**Project 1 Write-Up**

**Impacts of Trade on National Productivity and Well-Being**

Sources of data: <https://data.worldbank.org/>

Life Expectancy, Mortality Rates, Imports & Exports, Baseline Indicators, GDP per Capita

Core Message/Hypothesis:

* If the GDP of a nation rises, then the nation will be able to import more and experience improvements in well-being (life expectancy & infant mortality).
  + However, the nation will export less as it becomes more productive, since it will be able to produce more of its own goods.
* What is the import & export rates across countries and how do they compare to economic development?
  + The question is asked because we theorize that there is a strong correlation between import/export rates and economic development.
  + Developing nations need to rely on production & exports to grow, while more advanced economies tend to move from manufacturing to services, so the expectation is:
    - Export rates and economic development: strong negative correlation.
    - Import rates and economic development: strong positive correlation.
* How well do the fruits of economic development (Outputs) relate to GDP and how does that relate to wellbeing (life expectancy & infant mortality)?
* Does life expectancy increase with economic development across countries?
  + It is assumed that there is a strong positive correlation between life expectancy and economic development.
* Does infant mortality go down with economic development across countries?
  + It is assumed that there is a strong negative correlation between maternal & infant mortality rates and economic development.
* What are the import & export rates across countries and how do they compare to economic development?
  + The question is asked because we theorize that there is a strong correlation between import/export rates and economic development.
  + Developing nations need to rely on production & exports to grow, while more advanced economies tend to move from manufacturing to services, so the expectation is:
    - Export rates and economic development: strong negative correlation.
    - Import rates and economic development: strong positive correlation.

Data cleanup process

* We merged the tables for GDP per Capita, trade values, and well-being indicators.
  + In order to do that, we had to use the Add Suffix function to ensure that each set of columns could be properly identified.
* To enable merging by Country Code column, we used the Rename function to drop the suffix for those.

Data analysis process: Exports & Imports

* We started by looking at scatter plots showing the relationship between the trade indicators and GDP per Capita for years 1990 & 2017.
* Linear regression couldn’t initially be done, because there were NaN values in the data.
* The NumPy.IsNaN function was used to create a mask to filter out the NaN values to enable regression.
* The data showed that within any given year, the Exports didn’t have a strong correlation with GDP per Capita, but this was because of outliers. The same held true for imports.
* Because the data was heavily skewed by outliers, a decision was made to further investigate this data.
* To filter out the effects of the variation among countries, plots of average trade values vs average GDP per Capita were made. The results show that there is an extremely strong positive relationship between trade parameters and GDP per Capita
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* As a means of validating the data from the World Bank, the average of Imports of all countries was compared to the average Exports of all countries for every available year.
* The data shows a virtually perfect linear correlation, indicating that the dollar value of each import was matched by the dollar amount of each export. This would tend to make the data more trustworthy.

Data analysis process: Life Expectancy & Infant Mortality

Life Expectancy

* We started by looking at scatter plots showing the relationship between the life expectancy and GDP per Capita for years 1990 & 2017.
* The data showed that there wasn’t a linear relationship between Life Expectancy and GDP per Capita.
* It has been shown that there is a strong logarithmic relationship between Life Expectancy and GDP per Cap. This means that Life Expectancy grows with GDP, but the rate of improvement slows as an economy advances.

Infant Mortality Rate

* We started by looking at scatter plots showing the relationship between infant mortality rate and GDP per Capita for years 1990 & 2017.The data showed that there wasn’t a linear relationship between Infant Mortality Rate and GDP per Capita.
* It has been shown that there is a strong logarithmic relationship between Infant Mortality Rate and GDP per Capita. This means that Infant Mortality falls with GDP, but the rate of improvement slows as an economy advances.
* To filter out the effects of the variation among countries, the plot of average Infant Mortality Rate vs average GDP per Capita was made. The mean values of individual year columns were calculated and put in lists. The results show there is strong positive relationship between well-being and GDP per capita

Predictions

GDP per Capita differences

* We wanted to see the level of differences between the top 5 & bottom 5 countries in a couple of years.
* It was also desired to see whether any of the bottom 5 countries in one year “escaped” the bottom 5 and whether it was because of sharp increases in trade and/or whether it led to improvements in well-being values.
* There is a several order of magnitude difference in GDP per Capita between the top 5 & bottom 5 countries. The countries of Nepal, Tanzania, and Sierra Leone “escaped” the bottom 5.

Trade Values of bottom GDP per Cap (1990-2017)

* Of the countries of Nepal, Tanzania, and Sierra Leone that “escaped” the bottom 5, Nepal & Tanzania had the largest increases in trade, but Sierra Leone didn’t.
* This would likely indicate that trade can improve the productivity of a country, but it is not a perfect predictor for individual countries between two separate years.

Wellness Values of bottom GDP per cap (1990-2017

* Of the countries of Nepal, Tanzania, and Sierra Leone that “escaped” the bottom 5, all had relatively large improvements in life expectancy & infant mortality rates, but not always the largest.
* This would likely indicate that productivity of a country can improve well-being, but it is not a perfect predictor for individual countries between two separate years.

Questions after initial analysis.

* At what point does GDP have the highest impact in life expectancy and infant mortality?
* At what point does GDP increase start to have less of an effect on wellbeing?
* If we had more time, we would want to look deeper into what other factors were in play regarding wellbeing, and test to see if there are nations that had an increase in GDP but not in wellbeing.
* To dig deeper, looked at Life expectancy vs GDP (GDP between 2000 per cap – 10,000 per cap) and Life expectancy vs GDP (GDP between 16,000 per cap – 10,000 per cap) to see if we would find a certain GDP point where life expectancy is less impacted by GDP
* While there is still a relationship with the rise of GDP and increase in life expectancy, after about 10,000 GDP per Cap, the relationship strength begins to decrease partly because there is only so high you can go with life expectancy, but the data shows it doesn’t take a dramatic increase in productivity to improve well-being in less developed countries struggling with wellbeing of their citizens.

Conclusions

* EXPECTED
  + We initially expected exports to decrease as GDP increased, but the data indicates GDP and trade values move up or down together.
* FOUND
  + Based on regression analysis the data comparing GDP and how it is impacted by trade values (import/export), we were able to conclude imports and exports have a direct relationship with GDP.
* EXPECTED
  + We were correct in our in our initial hypothesis in saying, if GDP increases, then we can project life expectancy to increase and infant mortality rates to decrease based on analysis of regression.
* FOUND
  + Keeping in mind that at a certain point GDP increase does not have the same effect on well-being, we conclude, if a nation increases trade values then GDP will increase and subsequently wellbeing will likewise increase.