

HUMAN DEVELOPMENT INDEX

SCHADRACK, RAFAEL, LOÏC

WHAT IS THE HUMAN DEVELOPMENT INDEX (HDI)?

HDI measures human development of a country across these three key areas:



Health

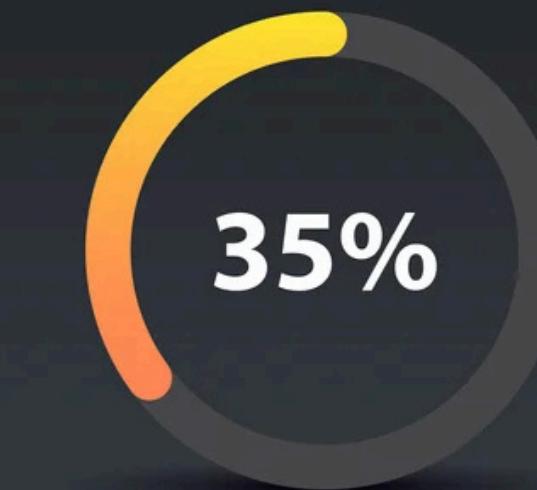
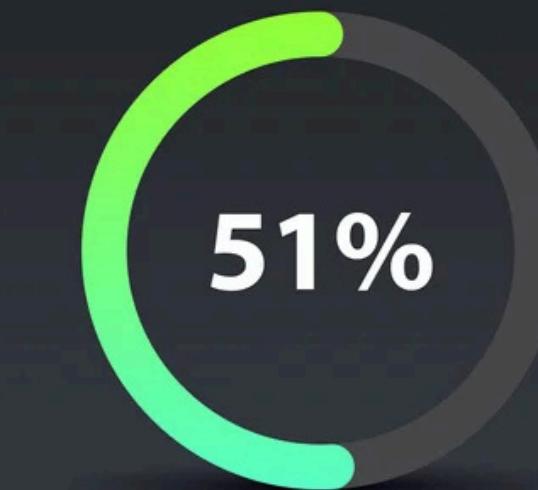
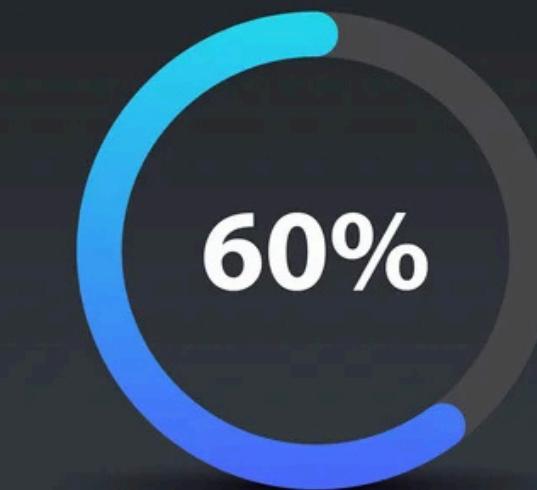
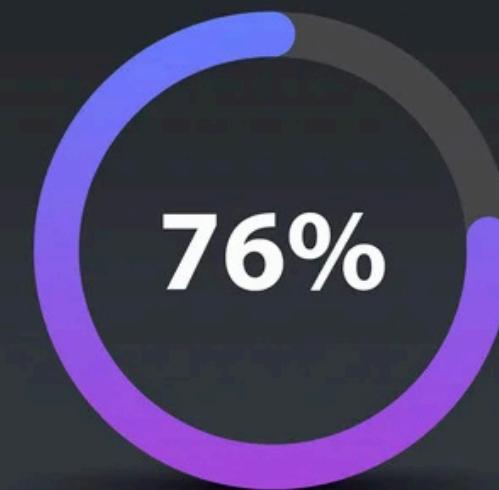
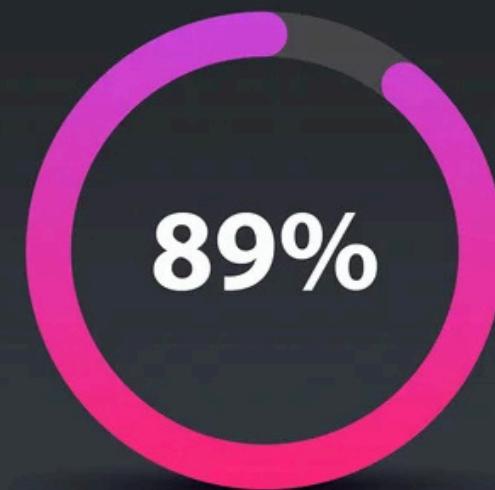
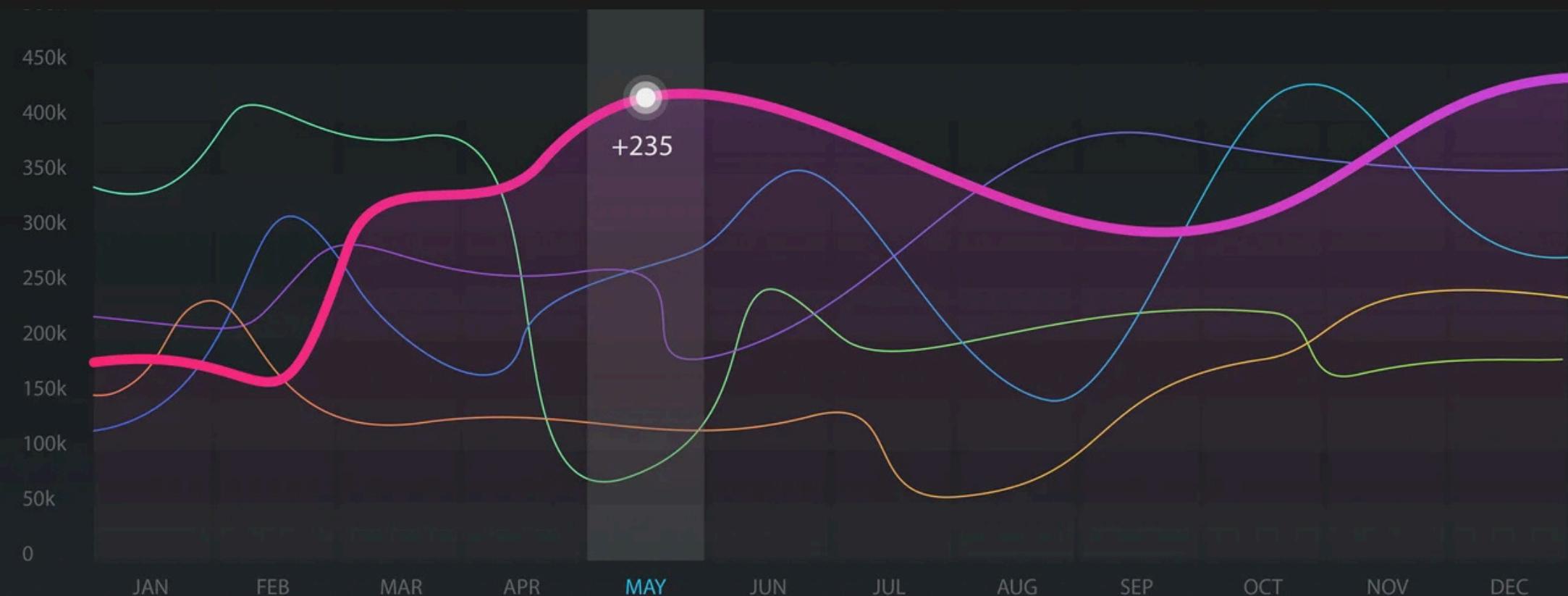
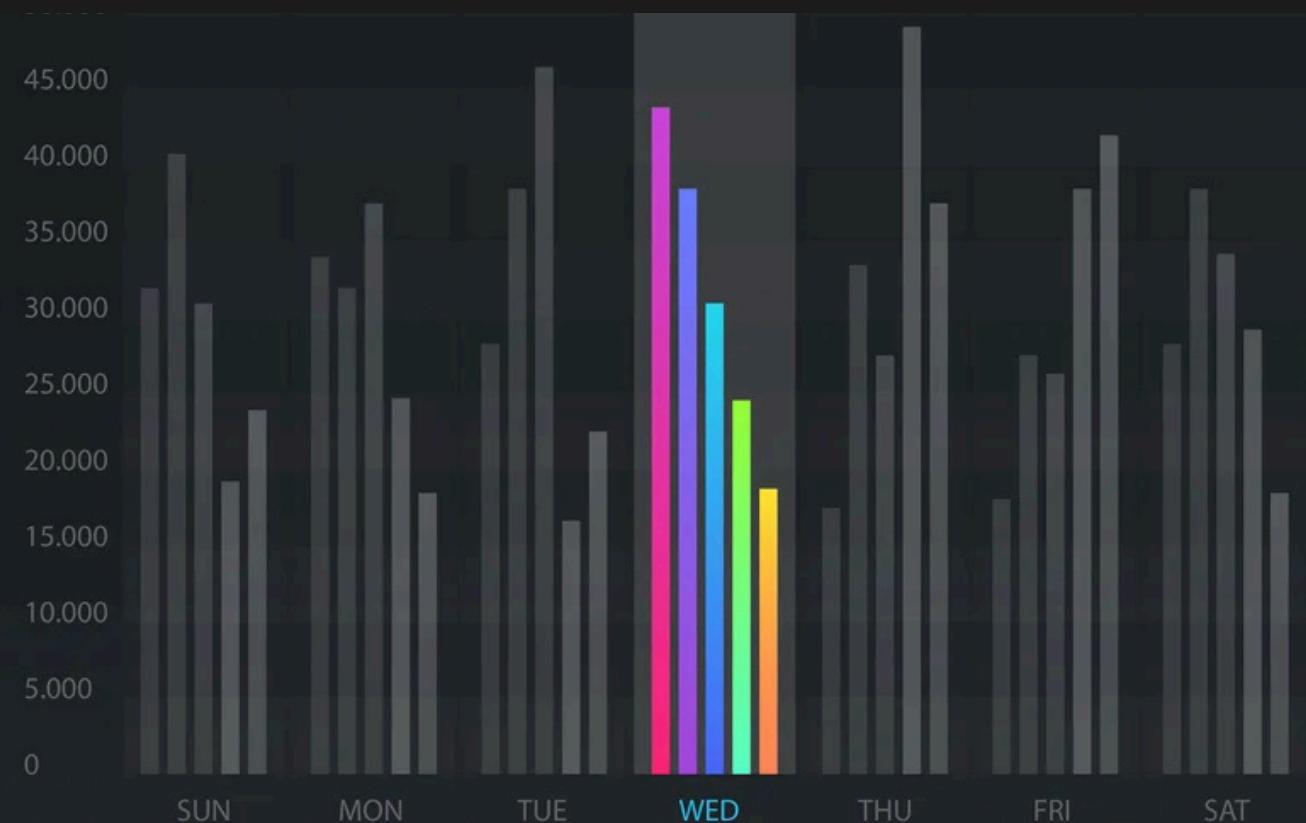


Education



Standard of Living

DATA OVERVIEW



HDI DATA OVERVIEW

SIZE

7000 rows and 35 columns

FACTORS

Country name, HDI rank, population, GDP(Gross Income per Capita), life expectancy, secondary and pre-secondary education, mean school year, etc.....

DATE

1999 to 2022

MISSING VALUES

11 %

DEFINITIONS

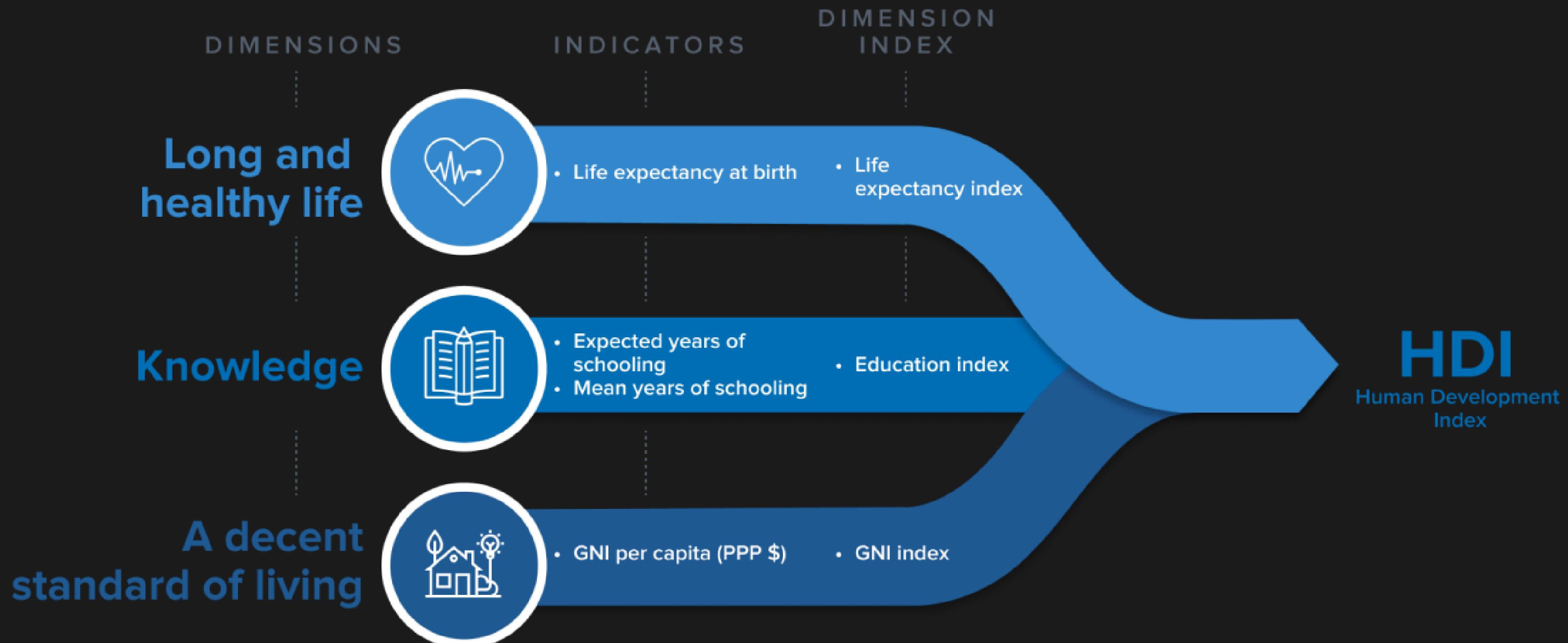


GROSS INCOME PER CAPITA

A measure of the average income earned per person in a given area, or country, during a specific year.

LIFE EXPECTANCY

The number of years a person can expect to live.



HDI DIMENSIONS AND INDICATORS

DATA PREPARATION



DEEPER OVERVIEW OF KEY FACTORS

Column	Min	Max	Mean
HDI	0.212	0.967	0.670
Life Expectancy	14.098	86.895	68.545
Gross Income Per Capita	415.683	~146K	~16K

INITIAL DATA CLEANING

1

Columns with most null
values are relatively
insignificant

2

Most 32/35 columns are
already numeric

3

Took Log of Gross Income
Per Capita

DEALING WITH NULLS

- Gender Inequality is not significant for models
- HDI and Gross Income Per Capita ARE important
 - non-gender related columns have low null counts

Column	Null Count
Gender Inequality	2087
hdi_f/m	1784
gender_development	1784
gross_inc_percap_f/m	1784

CREATING MODELS TO PREDICT HDI

- Model is highly accurate
- HDI was pre-engineered in the dataset
- Models "reverse engineer" HDI calculation
- Log(income) reduces income disparities impact

- **LE** : Life expectancy at birth
- **MYS** :Mean years of schooling
- **EYS** : Expected years of schooling
- **GNIpc** : Gross national income per capita

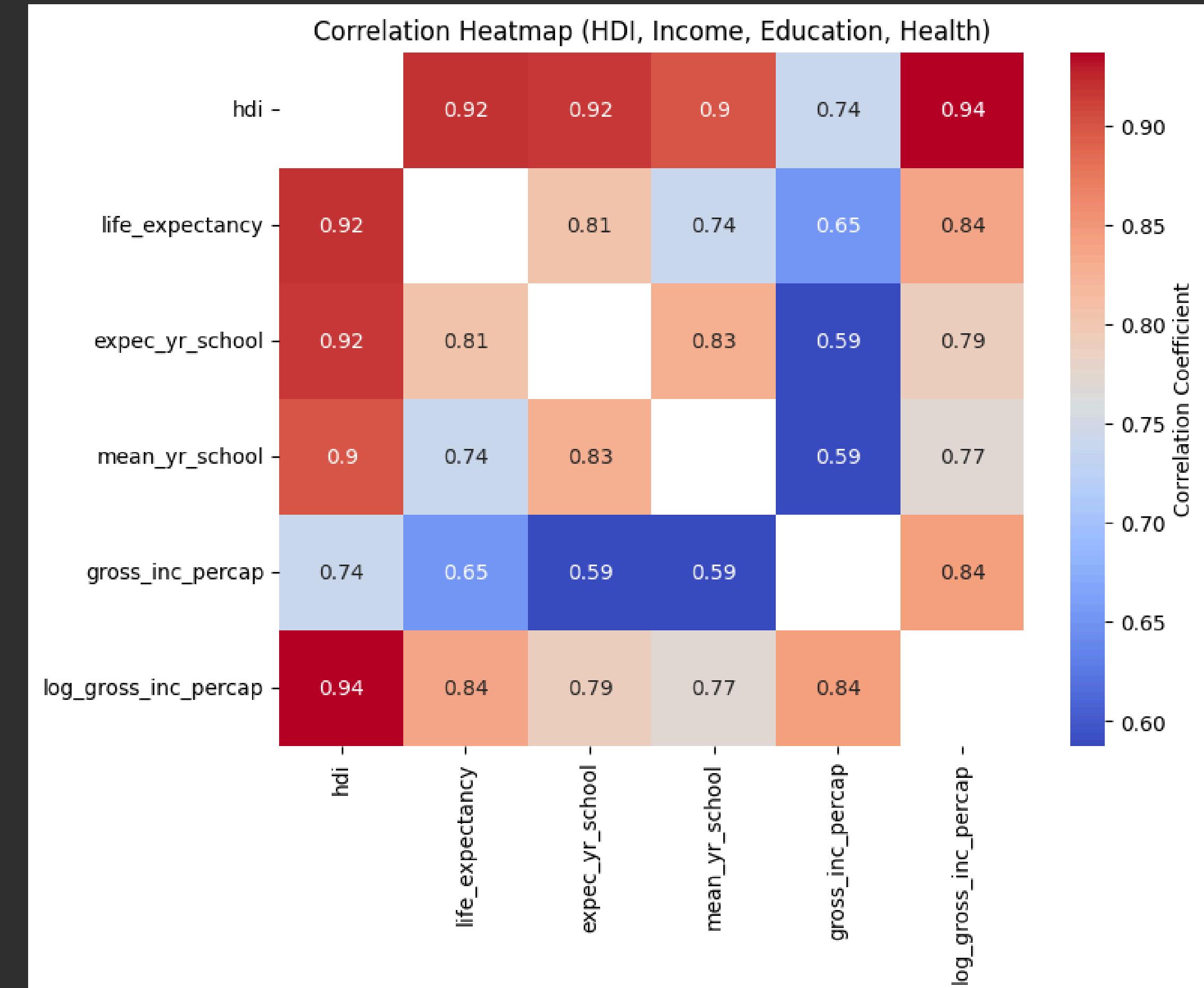
$$\text{Development Index} = \sqrt[3]{\text{Life Expectancy Index} * \text{Education Index} * \text{Income Index}}$$

$$\text{Life Expectancy Index} = \frac{\text{LE} - 20}{85 - 20}$$

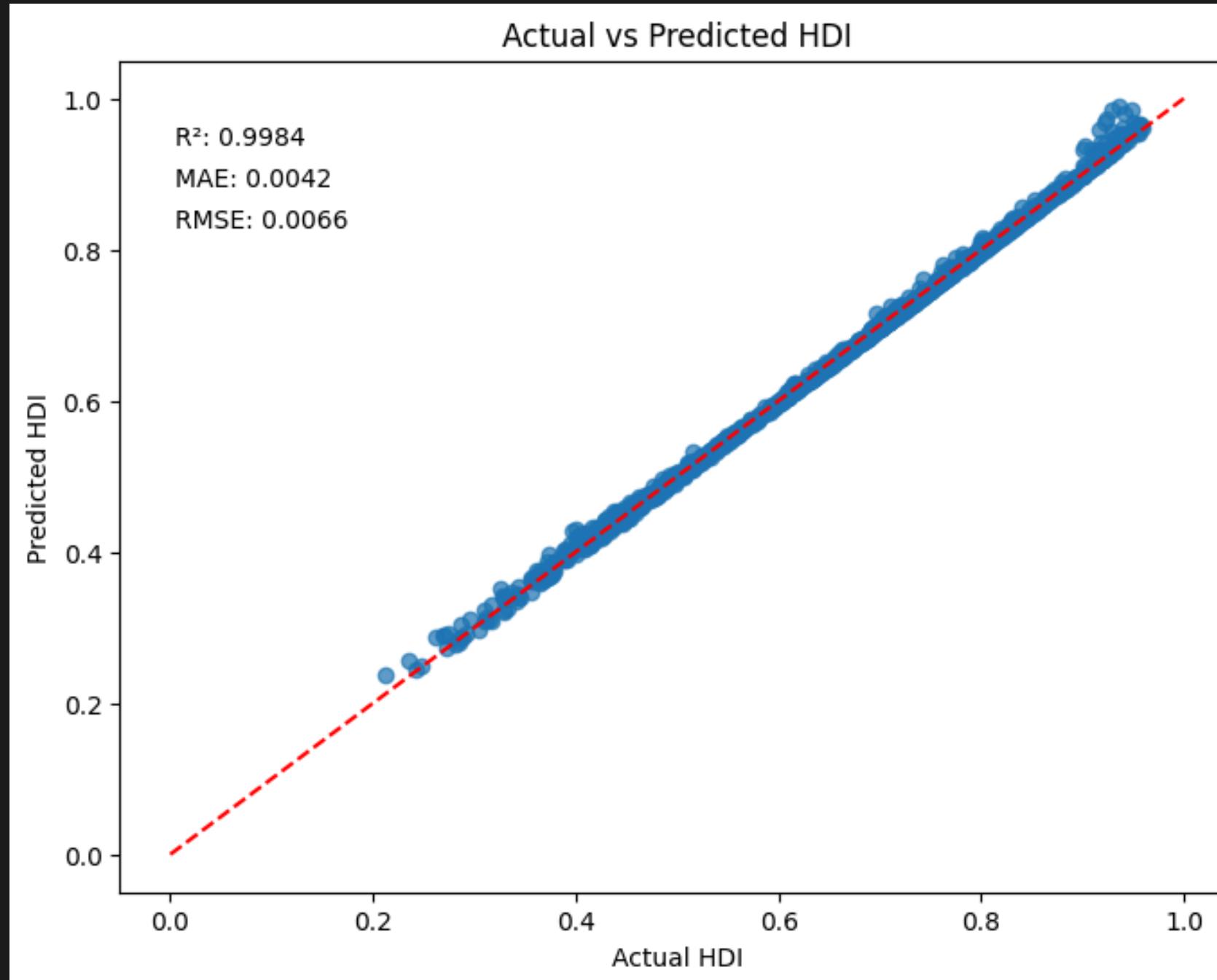
$$\text{Education Index} = \frac{\text{MYSI} + \text{EYSI}}{2}$$

$$\text{Income Index} = \frac{\ln(\text{GNIpc}) - \ln(100)}{\ln(20,000) - \ln(100)}$$

MOST IMPORTANT FEATURES



LINEAR REGRESSION MODEL- PREDICTING HDI

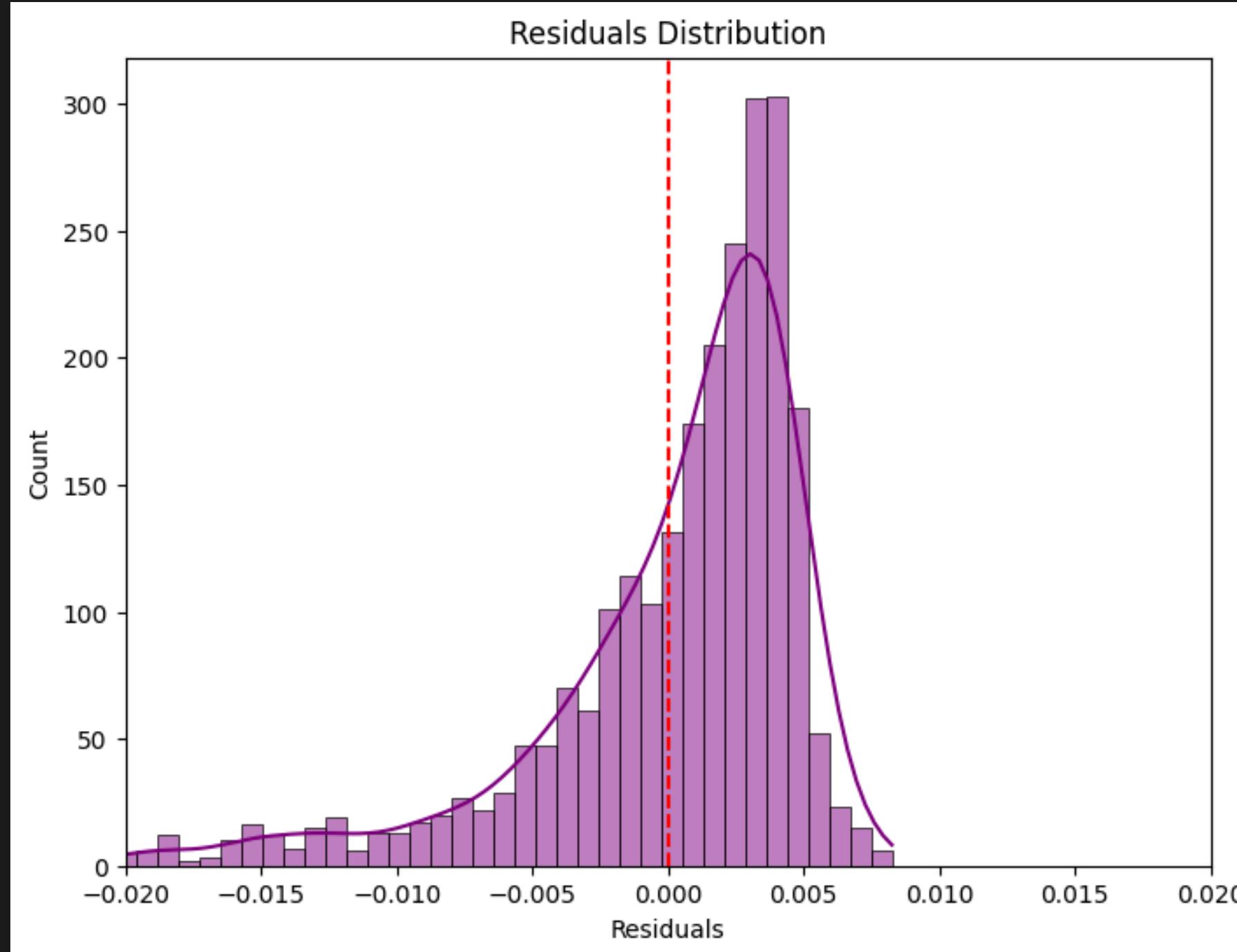


Model Performance

- R² : 0.9984
- Mean Absolute Error (MAE): 0.0042
- Root Mean Squared Error(RMSE): 0.0066

Our model accurately predicts HDI from life expectancy, education, and income – aligning closely with actual HDI values.

RESIDUALS DISTRIBUTION



Accuracy Check

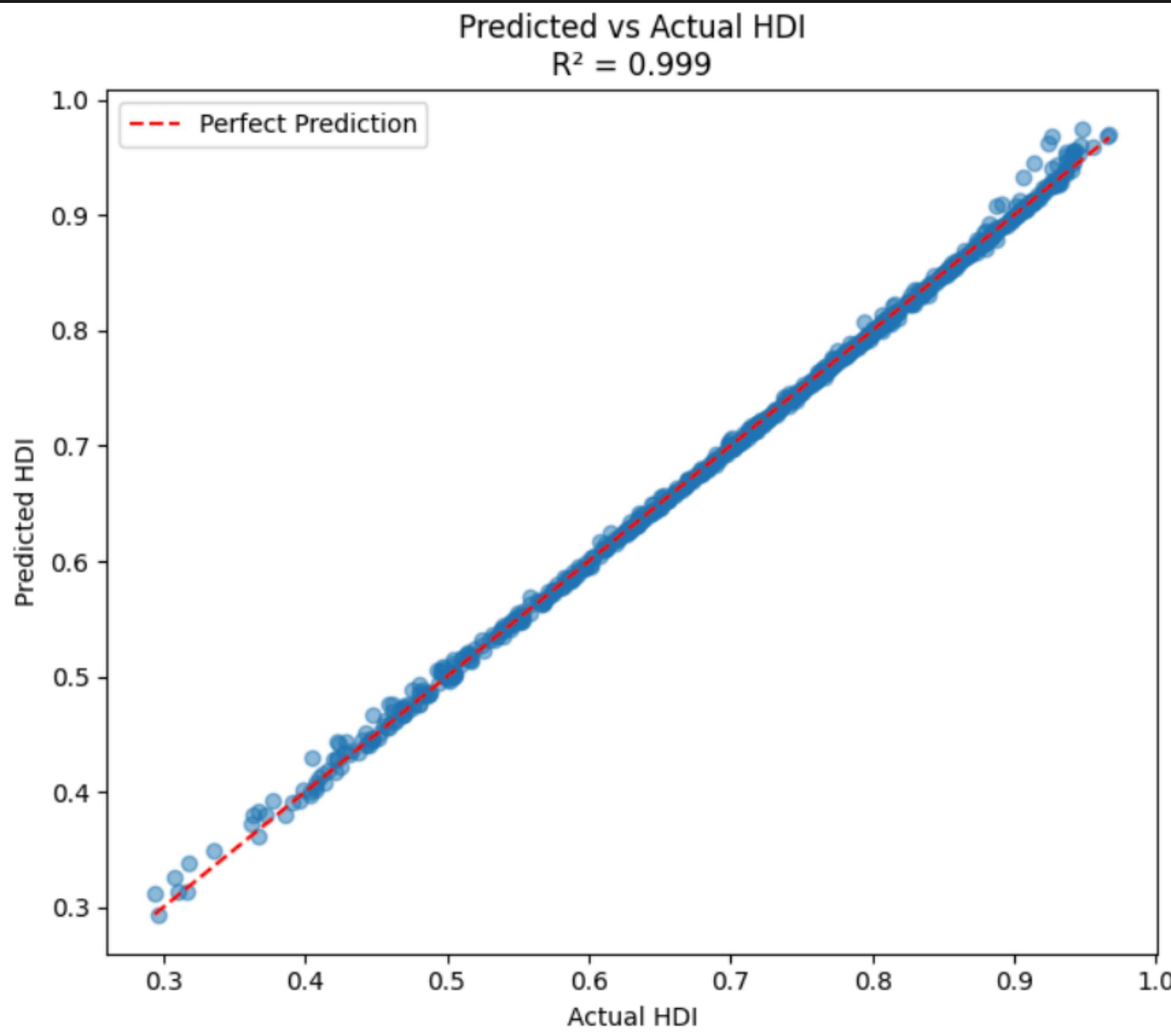
- $\text{Residuals} = \text{Actual HDI} - \text{Predicted HDI}$
- Most residuals around 0 → High accuracy.
- Slight right skew → Underestimation for some.

COEFFICIENT FEATURE CONTRIBUTION TO HDI

- Income is the strongest driver of HDI.
- Education is also a major factor.
- Health matters but has a smaller contribution.

Coefficient Per Unit	HDI Increase
Log(Gross Income Per Cap)	0.048027
Mean Year of school	0.012869
Expected Year of School	0.010965
Life Expectancy	0.004706

Predicted vs Actual HDI
 $R^2 = 0.999$



- $R^2 = 0.9999$
- Mean Absolute Error: 0.017
- Root Mean Squared Error: 0.022

WORLD HAPPINESS DATA OVERVIEW

SIZE

156 rows and 9 columns

FACTORS

Overall rank, Country or region, Score, GDP per capita, Social support, Generosity, Perceptions of corruption, etc.....

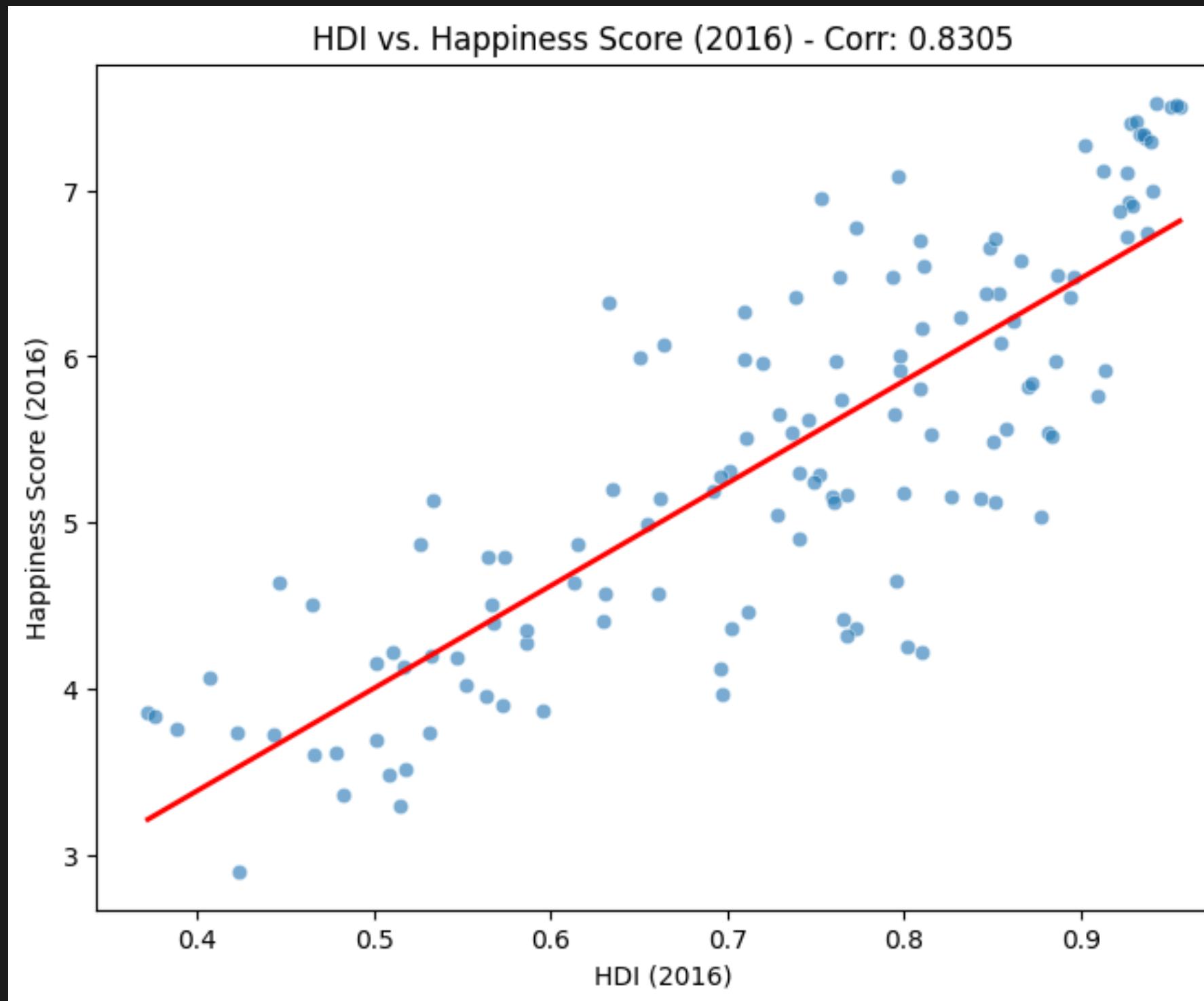
DATE

2015 to 2019

MISSING VALUES

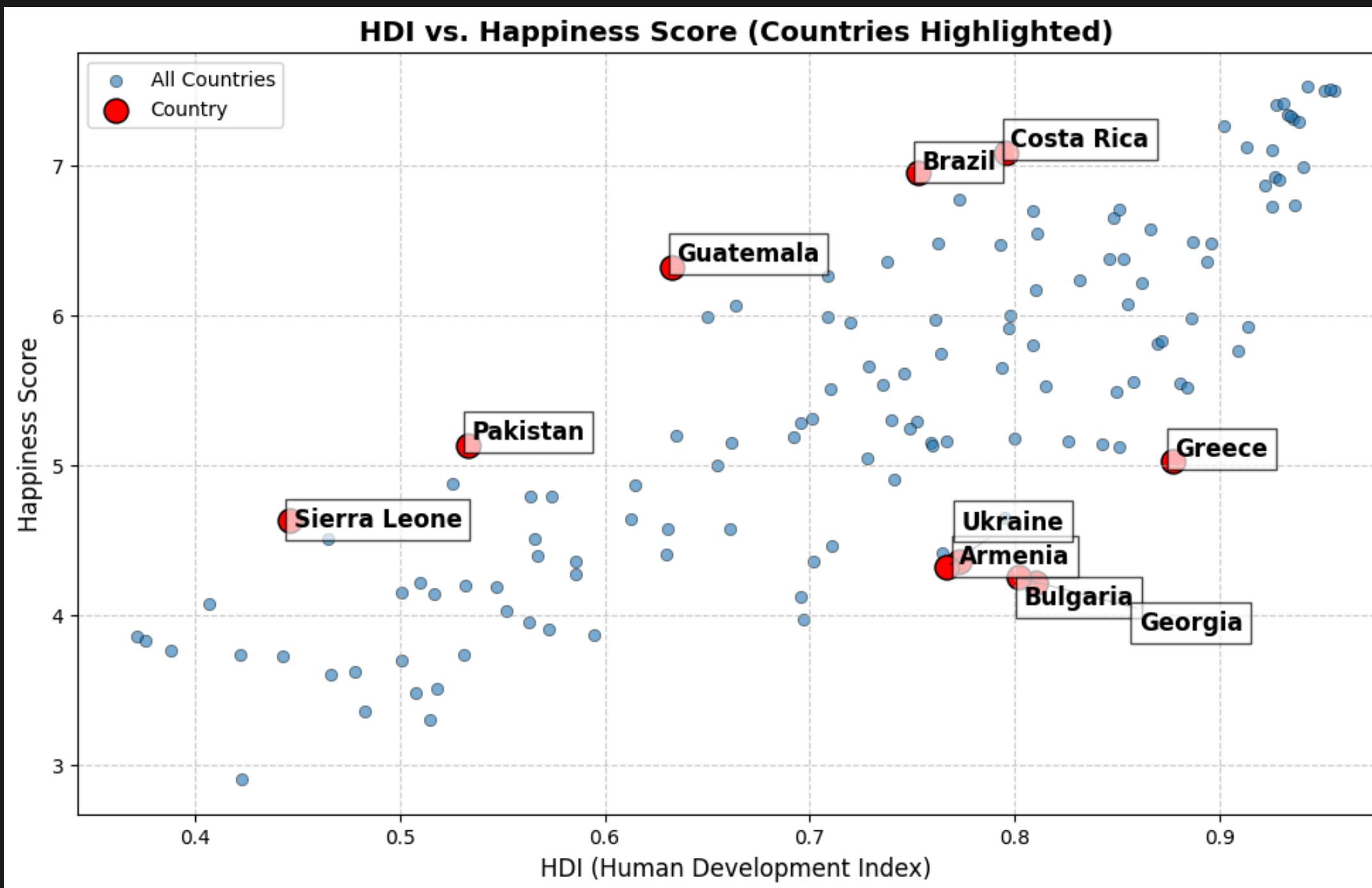
0 %

HDI VS. HAPPINESS SCORE (2016)



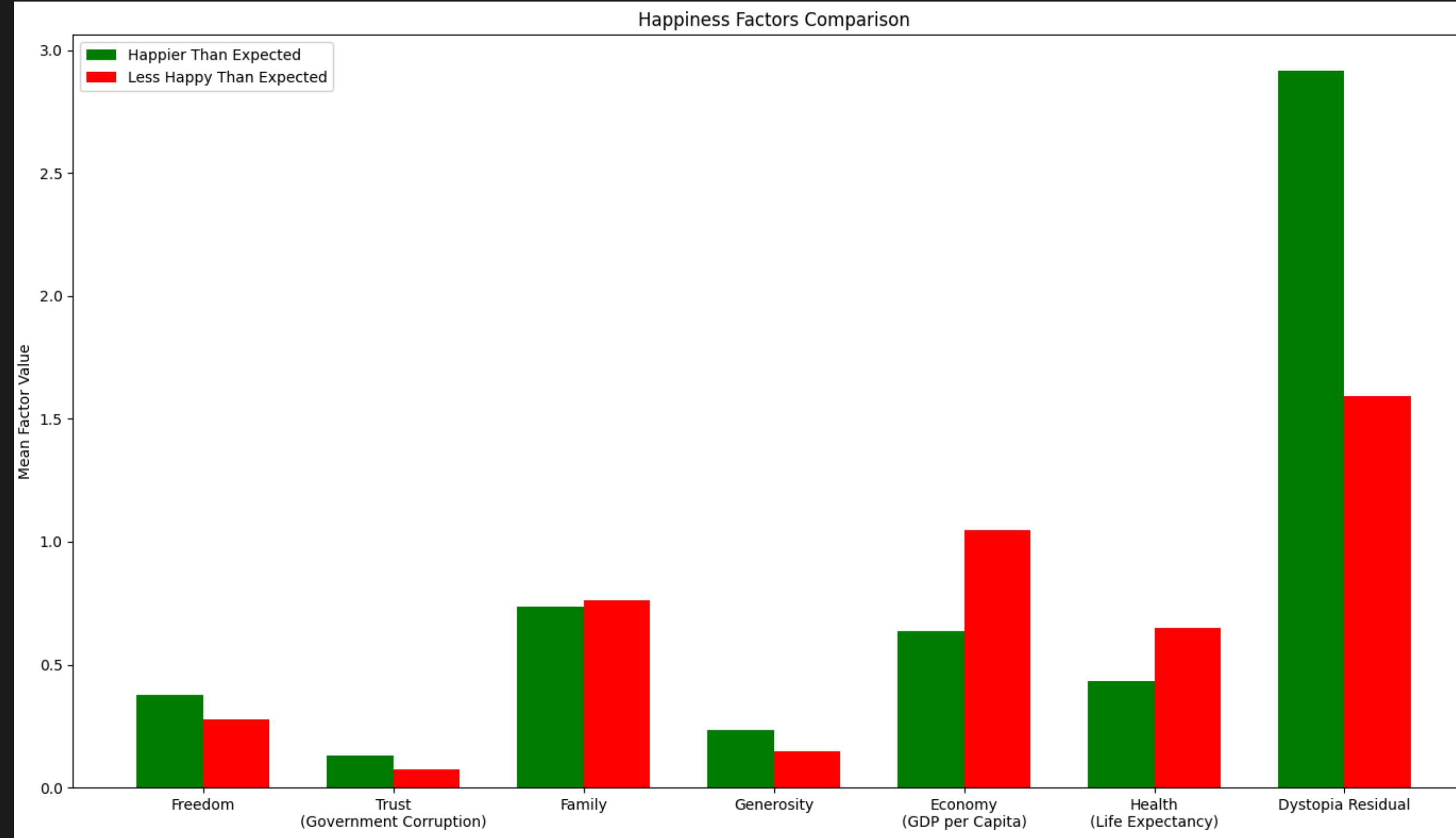
- Strong positive correlation (0.83).
- Higher HDI → Generally higher happiness.
- Some don't follow the trend.
- Happiness depends on more than HDI.
 - freedom, social support, and governance
 - Trust

COUNTRIES THAT DEVIATE FROM THE TREND

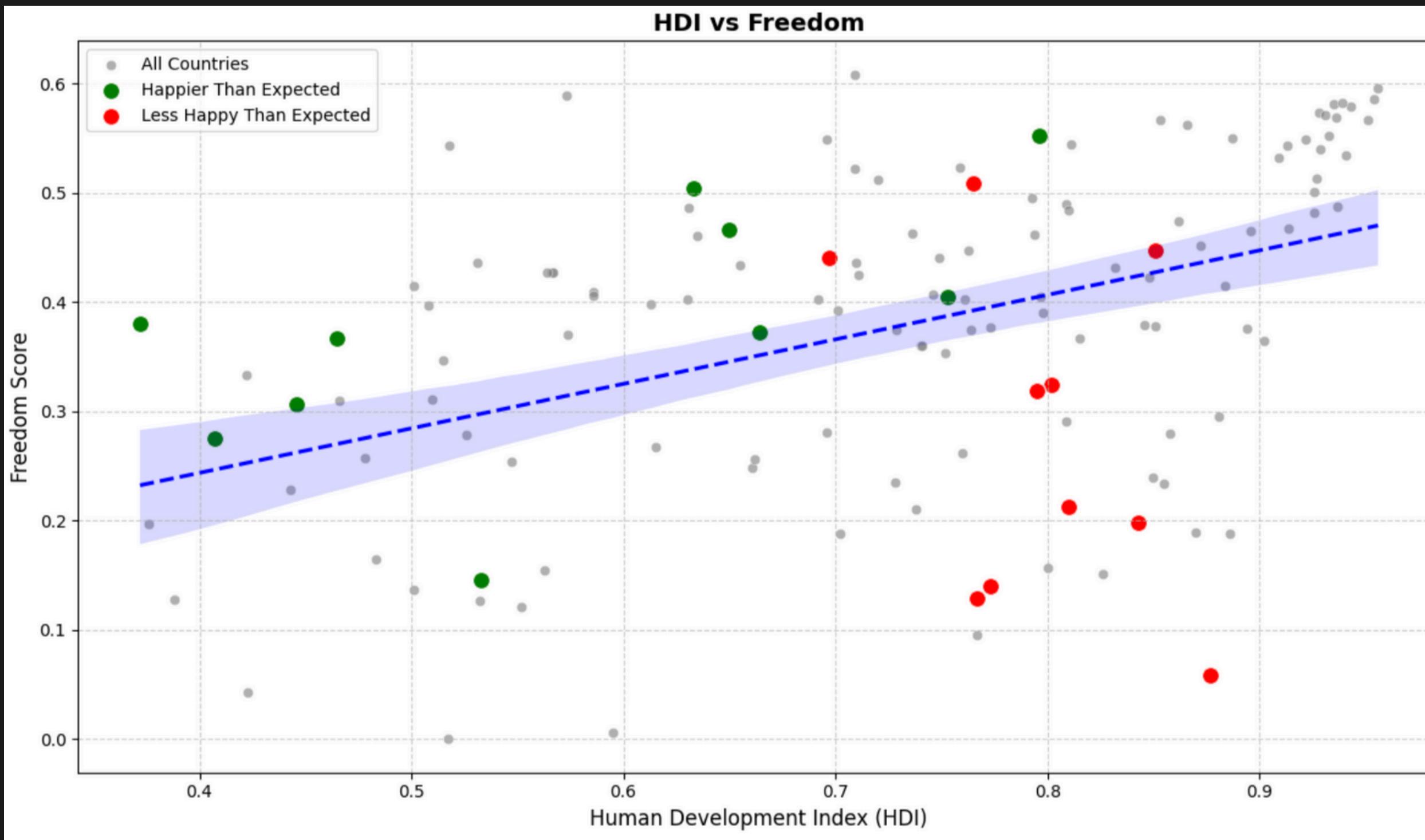


- Happier Than Expected:
 - Costa Rica, etc.
 - HDI 7.2 and Rank : 66
 - Happiness Rank : 14
- Less Happy Than Expected:
 - Ukraine, Greece, Georgia, etc.
- Possible factors:
 - Freedom, governance quality, cultural influences, economic disparity, and social trust.

FACTORS THAT CONTRIBUTE TO THESE DEVIATIONS

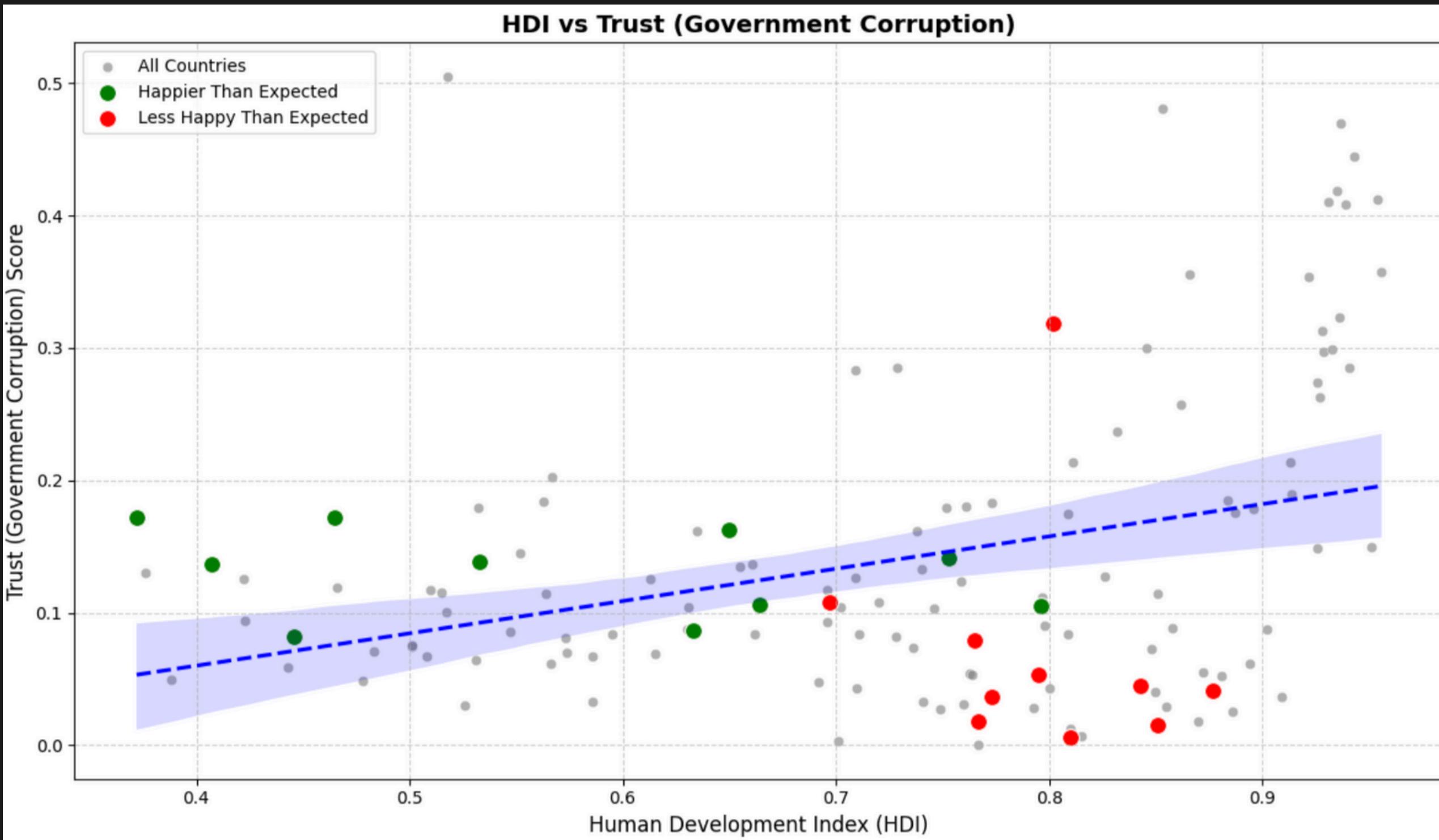


HDI AND FREEDOM SCORE



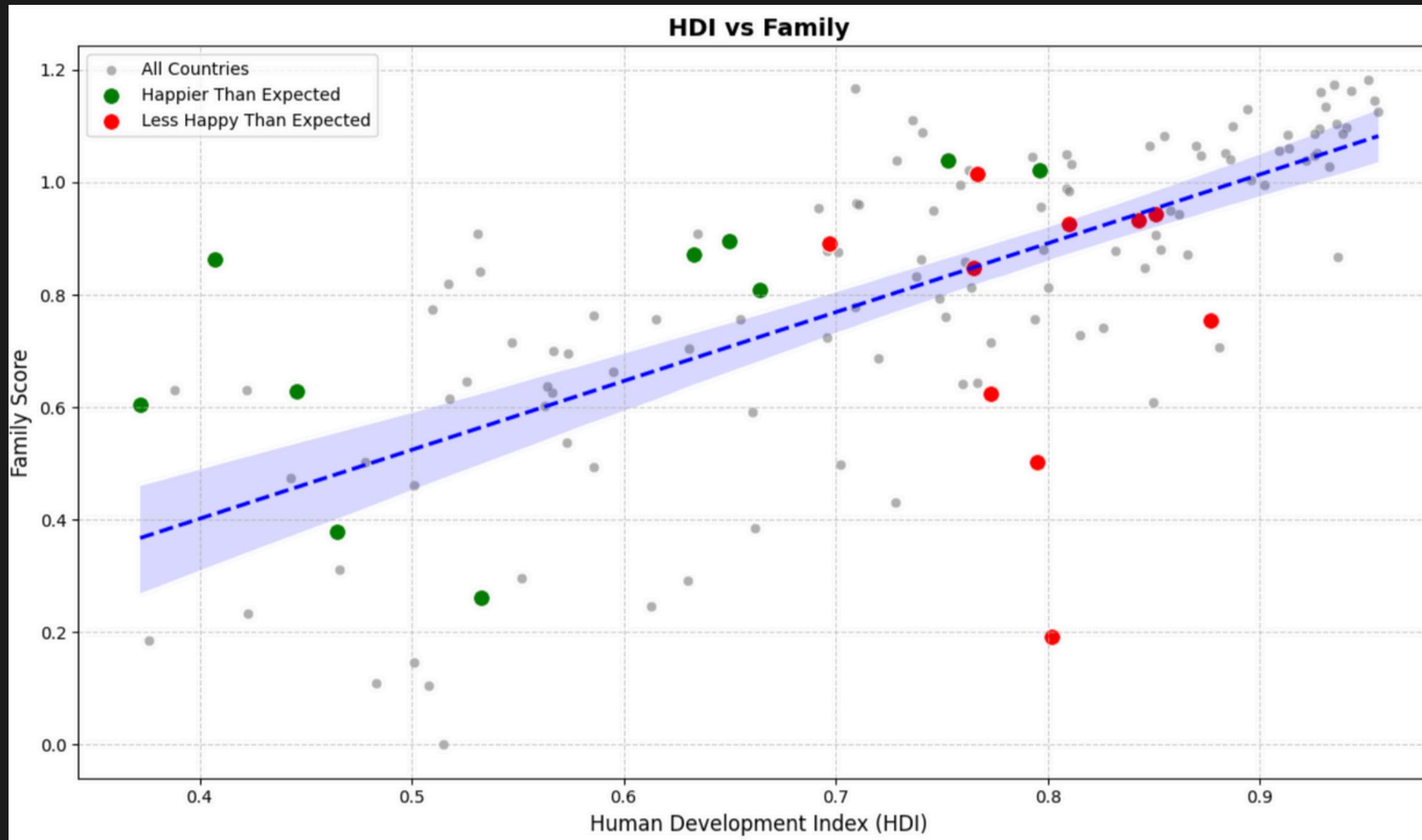
Freedom generally increases with HDI, but significant positive or negative deviations correlate with happiness levels

HDI AND TRUST



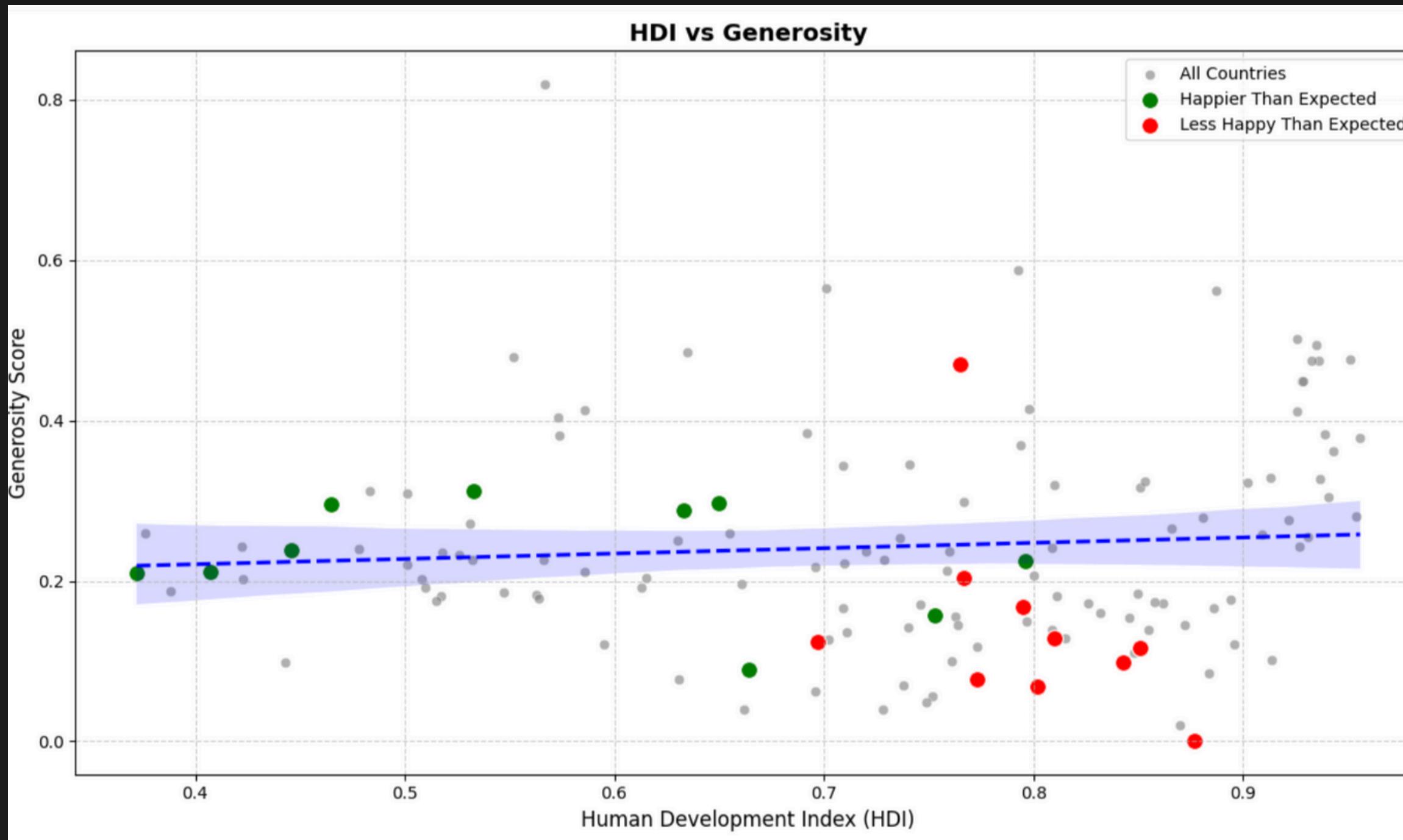
The gap between predicted and actual trust values grows larger at higher HDI levels

HDI AND FAMILY



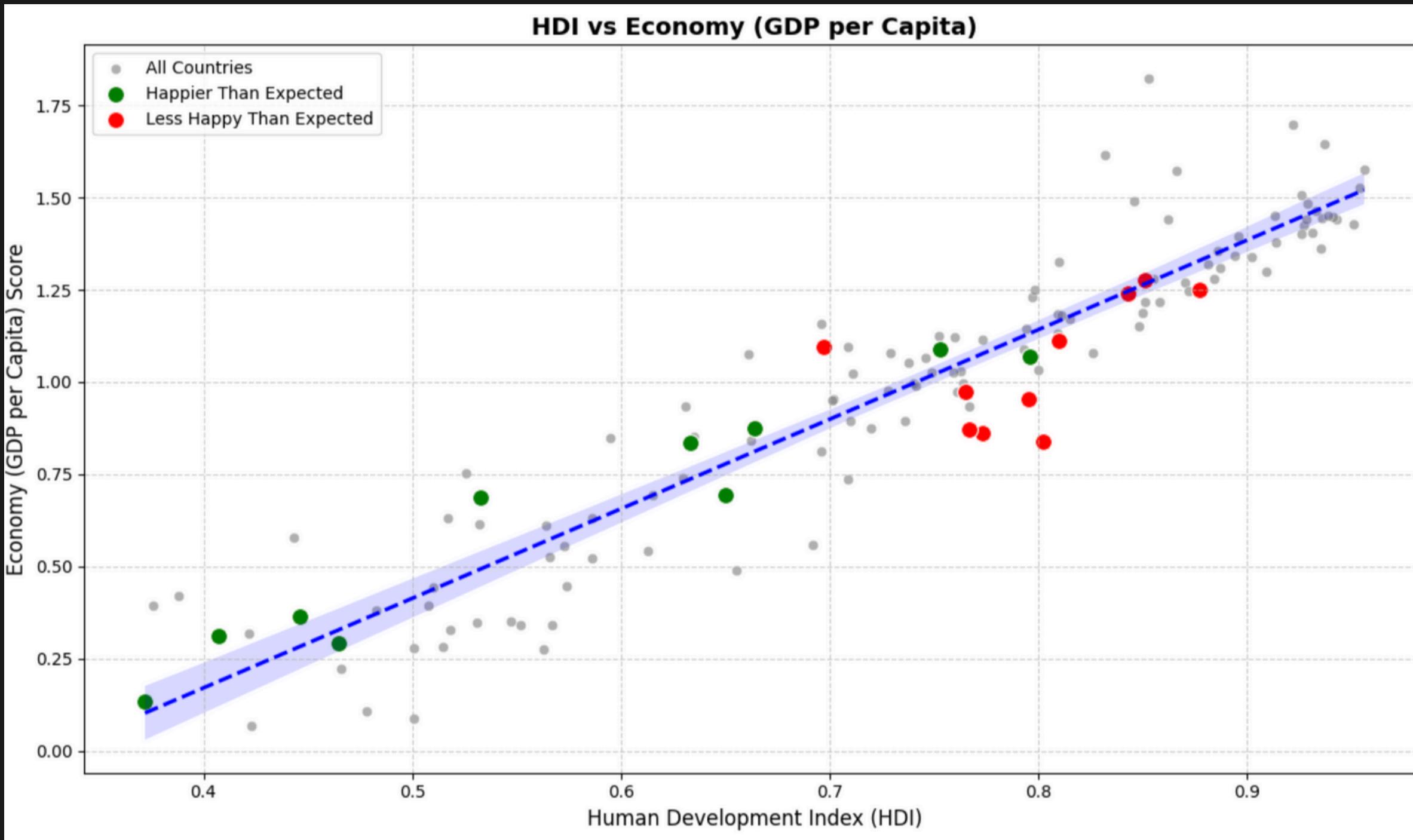
A few outliers in both groups show unusually low family scores relative to their HDI

HDI AND GENEROSITY



Less happy countries cluster
below the trend line, especially
at higher HDI levels

HDI AND ECONOMY



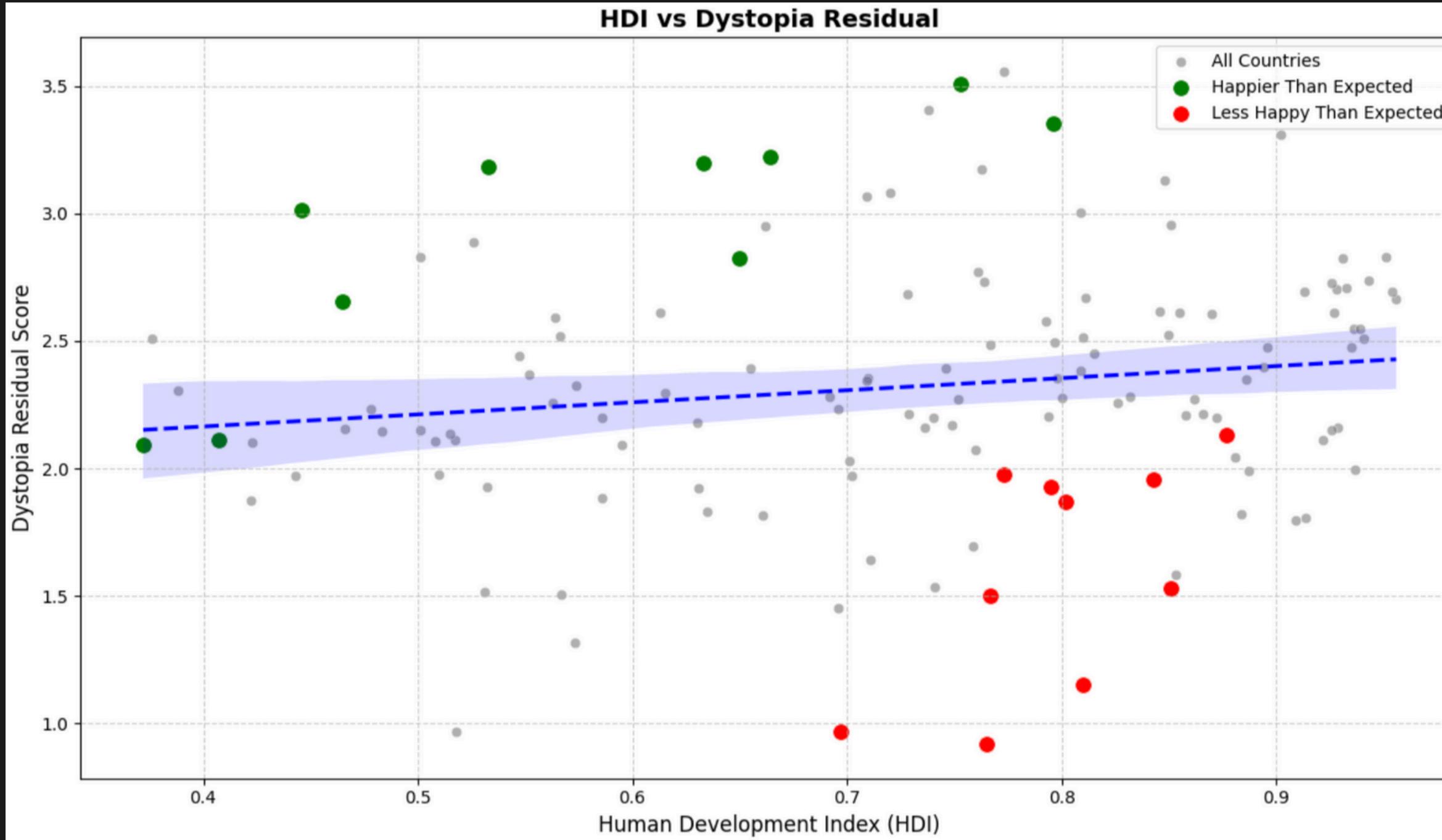
Smallest factor difference
between groups at similar HDI
levels

HDI AND HEALTH



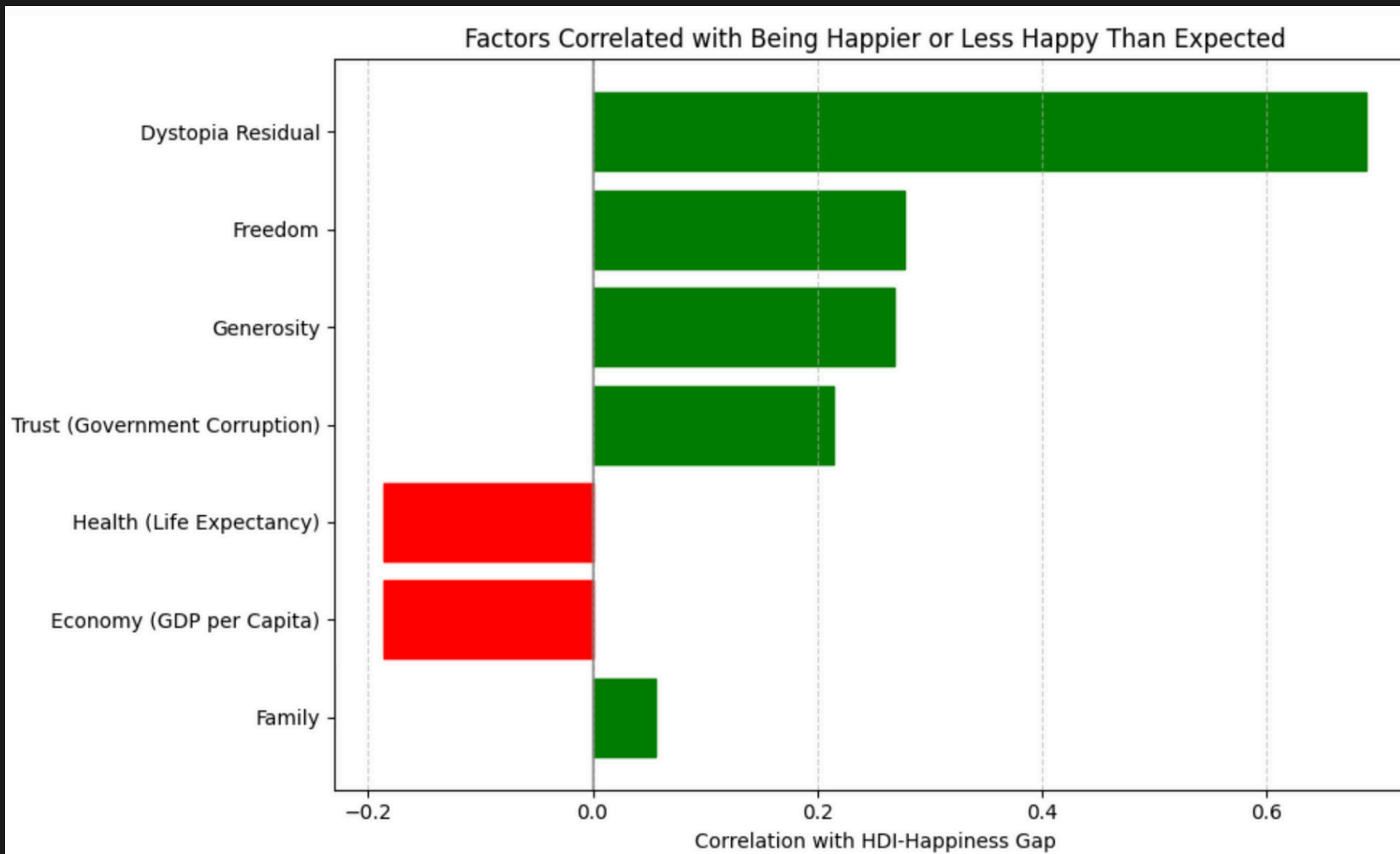
Health appears to be determined more by development level than other cultural/social factors

HDI AND DYSTOPIA RESIDUAL



Largest and most consistent separation between the two groups of any factor

HOW THIS PLAYS INTO DEVIATIONS



CONCLUSION

Key Takeaways

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- Income is important for HDI, but not everything.
 - Social factors matter more than economic ones
 - Education and health drive long-term HDI growth.
 - High-income countries → Small errors, big impact near HDI max.
 - Low-income countries → Fast progress can outpace income.
 - Policy Focus → Combine income growth with education & health.