What are the main factors behind human development?

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Prior to the year 1990, quantitative measurements of economic performance fixated on macroeconomic performance. This gave no consideration to geographical and social deviations, which limited the long withstanding economic analysis itself. In fact, more decontextualised macroeconomic data had not been invented until the advent of Keynsian macroeconomic tools in the 30s. Preceding this, measures of raw materials, flows of capital and assets in and out of countries were the preferred mode of measurement, following social criticism within the literary arts, which gave a clearer picture of real living standards and human development of the time.

In the HDI, human development is segmented into 3 components: health, education, and economic conditions. These are quantified at the national level via four metrics: life expectancy at birth, mean and expected years of schooling, and the logarithm of Gross National Income per capita (GNI) in Purchasing Power Terms (PPP). The mean and expected years of schooling are then aggregated into a single education index , which computes the HDI. The UN has been publishing the Human Development Reports regularly since 1990, providing the values of the HDIs for 190 countries around the world for the purpose of this study.

Thus, the purpose of this study is to measure the various tradeoffs between the measure of human development and 3 indices. Coming into this, I had 3 hypothesis in mind:

Hypothesis 1: The relationship between per capita GNI and HDI will have an income cut off point, where further increases in income will have a negligible effect on HDI.

Null Hypothesis: The marginal relationship between GNI and HDI remains statistically significant regardless of income level.

Hypothesis 2: A strong linear relationship between life expectancy and human development is observed.

Null Hypothesis: The relationship between life expectancy and human development is not statistically significant.

Hypothesis 3: The relationship between years of schooling and HDI will have a statistical cut off point, as years of schooling becomes large.

Null Hypothesis: The relationship between years of education and HDI remain statistically significant regardless of education level.

Empirical Design and Results

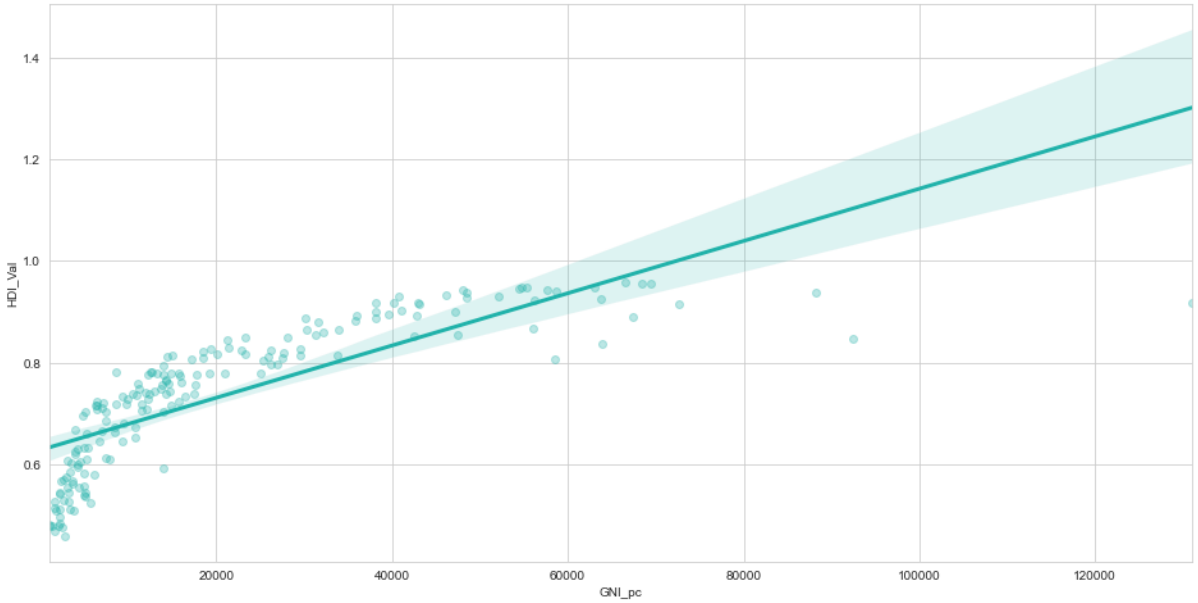
For the following regression analysis, data has been webscraped from the UNs human development reports website (http://hdr.undp.org/en/data), where Selenium webdriver is used to manipulate pages via javascript to iterate and store table data from each page into a dataframe of 190 countries. This data originates from the UNs From the 2020 Human Development Report and HDI rankings are from 2019.

I have conducted the following regression analysis:

Firstly, I decided to conduct an bivariate OLS regression on the relationship between Gross National Income per capita ($PPP) and HDI.

$$y(i) = \alpha + \beta GNI(i) + \varepsilon i(i)$$

Where y(i) is the Human Development Index variable for country i, βGNI(i) is an instrumental variable that predicts effects on y(i) and εi(i) is the error term.



Here, we conducted an Ordinary Least Squared (OLS) regression for 190 observations. The table here shows a statistical cut off point of income at approximately the 40,000 mark, proving hypothesis 1 and rejecting the null hypothesis. A strong linear relationship is generally observed between income and human development, with exponential diminishing marginal returns. Our R-squared value displays that 63.3% of variation in Human Development can be ascribed to Gross National Income. Our P value for the t statistic is zero, suggesting that the effect of Gross National Income on Human Development is statistically significant, especially given that the confidence interval is above 99%. For every $1 increase in GNI, the human development index increases by 5.136×10^{-6}.

OLS Regression Results

Dep. Variable:	HDI_Val	**R-squared:**	0.633

Model:	OLS	**Adj. R-squared:**	0.631
Method:	Least Squares	**F-statistic:**	307.2
Date:	Mon, 26 Apr 2021	**Prob (F-statistic):**	1.29e-40
Time:	20:18:19	**Log-Likelihood:**	192.28
No. Observations:	180	**AIC:**	-380.6
Df Residuals:	178	**BIC:**	-374.2
Df Model:	1		
Covariance Type:	nonrobust		

	coef	**std err**	**t**	**P>|t|**	**[0.025**	**0.975]**
const	0.6285	0.009	71.507	0.000	0.611	0.646
GNI_pc	5.136e-06	2.93e-07	17.528	0.000	4.56e-06	5.71e-06

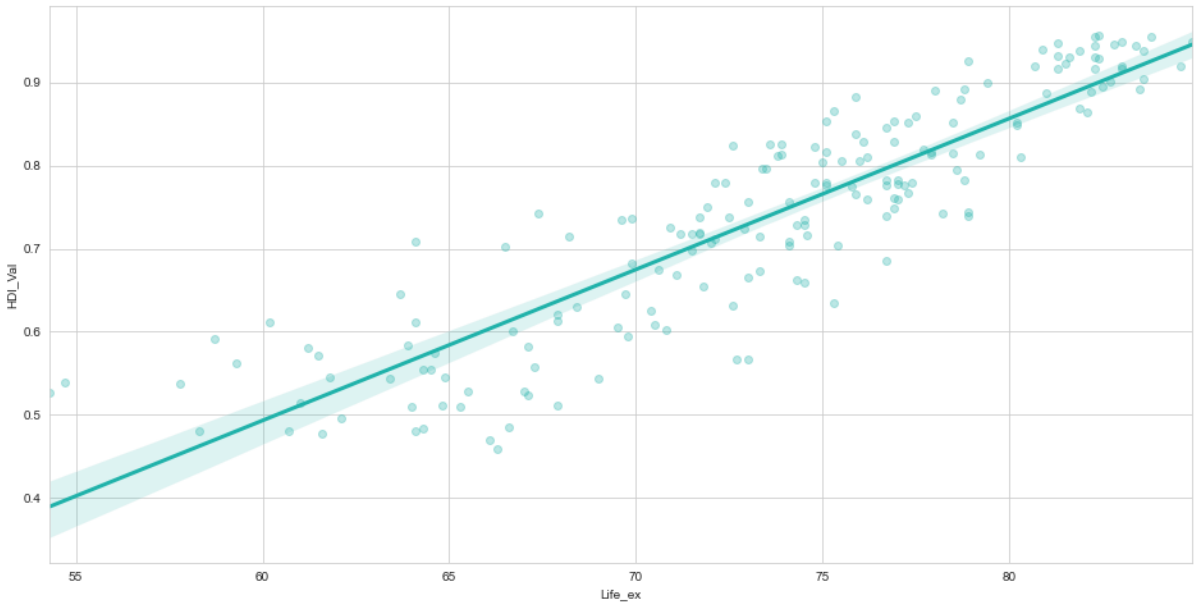
Omnibus:	37.481	**Durbin-Watson:**	0.963
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	56.502
Skew:	-1.142	**Prob(JB):**	5.38e-13
Kurtosis:	4.523	**Cond. No.**	4.23e+04

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 4.23e+04. This might indicate that there are
strong multicollinearity or other numerical problems.

Secondly, I conducted an bivariate OLS regression on the relationship between life expectancy and HDI.

$$y(i) = \alpha + \beta LifeEx(i) + \varepsilon i(i)$$

Where y(i) is an outcome for country i, βLifeEx(i) is an instrumental variable that predicts effects on y(i) and εi(i) is the error term.



Here, we conducted an Ordinary Least Squared (OLS) regression for 190 observations. The table here shows a strong and consistent linear relationship between life expectancy and Human Development throughout, thus proving Hypothesis 2 and rejecting our null hypothesis. Our R-squared value displays that 80% of variation in Human Development can be ascribed to Life Expectancy. Our P value for the t statistic is zero, suggesting that the effect of Life Expectancy on Human Development is statistically significant, especially given that the confidence interval is above 99%. For every year increase in Life Expectancy, the human development index increases by 0.0182.

OLS Regression Results

Dep. Variable:	HDI_Val	**R-squared:**	0.800
Model:	OLS	**Adj. R-squared:**	0.799
Method:	Least Squares	**F-statistic:**	711.4
Date:	Mon, 26 Apr 2021	**Prob (F-statistic):**	4.36e-64
Time:	20:21:45	**Log-Likelihood:**	246.82
No. Observations:	180	**AIC:**	-489.6
Df Residuals:	178	**BIC:**	-483.3
Df Model:	1		

Covariance Type:		nonrobust				
	coef	**std err**	**t**	**P>|t|**	**[0.025**	**0.975]**
const	-0.5963	0.050	-11.877	0.000	-0.695	-0.497
Life_ex	0.0182	0.001	26.673	0.000	0.017	0.020

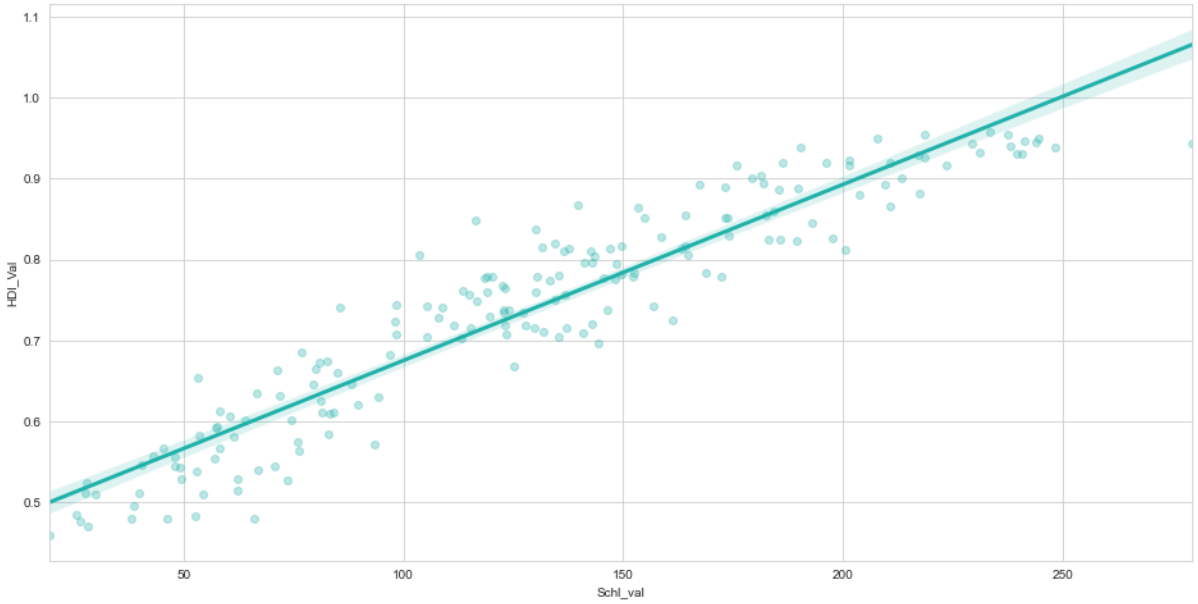
Omnibus:	1.565	**Durbin-Watson:**	1.570
Prob(Omnibus):	0.457	**Jarque-Bera (JB):**	1.622
Skew:	-0.218	**Prob(JB):**	0.444
Kurtosis:	2.836	**Cond. No.**	804.

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Thirdly, I conducted an covariate OLS regression on the relationship between expected years of schooling, mean years of schooling and the HDI.

$$y(i) = \alpha + (\beta ExpectedSchool(i) * \delta MeanSchool(i)) + \varepsilon i(i)$$

Where y(i) is an outcome for country i, βExpectedSchool(i) is an instrumental variable that predicts effects on y(i), δMeanSchool(i) is an instrumental variable that predicts effects on y(i) and εi(i) is the error term.



Here, we conducted an Ordinary Least Squared (OLS) regression for 190 observations. The table here shows a strong and consistent linear relationship between school length and Human Development throughout, thus disproving Hypothesis 3 and proving our null hypothesis. Our R-squared value displays that 88.6% of variation in Human Development can be ascribed to School Length. Our P value for the t statistic is zero, suggesting that the effect of School Length on Human Development is statistically significant, especially given that the confidence interval is above 99%. For every 1 year increase in School Length, the human development index increases by 5.86×10^{-5}.

OLS Regression Results

Dep. Variable:	HDI_Val	**R-squared:**	0.886
Model:	OLS	**Adj. R-squared:**	0.885
Method:	Least Squares	**F-statistic:**	1379.
Date:	Mon, 26 Apr 2021	**Prob (F-statistic):**	9.36e-86
Time:	20:22:21	**Log-Likelihood:**	297.22
No. Observations:	180	**AIC:**	-590.4
Df Residuals:	178	**BIC:**	-584.1
Df Model:	1		

Covariance Type:	nonrobust					
	coef	**std err**	**t**	**P>|t|**	**[0.025**	**0.975]**
const	0.4576	0.008	55.192	0.000	0.441	0.474
Schl_val	0.0022	5.86e-05	37.137	0.000	0.002	0.002

Omnibus:	0.168	**Durbin-Watson:**	1.679
Prob(Omnibus):	0.920	**Jarque-Bera (JB):**	0.232
Skew:	0.071	**Prob(JB):**	0.890
Kurtosis:	2.897	**Cond. No.**	337.

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Conclusion

As (Stanton, 2017) realises, 4 key aspects of human wellbeing are left out of the HDI; the extent of civil and political liberties, income distribution, access to health care, access to educational opportunities, environmental impacts on well-being, access to natural resources and financial literacy. Thus, HDI is a limited indicator itself in the measurement of economic development. However, for the sake of this analysis, it's the best measurement we have.

This analysis has limitations itself in the lack of multivariate analysis, which would've explained the interaction of the explanatory variables. This upon reflection appears to be quite obvious. The human development report does contain a myriad of data, which potentially can be studied for further statistical analysis, when integrated within the same dataframe, which would enable more brute force methods of computing and measuring further statistical correlations which otherwise may have fallen under the radar. For example, correlation matrix arguably should've been a core tool of further investigation. On the other hand, this isn't entirely lost given the high degree of multilinearity, which dampens the limitations of HDI.