The Efficacy of GDP as a Proxy for Societal Well-Being

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# Abstract

Gross Domestic Product, or GDP, is both one of the most widely used economic metrics and one of the most controversial. GDP is often seen as a general measure of well-being, wealth, development, and even quality of life. Detractors of the metric say that it simply measures how large an economy is, not living conditions or general health of those in that economy. Additionally, naysayers often accuse the pursuit of a higher GDP as being incompatible with environmental sustainability. Meanwhile, supporters of GDP acknowledge that the calculation fails to directly account for income equality, education, gender equality, and much more, but is a proxy for those things. That is, many aspects of society that cannot be directly measured with a dollar value do not factor into the number but are said to be ‘directly correlated’ with GPD.

# Introduction

In this paper, I will explore investigate the relationship between GDP and various ‘positive’ non-economic measures of a country’s well-being, such as life expectancy and gender equality, as well as explore the relationship between GDP and ‘negative’ measures, such as CO2 emissions, income inequality Furthermore, I will discuss the Human Development index (HDI) and compare it to GDP.

# GDP as a PRoxy for Positive non-economic measures

Is it true that there are strong relationships between GDP and non-economic measures, even if those relationships are not necessarily causal? To answer this question, I combined data from gapminder.org with Gender Inequality Index (GII) data, and then examined the relationships between GDP and life expectancy and gender equality across time. As a case study, only the United States was analyzed, as there was not available GII data on all countries and regions present in the Gapminder data. An additional difficulty was that GII data started being recorded in 1995, and is was not recorded every year.

For each measure, I will examine graphs and correlations, as well as conduct statistical tests as appropriate to quantify the strength of the relationships. Note that in all graphs and descriptive statistics, GDP is per capita, in US dollars, and adjusted for inflation.

## Life Expectancy

Chart, scatter chart

Description automatically generatedDo life expectancy and GDP vary together? The first year of data in which life expectancy and GDP data were recorded in the US was 1960. First, I looked at a scatterplot of GDP vs. life expectancy:

Figure . Relationship between GDP and Life Expectancy

The above graph shows a clear positive, mostly linear relationship between GDP and life expectancy. But to quantify this relationship I looked at the correlation between the two. I found that there is a very strong, positive, linear relationship between the two (*r* = 0.97246).

Additionally, I wanted to run a simple linear regression with life expectancy as the response and GDP as the predictor. But first I had to ensure that this was a valid assumption by checking the conditions. It is clear from the plot that there is a linear relationship between the two variables, and I’d venture to say the observations are independent. According to a Shapiro-Wilks test for normality, there’s not enough evidence to say that the residuals do not come from a Normal Distribution, so normality is satisfied. Finally, there is no fan shape in the residuals vs. fitted values plot, so there’s reasonably constant variance across values of GDP.

There is very strong evidence (*p* < 0.0001) that life expectancy is associated with GDP. So, I answered my question. GDP and life expectancy do vary together. One thing to take into account when interpreting this relationship is that while life expectancy is not *directly* taken into account in the calculation of GDP, one could argue that it is *indirectly* taken into account. The longer people live, the longer they are able to work, producing goods and services that contribute to GDP. If every person in the United States dropped dead on their 30th birthday, we would not have as productive an economy.

## Gender Equality

I’ve established that there’s a relationship between GDP and life expectancy. What about something a little less concrete: gender equality? The Gender Inequality Index was first formulated in 1995 as part of the Human Development Report by the United Nations. Because gender inequality is detrimental to a nation’s economy as a whole, this metric measures the ‘the loss of achievement within a country due to gender inequality’ (SOURCE). It takes into account reproductive health, empowerment, and economic status, and takes a value between 0 and 1. Lower values represent more equality, while higher values represent less equality. For reference, in 2017 the country with the lowest value was Switzerland with a score of 0.039, while the highest value was Yemen, with 0.834. The Untied States sits at 0.189 (41st place).

Another problem is that, while data collection began in 1995, it was not consistent. After 1995, data was sparse for a time, only recording 2005 and 2010, but then recording every year up until 2018 after that. Below is a figure showing the relationship between GDP and GII:

Chart, scatter chart

Description automatically generated

Figure 2. Relationship between GDP and Gender Inequality

There appears to be small-to-moderate negative linear relationship in the points above. The relationship is not strong enough to be confident in without looking at numbers first. So, I first calculated the correlation between the two variables, and found that there is a very strong, negative linear relationship between GDP and gender inequality (*r* = -0.95136), meaning increasing GDP is associated with decreasing gender inequality.

Running a simple linear regression on these measures, the small sample size (11 years) turned out to be problematic, as having such a small number of points can lead to unstable parameter estimates. Additionally, 1995 proved to be a very highly influential point with high leverage. In most situations, this point would be removed in order to get a better-fitting line, but there was barely any data to begin with in this situation. So, I cannot trust the results of the regression.

Based on the correlation coefficient alone, I am confident that these two measure are highly correlated. Just like with life expectancy, while GDP does not directly measure gender inequality, according to the creators of the Gender Inequality Index, inequality leads to loss of achievement and potential, therefore affects the production of goods and services.

# GDP’s Relationship with Negative Non-economic measures

![Chart, line chart

Description automatically generated]()If GDP measure a country’s total output of goods and services, then how can it address things like environmental sustainability and income inequality? The ‘externalities’ (to use an economics term) of production do not factor into the equation. Things like air pollution negatively impacting health, or billionaires technically producing more and more, gaining wealth while some people can’t afford their medications. To see how GDP squares with these effects, I examined how they changed across time with GDP:

Figure 3. How GPD, CO2 Emissions, and Income Inequality Change Across Time

## CO2 Emissions

Emissions (metric tonnes per person) do not appear to have any discernible relationship with GDP. In fact, it is difficult to even describe the nature of the relationship between emissions and time. It appears that they decreased sharply until about 1985, and then takes on a concave parabolic shape, reaching a minimum (of the data collected) in the final year of data collected, 2016.

Meanwhile GDP increases at a surprisingly constant rate, only decreasing for a short time during the 2008 recession. Because there does not appear to be a linear relationship between the two variables, analyzing the correlation between the two or fitting a simple linear regression model is not appropriate. Therefore, I cannot conclude that there is any sort of positive linear relationship between GDP and CO2 emissions, nor can I conclude that there is a negative one.

## Income inequality

The Gini Index measures income inequality in a country, with a value of 0 representing perfect equality and 100 representing complete inequality. For reference, the country with the lowest score in 2016 was Ukraine, with 25, and the country with the highest value was South Africa, with 63. The United States ranked 51st, with a value of 41.5.

The graphs above clearly show a positive linear relationship between GDP and Gini Index, as does the correlation coefficient (r = 0.907). Additionally, running a simple linear regression between the two variables showed that this relationship was statistically significant (*p* < 0.0001). All assumptions were satisfied for this regression.

Unlike with CO2 emissions, there is a definite association between GDP and income inequality, that is, GDP increasing is associated with an increase in income inequality.

# Discussion

There were very clear relationships between GDP and the following measures: life expectancy, gender equality, and income inequality. There did not appear to be a relationship between GDP and CO2 emissions. So, it does appear that while the calculation of GD may not incorporate ‘positive’ qualities of a county’s development such as life expectancy and gender equality, it is directly correlated with them. On the other hand, GDP increasing is associated with increasing income inequality. From this, one can conclude that there are obvious benefits associated with having a higher GDP, but those benefits don’t apply equally to everybody. As we’ve seen, as GDP gets higher and higher, the distribution of benefits applies to fewer and fewer people.

If GDP is flawed in this way, then what’s the alternative? The United Nations developed the Human Development index (HDI) “to emphasize that people and their capabilities should be the ultimate criteria for assessing the development of a country, not economic growth alone.” (SOURCE). It directly incorporates life expectancy, education, and standard of living into the calculation. Taking values between 0 and 1, with 1 being best, Norway leads the world in HDI at 0.954, while Niger is at the bottom with 0.377 (all 2018). The United States has a value of 0.92, tying the United Kingdom for 15th place.

![Chart, line chart

Description automatically generated]()HDI was first devised in 1990, so there is not as much data as GDP. However, here’s how HDI squares with the measures discussed previously:

Figure 4. HDI and All Variables Over Time

It appears that HDI is almost identical to GDP, even in the slight dip of the 2008 recession. For a well=developed country like the United States, I this more or less makes sense, because life expectancy is relatively high, almost all people are educated (though HDI doesn’t take into account quality of education), so the only variable part is income/standard of living, which is what GDP attempts to measure.

# Conclusion <heading 1>

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data one;

set two;

if mix(var1, var2) > 0 then do;

**List: Numbered or Ordered**

1. numbered list item
2. numbered list item
3. numbered list item

**List: Bulleted or Unordered**

* This is a sample bulleted list item.
* This is a sample bulleted list item.

**Output Sample**

CREATE TABLE ALLACCTX(SourceSystem varchar(4),

cctnum numeric(18,5) CONSTRAINT "ALLACCT\_PK" PRIMARY KEY,

ccttype numeric(18,5),balance numeric(18,5),clientid numeric(18,5),

losedate date,opendate date,primary\_cd numeric(18,5),status varchar(1))

Output 2. Output from a CREATE TABLE Statement

**Table Sample**

| **Heading for Column 1** | **Heading for Column 2** | **Heading for Column 3** | **Heading for Column 4** |
| --- | --- | --- | --- |
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Table 2. Sample Table

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1. Click **References** on the main Word menu.
2. Click **Insert Caption**.
3. Select the **Label** type you want.
4. Click **OK**.

To insert a cross-reference:

1. Click **References** on the main Word menu.
2. Click **Cross-reference**.
3. In the **Reference type** list box, select Figure, Table, Display, or Output.
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1. Click **Insert** on the main Word menu.
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3. In the Insert Picture dialog box, navigate to the file you want to insert.
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