Data Driven Insights on Economic Growth, Public Debt and Social Development

BANA 698

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DATA INTRODUCTION

Database Source: https://data.worldbank.org

Key Attributes:

- Country Name: Name of the country
- Series Name: Indicators
- Year: Calendar year of the observation
- Value: Numeric value of the indicator

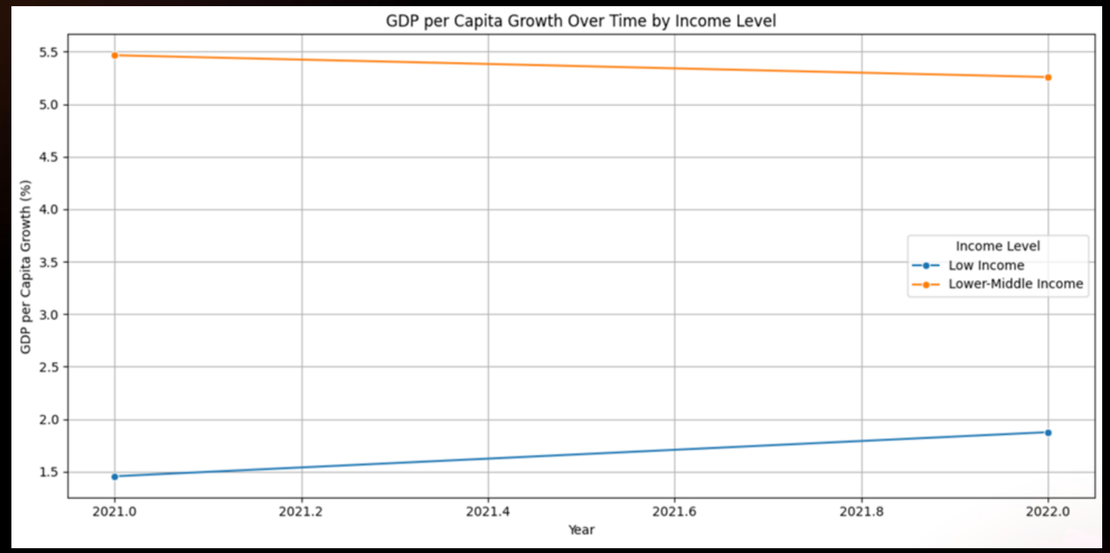
Key Indicators:

- Public Debt
- Economic
- Environmental
- Social
- Statistical

Research Objective:

How does a nation's socioeconomic indicators influence the volume of foreign direct investment (FDI) it receives, and what is the subsequent impact on its gross domestic product (GDP) growth?

ECONOMIC TRENDS BY INCOME LEVEL



GDP per Capita Growth:

Low Income Countries:

- Modest growth increase (from ~1.5% to ~2%)
- Gradually improving economic outlook

Lower-Middle Income Countries:

- High growth with slight decrease (from ~5.5% to ~5%)
- Strong, stable economic performance

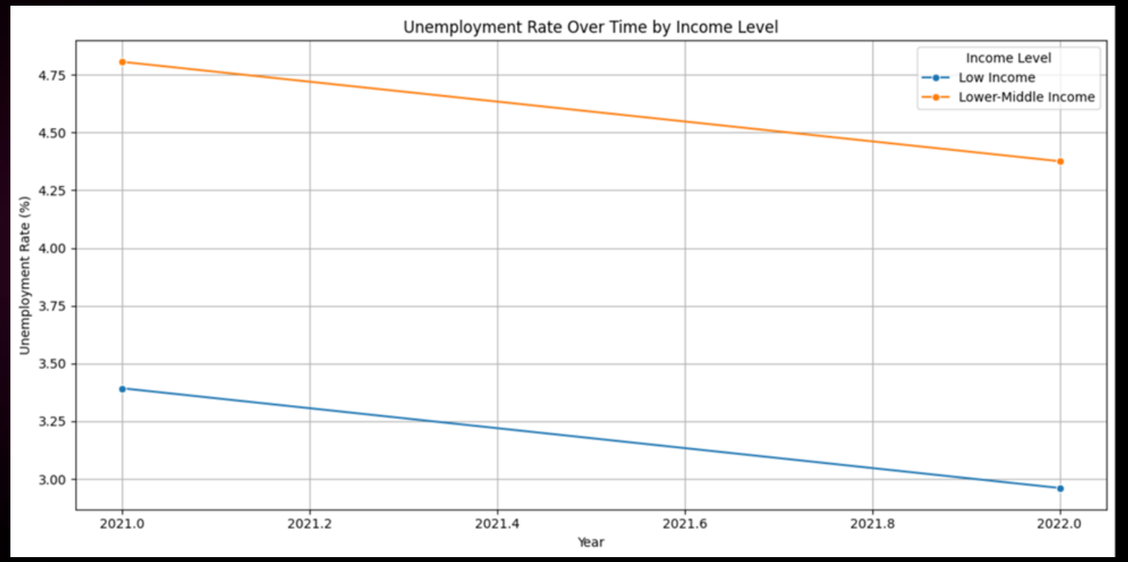
Unemployment Rate:

Low Income Countries:

- Unemployment rate decreased (from ~3.3% to ~3%)
- Positive employment trends

Lower-Middle Income Countries:

- Noticeable decline in unemployment (from ~4.75% to ~4.25%)
- Improving labor market conditions



IMPACT OF DOMESTIC AND EXTERNAL DEBT ON GDP GROWTH

GDP Growth:

- Gradual decline from around 6% to below 5%.
- Suggests challenges in sustaining growth levels.

Domestic Debt (% of GDP):

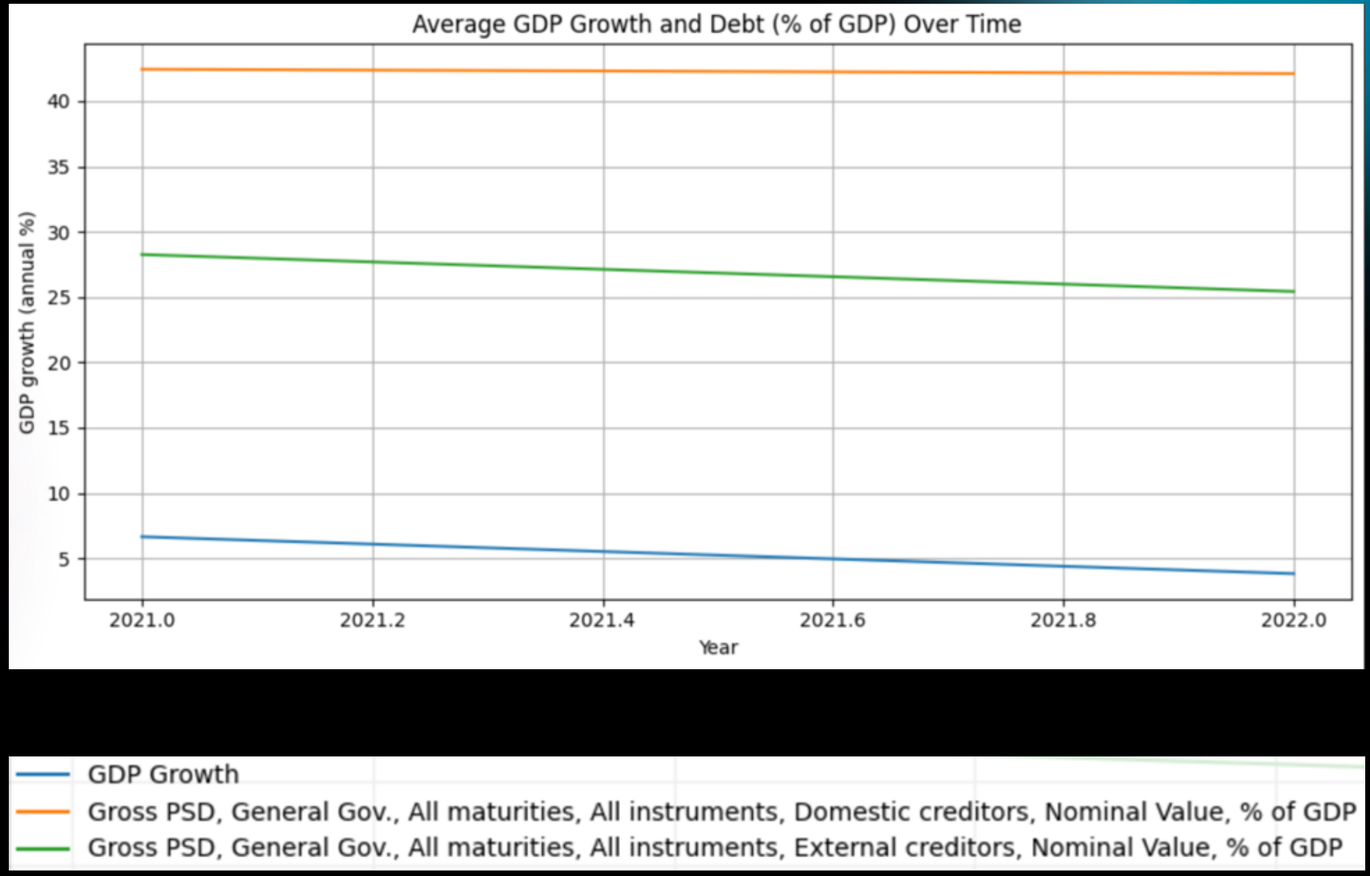
- Consistently high (~43%) and stable.
- Indicates significant domestic borrowing.

External Debt (% of GDP):

- Noticeable decrease (from ~29% to ~27%).
- Suggests reduction in dependency on external borrowing.

Economic Implications:

- High Domestic Debt
- Decreasing External Debt
- GDP Growth Slowdown



GDP GROWTH CLASSIFICATION: LOGISTIC REGRESSION ANALYSIS

High-Growth Economies (Blue):

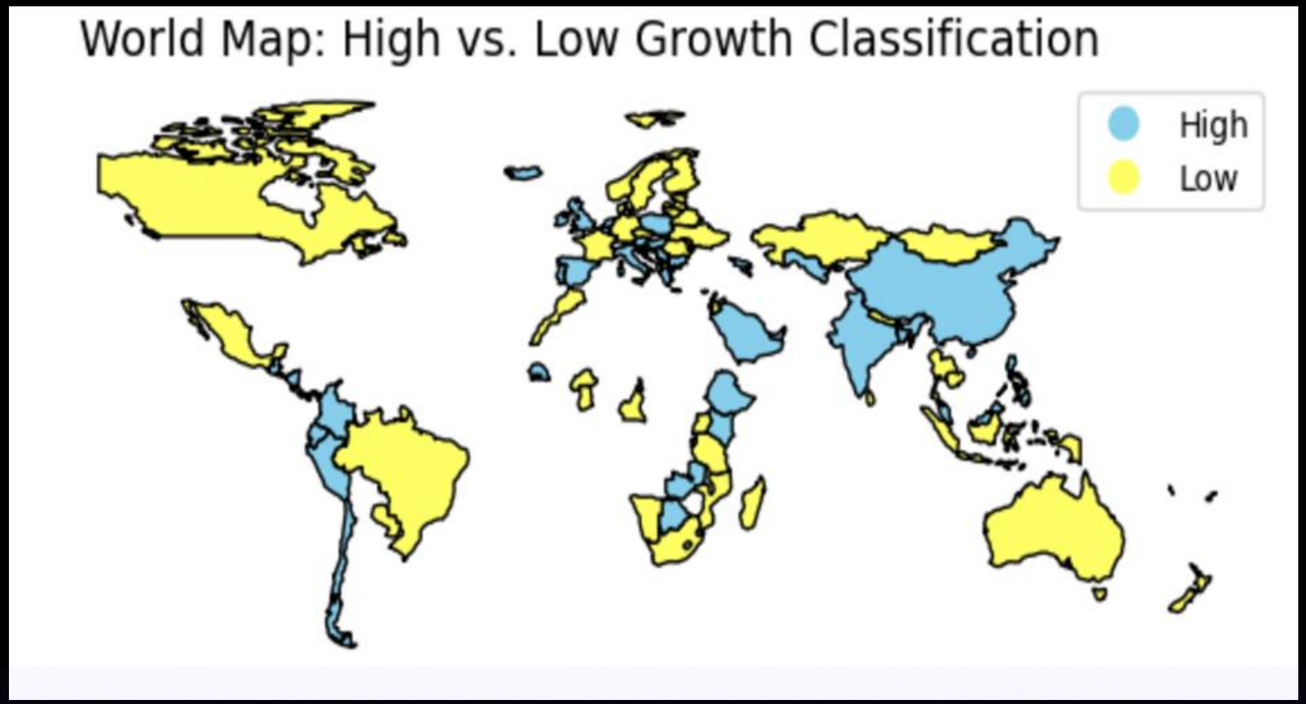
- Mostly emerging markets.
- Includes countries in Asia, parts of Europe, and selective regions in Africa and Latin America.

- Implications for FDI:
  - Attractive for high returns and market penetration.
  - Higher volatility and risk potential.

Low-Growth Economies (Yellow):

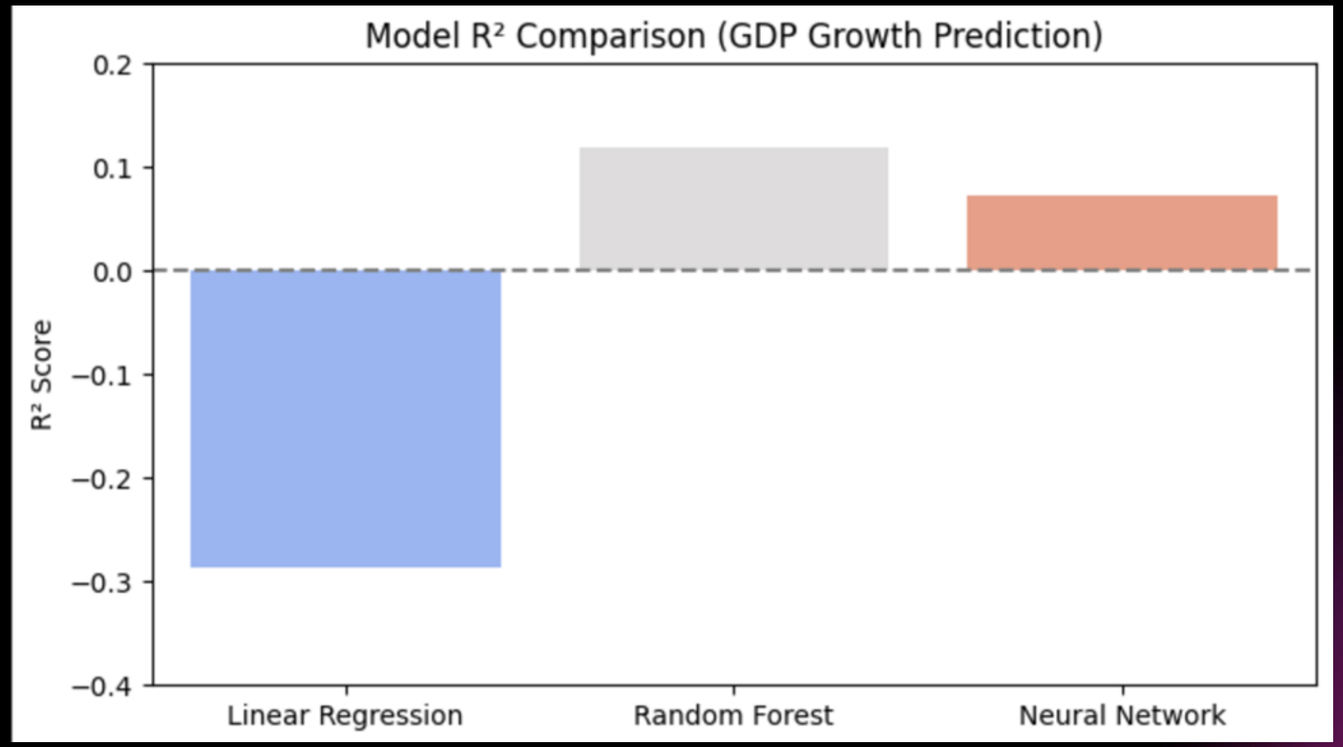
- Dominantly advanced and mature economies.
- Includes North America, Australia, and certain countries in Africa and South America.

- Implications for FDI:
  - Stability-focused investments.
  - Predictable environments but lower returns.



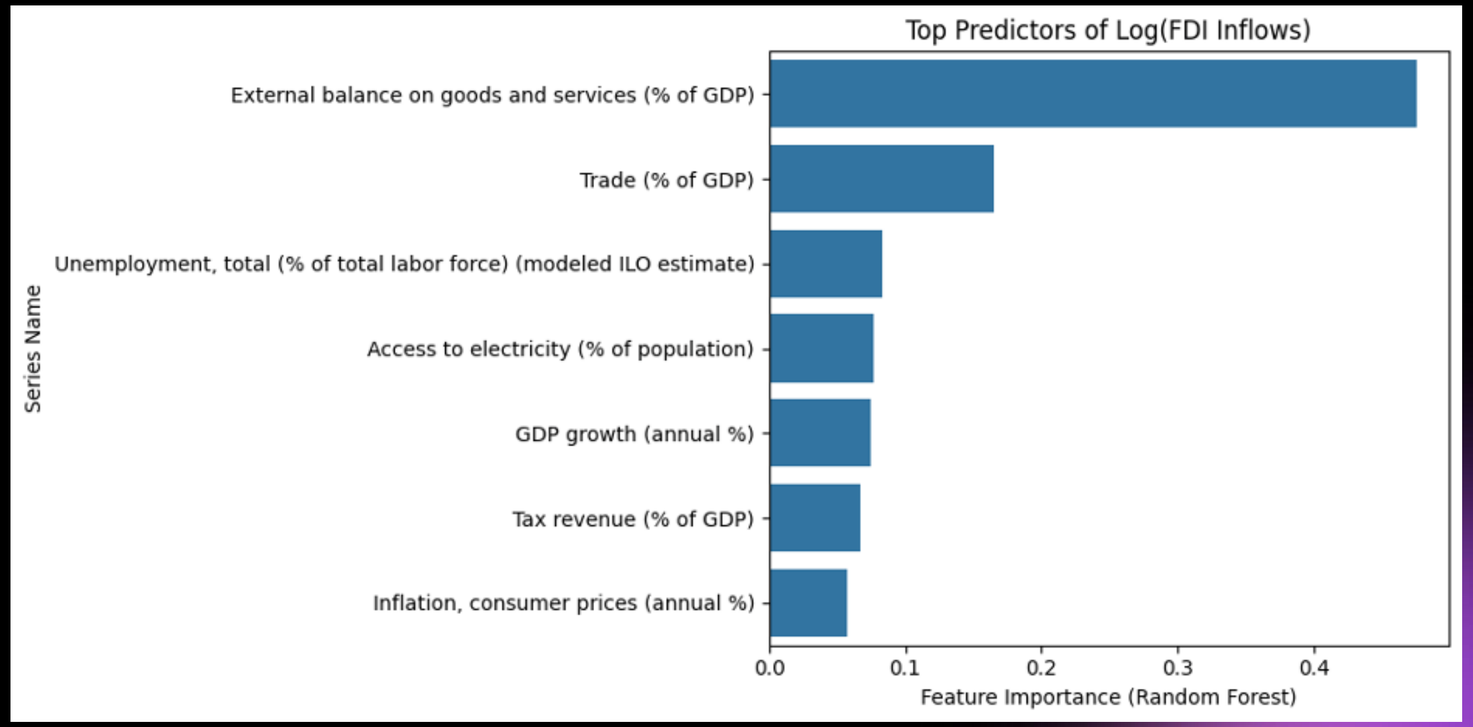
GDP GROWTH PREDICTION: COMPARING MODELING APPROACHES

- Linear Regression:
  - Negative R^2 (~ -0.3), indicating poor predictive performance.
  - Unable to capture complex relationships effectively.
- Random Forest:
  - Positive R^2 (~0.15), indicating moderate predictive capability.
  - Better captures non-linear relationships compared to linear regression.
- Neural Network:
  - Positive R^2 (~0.1), better than linear regression but slightly lower than Random Forest.
  - Effective in modeling complex, non-linear data patterns.



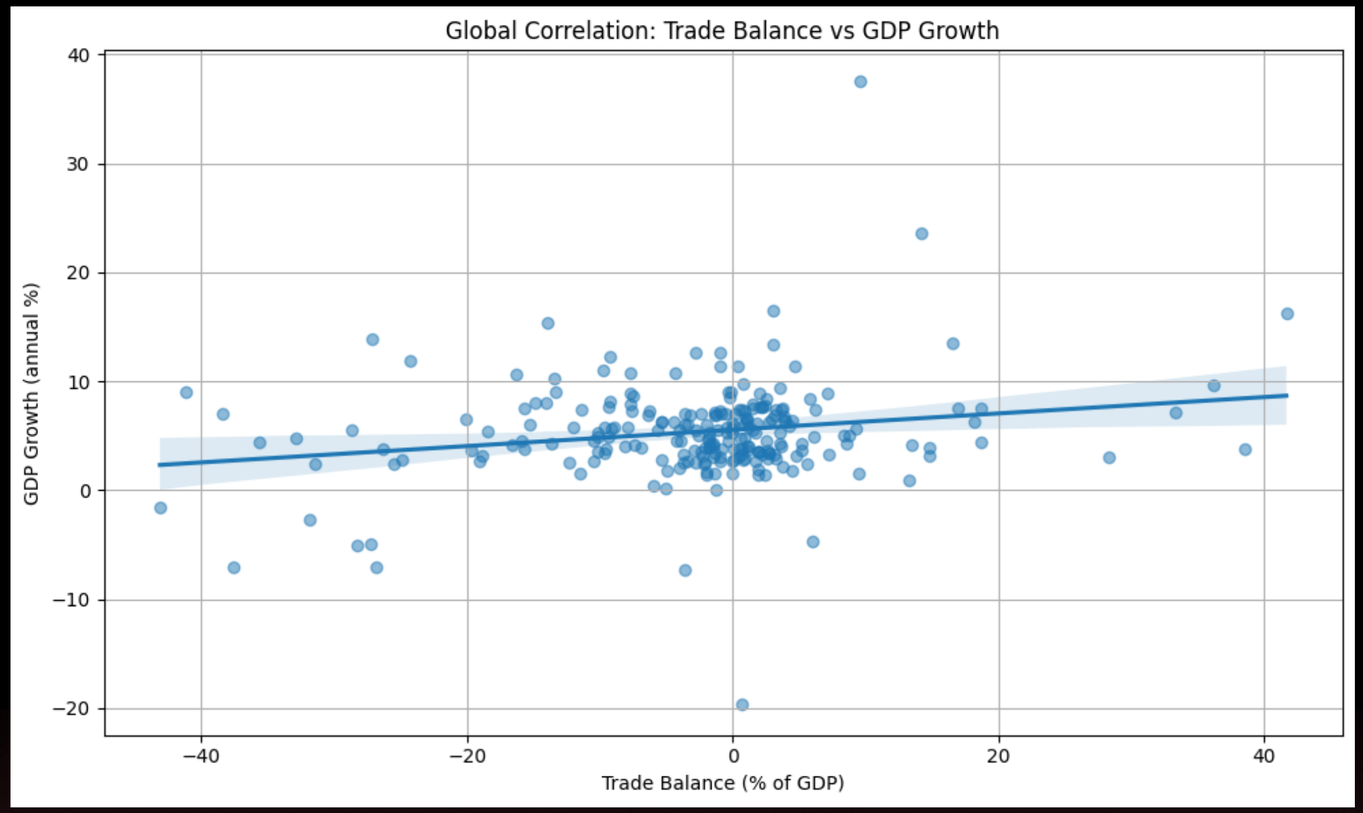
KEY PREDICTORS OF FDI

- Filtered dataset to focus on developing countries.
- Applied log transformation to FDI inflow values for stability.
- Applied Random Forest (R^2: 0.62) and Linear Regression (R^2: 1.0).
- Random Forest - Best performing
- Linear Regression- Overfitting
- Our top predictor of FDI Inflows turned out to be External balance on goods and services.

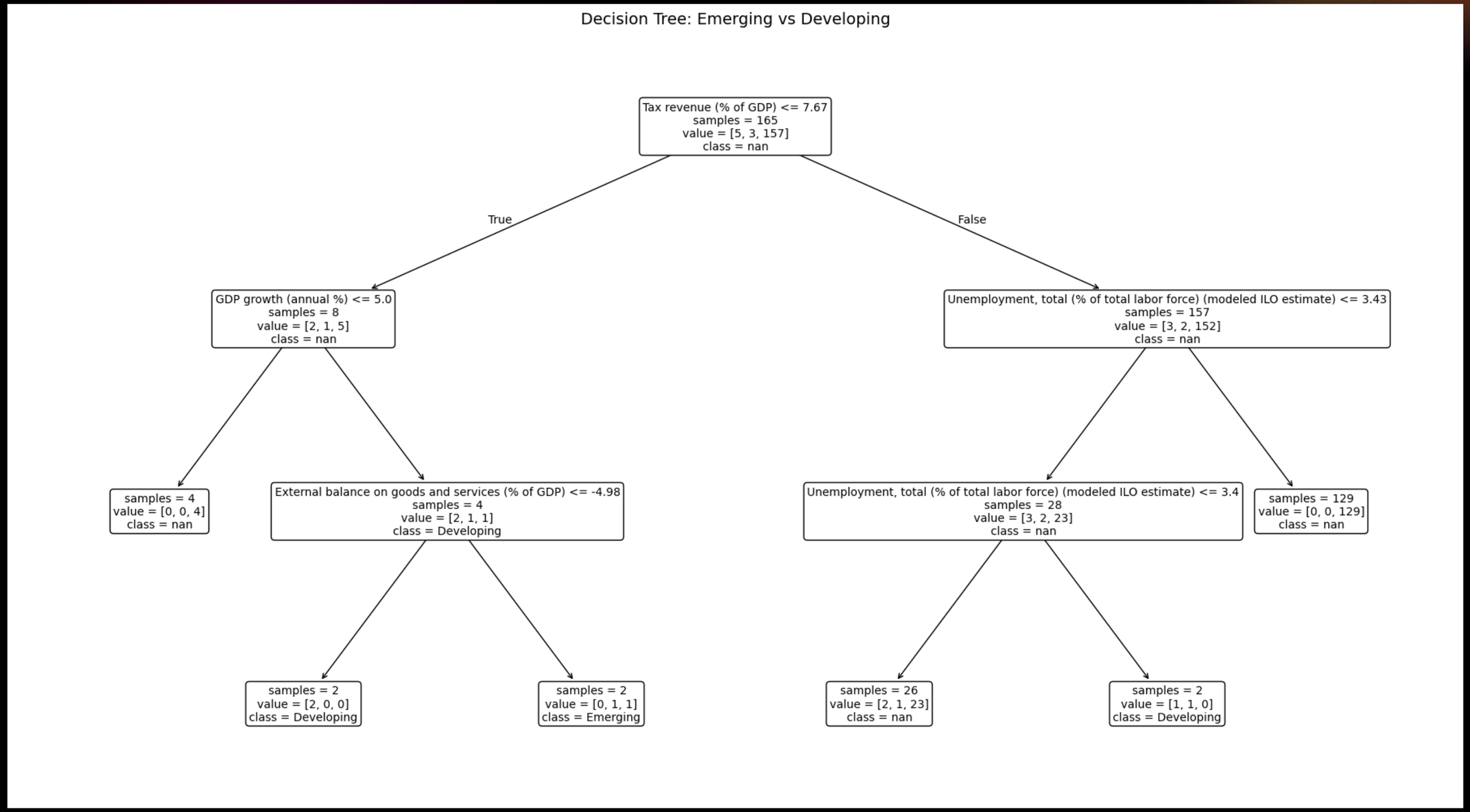


TRADE BALANCE VS GDP GROWTH

- Positive correlation is observed between Trade Balance and GDP growth.
- The correlation is weak (0.197) but suggests a systematic global trend.
- Most developing countries are clustered near zero with moderate GDP growth.



EMERGING vs DEVELOPING



EMERGING vs DEVELOPING

- Countries with low tax revenue and low economic growth are usually classified as Developing.
- Countries with higher tax revenue and lower unemployment have a better chance of being labeled as Emerging.
- This helps us understand which economic factors most influence a country's development tier.

SIGNIFICANCE OF EXTERNAL DEBT ON GDP GROWTH (T-TEST)

Objective: Examine if there's a significant difference in GDP growth between countries with high vs low external debt.

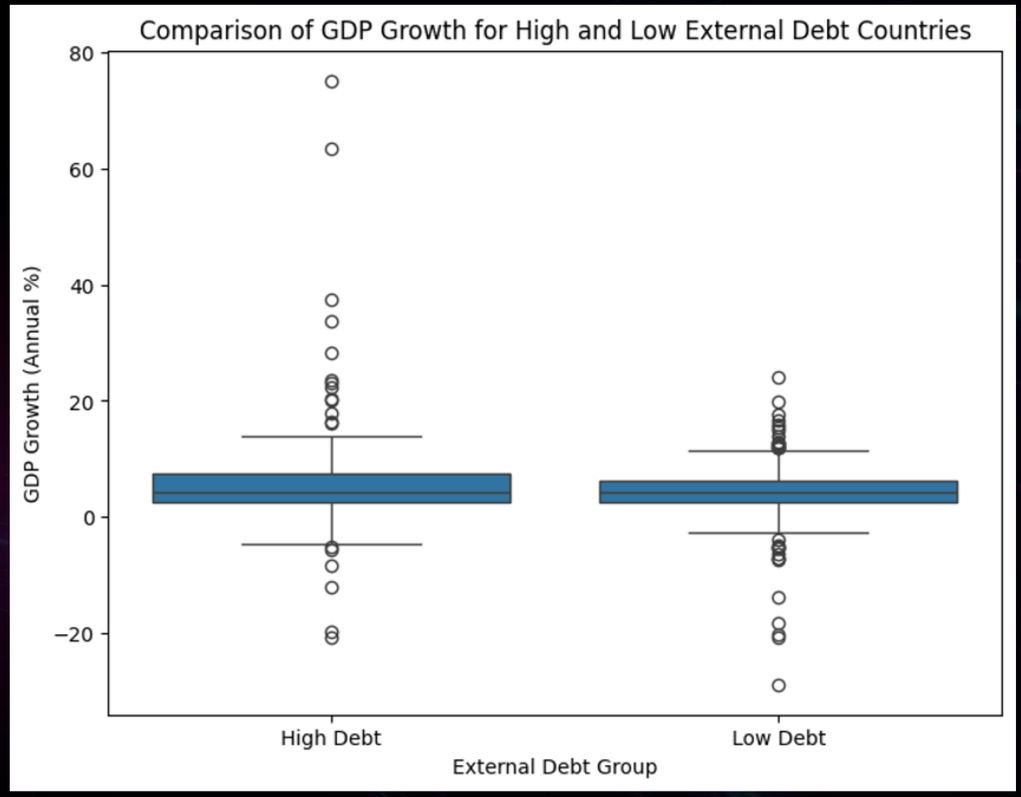
Method: T-test to compare GDP growth between two groups (high debt vs low debt).

Results:

p-value: 0.0023 (<0.05 significant level; statistically significant)

Interpretation:

Countries with high external debt exhibit greater variability in GDP growth, while those with low external debt have more stable and consistent growth.



IMPACT OF ECONOMIC FACTORS ON GDP PER CAPITA GROWTH

Objective: Analyze how inflation, trade balance, and public debt influence GDP per capita growth.

Method: Multiple linear regression to determine the impact of inflation, trade balance, and public debt on GDP per capita growth.

Results:
R-squared: 0.026 (indicating the model explains ~2.6% of the variation in GDP per capita growth)

Significant Factors:
Inflation: Coefficient = -0.0342 (negative impact)
Public Debt: Coefficient = -0.1180 (negative impact)
Trade Balance: Not statistically significant (p-value = 0.996)

OLS Regression Results

Dep. Variable:	GDP_per_Capita_Growth	R-squared:	0.026
Model:	OLS	Adj. R-squared:	0.022
Method:	Least Squares	F-statistic:	6.997
Date:	Sat, 19 Apr 2025	Prob (F-statistic):	0.000120
Time:	07:17:04	Log-Likelihood:	-2569.8
No. Observations:	798	AIC:	5148.
Df Residuals:	794	BIC:	5166.
Df Model:	3		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	5.9832	0.570	10.502	0.000	4.865	7.101
Inflation	-0.0342	0.011	-3.007	0.003	-0.056	-0.012
Trade_Balance	1.642e-05	0.004	0.004	0.996	-0.007	0.007
Public_Debt	-0.1180	0.033	-3.605	0.000	-0.182	-0.054

Omnibus:	660.219	Durbin-Watson:	2.123
Prob(Omnibus):	0.000	Jarque-Bera (JB):	41955.376
Skew:	3.252	Prob(JB):	0.00
Kurtosis:	37.922	Cond. No.	259.

Interpretation: Inflation and public debt have a negative impact on GDP per capita growth, while trade balance does not significantly influence GDP per capita growth in this model.

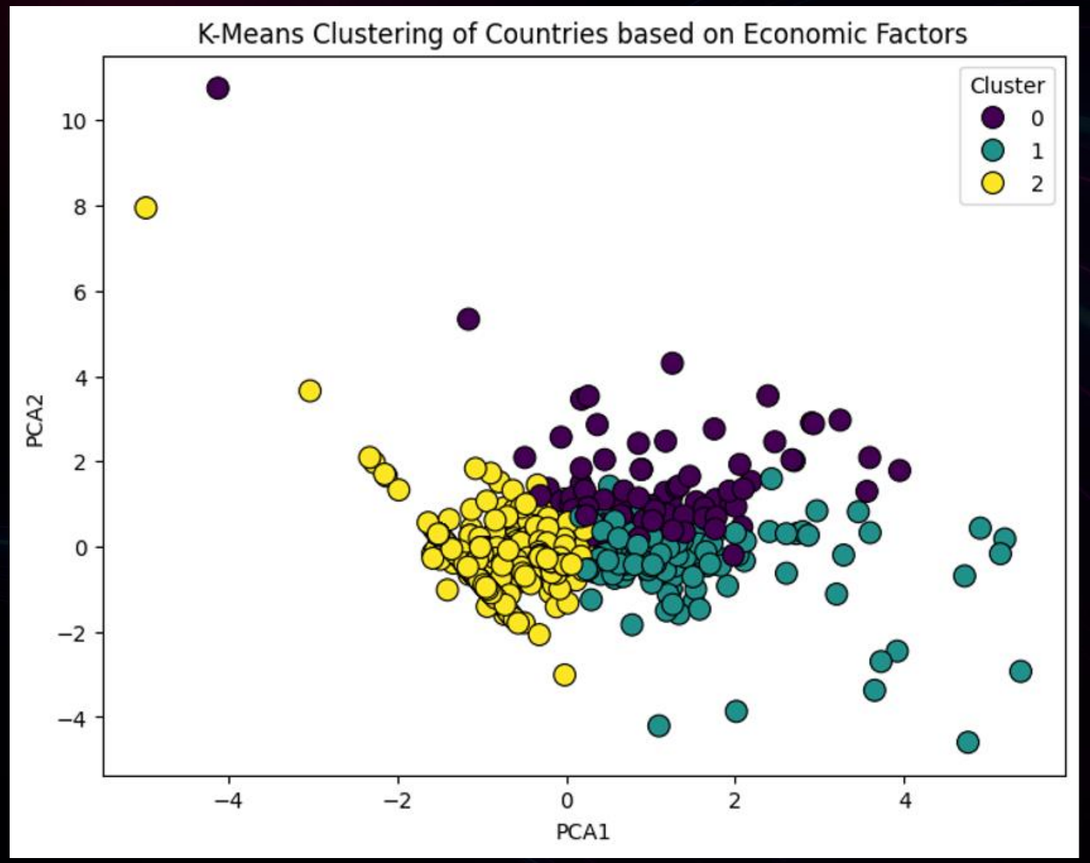
CLUSTERING OF COUNTRIES BASED ON ECONOMIC INDICATORS

Objective: Identify distinct clusters of countries based on economic growth, public debt levels, and trade balance using K-Means Clustering.

Method: K-means clustering to identify groups of countries with similar economic profiles.

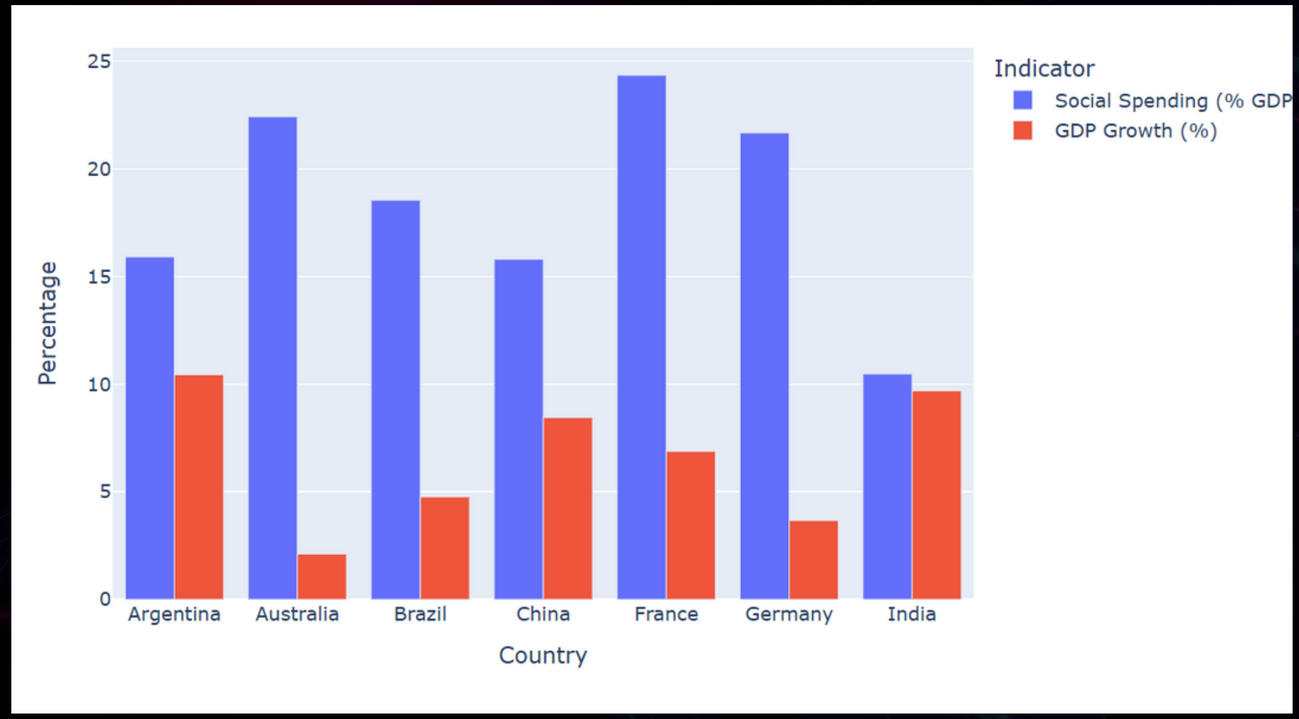
Results:
Optimal Number of Clusters: 3 clusters (determined by the Elbow Method).
Cluster Characteristics: Countries are grouped into 3 distinct clusters based on GDP growth, public debt, and trade balance.

Interpretation: The clustering reveals that countries with similar economic profiles (based on debt, trade balance, and GDP growth) tend to exhibit similar economic behaviors, which can provide insights into investment trends and policy implications



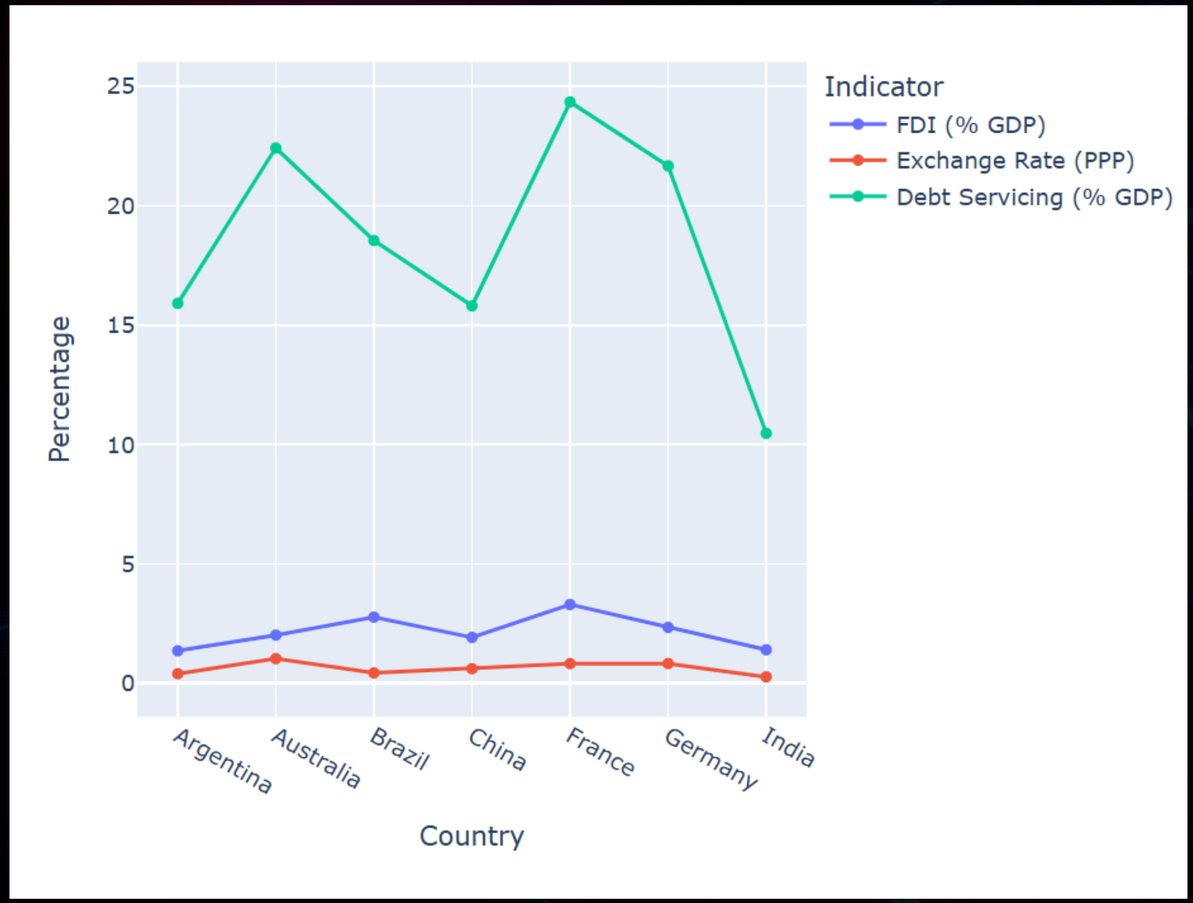
SOCIAL SPENDING AND ECONOMIC STABILITY

- The analysis explores whether higher social spending leads to better economic stability.
- The bar chart shows that countries with high social spending still display varied GDP growth, indicating mixed stability.
- An F-Test compared variances in social spending and GDP growth to assess predictability.
- Argentina stood out with 10.44% GDP growth and 15.92% social spending, likely driven by post-COVID recovery.
- Conclusion: High social spending doesn't guarantee stable economic growth other factors play a key role.



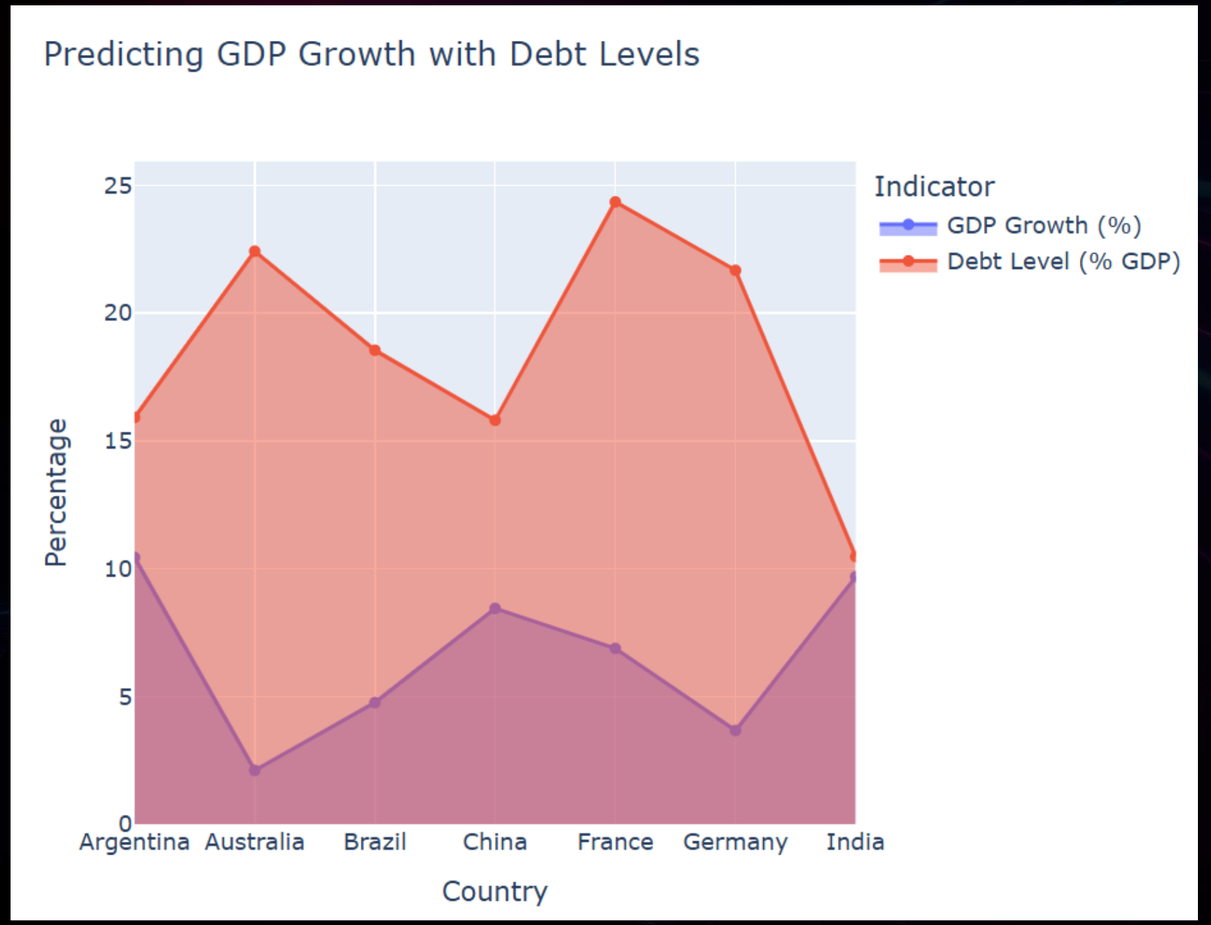
DEBT SERVICING, EXCHANGE RATES, AND FDI

- The objective is to understand how debt servicing costs and exchange rates affect investment inflows.
- A descriptive analysis was conducted by comparing FDI inflows, exchange rates (PPP), and debt servicing (via government expenditure) across countries.
- Using the Elbow Method, 3 optimal clusters were identified based on GDP growth, public debt, and trade balance.
- These clusters reveal that countries with similar economic profiles tend to show similar investment behaviors.
- Insight: Grouping by debt, trade, and growth can inform investment trends and support targeted policy decisions.



CLUSTERING OF COUNTRIES BASED ON ECONOMIC INDICATORS

- The key question is whether GDP growth can be predicted based on debt levels.
- The area chart shows a possible correlation between government debt (as % of GDP) and GDP growth.
- A correlation analysis was conducted to explore this relationship, forming a basis for future ANN-based prediction models.
- India's high growth (9.69%) with moderate debt (17.95%) contrasts with France's lower growth (6.88%) and higher debt (24.35%).
- Insight: These contrasts highlight varying fiscal strategies and support the potential for predictive modeling using debt metrics.



DISCUSSION

Trade Balance Drives FDI

External Balance on Goods and Services was the top FDI predictor (Random Forest $R^2 = 0.62$); emerging economies with stable trade and strong tax revenue attracted more FDI.

Debt Profiles Affect GDP Growth

Countries with low external debt showed significantly more stable GDP growth ($p = 0.0023$) compared to high-debt nations.

Public Debt & Inflation Hurt Growth

Regression analysis showed negative impacts of public debt (-0.118) and inflation (-0.0342) on GDP per capita growth; trade balance was not statistically significant.

Social Spending & Exchange Rates Add Nuance

High social spending alone doesn't ensure stability; exchange rates and debt servicing shape FDI differently across country strategies (e.g., India vs France).

Thank You