GLOBAL FERTILITY DYNAMICS

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AGENDA

- Project Concept Overview
- Geographic and Cultural Mapping of Countries
- Analyzing Ten Key Features
- Evaluation of Predictive Models
- Summary and Key Insights

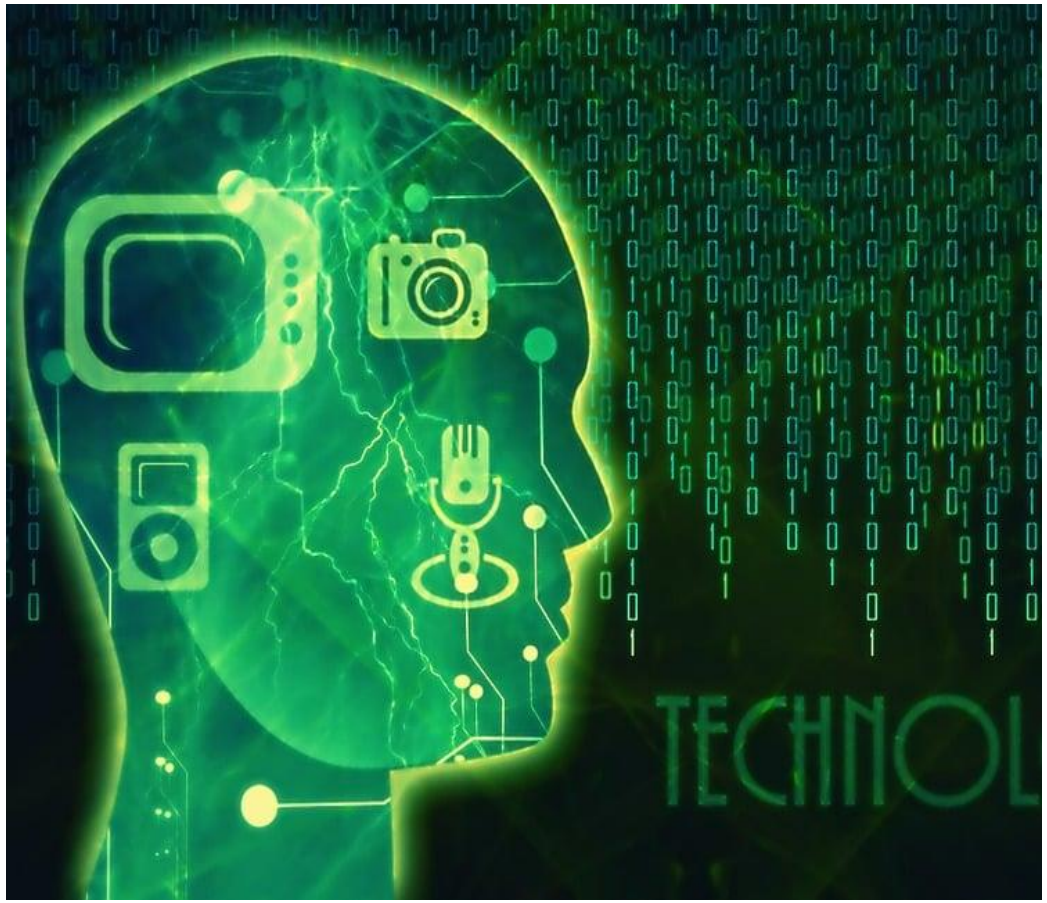
The global **Total Fertility Rate (TFR)** has seen a significant decline, dropping from nearly **5 children** per woman **70** years ago to **2.3 children** today.

This sharp decrease reflects profound changes in global demographic trends, and while it suggests progress in areas like family planning and economic development, it also introduces new uncertainties and challenges.

This project investigates the significant global decline in fertility rates over the past four decades, focusing on **two distinct groups of countries**.

- Top 10 Countries with the highest fertility rates.
- Top 10 Countries with the lowest fertility rates.

The goal is to explore the commonalities and differences between these groups and to analyze the relationship between fertility and factors such as economic sectors, demographics education, and health system.



PROJECT CONCEPT OVERVIEW

GEOGRAPHIC AND ECONOMIC OVERVIEW OF COUNTRIES WITH THE HIGHEST FERTILITY RATES

TOP 10 HIGHEST FERTILITY COUNTRIES – WESTERN AFRICA

- **Niger**
  - Population: 27.3 million (2024 estimate)
  - GDP per capita: $583
- **Mali**
  - Population: 24.2 million (2024 estimate)
  - GDP per capita: $805
- **Benin**
  - Population: 14 million (2024 estimate)
  - GDP per capita: $1,386
- **Guinea**
  - Population: 14.5 million (2024 estimate)
  - GDP per capita: $1,207

The primary Economy activity is agriculture, employs over 75% of population in these four countries.

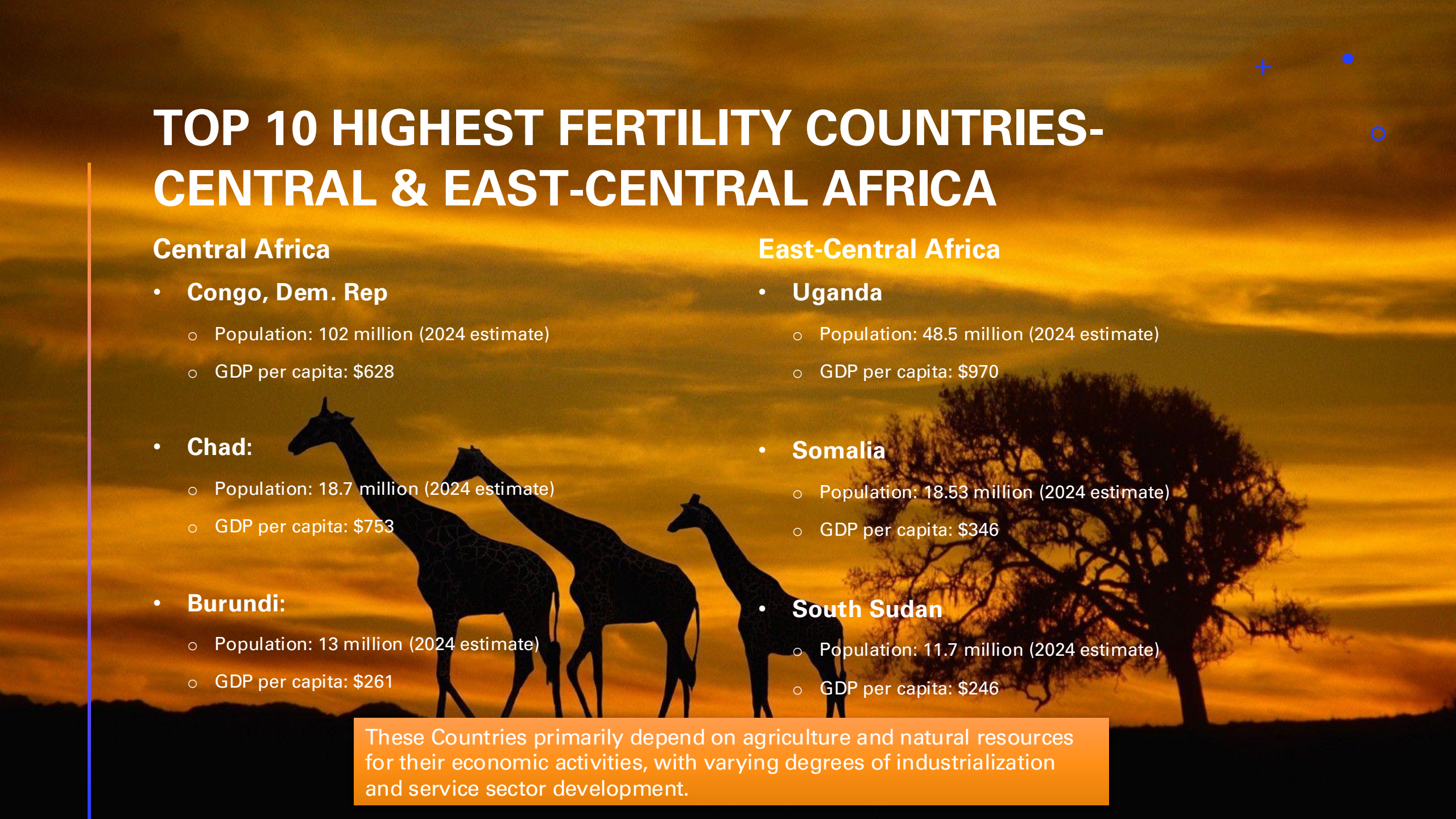
TOP 10 HIGHEST FERTILITY COUNTRIES- CENTRAL & EAST-CENTRAL AFRICA

Central Africa

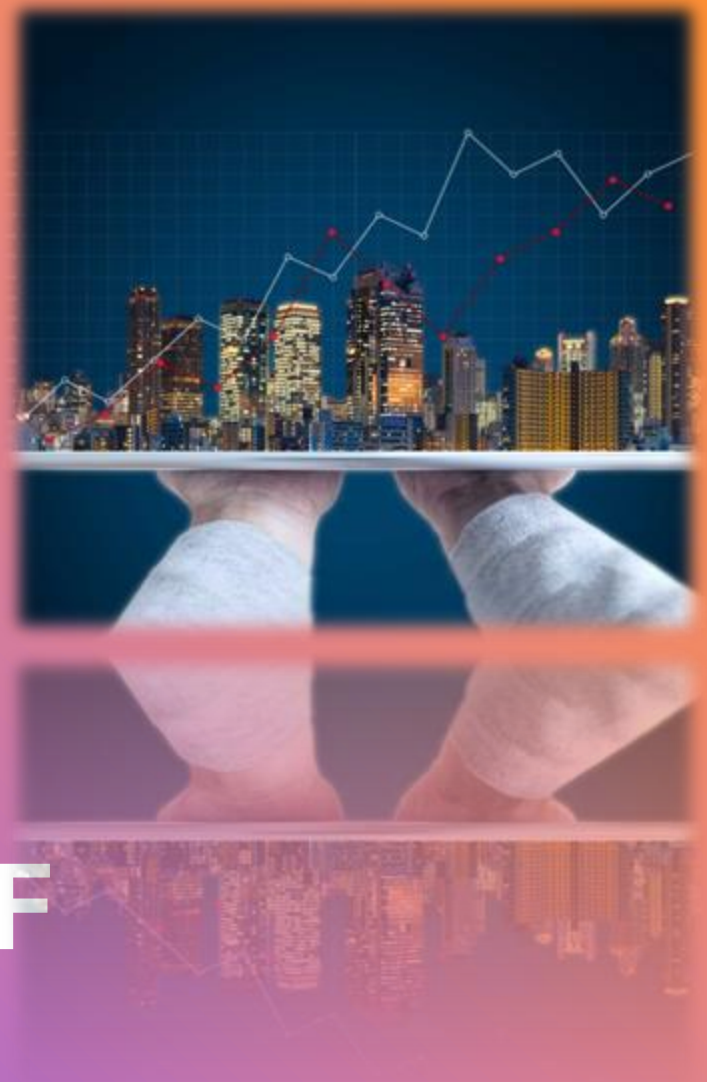
- **Congo, Dem. Rep**
  - Population: 102 million (2024 estimate)
  - GDP per capita: $628
- **Chad:**
  - Population: 18.7 million (2024 estimate)
  - GDP per capita: $753
- **Burundi:**
  - Population: 13 million (2024 estimate)
  - GDP per capita: $261

East-Central Africa

- **Uganda**
  - Population: 48.5 million (2024 estimate)
  - GDP per capita: $970
- **Somalia**
  - Population: 18.53 million (2024 estimate)
  - GDP per capita: $346
- **South Sudan**
  - Population: 11.7 million (2024 estimate)
  - GDP per capita: $246



These Countries primarily depend on agriculture and natural resources for their economic activities, with varying degrees of industrialization and service sector development.



GEOGRAPHIC AND ECONOMIC OVERVIEW OF COUNTRIES WITH THE LOWEST FERTILITY RATES

TOP 10 LOWEST FERTILITY COUNTRIES – EUROPE

- **Ukraine**
  - Population: 36 million (2024 estimate)
  - GDP per capita: $4,284
- **Moldova:**
  - Population: 2.5 million (2024 estimate)
  - GDP per capita: $5,316
- **Italy:**
  - Population: 58 million (2024 estimate)
  - GDP per capita: $37,631
- **Spain:**
  - Population: 47 million (2024 estimate)
  - GDP per capita: $33,601
- **Poland:**
  - Population: 37 million (2024 estimate)
  - GDP per capita: $21,953
- **Bosnia and Herzegovina:**
  - Population: 3.2 million (2024 estimate)
  - GDP per capita: $7,254

These Countries have diverse economies, ranging from manufacturing in automotive, fashion, tourism and energy. Ukraine and Moldova rely heavily on energy imports, which makes them vulnerable to energy price fluctuations and geopolitical tensions, particularly with Russia.

TOP 10 LOWEST FERTILITY COUNTRIES – EAST ASIA

1. Singapore

- Population: 5.6 million (2024 estimate)
- GDP per capita: $82,794
- Primary Economy : Finance , Trade and Logistics

2. South Korea

- Population: 51 million (2024 estimate)
- GDP per capita: $37,332
- Primary Economy: Manufacturing and Industry

Both South Korea and Singapore have highly developed, diverse economies with a strong emphasis on technology, finance, and trade

- **Mauritius**
  - Location: an island nation located in the Indian Ocean
  - Population: 1.3 million (2024 estimate)
  - GDP per capita: $12,051

- **Puerto Rico:**
  - Location: an unincorporated territory of the United States, located in the **northeastern Caribbean Sea**
  - Population: 3.2 million (2024 estimate)
  - GDP per capita: $32,029

Mauritius and Puerto Rico are both islands, relying heavily on tourism, services, and manufacturing.

TOP 10 LOWEST FERTILITY COUNTRIES- ISLAND

TEN KEY FEATURES

Interactive Dashboard Visualization

KEY FEATURES

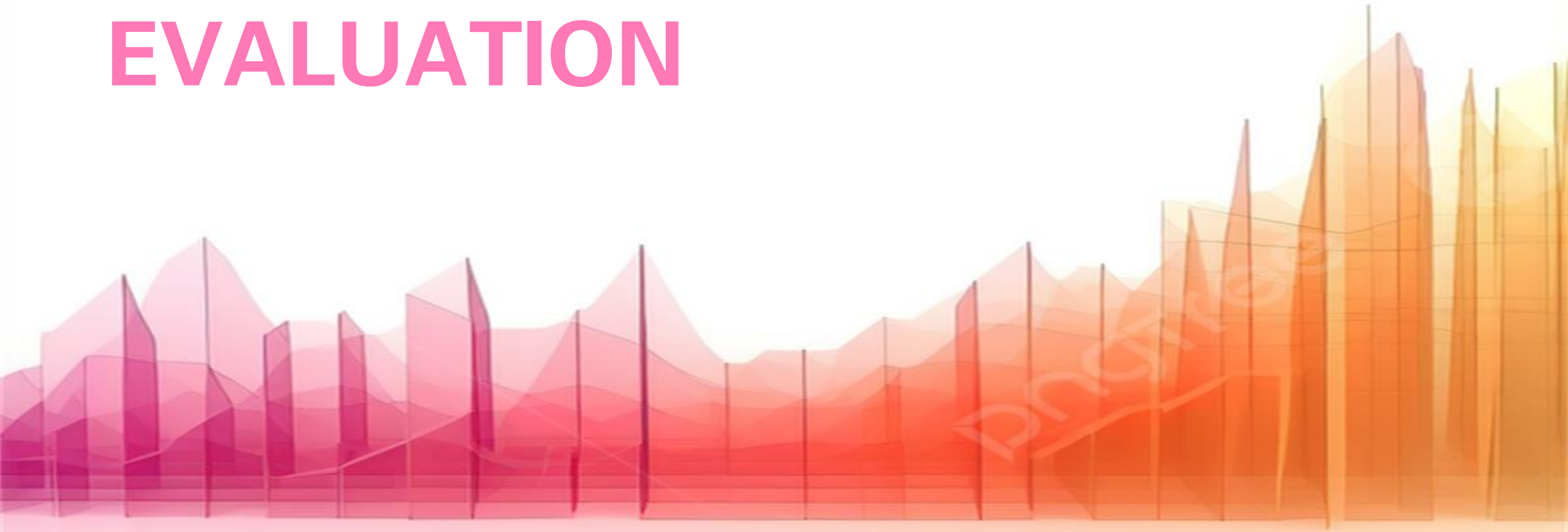
Economic Sectors:	• GDP per capita (current US$) • Inflation, consumer prices (annual %) • Unemployment (% of total labor force)
Demographics Sectors:	• Population Growth (annual %) • Urban population (% of total population) • Net migration
Education:	• Secondary education enrollment
Health System:	• Domestic general government health expenditure per capita (current US$) • Domestic private health expenditure per capita (current US$)

CORRELATION ANALYSIS OVERVIEW

- **High Fertility Countries**
  - The Fertility rate has a strong negative correlation with Year (-0.68), with time goes by, the fertility rate goes down.
  - The Fertility rate has a strong negative correlation with GDP per capita, with a coefficient of -0.59.
  - The Fertility rate also shows a moderate negative correlation with Health expenditure, both General health (-0.45) and Private health (-0.53).
  - GDP per capita has a moderate positive correlation with Health Expenditure (General health: 0.7; Private health: 0.83).
  - Population Growth has a strong positive correlation with Net Migration, with a coefficient of 0.58.
  - Urban Population has a moderate positive correlation with Secondary Education, with a coefficient of 0.41.
  - Inflation has a moderate positive correlation with Net Migration, with a coefficient of 0.46.

- **Low fertility Countries**
  - The Fertility rate has a strong relationship with Year (-0.61), with time goes by, fertility rate goes down.
  - The Fertility rate has a moderate negative correlation with GDP per capita, with a coefficient of -0.48.
  - The Fertility rate also shows a moderate negative correlation with Health Expenditure, both General health (-0.41) and Private health (-0.49).
  - GDP per capita has a strong positive correlation with Urban Population (0.64) and a strong positive correlation with Health Expenditure (General health expenditure: 0.7; Private health expenditure: 0.83).
  - Net Migration has a moderate positive correlation with Population Growth, with a coefficient of 0.44.

PREDICTIVE MODEL EVALUATION



PREDICTIVE MODEL METRICS

Model	Country Fertility	RMSE	MSE	R2	
Polynomial Regression	High	0.38	0.15	0.79	
LassoCV	High	0.2	0.04	0.94	Best Model
RidgeCV	High	0.24	0.06	0.92	
Polynomial Regression	Low	0.39	0.15	-0.26	
LassoCV	Low	0.16	0.02	0.80	
RidgeCV	Low	0.12	0.01	0.88	Best Model

TIME SERIES ANALYSIS

- For high fertility country model, when both 'p=0' and 'q=0', the model does not use past observations to predict future values. while d= 1, the model predicts the next value will be the same as the previous value plus a constant drift term.

Model	Country Fertility	p	d	q	RMSE	MSE
Auto Arima	High	0	1	0	1.32	1.73
Auto Arima	Low	1	0	0	0.41	0.17

Year	High Fertility Prediction	Low fertility Prediction
2024	4.45	1.28
2025	4.55	1.30
2026	4.65	1.32
2027	4.75	1.33
2028	4.84	1.35
2029	4.93	1.36
2030	5.01	1.38

KEY INSIGHTS

- **High-Fertility Countries:**
  - Predominantly located in Africa.
  - Characterized by low GDP, low health expenditure, and low urbanization.
  - Over 75% population employed for agriculture.
  - Over the past 40 years, these countries have faced challenges such as corruption, political conflict, and widespread poverty.

- **Low-Fertility Countries:**
  - Mostly found in East Asia and Europe.
  - Display higher GDP, higher health expenditure, and higher urbanization.
  - Diverse Economy activities with emphasis on technology, finance, and manufacturing.
  - Stable political environments with less corruption and no ongoing wars, excluding Ukraine due to ongoing conflicts.

- **Common Trends:**
  - Both groups show a decreasing trend in fertility rates over the 40-year period.
  - Despite the fertility decline, GDP has grown, and spending on health has increased in both groups.
  - The global total fertility rate (TFR) as of today is 2.3 children, down from almost 5 children 70 years ago, indicating significant demographic shifts that pose future challenges.

CONCLUSION

The analysis reveals that wealthier countries with stable political environments, higher GDP, and better health expenditure tend to have lower fertility rates. Conversely, countries with higher fertility rates often face significant challenges such as political instability, poverty, and low investment in health systems. The global decline in fertility rates underscores the need to address these disparities and prepare for potential demographic and socioeconomic challenges in the future.


Thank you!