

Driving Economic Growth: The Interplay of Productivity and Infrastructure

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INTRODUCTION

Topic Explanation

This paper discusses the possible factors that affect the economic development of a country, mainly focusing on two important variables, productivity and infrastructure. It argues that there is a strong relation between productivity, infrastructure and GDP growth.

SAMPLING TECHNIQUE

The dataset utilized in this study is sourced from the World Bank, representing a convenience sample derived primarily from member countries' statistical systems. The analysis focuses on key indicators including a country's GDP, Railway Transportation, and Exports of goods for the year 2019. Only the data from the top 100 countries are included in the source.

BACKGROUND INFORMATION

Variable Definitions

Independent Variable:

- I. **Railway Transportation Network Size:** It indicates how developed a country's infrastructure is. The data comes from the official website of the World Bank.
- II. **Exports of Goods:** It offers people and firms more markets for their goods. Productivity has a strong effect on the amount of exports. For instance, a country has to produce goods first and then sell them to the other countries, so a large export country indicates a high productivity, and thus in this paper the exports data are used to represent the productivity of a country. The data comes from the official website of the World Bank.

Dependent Variable:

- I. **GDP:** This is one of the most significant indicators that demonstrates a country's size and growth of economy. The data comes from the official website of the World Bank.

HYPOTHESIS

The growth of a country's GDP is notably influenced by the size of its railway transportation network and the volume of its goods exports. This relationship is grounded in the pivotal role played by a country's railway infrastructure in efficiently connecting its provinces and cities, facilitating the seamless movement of both people and goods to their destinations. This, in turn, stimulates trade activities and bolsters the local economy. Additionally, the quantity of goods exported by a country serves as a tangible indicator of its trade engagement with other nations, thereby making a significant contribution to the overall expansion of its GDP.

RAW DATA TABLE

Country	Exports (Trillion USD)	Railway Transportation (km)	GDP (Trillion USD)
United States	2.52	149,407	21
China	2.64	146,300	14
Japan	0.894	27,311	5.1
Germany	1.81	40,625	3.9
India	0.529	99,235	2.8
United Kingdom	0.88	16,320	2.8
France	0.862	29,273	2.7
Italy	0.635	16,788	2

Brazil	0.265	29,817	1.9
Canada	0.556	64,000	1.7
Russian Federation	0.482	85,600	1.7
Korea, Rep	0.658	4,165	1.6
Australia	0.337	33,168	1.4
Spain	0.487	16,355	1.4
Mexico	0.492	23,389	1.3
Indonesia	0.206	5,368	1.1
Netherlands	0.751	3,055	0.91
Saudi Arabia	0.286	5,590	0.792
Turkey	0.249	12,740	0.761
Switzerland	0.48	5,196	0.731
Poland	0.331	19,209	0.596
Thailand	0.324	4,900	0.544
Sweden	0.255	14,180	0.533
Belgium	0.436	3,607	0.533
Venezuela, RB	0.81	336	0.482
Nigeria	0.064	3,600	0.448
Argentina	0.078	36,966	0.445
Austra	0.247	5,527	0.445
United Arab Emirates	0.389	264	0.421

Norway	0.147	3,848	0.405
Ireland	0.511	1,931	0.399
Israel	0.117	1,486	0.394
Philippines	0.107	532	0.376
Singapore	0.659	240	0.374
Malaysia	0.238	2,783	0.364
Hong Kong, China	0.645	218	0.363
South Africa	0.105	22,387	0.351
Denmark	0.205	1,987	0.348
Colombia	0.051	1,663	0.323
Egypt	0.053	7,024	0.303
Bangladesh	0.046	2,835	0.303
Chile	0.078	6,634	0.279
Pakistan	0.028	8,100	0.278
Finland	0.107	5,926	0.268
Vietnam	0.28	3,364	0.261
Iran	0.065	16,998	0.258
Czech Republic	0.187	9,567	0.252
Romania	0.101	10,774	0.249
Portugal	0.104	2,546	0.239
Peru	0.055	2,020	0.228

Iraq	0.089	2,023	0.222
New Zealand	0.057	4,128	0.212
Greece	0.082	2,240	0.205
Kazakhstan	0.066	15,530	0.181
Qatar	0.092	0	0.175
Algeria	0.039	4,440	0.171
Hungary	0.135	7,945	0.163
Ukraine	0.063	20,952	0.153
Kuwait	0.073	0	0.136
Morocco	0.047	2,109	0.119
Ecuador	0.024	966	0.108
Slovak Republic	0.097	3,626	0.105
Puerto Rico	0.061	17	0.104
Cuba	0.015	5,476	0.103
Ethiopia	0.008	2,185	0.0959
Kenya	0.011	2,541	0.0955
Angola	0.035	2,761	0.0894
Dominican Republic	0.021	517	0.0889
Sri Lanka	0.019	1,508	0.084
Myanmar	0.022	11,025	0.0798
Guatemala	0.013	885	0.077

Oman	0.04	0	0.0763
Luxembourg	0.148	275	0.0711
Bulgaria	0.044	4,030	0.0686
Ghana	0.024	953	0.0672
Panama	0.027	355	0.0668
Belarus	0.041	5,459	0.0644
Costa Rica	0.022	278	0.0639
Uruguay	0.017	2,933	0.0612
Tanzania	0.009	2,722	0.0611
Croatia	0.032	2,604	0.0608
Côte d'Ivoire	0.014	630	0.0585
Uzbekistan	0.017	4,735	0.0577
Macao, China	0.045	0	0.0551
Lithuania	0.042	1,911	0.0546
Slovenia	0.045	1,209	0.0542
Libya	0.034	560	0.0521
Lebanon	0.018	335	0.052
Serbia	0.026	3,764	0.0515
Congo, Dem. Rep.	0.015	795	0.0504
Azerbaijan	0.023	2,068	0.0481
Turkmenistan	0.009	5,080	0.0452

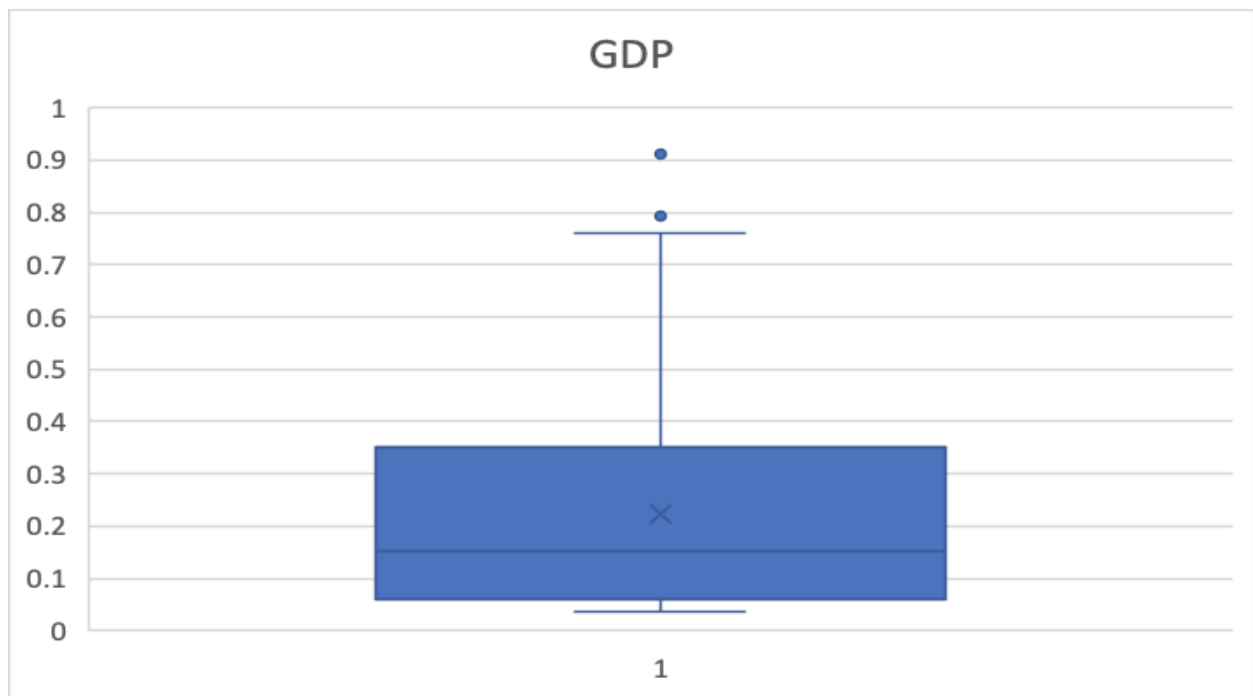
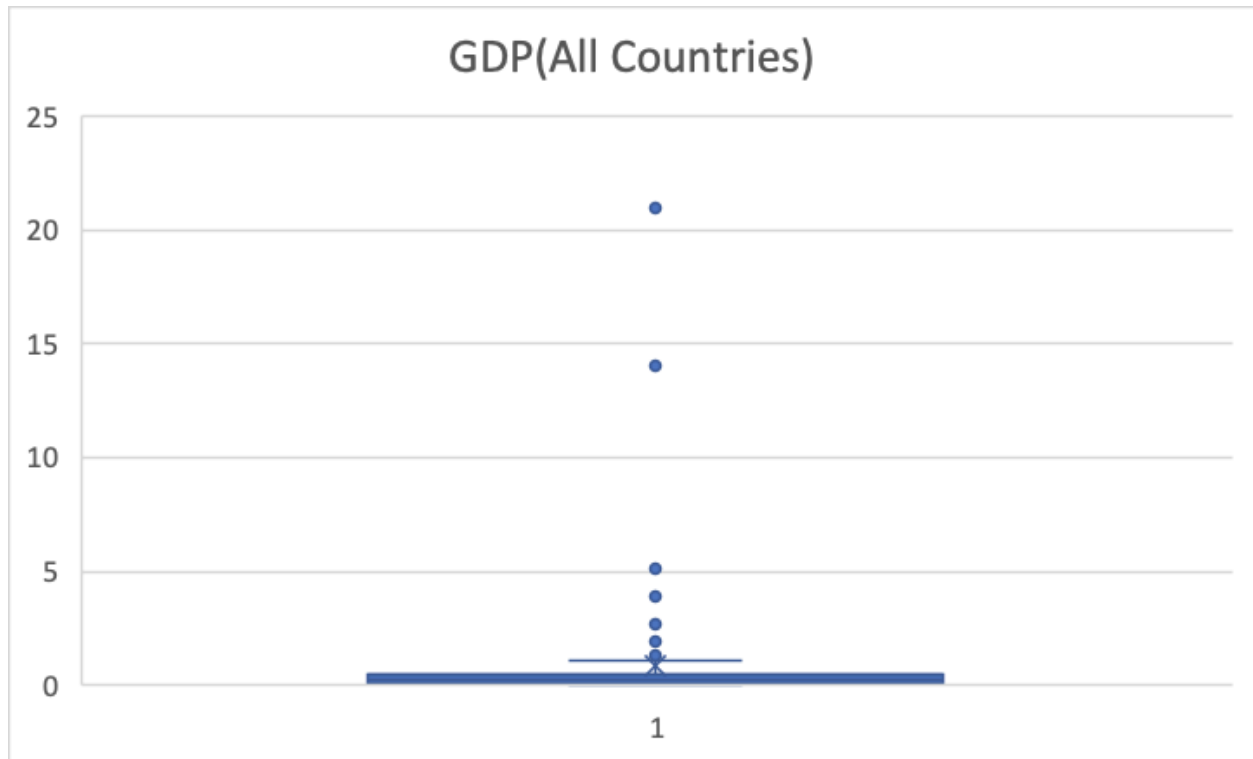
Jordan	0.016	622	0.0445
Bolivia	0.01	2,866	0.0409
Syrian Arab Republic	0.016	2,139	0.0404
Tunisia	0.019	2,165	0.0392
Cameroon	0.008	977	0.039
Bahrain	0.03	0	0.0385
Paraguay	0.013	38	0.0379

ONE VARIABLE ANALYSIS

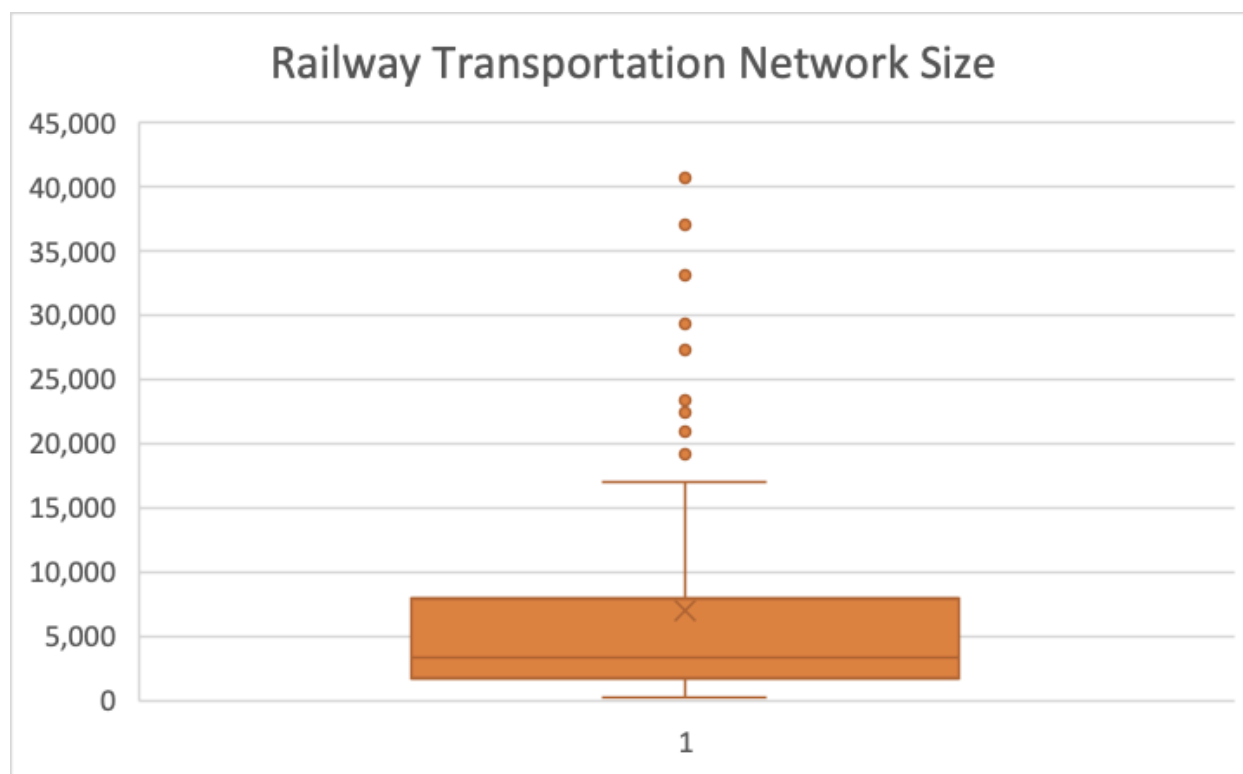
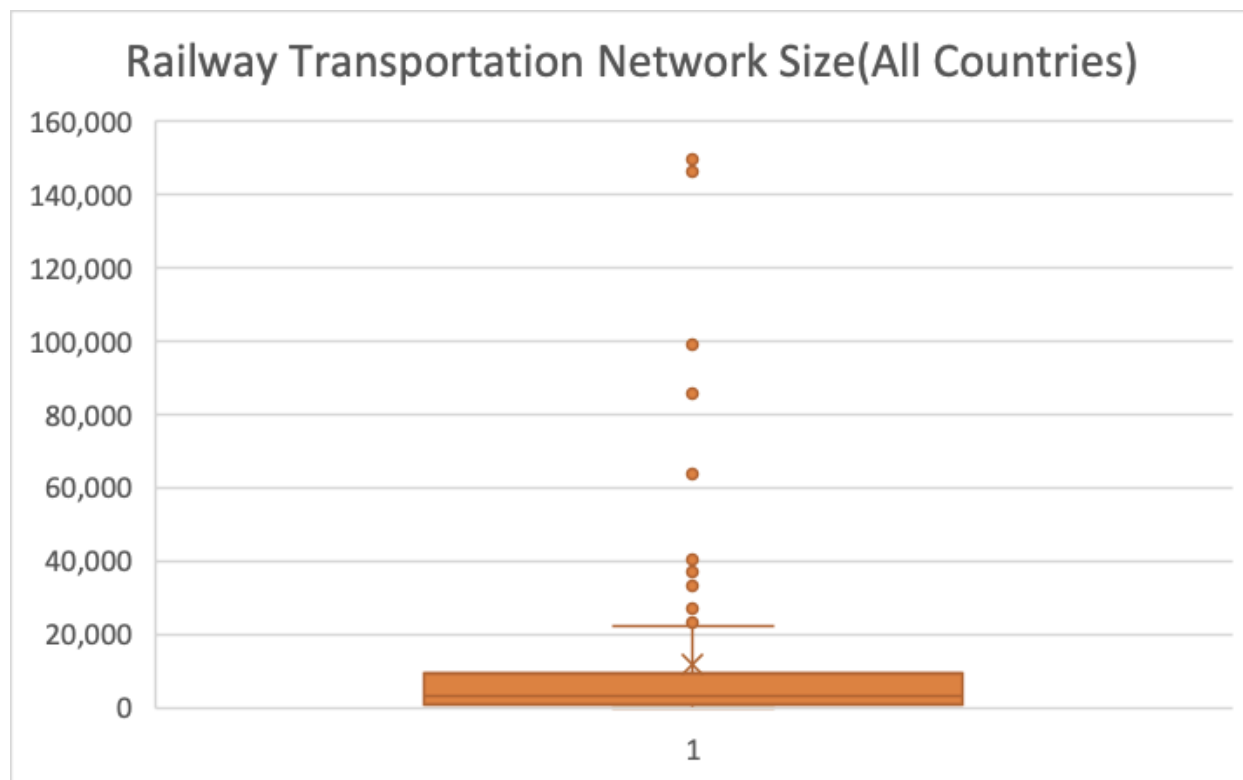
Table

2019	Mean	Median	Q1	Q3	IQR	STDEVS	Range
GDP	0.86	0.23	0.08	0.51	0.43	2.59	20.96
Railway Transportation	11,672	3,055	1,093	10,170.5	9,077.5	25,316	149,407
Export of goods	0.25	0.073	0.03	0.31	0.28	0.44	2.63

Box and whisker Plots

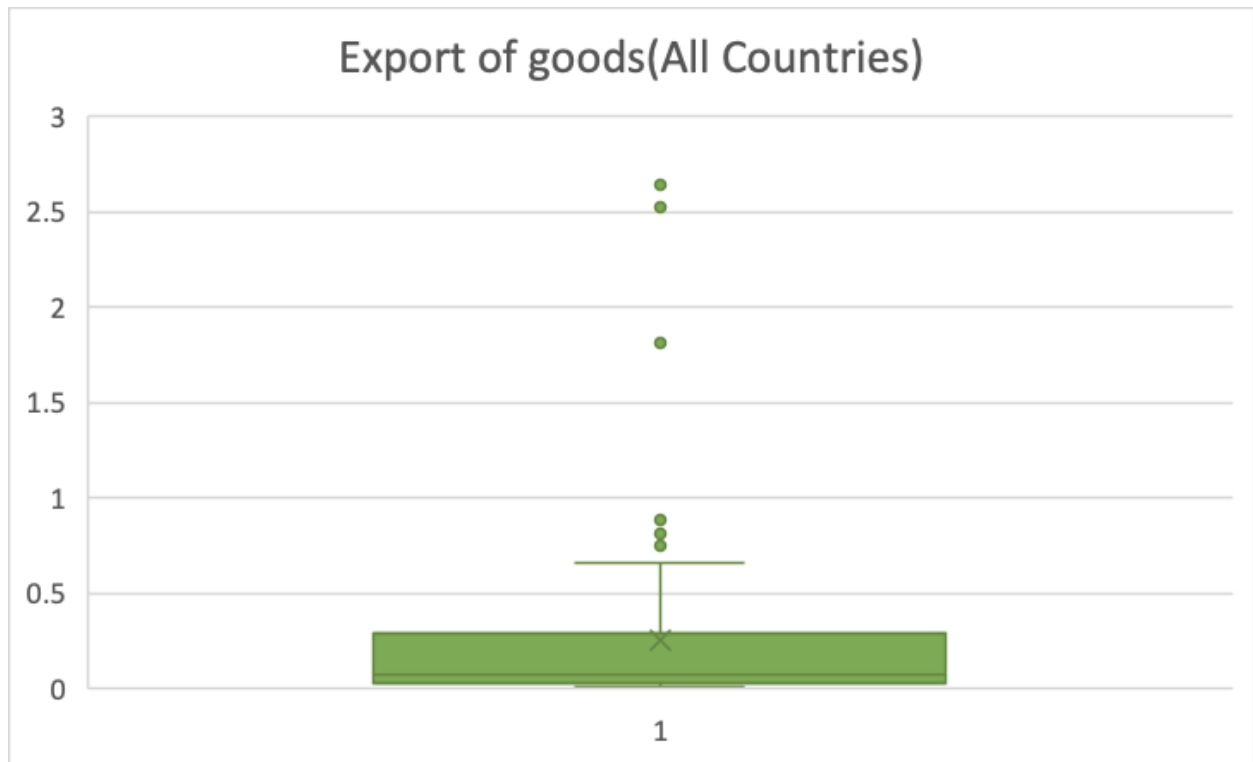
Graph 1: GDP

(Top 15 countries are hidden to make the graph clearer)

Graph 2: Railway Transportation

(Top 5 countries are hidden to make the graph clearer)

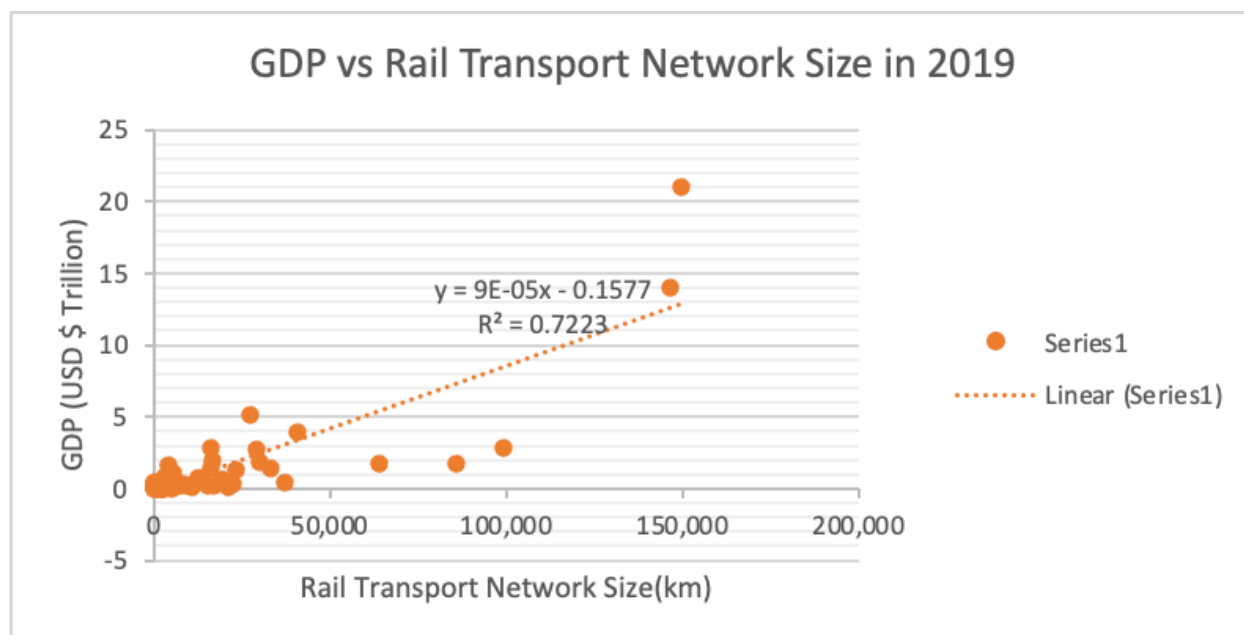
Graph 3: Exports



(Top 3 countries are hidden to make the graph clearer)

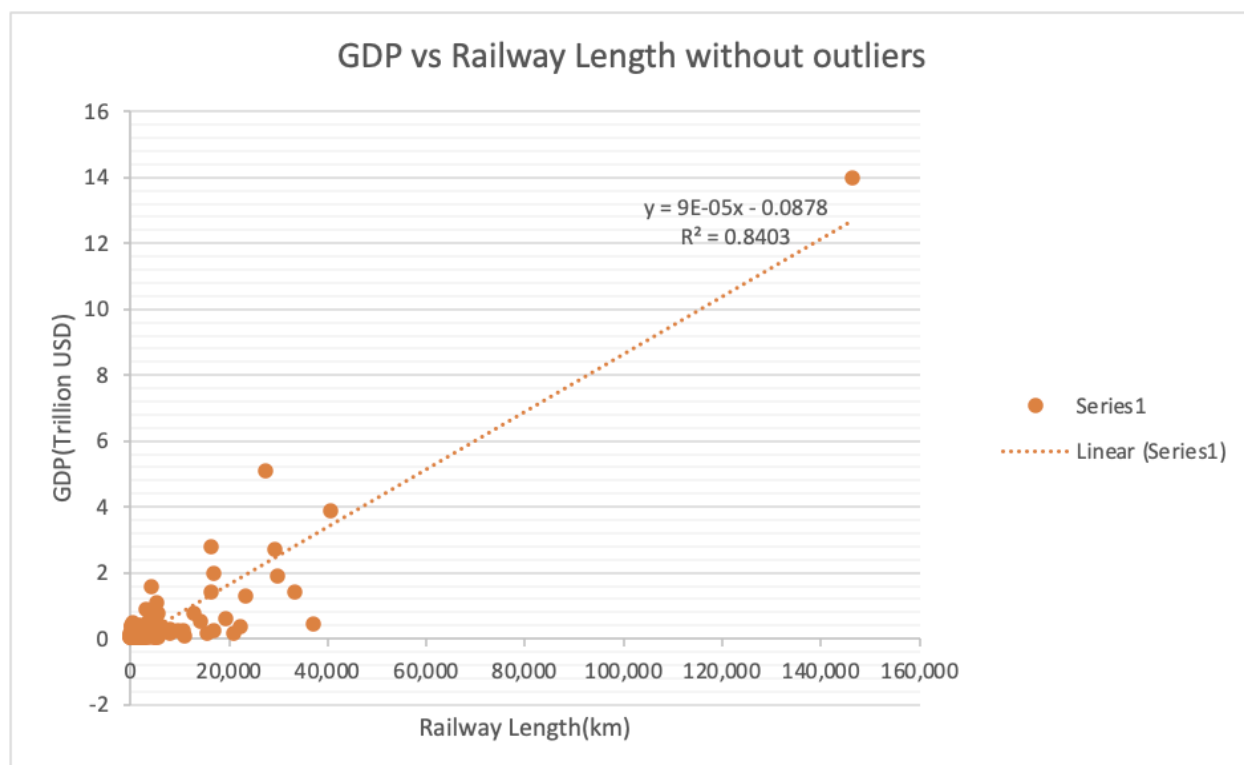
TWO VARIABLE ANALYSIS

Graph 4: GDP vs Railway Transportation



★ **R-Value = 0.85 Strong Positive Correlation**

★ **Outliers: US, India, Russia, Canada**

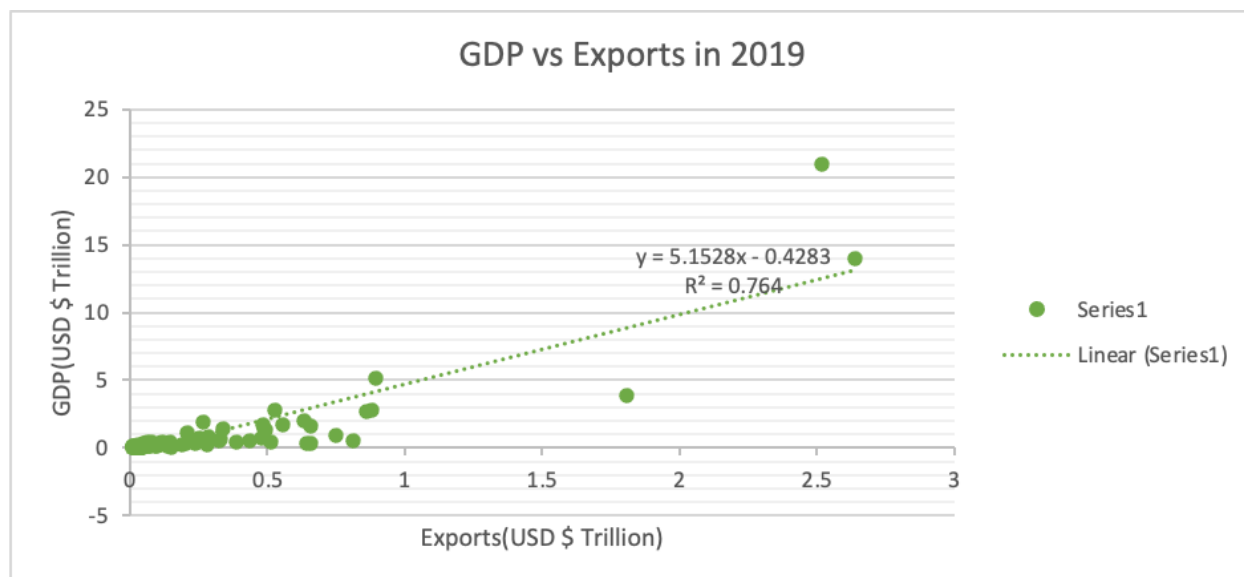


★ **R-Value = 0.92 Strong Positive Correlation**

Outliers Explanation

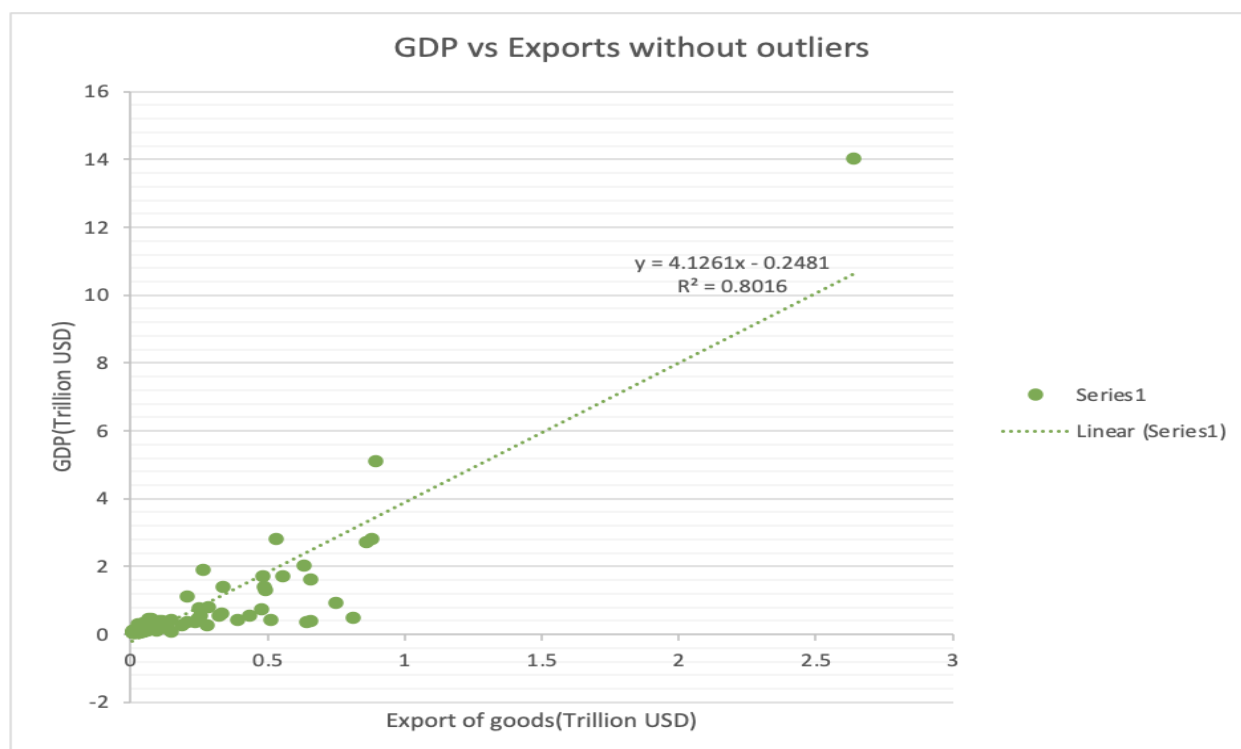
The correlation coefficient before removing the outliers is 0.85. With the outliers removed, the coefficient increases to 0.92, which is a strong positive correlation. The line of best fit tells us that the longer the railway is, the higher the GDP will be. The four outliers, USA, India, Russia and Canada, share a common factor of a vast territory, and thus it is essential for them to construct a long railway. It is obvious that the point of the US lies far above the line of best fit, while the other three outliers have a longer railway but a lower GDP. The points of the US and China are so high that they are pulling the line of best fit up, causing Canada, India and Russia to be outliers.

Graph 5: GDP vs Exports of goods



★ **R-Value = 0.87 Strong Positive Correlation**

★ **Outliers: US, Germany**



★ R-Value = 0.90 Strong Positive Correlation

Outliers Analysis

The correlation coefficient before removing the outliers is 0.87. With the outliers removed, the coefficient increases to 0.90, which is a strong positive correlation. In 2019, most of the countries' GDP were under 5 trillion dollars and their exports of goods were lower than 3 trillion dollars. There are three special points, USA, China and Germany. Germany's point is lower than the line of best fit which means that Germany's GDP is supposed to be higher due to its volume of exports. Germany has a large amount of exports because its scientific technology is advanced, especially automated and mechanized production, which boosts the manufacturing speed and output.

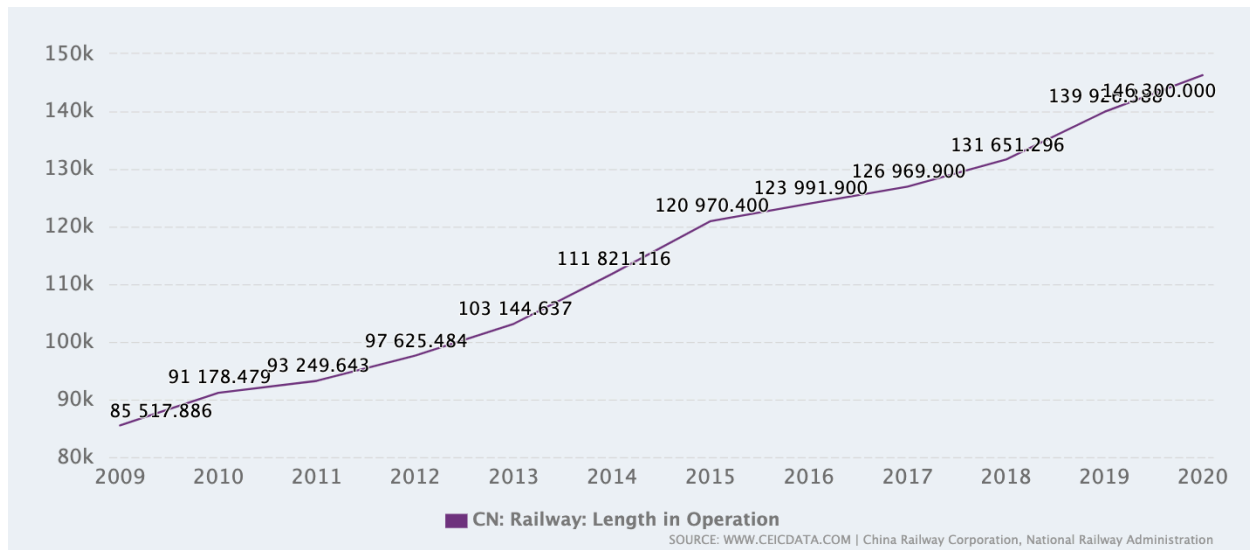
<u>Extraneous variable</u>	Effect on Railway Transportation
Territory	It is necessary for the countries with a large area such as India to construct a number of long railways, while smaller countries such as Germany do not need a railway length as long as India has. However, Germany's economy is more developed than India. Hence the length of a country's railway does not necessarily correlate to the extent of its economic development.

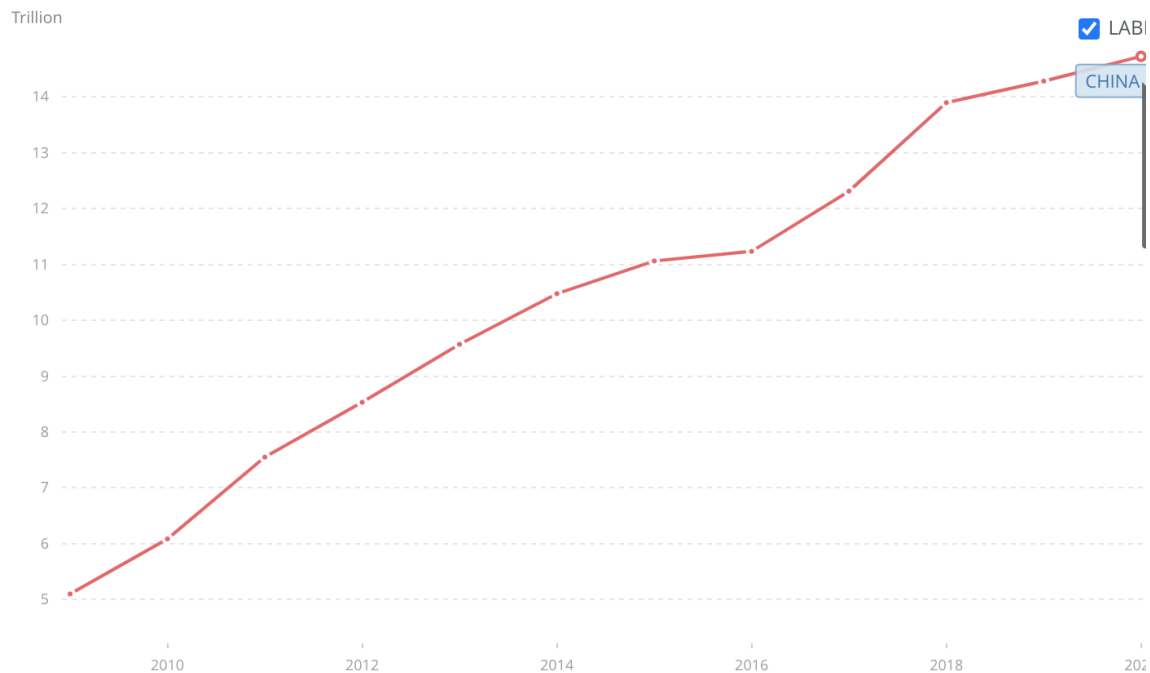
<u>Hidden Variable</u>	Effect on GDP and Exports
Technology and population	Technology plays an important role in the growth of the economy. For example, Germany has a smaller population but more advanced technologies than India has, which results in its higher productivity and GDP. By contrast, India has a much bigger population but its exports are very low, resulting in a rather lower GDP.
Geographical Location	Generally, coastal cities are more developed than inland cities due to the convenient transportation. Even if the railway

system in an inland city is very developed, it is still hard for those cities to export goods because the expense of transport is higher. Most of the companies do not want to stay in regions with high transportation expenses, and that is why the GDP and export of those regions are lower than those of coastal regions.

Additional Graphs

Graph 6: China's railway length from 2009 to 2020



Graph 7: China's GDP from 2009 to 2020

The two graphs illustrate the growth of China's rail length and GDP from 2009 to 2010. The two graphs look very similar because both of the two variables are increasing fast during these years, indicating the strong relationship.

CONCLUSION

Limitation and Inadequacy

- **GDP:** In this paper GDP is used to determine how an economy is going. However, it does not mean that a country with a low GDP is not wealthy. For instance, some countries such as Luxemburg, Switzerland and Denmark do not have a high GDP due to the small population, but these countries are very wealthy and highly developed.

- **Export of goods:** Export is not the best indicator to illustrate a country's productivity because it is not necessary for a country to export all its goods to the world. In fact a country keeps most of the produced goods for domestic sales.
- **Railway Transportation:** Railway demonstrates a country's power of construction, but it cannot indicate a country's overall ability of infrastructure. Different countries or cities prefer different ways of transportation. Short railway does not necessarily indicate underdeveloped infrastructure.

Bias

Sampling Bias: There were 5 countries missing the data for railway length, so some data from other websites are used to fill in the blank. Those data are not ensured to be accurate.

Conclusion

By observing the two graphs, the undeniable influence of productivity and infrastructure on the economy becomes evident. Typically, elevated levels of productivity coupled with well-developed infrastructure serve as catalysts for trade, which stands as the cornerstone of economic advancement. In nations where the railway system remains underdeveloped, industrial output and export levels tend to stagnate due to the costly and time-intensive process of delivering materials to manufacturers. Thus, the significance of a robust railway network in fostering economic growth cannot be overstated. Moreover, an advanced transportation system not only facilitates smoother logistics but also enhances a country's appeal to investors and tourists, thereby contributing to a higher GDP.

REFERENCE

“China Railway: Length in Operation”. (2023). CEIC.

<https://www.ceicdata.com/en/china/railway-length-in-operation/cn-railway-length-in-operation>

“Exports of Goods and Services (Current US\$)”. (2019). The World Bank.

<https://data.worldbank.org/indicator/NE.EXP.GNFS.CD>.

“GDP (Current US\$)”. (2019). The World Bank.

<https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?end=2019&start=1960>.