

## Cluster Analysis Summary

In this analysis, I examined long-term development patterns across countries using GDP per capita and life expectancy data recorded over multiple years. The dataset was reshaped into a wide format so that each row represents one country with yearly indicators as features. Since the variables differ in scale, the data was standardized before applying clustering.

Using K-Means, I grouped the countries into six clusters, which provided a clear and interpretable structure based on their economic and health development trends.

## Cluster Characteristics

Cluster	General Pattern	Description	Example Countries
C1	Very low baseline	Low GDP and life expectancy with slow improvement.	Afghanistan, Niger, Sierra Leone
C2	Early developing stage	Gradual improvement in health, moderate economic growth	Kenya, Zambia, Bangladesh
C3	Emerging growth phase	Noticeable upward trend in both indicators.	India, Indonesia, Egypt
C4	Middle-income stable growth	Balanced growth with moderate stability	Brazil, Mexico, Turkey
C5	High level, slower growth	Already high indicators; growth has plateaued	Japan, Italy, Spain
C6	Sustained high development	Consistently high GDP and life expectancy	United States, Germany, Switzerland

## MDS (2-D Projection) Interpretation

The MDS projection visualizes the similarity between countries. The clusters form a developmental gradient:

- C6 countries are tightly grouped, reflecting very similar high-development profiles.
  - C1 and C2 are positioned far from the others, showing clear developmental separation.
  - C3 → C4 → C5 → C6 follows a progressive, continuous improvement trend.

This suggests that development generally occurs incrementally rather than in sudden jumps.

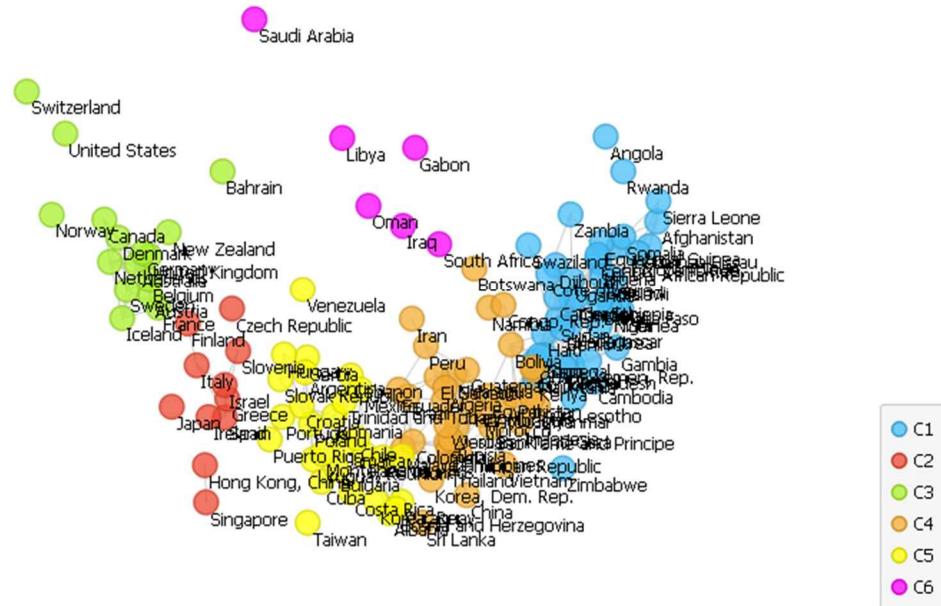


Figure 1. MDS Projection of Countries Based on GDP per Capita and Life Expectancy

## Cross-Continental Similarities

Interestingly, several countries from different continents appear close together in the MDS map:

- Chile (South America) and Portugal (Europe) share similar growth trajectories.
- South Korea clusters closer to Western European countries rather than other Asian developing nations.

This indicates that policy choices, industrialization timing, and social welfare systems can be more influential than geographic proximity in shaping development.

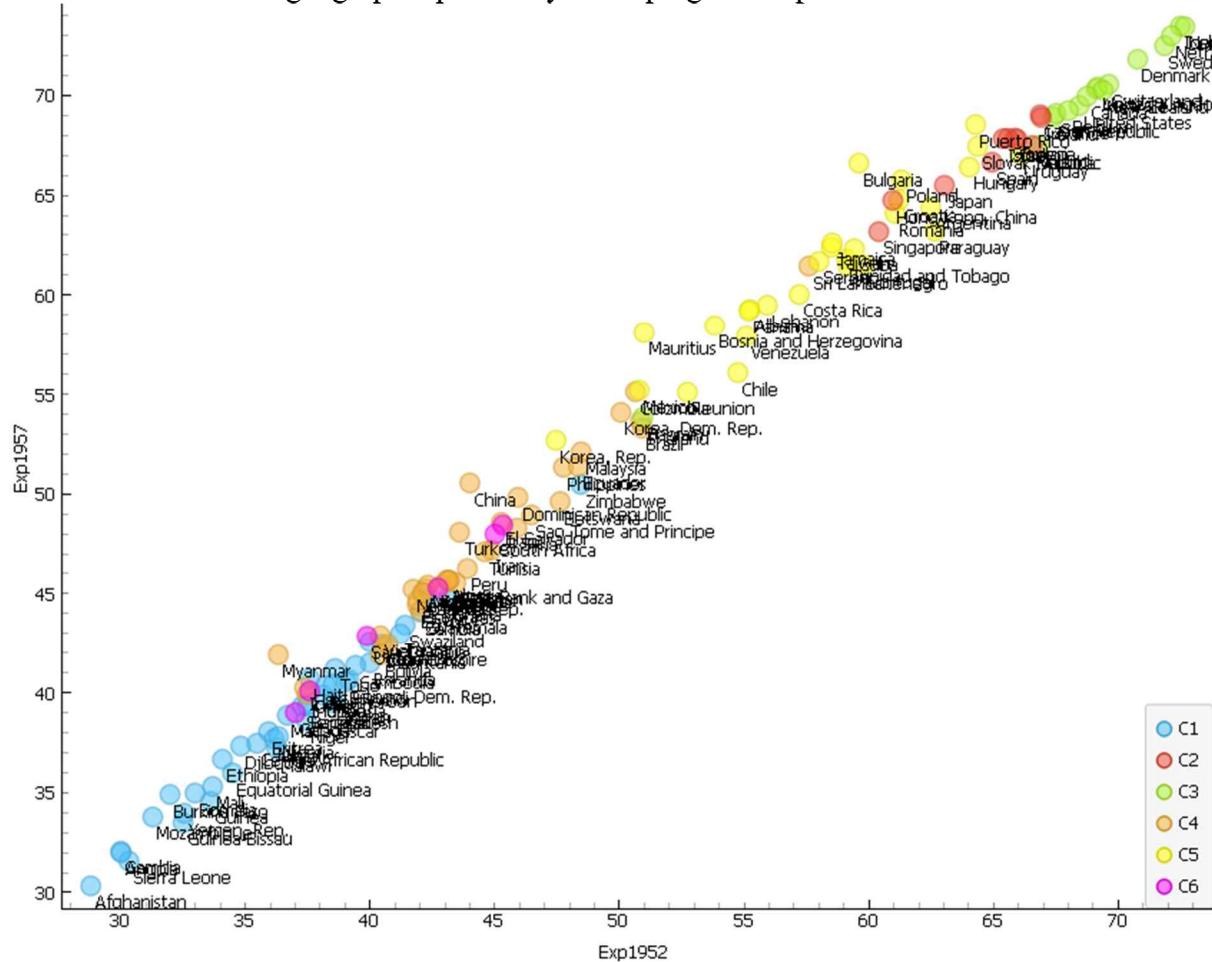


Figure 2. Connected Scatter Plot Showing Development Trajectories of Clusters

## Outliers

Some countries show distinctive patterns:

- Saudi Arabia: High GDP due to resource wealth, but life expectancy improvements are slower.
- Cuba: Achieves relatively high life expectancy despite lower economic output.

These examples show that economic wealth does not directly translate into health outcomes, and national priorities and systems matter significantly.

## Conclusion

The clustering and MDS visualization reveal a clear, structured pathway of national development. Countries tend to progress along a gradual continuum rather than at random. At the same time, unique historical and policy factors can create exceptions, showing that development is shaped not just by income but by social and political choices.