RESEARCH REPORT

Artificial Intelligence and Economic Growth

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SUMMARY

The main purpose of this study was to analyze different government's readiness to induce artificial intelligence in their economy. It was a research study that looked at the data for 20 countries corresponding to government's readiness to use artificial intelligence. A comment can be made on the impact of government's readiness to use artificial intelligence on country's economic growth. Through this study, an effort is made to find what other factors can affect a country's economic growth along with artificial intelligence. The results of this study indicate that artificial intelligence cannot impact country's growth in isolation. Artificial intelligence must be coupled with educated and healthy population. Therefore, government should invest in education sector and health sector. High population alone would not ensure country's growth, in fact skilled labor and less unemployed labor can help one achieve this goal.

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1. INTRODUCTION

1.1 ARTIFICIAL INTELLIGENCE

Do you ever wonder how YouTube recommends you shows based on your watching history or how Alexa ends up playing your favorite song when you say so, that's what we call artificial intelligence. Artificial Intelligence in layman's term means an attempt to imitate human intelligence. In a broad definition, Artificial Intelligence is a collective term for computer systems that can sense their environment and respond to what they are sensing around. Artificial Intelligence allows machines to understand and achieve specific goals.

1.2 HISTORY OF ARTIFICIAL INTELLIGENCE

There is no doubt that computers existed before 1950s as well but there was something fundamentally wrong with computers, they could only execute a command given to them but could not store them, in basic terms, computers were told what to do but couldn't remember or understand what they did. This however changed after a conference where top researchers were brought together for an open-ended discussion on Artificial Intelligence, the term which was coined at the event itself. Sadly, the discussion didn't go that far because of the failure to agree on standard methods for the field, despite this the importance of conference cannot be undermined as it led to the foundation of research on AI.

After this conference, AI flourished, computers became faster and could store more information and commands and became more accessible to people and companies. People started realizing the importance of computers exhibiting the intelligence close to humans but it was 1997 that changed the way people saw Artificial Intelligence as 1997 world chess champion Gary Kasparov was defeated by IBM's Deep Blue, a chess playing computer program, it was that time when people realized that computers can now exhibit intelligence better than human beings and the growth continued and today just a very simple search on google and google can understand what you are thinking and what you want.

1.3 TYPES OF ARTIFICIAL INTELLIGENCE

Since AI is all about imitating human intelligence so the degree to which AI system can replicate human intelligence becomes one criterion of classifying Artificial Intelligence. According to this system of classification, there are four types of AI or AI-based systems: reactive machines, limited memory machines, theory of mind, and self-aware

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AI. The alternate system of classification that is more generally used in tech parlance is the classification of the technology into Artificial Narrow Intelligence (ANI), Artificial General Intelligence (AGI), and Artificial Superintelligence (ASI).

1.4 IMPACT OF ARTIFICIAL INTELLIGENCE

When Artificial intelligence is ruling the world around us, it becomes important to understand how this is going to impact people in the long run. While machines are taking up the jobs and tasks which were earlier performed by a man as machines have developed intelligence, memory and labor but this way man is free to do the task that he is good at i.e. empathy and creativity which is yet to be taken by any machine and since most of the tasks will be performed by machines, the scope of mistake reaches to zero leading to efficient work and more productivity in turn helping the country to grow better. According to McKinsey, AI has the potential to deliver additional global economic activity of around $13 trillion by 2030, or about 16 percent higher cumulative GDP compared with today. This amounts to 1.2 percent additional GDP growth per year. Not just this, with better monitoring and diagnostic capabilities, artificial intelligence can dramatically influence healthcare. By improving the operations of healthcare facilities and medical organizations, AI can reduce operating costs and save money. One estimate from McKinsey predicts big data could save medicine and pharma up to $100B annually. The true impact will be in the care of patients. Potential for personalized treatment plans and drug protocols as well as giving providers better access to information across medical facilities to help inform patient care will be life-changing. This makes it clear that AI will not just affect the growth of countries but also the development of countries.

1.5 IMPORTANCE AND OBJECTIVES OF THE STUDY

It becomes imperative to understand the change in artificial intelligence score of 12 different countries, corresponding to the change in their economic growth measured by GDP in 2019.

We wish to answer the following question using our analysis.

1. What relationship can be observed by different countries between country's Artificial Intelligence readiness score and economic growth?
2. What other factors other than AI can affect economic growth?

Whether or not Artificial Intelligence should be used to increase economic growth and development is not the main objective of this study.

2. THEORETICAL FRAMEWORK

In order to answer our research queries, data of 20 countries corresponding to their Artificial Intelligence score and Economic growth is being studied.

The primary relationship being studied is that of Artificial intelligence score and Economic growth i.e. GDP growth. According to our hypothesis, this will exhibit a positive relationship, higher AI score means the government's readiness to use Artificial Intelligence is more therefore economic growth would be high.

However, several other factors can also contribute to the economic growth along with government's readiness to use artificial intelligence in a country. The secondary variables considered are (i) adult literacy rate (ii) life expectancy (iii) population (iv) unemployment rate. Unemployment rate is expected to exhibit a negative relationship with economic growth of any country. The remaining variables are expected to exhibit a positive relationship with economic growth of a country. The reasons for our hypothesis are as follows.

I. Higher adult literacy implies educated labor force thus better productivity and higher economic growth.
II. Higher life expectancy implies that people live healthy life and thus can be more productive without getting ill leading to better economic growth.
III. More population will lead to more human capital that can be used to enhance more economic growth.
IV. Higher unemployment rate leads to low economic growth as the potential growth is not met and country has the capacity to do better with unemployed people.

3. DATA AND METHODOLOGY

3.1 DATA TYPE AND SOURCE

The study is based on the secondary data. Data used for the purpose of this study was taken from online sources. Data sources have been mentioned below the tables provided in this section and in the references.

3.2 DATA SELECTION

The 20 countries were chosen based on the availability of data. No specific criterion was used for the purpose of the selection.

The data of 2019- 2020 was used for the analysis. However, on few occasions, data for 2019 was not available- reason being a lack of centralized source, inconsistent data keeping practice across different countries, unavailability of data for some countries. The effective time period is thus 2017 to 2020. All precautions were taken to maintain uniformity and accuracy.

3.3 DEFINITION OF VARIABLES

The following variables have been used in our analysis. A unique alphabet has been assigned to them.

A: Economic growth (GDP per capita)

GDP per capita has been used as a yardstick to measure a country's economic growth.

B: Artificial Intelligence score based on the government's readiness to use Artificial Intelligence

Higher the AI score, more the government is ready for incorporating Artificial Intelligence in the economy and therefore higher economic growth.

C: Adult literacy rate

D: Life expectance

E: Population

F: Unemployment rate

3.4 METHOD OF ANALYSIS

In order to ascertain these relationships, we will be making use of a statistical measure called correlation. Correlation indicates the extent to which two or more variables fluctuate together. A positive correlation indicates the extent to which those variables increase or decrease in parallel; a negative correlation indicates the extent to which one variable increases as other decreases. The calculations were made using MS Excel software.

3.5 PRESENTATION OF DATA – TABULAR

The data has been represented using the tables below. The value of the variables is color coded as follows:

Highest value

Lowest value

Table 3.1 GDP per capita and government's readiness to use Artificial Intelligence score for 20 countries

S NO.	COUNTRY	GDP PER CAPITA (2020) US$	ARTFICIAL INTELLIGENCE SCORE
		A	B
1	Afghanistan	508.6	0.684
2	Australia	51812.2	8.126
3	Bangladesh	1968.8	3.808
4	Brazil	6796.8	6.157
5	China	10500.4	7.37
6	Costa Rica	12076.8	5.202
7	Egypt	3547.9	3.499
8	Ghana	2328.5	4.888
9	India	1900.7	7.515
10	Iraq	4157.5	1.657
11	Italy	31676.2	7.533
12	Japan	40113.1	8.582
13	Nigeria	2097.1	3.672
14	Portugal	22439.9	6.693
15	Russia	10126.7	6.748
16	Saudi Arabia	20110.3	4.779
17	Singapore	59797.8	9.986
18	Spain	27057.2	6.332
19	Uganda	817	4.37
20	USA	63543.6	8.804

Source:

1. A: World Bank
2. B: Oxford Insights

Table 3.2 GDP per capita and adult literacy rate for 20 countries

S. NO.	COUNTRY	GDP PER CAPITA (2020) US$	ADULT LITERACY RATE
		A	C
1	Afghanistan	508.6	43.019
2	Australia	51812.2	99
3	Bangladesh	1968.8	74.684
4	Brazil	6796.8	93.227
5	China	10500.4	96.84
6	Costa Rica	12076.8	97.863
7	Egypt	3547.9	71.168
8	Ghana	2328.5	79.039
9	India	1900.7	74.372
10	Iraq	4157.5	85.599
11	Italy	31676.2	99.155
12	Japan	40113.1	99
13	Nigeria	2097.1	62.016
14	Portugal	22439.9	96.137
15	Russia	10126.7	99.73
16	Saudi Arabia	20110.3	95.328
17	Singapore	59797.8	97.344
18	Spain	27057.2	98.43
19	Uganda	817	76.527
20	USA	63543.6	99

Source:

C: World Bank, Our World in Data, UNICEF

Table 3.3 GDP per capita and Life expectancy

S. NO.	COUNTRY	GDP PER CAPITA (2020) US$	LIFE EXPECTANCY
		A	D
1	Afghanistan	508.6	64.8
2	Australia	51812.2	83.4
3	Bangladesh	1968.8	72.6
4	Brazil	6796.8	75.9
5	China	10500.4	76.9
6	Costa Rica	12076.8	80.3
7	Egypt	3547.9	72
8	Ghana	2328.5	64.1
9	India	1900.7	69.7
10	Iraq	4157.5	70.6
11	Italy	31676.2	83.5
12	Japan	40113.1	84.6
13	Nigeria	2097.1	54.7
14	Portugal	22439.9	82.1
15	Russia	10126.7	72.6
16	Saudi Arabia	20110.3	75.1
17	Singapore	59797.8	83.6
18	Spain	27057.2	83.6
19	Uganda	817	63.4
20	USA	63543.6	78.9

Source:

D: World Bank

Table 3.4 GDP per capita and Population for 20 countries

S. NO.	COUNTRY	GDP PER CAPITA (2020) US$	POPULATION
		A	E
1	Afghanistan	508.6	38041757
2	Australia	51812.2	25365745
3	Bangladesh	1968.8	163046173
4	Brazil	6796.8	211049519
5	China	10500.4	1397715000
6	Costa Rica	12076.8	5047561
7	Egypt	3547.9	100388076
8	Ghana	2328.5	30417858
9	India	1900.7	1366417756
10	Iraq	4157.5	39309789
11	Italy	31676.2	59729081
12	Japan	40113.1	126264931
13	Nigeria	2097.1	200963603
14	Portugal	22439.9	10286263
15	Russia	10126.7	144406261
16	Saudi Arabia	20110.3	34268529
17	Singapore	59797.8	5703569
18	Spain	27057.2	47133521
19	Uganda	817	44269587
20	USA	63543.6	328329953

Source:

E: World Bank

Table 3.5 GDP per capita and Unemployment rate for 20 countries

S. NO.	COUNTRY	GDP PER CAPITA (2020) US$	UNEMPLOYMENT RATE
		A	F
1	Afghanistan	508.6	11.18
2	Australia	51812.2	5.16
3	Bangladesh	1968.8	4.37
4	Brazil	6796.8	12.82
5	China	10500.4	5.15
6	Costa Rica	12076.8	11.49
7	Egypt	3547.9	7.84
8	Ghana	2328.5	4.22
9	India	1900.7	5.27
10	Iraq	4157.5	13.02
11	Italy	31676.2	9.95
12	Japan	40113.1	2.4
13	Nigeria	2097.1	8.53
14	Portugal	22439.9	6.46
15	Russia	10126.7	4.5
16	Saudi Arabia	20110.3	6.04
17	Singapore	59797.8	3.1
18	Spain	27057.2	14.1
19	Uganda	817	10.09
20	USA	63543.6	3.67

Source;

F: World Bank

Table 3.6 Correlation between the various variables

Variable	B	C	D	E	F
A	0.759793	0.618343	0.715791	-0.179038	-0.402411

3.7 PRESENTATION OF DATA- GRAPHICAL

The relationship between the variables has been represented through scatter plots.

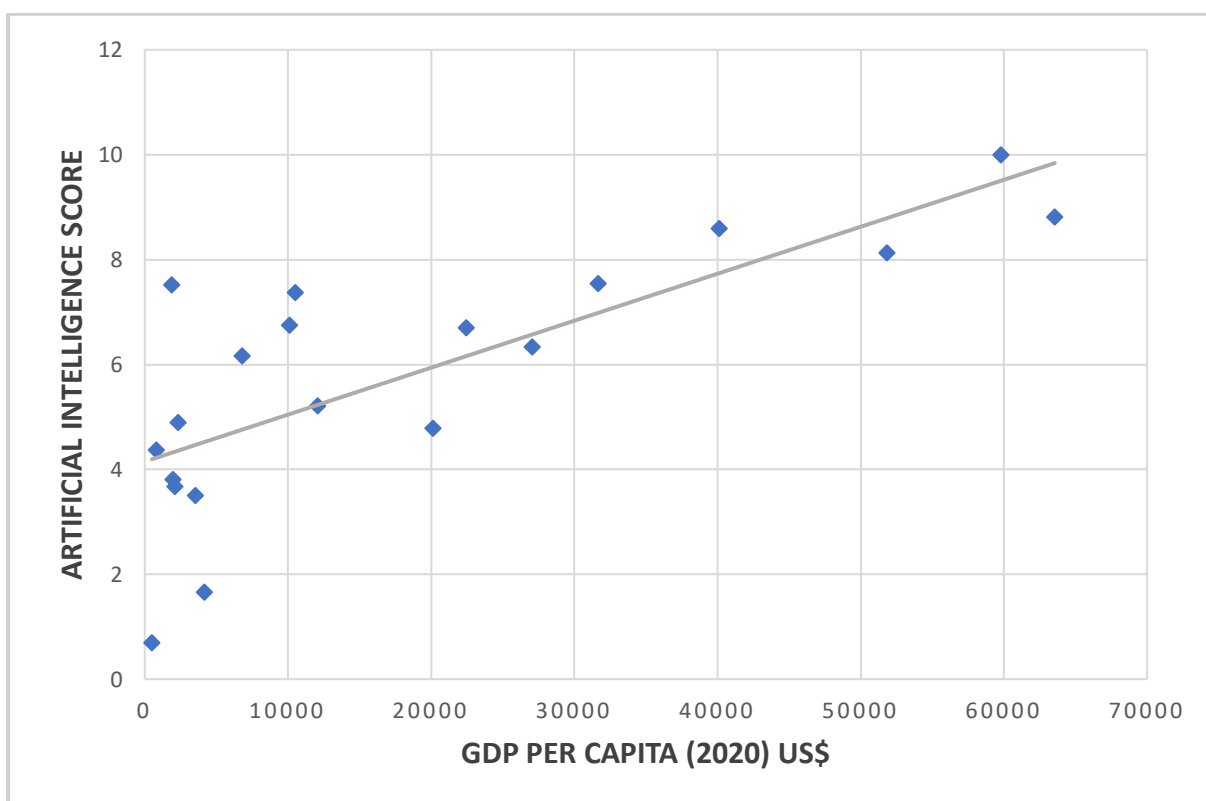**Figure 3.1 GDP per capita and government's readiness to use Artificial Intelligence score for 20 countries**

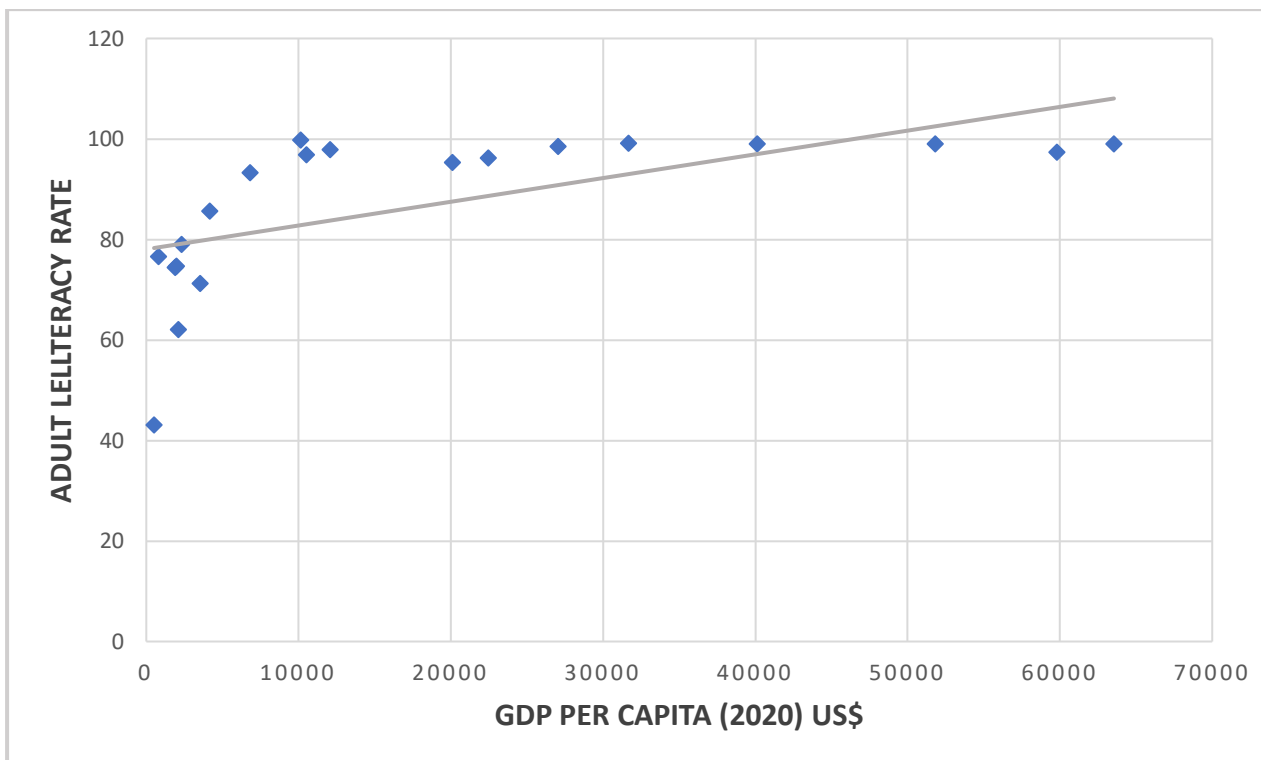**Figure 3.2 GDP per capita and adult literacy rate for 20 countries**

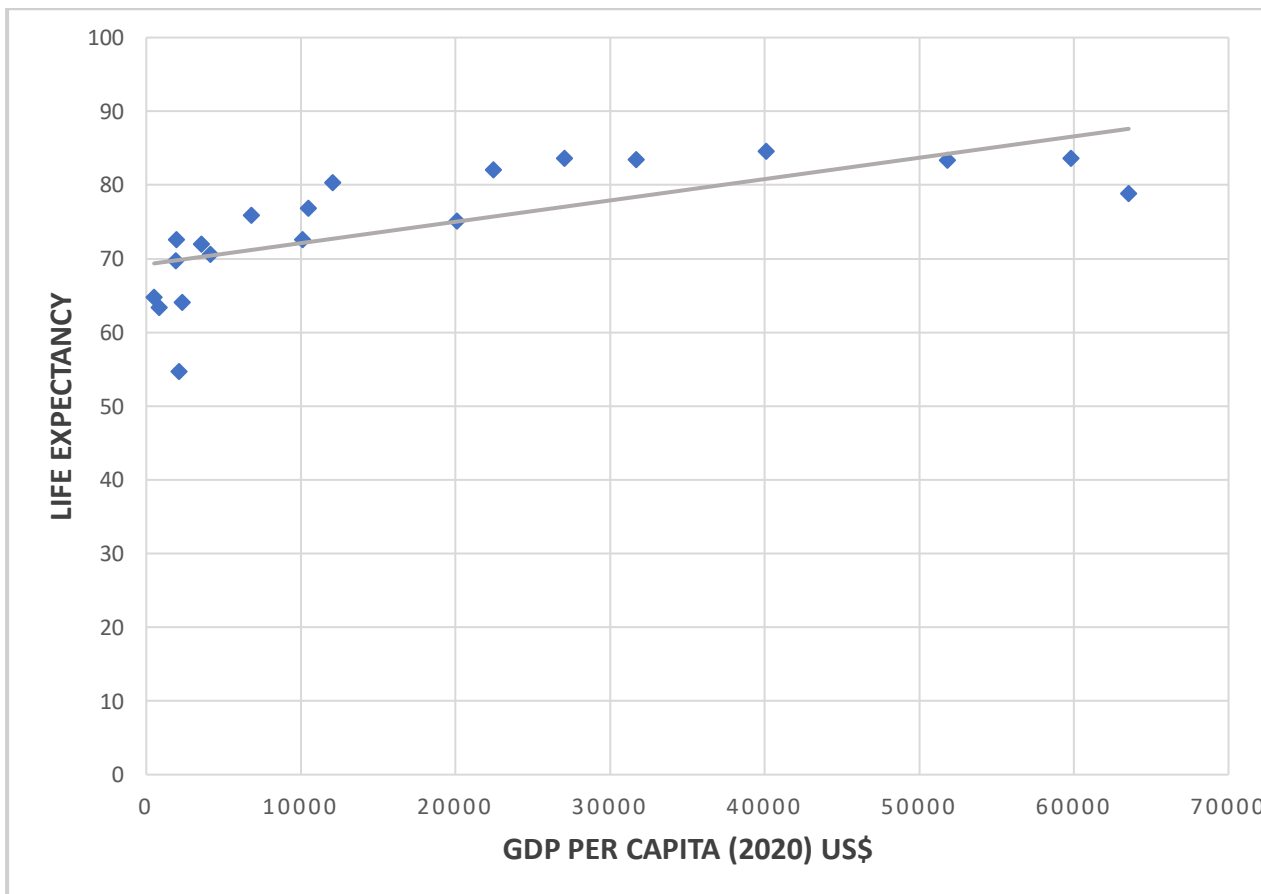**Figure 3.3 GDP per capita and Life expectancy for 20 countries**

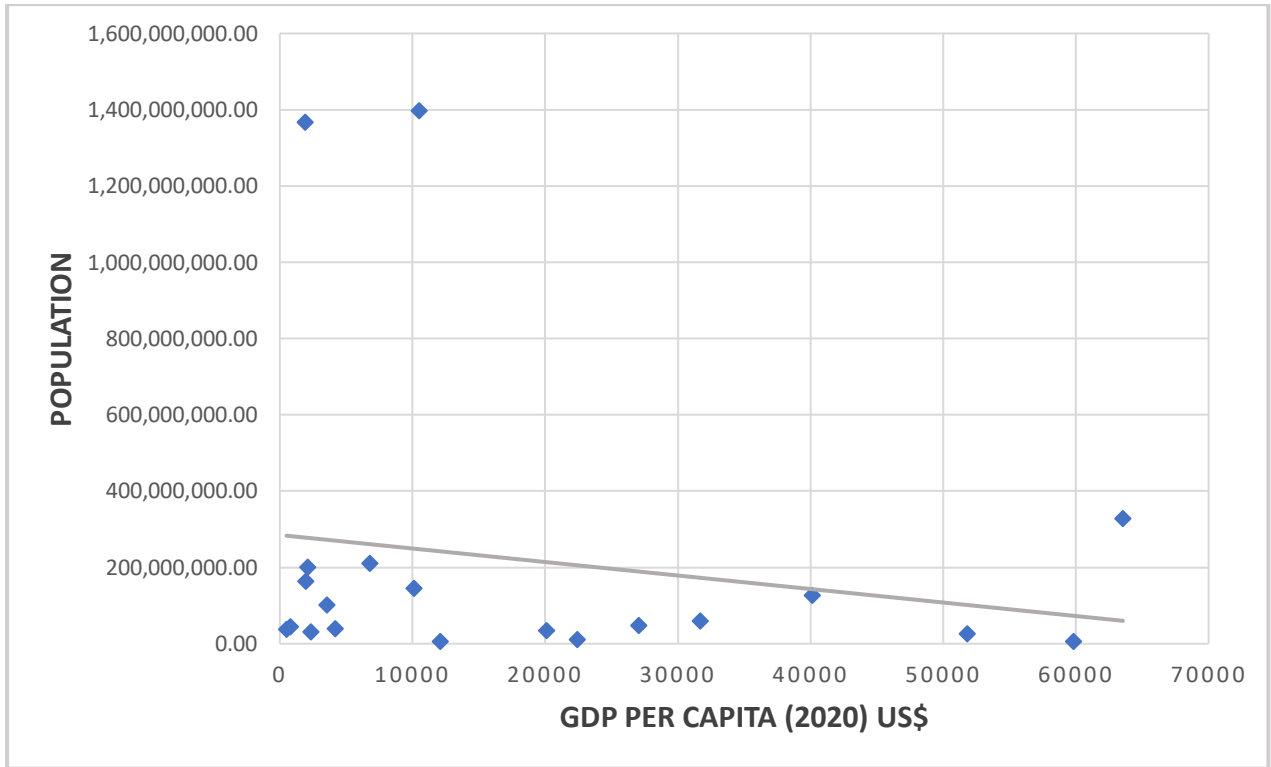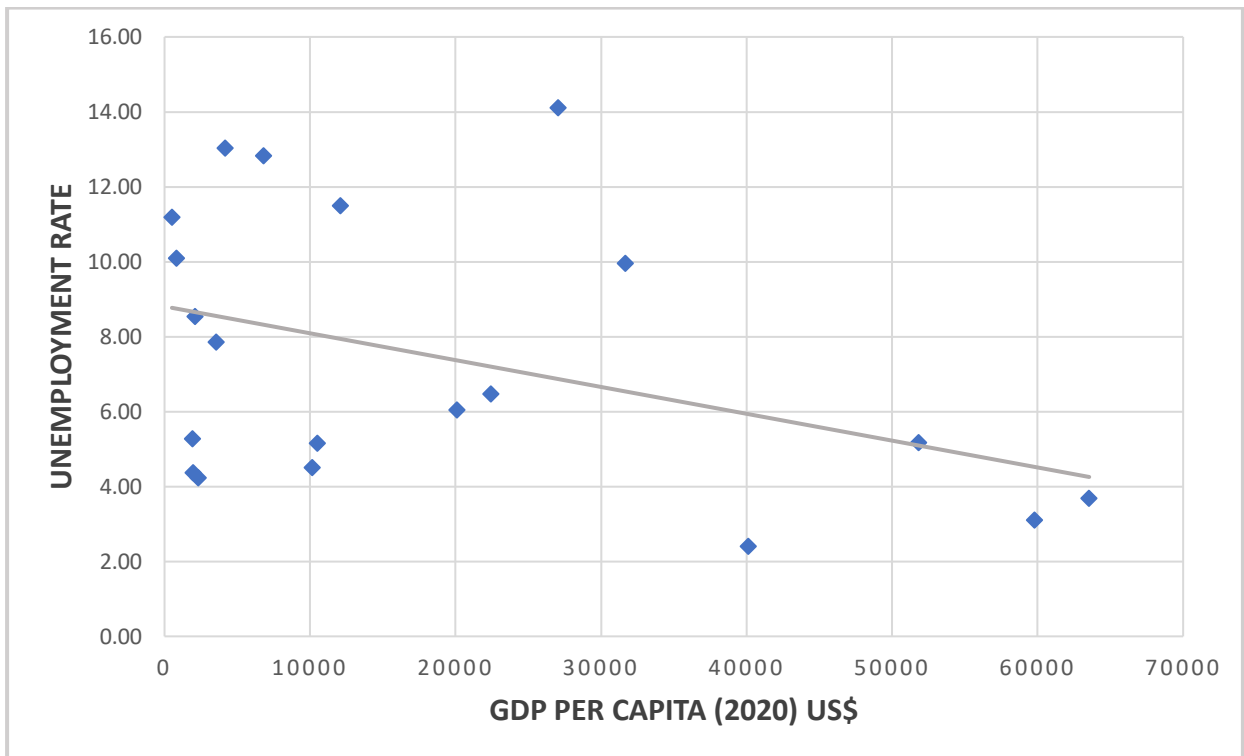**Figure 3.4 GDP per capita and Population for 20 countries**

Figure 3.4 GDP per capita and Population for 20 countries

4. DISCUSSION OF RESULTS

1. The relationship between variables A and B is positive in nature as expected and it is quite strong. Therefore, countries with higher AI readiness score i.e. countries who are ready to incorporate more AI or who have incorporated AI will increase their GDP per capita faster than other countries but countries with high labor to output ratio like India might be at a disadvantage which is not shown in the above relationship, reason being, machines taking up the jobs of labor leaving them unemployed, therefore many other factors will also influence the GDP per capita.

2. The relationship between variables A and C is positive in nature as expected and is quite strong. Therefore, investing in education of population will help a country to prosper better.

3. The relationship between variables A and D is positive in nature as expected and is quite strong. Therefore, providing better health facilities will in turn affect a person's productivity and will affect the GDP of a country.

4. The relationship between variables A and E is negative in nature contradicting our hypothesis, however it is quite weak. Therefore, high population in counties like India does not ensure high GDP if it is not coupled with high income and equitable distribution of resources.

5. The relationship between A and F is negative in nature as expected, however it is weak, therefore creating job opportunities in counties becomes important.

6. Artificial Intelligence cannot be the only factor to increase a country's growth, a combination of policies must be initiated. Artificial Intelligence might increase country's growth, but it becomes equally important to understand how that Artificial Intelligence ends up affecting the population of a country.

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5. CONCLUSION

5.1 CONCLUDING STATEMENT

The results of the study indicate that artificial intelligence however does affect the growth of a country with higher GDP per capita but there are other factors that are equally affecting a country's growth. In countries like India and China where population is an important factor, it becomes difficult to understand the relationship between AI and Economic growth, especially in India where labor to output ratio is high and bringing AI would mean lesser jobs for people of the country as machines will be taking up such jobs, increasing unemployment in the country. Needless to say that such type of unemployment is called Technological unemployment and is a key type of Structural Unemployment, but if some economists are to be believed, the effects of such an unemployment does not last long and is covered by the growth of the country. However there are other sets of economists who do not believe in this ideology and are totally against the idea of machines taking up more and more jobs of people in a country like ours. It is pertinent to note here that other sets of variables are equally affecting the Economic growth as much as AI is affecting so AI in isolation would not affect the growth the way it would affect with the combination of other factors. Countries should invest more in education, health and create more job opportunities.

One can conclude by quoting Michael Spence

"The world we are entering is one in which the most powerful global flows will be ideas and digital capital, not goods, services, and traditional capital. Adapting to this will require shifts in mindsets, policies, investments (especially in human capital), and quite possibly models of employment and distribution. No one knows fully how all of this will play out. But attempting to understand where the technological forces and trends are leading us is a good place to start"

5.2 LIMITATIONS OF THE STUDY

1. The number of countries studied was low. By including more countries, the analysis could have been made more accurate.
2. The data for a few countries was inconsistent. If data was compatible, then results would have been more accurate.
3. Considering a government's readiness to use AI provided one-dimensional results. By incorporating a country's current artificial intelligence usage, a stronger general theory could be developed.

5.3 SCOPE FOR FURTHER RESEARCH

1. The impact of recent increase in usage of artificial intelligence in different countries during covid can be studied once the data becomes available. The study will help us to underline the importance of artificial intelligence in each country.
2. Similar studies of artificial intelligence affecting different sectors in a country can allow us to further strengthen our general model.

6. REFERENCES

1. "7 types of Artificial intelligence", *Forbes*
   https://www.forbes.com/sites/cognitiveworld/2019/06/19/7-types-of-artificial-intelligence/?sh=699489a3233e

2. "Notes from the AI frontier: Modeling the impact of AI on the world economy", *McKinsey and Company* available at
   https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-modeling-the-impact-of-ai-on-the-world-economy

3. "What is the impact of Artificial Intelligence on the society?", *Bernard Marr & Co* available at
   https://bernardmarr.com/what-is-the-impact-of-artificial-intelligence-ai-on-society/#:~:text=Artificial%20intelligence%20can%20dramatically%20improve,creativity%20and%20empathy%20among%20others.

4. "GDP per capita (current US$)", *World Bank* available at
   https://data.worldbank.org/indicator/NY.GDP.PCAP.CD

5. "Government Artificial Intelligence Readiness Index,2019", *Oxford Insights and International Development Research Centre* available at
   https://www.oxfordinsights.com/ai-readiness2019

6. "Literacy rate, Adult total (%of people ages 15 and above)", *World Bank* available at
   https://data.worldbank.org/indicator/SE.ADT.LITR.ZS

7. "Literacy rate, Adult total (%of people ages 15 and above)", *Our World in Data* available at
   https://ourworldindata.org/grapher/literacy-rate-adults?tab=table

8. "Youth and Adult literacy rates", *UNICEF* available at
   https://data.unicef.org/resources/dataset/education-literacy-data

9. "Life Expectancy at Birth, total (years)", *World Bank* available at
   https://data.worldbank.org/indicator/SP.DYN.LE00.IN

10. "Population Total", *World Bank* available at
    https://data.worldbank.org/indicator/SP.POP.TOTL

11. "Unemployment, total (% of total labor force) (national estimate)", *World Bank* available at
    https://data.worldbank.org/indicator/SL.UEM.TOTL.NE.ZS

12. "Labor's Digital Displacement", *Michael Spence,* Project Syndicate (22.05.2014) available at
https://www.project-syndicate.org/commentary/michael-spence-describes-an-era-in-which-developing-countries-can-no-longer-rely-on-vast-numbers-of-cheap-workers