The Impact of Economic on Scientific Output: A global Perspective in 2020

Group 6

1 Introduction

```
data6<-read.csv("data6.csv")
data6$levels<-ifelse(data6$GDP<12000,"low",
                     ifelse(data6$GDP<40000,"moderate","high"))
data6$levels<-factor(data6$levels,levels=c("low","moderate","high"))
write.csv(data6,"data4.csv",row.names=FALSE)
gdp_level_counts<-table(data6$levels)
print(gdp_level_counts)
```

```
     low moderate     high 
      64       59       36 
```

Education plays a fundamental role in shaping economic growth, social development, and knowledge creation. Governments worldwide invest in education spending (ES) as a means to enhance educational quality, promote research, and drive innovation. However, the extent to which education investment translates into measurable scientific output remains an open question, particularly across countries with different levels of economic development. This study aims to examine the relationship between education spending and the number of scientific and technical journal articles published per million people (articles), with a focus on how this relationship varies across economies of different sizes.

The dataset used in this study consists of education spending as a percentage of GDP and the number of published scientific articles from various countries. To account for economic disparities, countries are categorized into three groups based on their Gross Domestic Product (GDP): high, moderate, and low. By analyzing these groups separately, we seek to determine whether increased investment in education leads to greater scientific productivity and whether this effect is dependent on economic status.

Table 1: Mean, median and standard deviation (sd) education spending and articles by levels of countries' GDP.

	articles			ES		
levels	Mean	Median	Std.Dev	Mean	Median	Std.Dev
low	37.64	15.24	62.56	4.34	3.95	2.12
moderate	321.38	164.81	345.79	4.41	4.39	1.25
high	1,442.09	1,453.66	651.37	5.20	5.39	1.53

2 Exploratory data analysis

Table 1 displays the mean, median and standard deviation for scientific output (articles) and education spending (ES) across different GDP levels: From Table 1, we can see that high GDP countries produce significantly more scientific articles compared to moderate and low GDP countries. Additionally, education spending (ES) is, on average, higher in high GDP countries, while moderate and low GDP countries exhibit similar levels of ES.

From the standard deviation, the variability in scientific output is relatively high, particularly in the high GDP group, indicating substantial differences in research productivity among these countries. Conversely, moderate and low GDP groups display lower variability, suggesting more consistent but lower research output.

Figure 1 illustrates the distribution of scientific articles across different GDP levels, showing a clear trend in research output. High GDP countries exhibit the highest median number of published articles, with a wider distribution, indicating significant variability among nations. Moderate GDP countries show lower and more concentrated research output, suggesting that while some countries perform relatively well, overall scientific productivity remains moderate. In contrast, low GDP countries demonstrate minimal research output, with most values clustered near the lower end. This pattern suggests that higher GDP is generally associated with increased research productivity, though variability exists, particularly among high-income countries.

Table 2 displays the correlation between education spending (ES) and scientific output (articles) across different GDP levels. A moderate positive correlation is observed in high GDP countries ($r = 0.5432$), suggesting that higher education investment is linked to increased research output.

In moderate GDP countries, the correlation is near zero ($r = 0.0043$), indicating that education spending has little direct impact on scientific output. For low GDP countries, the correlation is weakly positive ($r = 0.2936$), implying that while education spending may contribute to research productivity, economic and infrastructural limitations likely play a significant role.

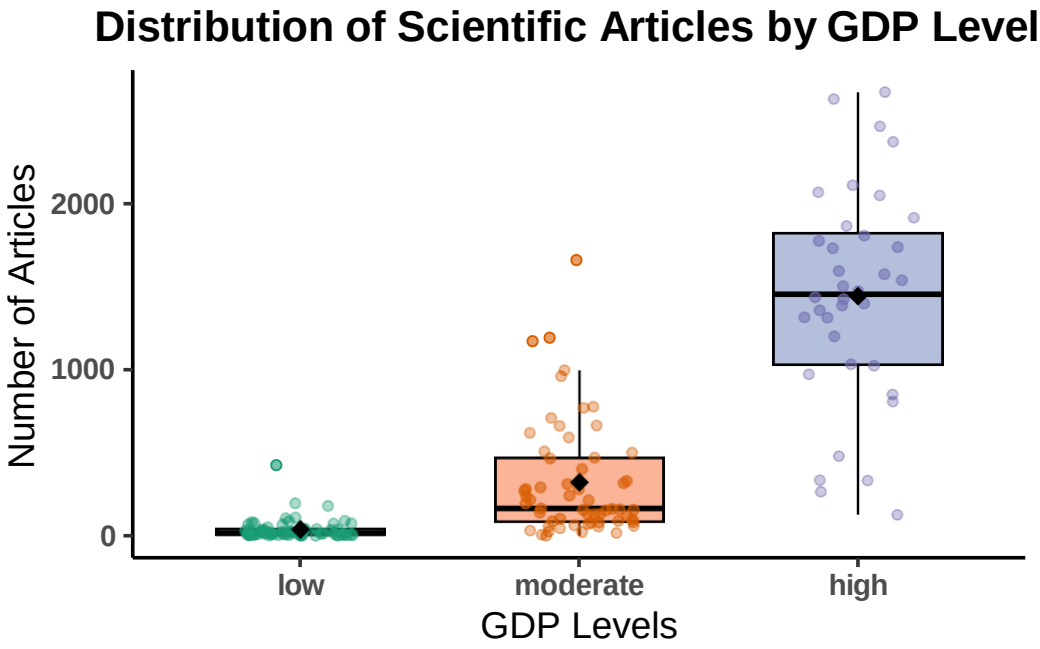

Figure 1

Table 2: Correlation between education spending and articles by levels.

levels	Correlation
low	0.2936
moderate	0.0043
high	0.5432

Figure 2 displays the relationship between education spending (ES) and scientific output (articles) across different GDP levels.In high GDP countries, there appears to be a positive association, with higher education spending generally corresponding to greater research output. Moderate GDP countries show a more dispersed pattern, suggesting that education spending alone may not be a strong predictor of scientific output. In contrast, low GDP countries tend to have consistently low research output, regardless of education spending, forming a distinct cluster at the lower end of the graph.

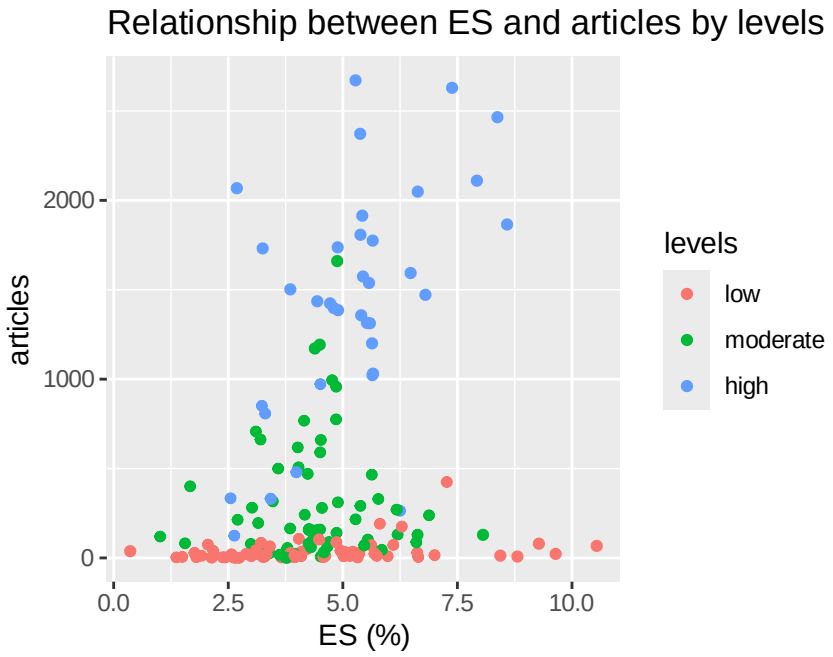

Figure 2: Relationship between education spending and articles by levels.

Figure 3 displays all the visualization results.

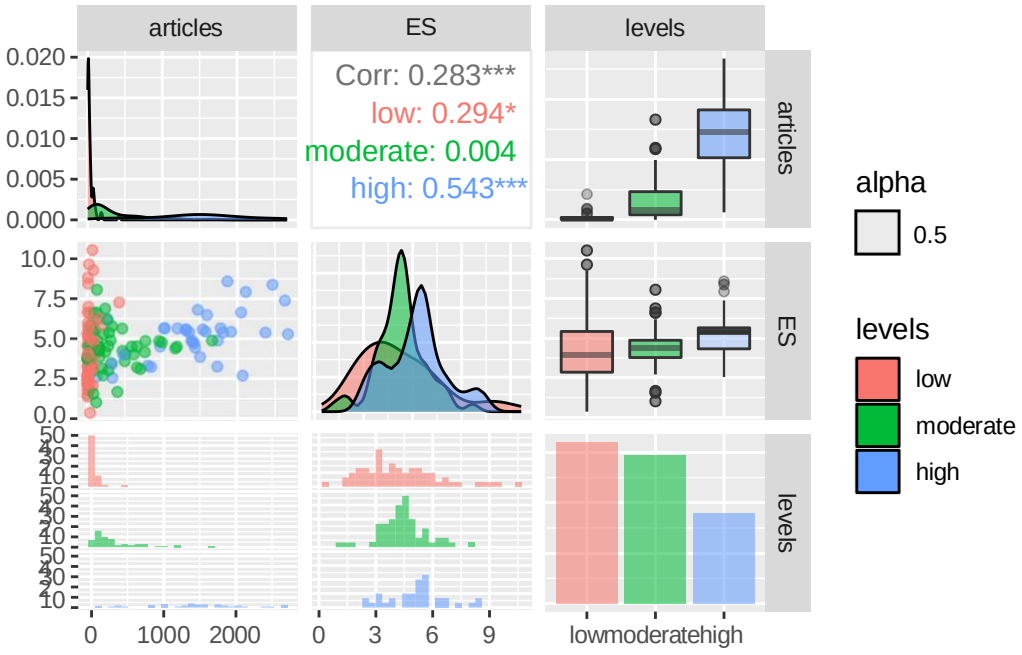
articles
ES
levels
Corr: 0.283***
low: 0.294*
moderate: 0.004
high: 0.543***
0.020
0.015
0.010
0.005
0.000
10.0
7.5
5.0
2.5
0.0
0
1000
2000
0
3
6
9
low
moderate
high
alpha
0.5
levels
low
moderate
high

Figure 3