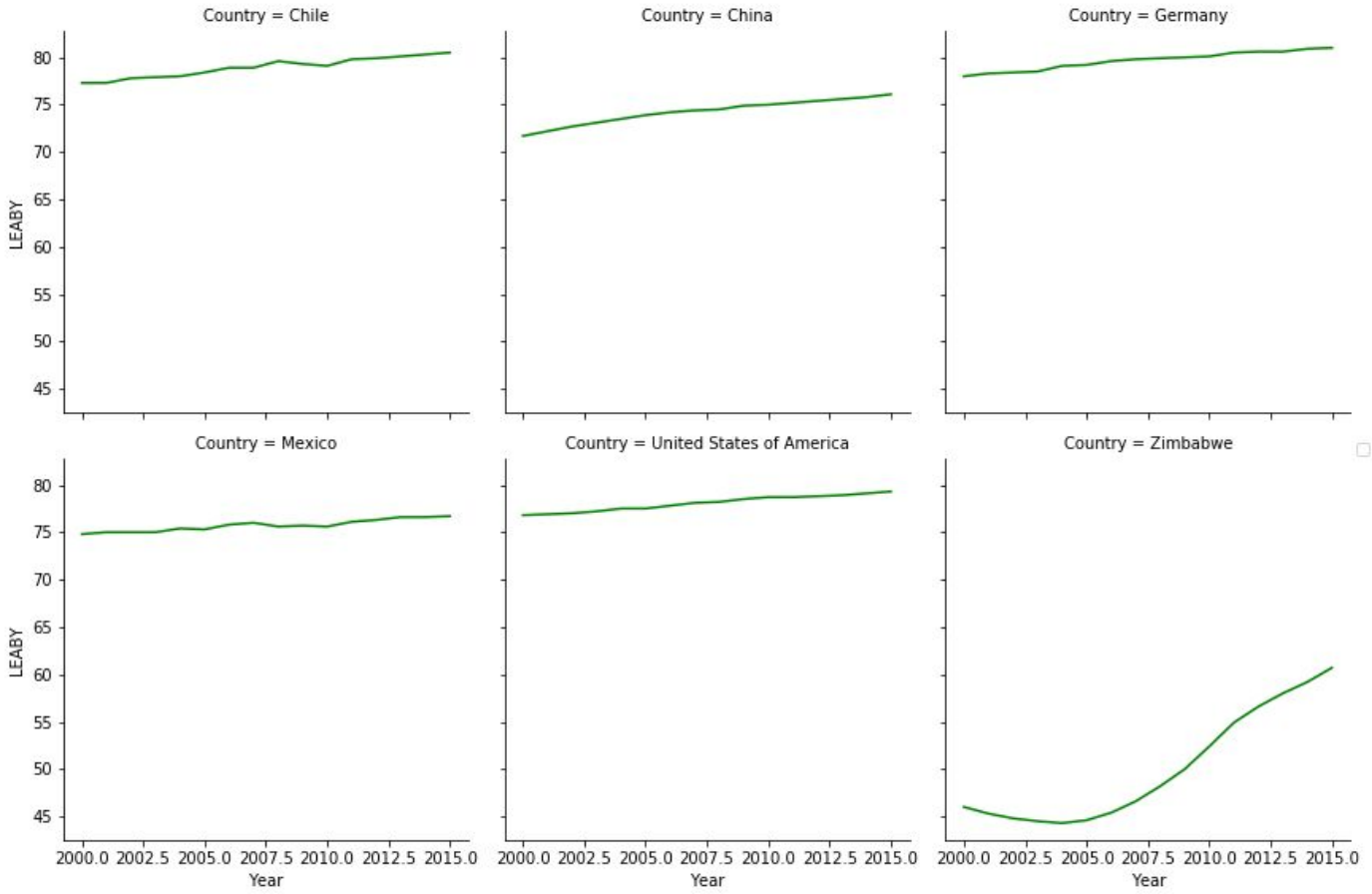
Country = China
Country = Germany
Country = Mexico
Country = United States of America
Country = Zimbabwe
1e13
GDP
Year
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2000.0
2002.5
2005.0
2007.5
2010.0
2012.5
2015.0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Country = Germany
Country = Mexico
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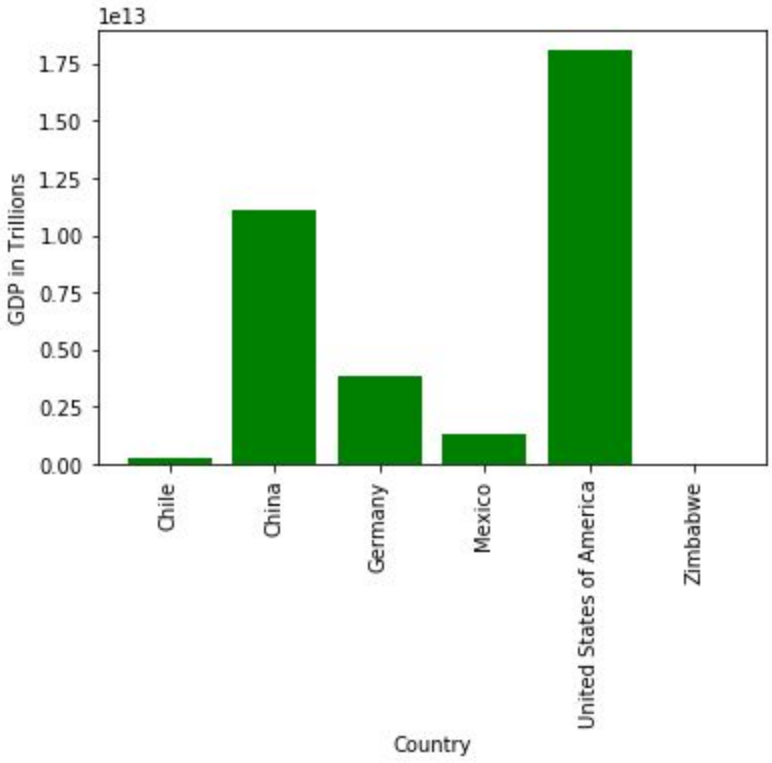
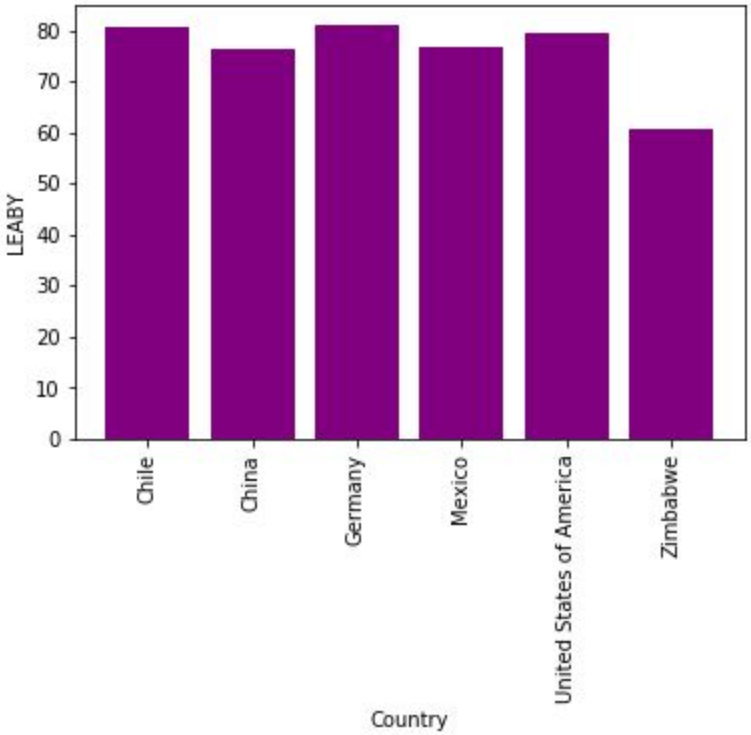
Country = Zimbabwe
LEABY
Year
45
50
55
60
65
70
75
80
2000.0
2002.5
2005.0
2007.5
2010.0
2012.5
2015.0


1e13
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
GDP in Trillions
Chile
China
Germany
Mexico
United States of America
Zimbabwe
Country


80
70
60
50
40
30
20
10
0
LEABY
Chile
China
Germany
Mexico
United States of America
Zimbabwe
Country