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# Modeling the Relationship Between GDP Growth and Population Growth in Africa


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**Abstract**

This study analyzes the relationship between GDP growth and population growth in Africa. To investigate this relationship, we constructed a multiple linear regression model with GDP growth as our response variable, population growth as our primary explanatory variable of interest, and inflation, development assistance, internet, and barter as our control explanatory variables. A t-test and 95% confidence interval yielded non statistically discernible evidence in favor of a slight positive linear relationship between GDP growth and population growth.


**Introduction**

In this case study we explore the relationship between GDP growth and population growth in Africa. For some time, economists have been concerned with rapid population growth and its effect on the rest of the world. Especially for Third World countries, population growth makes it more difficult to afford the increase in public expenditures that are needed for poverty, famine, education, and other essential services. Some argue that increased population growth is beneficial to the economy as it increases the size of the labor force, and thus increases overall production. Others have argued that an increase in population growth is detrimental to economic growth, as more people have to share the overall economic production of the economy. Economists who hold this view believe that developing countries have a less productive labor force, and as a result, increasing the labor force does not lead to an equal increase in production. To test our theory, we developed a multiple linear regression model based on the economic development of African countries from 2019, using the World Bank's Databank of World Development Indicators. Additional details about the model will be provided in the sections below.

**Methods**

To explore the relationship between GDP growth and population growth in Africa, it is necessary to fit a linear regression model with GDP growth (annual %) as the response variable and population growth (annual %) as the primary explanatory variable of interest. However, because this is merely an observational study, there is likely the presence of many confounding variables. Thus, it is desirable to include additional explanatory variables in the model to help control for the presence of some outside factors. After consulting the 2019 World Bank's Databank of Word Development Indicators, we decided the following variables would be the most useful in aiding with the control of outside factors: inflation (GDP deflation, annual %), internet (individuals using the internet, % of population), barter (net barter terms of trade index, 200 = 100), and development assistance (net official development assistance and aid received, current US$). We decided that these variables were important to include in the model because all of them have little to do with population growth but are related to GDP. It is important to note that even with the addition of these variables, we are still conducting a study observing data collected on an

unaltered environment, so it is not possible to assert causation. As a result, our only goal for building this model is to investigate a linear relationship between GDP growth and population growth.

**Results**

Most of the variables appear to adhere to the model assumptions and there is no clear evidence of multicollinearity (*Figure 1*). However, the plots with inflation as one of the variables looked very stacked and hard to interpret. In addition, the development assistance vs population growth plot appears to have a slightly stacked shape. To remedy these issues, log(inflation) was plotted in place of inflation and log(development assistance) was plotted in place of development assistance (*Figure 2*). From the scatter plots, there is indication that there might be a slightly positively correlated linear relationship between GDP growth and population growth (*Figure 2*).

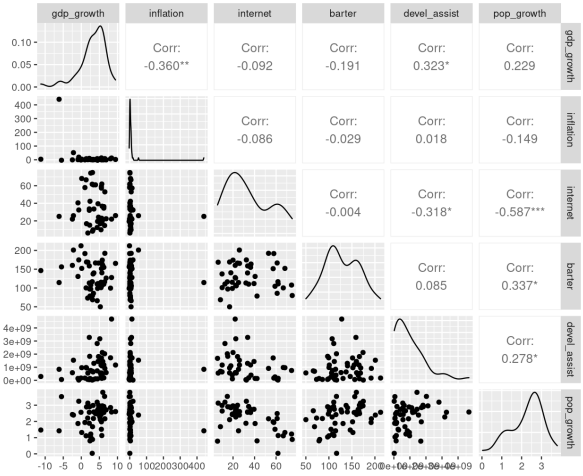


*Figure 1. Scatterplot of relevant variables.*

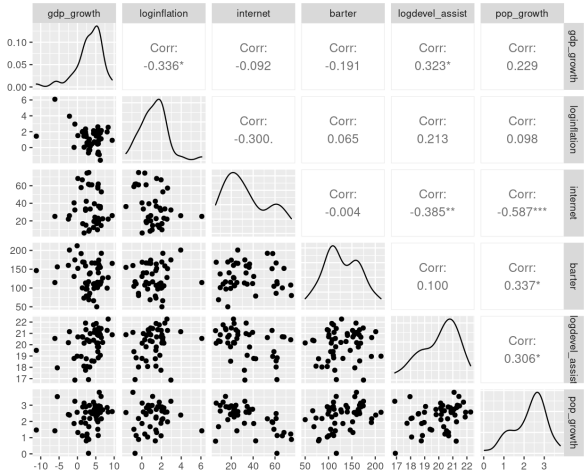


*Figure 2. Scatterplot of transformed relevant variables.*

To investigate this relationship further, a linear regression model (*Table* 1) was fitted as described in the methods section. The equation is as follows: $\text{yhat}_{\text{gdp\_growth}} = 10.349 + 1.565x_{\text{population\_growth}} + 0.027x_{\text{internet}} - 0.17x_{\text{barter}} - 1.065x_{\text{loginflation}} + 0.650x_{\text{logdevel\_assit}}$. In *Table 1* we can see that the standard error for the intercept variable is much larger than the others. However, once more analysis on the model assumptions was completed, it became clear that the assumptions are well met, especially considering this is an observational study conducted on people. We can see that there is moderately weak evidence in favor of there being a positive linear association between GDP growth and population growth (t-value: 1.947, p-value: .0601). To reinforce our results, we conducted a 95% confidence interval and found that we are 95% confident that a one percent increase in population growth is associated with an increase in GDP growth between -0.0827 % and 3.2133% after controlling for log inflation, internet, barter, and log development assistance. The fact that zero is just barely in the confidence interval suggest that there is barely enough evidence to accept the null hypothesis and assert there is no statistically discernible correlation between GDP growth and population growth.

| | Estimate | Standard Error | t value | p value |
|---|---|---|---|---|
| Intercept | -10.349 | 6.9148 | -1.497 | 0.1450 |
| Pop_growth | 01.565 | 0.8100 | 1.932 | 0.0619 |
| Loginflation | -01.065 | 0.3046 | -3.497 | 0.0014 |
| Internet | 00.027 | 0.0309 | 0.865 | 0.3935 |
| Barter | -00.017 | 0.0134 | -1.284 | 0.2081 |
| Logdevel_assist | 00.650 | 0.3341 | 1.947 | 0.0601 |

*Table 1. R output from the multiple linear regression model.*

## Discussion

Based on the results of our analysis, we can see that there is a hint of evidence of a positive linear association between GDP growth and population growth, but not enough to be very strong or statistically discernible evidence. Based on the two economic theories described in the introduction, this is not a particularly surprising result. As Africa is comprised of mostly developing countries, it is likely that the population growth does not increase the GDP much because the labor force is not very productive. However, it would appear as though the labor force is productive enough to prevent a negative linear association between GDP growth and population growth. However, because we are looking at over all GDP growth, and not GDP per capita growth, it is hard to assert weather the labor force in Africa is productive enough to compensate for more people sharing a similar amount of GDP. I believe that this would be a very interesting area for future study. In addition, I think it would be interesting to compare the linear relationship between GDP growth and population growth for a set of developing countries to the relationship for a set of developed countries. This could give better insight into the differences of labor productivity in developing countries versus developed countries. It would also allow for the analysis of the importance of family planning in a developing country versus a developed country.