**Introduction:**

In this research project, I will analyze the relationship between technological growth rates of nation and the growth rate of GDP per capita from 1970 to 1999. Finding this relationship is important, as certain technologies may provide a larger or faster rate of development for certain countries. This is essential for policymakers that want to increase development or GDP per capita with technological methods.

To start my analysis, I hypothesize that technology growth will lead to greater GDP per capita growth for developing nations from 1970 to 1999.

**Data:**

In the research, I pulled data from two different sources. For the GDP data, I retrieved it from the Groningen Growth and Development Centre at the University of Groningen. It includes variables such as real GDP, country, population, year, etc. Since I am analyzing the relationship between technology and GDP per capita, a new variable needed to be created to reflect GDP per capita. I took the variable for real GDP, at constant 2017 national prices in millions of U.S. dollars and divided it by population for each country to get GDP per capita.

For the technological data, I pulled it from the National Bureau of Economic Research (NBER). In this data set, it has variables such as country, year, and several different technologies. To analyze a relationship between technology and GDP growth, I chose five technology variables. The variables I chose to include in my model were the number of computers, telephones, cars, tractors, and rail lines in each country.

To calculate the growth rates of GDP per capita and several of my technological variables, I used the following formula:

𝐺𝑟𝑜𝑤𝑡ℎ 𝑅𝑎𝑡𝑒ₜ = [(Xₜ+1/Xₜ) – 1] x 100.

In this formula, X represents of variable of choice (GDP per capita, phones, cares, etc.). The growth rates were later collapsed to account for the differing population size of each country. The table below provides a summary of our growth variables:

Variable | Obs Mean Std. dev. Min Max

-------------+---------------------------------------------------------

gdp\_growth | 60 2.485036 1.382984 -.7324183 5.455446

car\_growth | 60 6.542812 3.537811 1.48544 14.52225

computer\_g~h | 39 48.20928 46.15806 10.84541 184.4665

phone\_growth | 60 8.994832 7.14121 -.1819494 34.84903

tractor\_gr~h | 60 4.329708 5.109885 -2.290229 20.14452

-------------+---------------------------------------------------------

rail\_growth | 60 -.0140872 1.336 -4.575728 4.901194

The scatter plots below represent the relationship between the growth rate of cars in a country with GDP per capita growth for developed and undeveloped nations. We define our developed nations as France, Germany, Italy, Japan, United Kingdom, and the United States of America. We can see a slight positive relationship for developed nations and a slight negative relationship for undeveloped nations.





**Analysis:**

The following regression model was used to analyze the impact of technological growth on GDP growth:

This regression model conforms to OLS since it is a linear relationship, has random sampling from several countries over time, contains sampling variation in each of the explanatory variables as seen with the graphs above, and ZCM. It is assumed that unobservable factors impacting GDP are not systematically related to the technology variables.

The following tables below are the results of regression from our formula for developed and undeveloped nations:

Developed Nations

---------------------------------------------------------------------------------

gdp\_growth | Coefficient Std. err. t P>|t| [95% conf. interval]

----------------+----------------------------------------------------------------

computer\_growth | -.0135077 .0074093 -1.82 0.091 -.0295145 .002499

car\_growth | -.0102865 .0990231 -0.10 0.919 -.2242128 .2036399

phone\_growth | .3057165 .1679562 1.82 0.092 -.0571307 .6685638

tractor\_growth | .4684468 .2471209 1.90 0.080 -.0654253 1.002319

rail\_growth | -.0522794 .1533361 -0.34 0.739 -.383542 .2789832

\_cons | 1.563748 .7739803 2.02 0.064 -.1083351 3.235831

---------------------------------------------------------------------------------

With large p-values, rail and car growth are very unlikely to be statistically significant. If we chose a significance level of 10%, we are likely to include computer, phone, and tractor growth as statistically significant. As it can be seen with phone and tractor growth, there is a medium sized positive coefficient, therefore indicating that there is a significant positive relationship between tractor and phone growth with GDP per capita growth. On the other hand, computer, car, and rail growth can be seen with smaller negative coefficients. This indicates a slight negative relationship between computer, car, and rail growth rates and GDP per capita growth.

Undeveloped Nations

---------------------------------------------------------------------------------

gdp\_growth | Coefficient Std. err. t P>|t| [95% conf. interval]

----------------+----------------------------------------------------------------

computer\_growth | .0207904 .006877 3.02 0.009 .0060407 .0355401

car\_growth | .3836754 .1336146 2.87 0.012 .0971006 .6702503

phone\_growth | .0601538 .0349359 1.72 0.107 -.0147763 .1350839

tractor\_growth | .1311838 .074009 1.77 0.098 -.0275498 .2899174

rail\_growth | -1.013666 .432819 -2.34 0.034 -1.94197 -.0853613

\_cons | -3.540017 1.65015 -2.15 0.050 -7.079238 -.0007961

---------------------------------------------------------------------------------

Aside from phone growth, all p-values would fall under the 10% significance level and can be considered statistically significant. One interesting point in our data for undeveloped nations is rail growth. Outside of rail growth, other technological variables have a smaller positive coefficient, indicating that growth in technology is related to a growth in GDP per capita. Rail growth in our model has a strong negative coefficient, indicating that the growth of rail lines in a nation has a negative relationship with GDP per capita.

Overall, I would expect technology variables to have a slightly larger relationship with GDP growth for developing nations. Aside from rail growth, technology tended to have a slight positive relationship with GDP growth for undeveloped nations. I would also recommend doing further research and possibly adapting the criteria for developed nations as the results were far less statistically significant than developing nations.

**Conclusion:**

In our model, there were several points of limitation. One was the selection of developed and undeveloped nations over time. In our model, we only indicated a small number of countries as developed. This does not reflect the real world as there are other smaller countries that qualify as developed such as Switzerland, South Korea, Singapore, etc. It also does not reflect the development status of each nation over time. Countries such as Venezuela could have been included as a developed nation near the beginning of our model in 1970 but become undeveloped by 1999. This methodology of indicating which countries are developed leaves out several factors. Another limitation in our model is the possible inaccuracies in data for undeveloped countries. Undeveloped nations tend to have less accurate and extensive recordkeeping compared to developed countries due to a lack of resources.

In conclusion, the data from my model supports my hypothesis of the growth of technology in undeveloped nations having a greater effect on GDP per capita growth. Aside from rail growth, technological growth had a positive relationship with GDP growth for developing nations. Developed countries had more small and negative coefficients attached to growth, indicating a small negative relationship between technological growth and GDP per capita growth. Since our developed nation pool is smaller and less statistically significant, I recommend doing further research and group more countries in this area. I also recommend doing further research on rail growth for undeveloped nations and the strong negative relationship on GDP growth.