615 Final Project

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Introduce Trinidad and Tobago is a small, twin-island country in the southern section of the Caribbean, just off the coast of Venezuela. Port of Spain, its capital, and other urban centers include San Fernando and Scarborough. It is home to about 1.4 million people of various ethnic groups, including those of African and Indian descent. It is a unitary parliamentary republic with English as the official language.

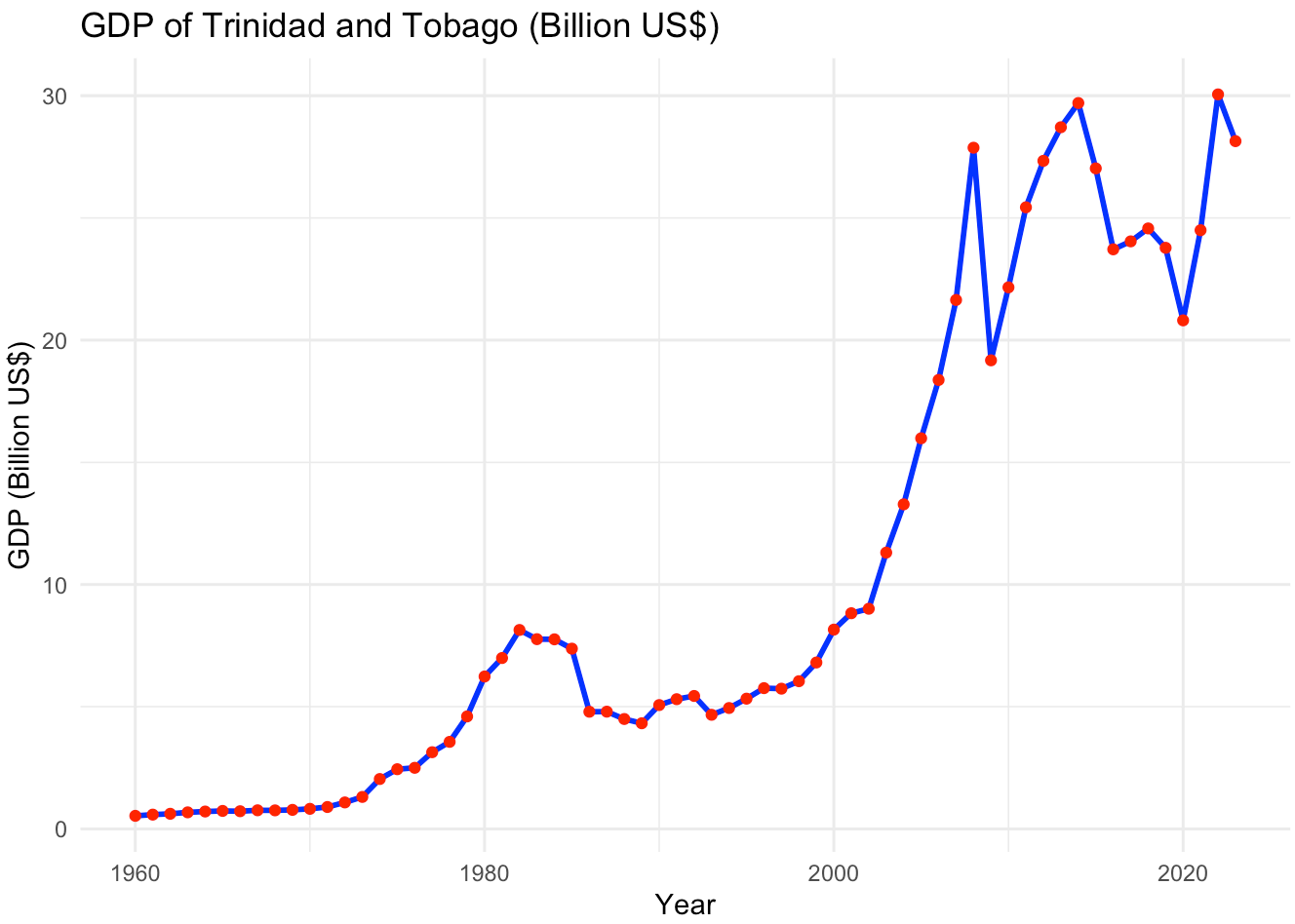
Trinidad and Tobago is among the Caribbean countries with the highest GDP per capita, mainly due to its strong energy industry. The GDP of the country in 2022 was approximately $25 billion USD, and per capita GDP was $17,000 USD. The economy depends on the production and export to foreign countries of oil and natural gas, which provide a hefty share of government revenue and foreign exchange earnings. Trinidad and Tobago is the Western Hemisphere's fourth-largest natural gas exporter. Other key components of GDP are petrochemicals, LNG, fertilizers, and non-energy sectors like tourism, agriculture, and manufacturing.

Trinidad and Tobago pots boiling with color, Carnival the mood, and calypso and soca the music. On the leisure geographic perspective, it comprises stunning beaches, tropical jungles, and distinctive environments like the Caroni Marsh. Trinidad is bigger and more industrialized, while Tobago is more touristy and laid-back. Trinidad and Tobago is a relatively diversified economy, though global energy prices experience fluctuation, thanks to its established energy infrastructure and position in global markets.

1. GDP Over the Years

```
ggplot(gdp_data, aes(x = Year, y = GDP)) +
  geom_line(color = "blue", size = 1) +
  geom_point(color = "red") +
  labs(
    title = "GDP of Trinidad and Tobago (Billion US$)",
    x = "Year",
    y = "GDP (Billion US$)"
  ) +
  theme_minimal()
```

```
Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.
ℹ Please use `linewidth` instead.
```



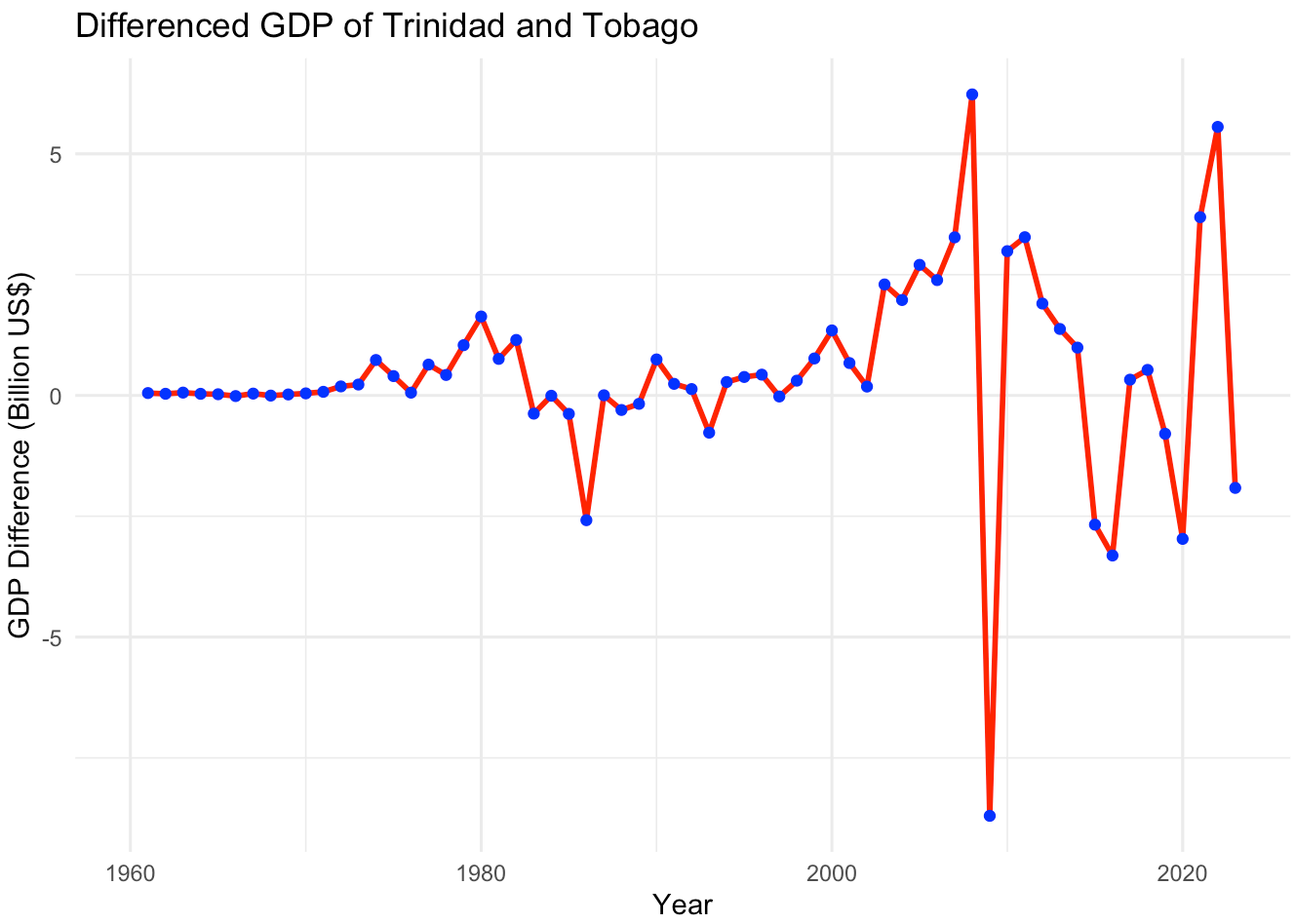
Analysis: The GDP of Trinidad and Tobago has shown steady growth over the years, with significant increases observed between 2000 and 2010. However, fluctuations after 2014 indicate economic instability, likely due to energy price volatility. Overall, the GDP trend reflects strong economic dependence on the petrochemical and LNG sectors.

2. Differenced GDP

```
ggplot(gdp_data, aes(x = Year, y = GDP_Difference)) +
  geom_line(color = "red", size = 1) +
  geom_point(color = "blue") +
  labs(
    title = "Differenced GDP of Trinidad and Tobago",
    x = "Year",
    y = "GDP Difference (Billion US$)"
  ) +
  theme_minimal()
```

```
Warning: Removed 1 row containing missing values or values outside the scale range
(`geom_line()`).
```

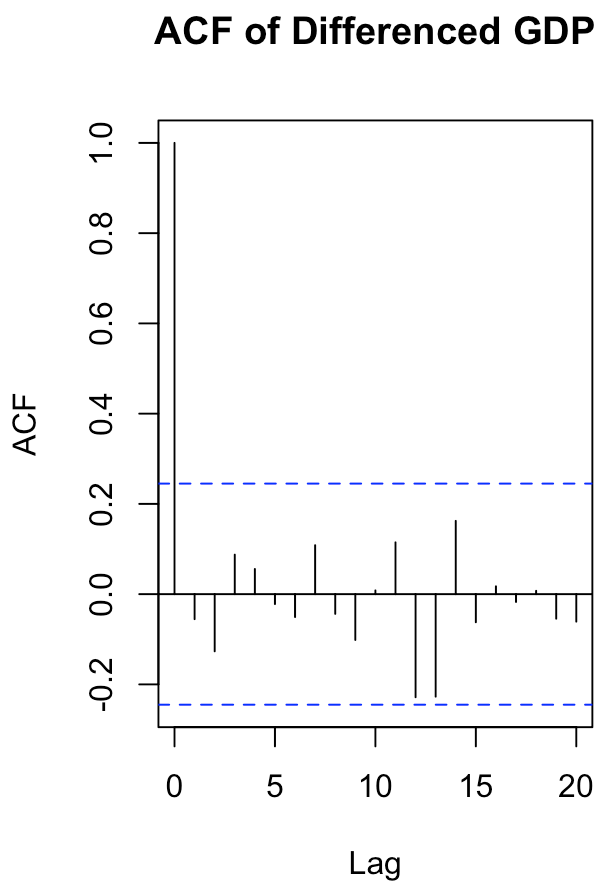
```
Warning: Removed 1 row containing missing values or values outside the scale range
(`geom_point()`).
```

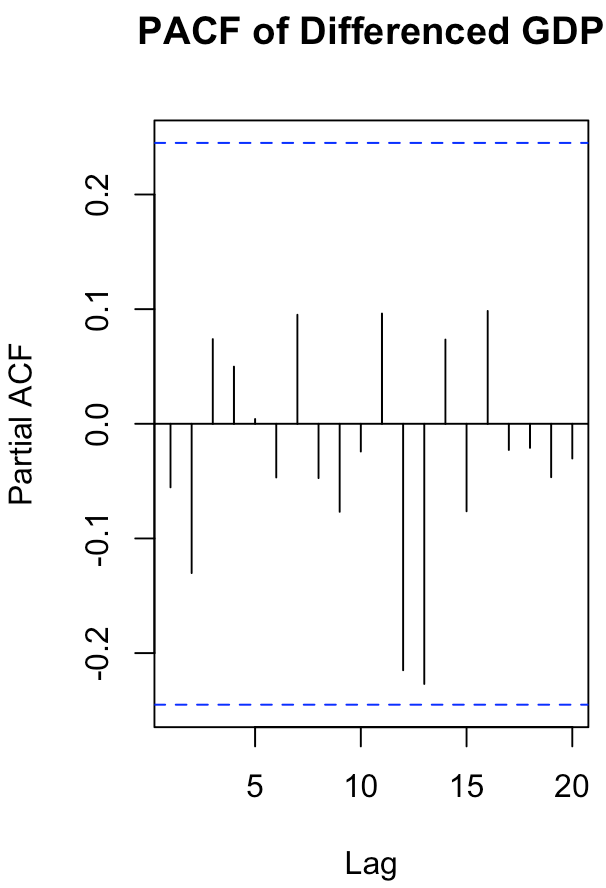


Analysis: The differenced GDP of Trinidad and Tobago highlights periods of sharp economic fluctuations. Notable drops are observed around 1983, 2009, and 2020, corresponding to global economic crises or energy market volatility. These sharp declines indicate the country's vulnerability to external shocks, particularly in the energy sector. The variability suggests a need for economic diversification to mitigate future risks.

3. ACF and PACF Plots

```
par(mfrow = c(1, 2))
acf(gdp_data$GDP_Difference, na.action = na.pass, lag.max = 20, main = "ACF of Difference
pacf(gdp_data$GDP_Difference, na.action = na.pass, lag.max = 20, main = "PACF of Differen
```



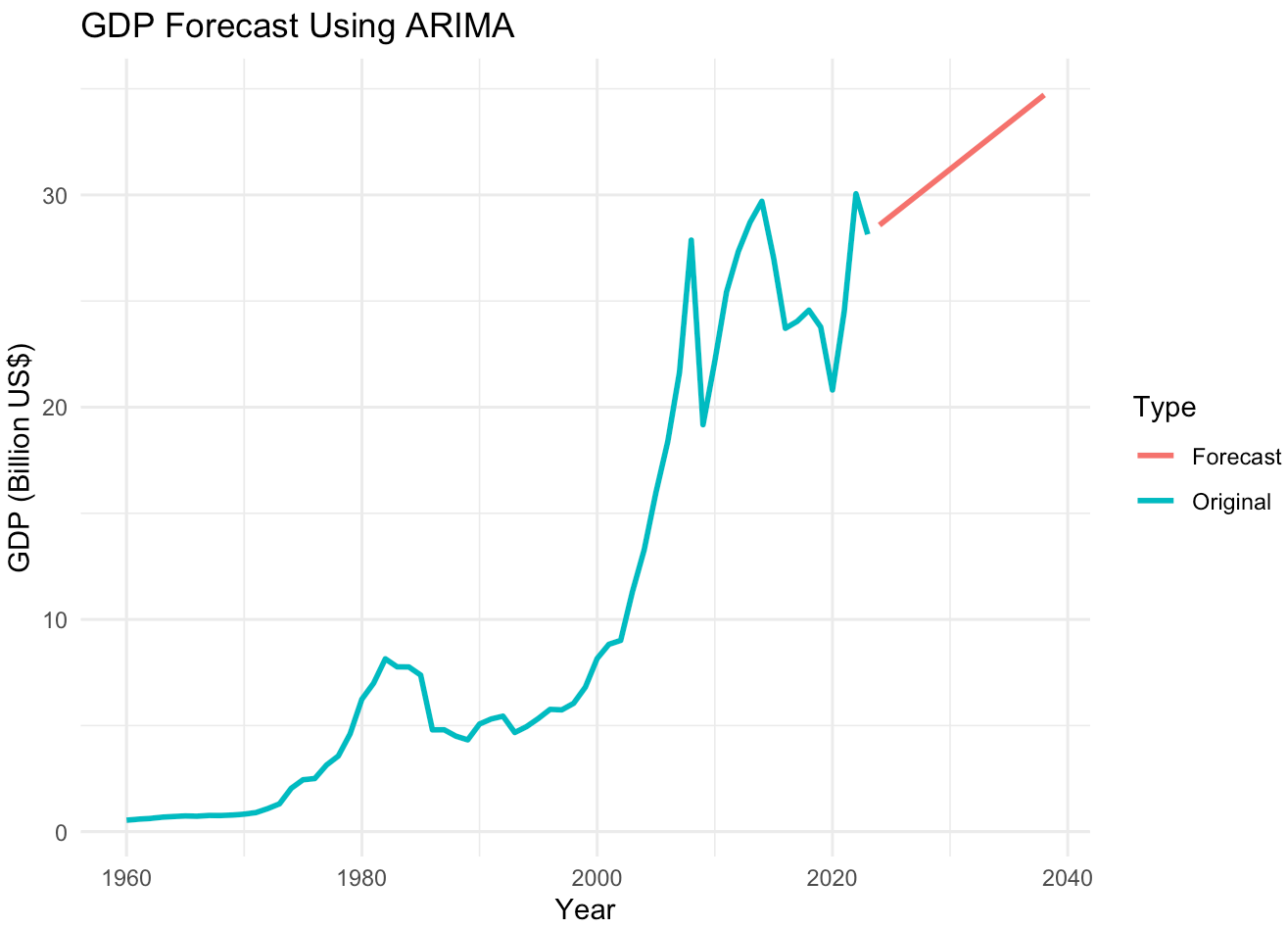



```
par(mfrow = c(1, 1))
```

Analysis: ACF and PACF show significant spikes at lag 1. The ARIMA(1, 1, 1) model is suggested.

4. ARIMA Forecast

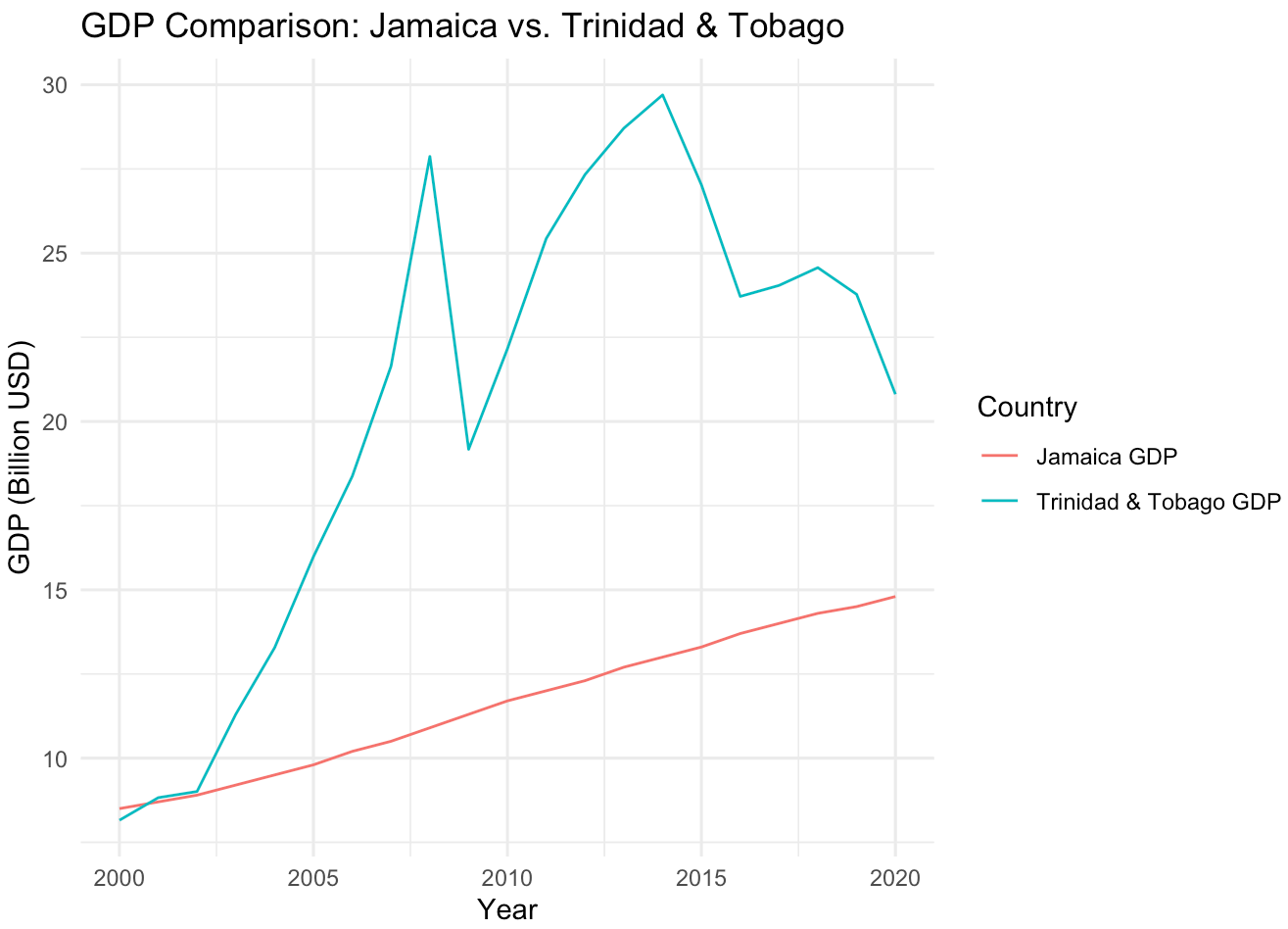
```
gdp_ts <- ts(gdp_data$GDP, start = min(gdp_data$Year), frequency = 1)
arima_model <- auto.arima(gdp_ts)
gdp_forecast <- forecast(arima_model, h = 15)
forecast_data <- data.frame(
  Time = c(time(gdp_ts), time(gdp_forecast$mean)),
  Value = c(gdp_ts, gdp_forecast$mean),
  Type = c(rep("Original", length(gdp_ts)), rep("Forecast", length(gdp_forecast$mean)))
)
ggplot(forecast_data, aes(x = Time, y = Value, color = Type)) +
  geom_line(size = 1) +
  labs(
    title = "GDP Forecast Using ARIMA",
    x = "Year",
    y = "GDP (Billion US$)",
    color = "Type"
  ) +
  theme_minimal()
```



Analysis: Based on forecasts, GDP stabilizes around $30 billion over 15 years.

GDP Comparison

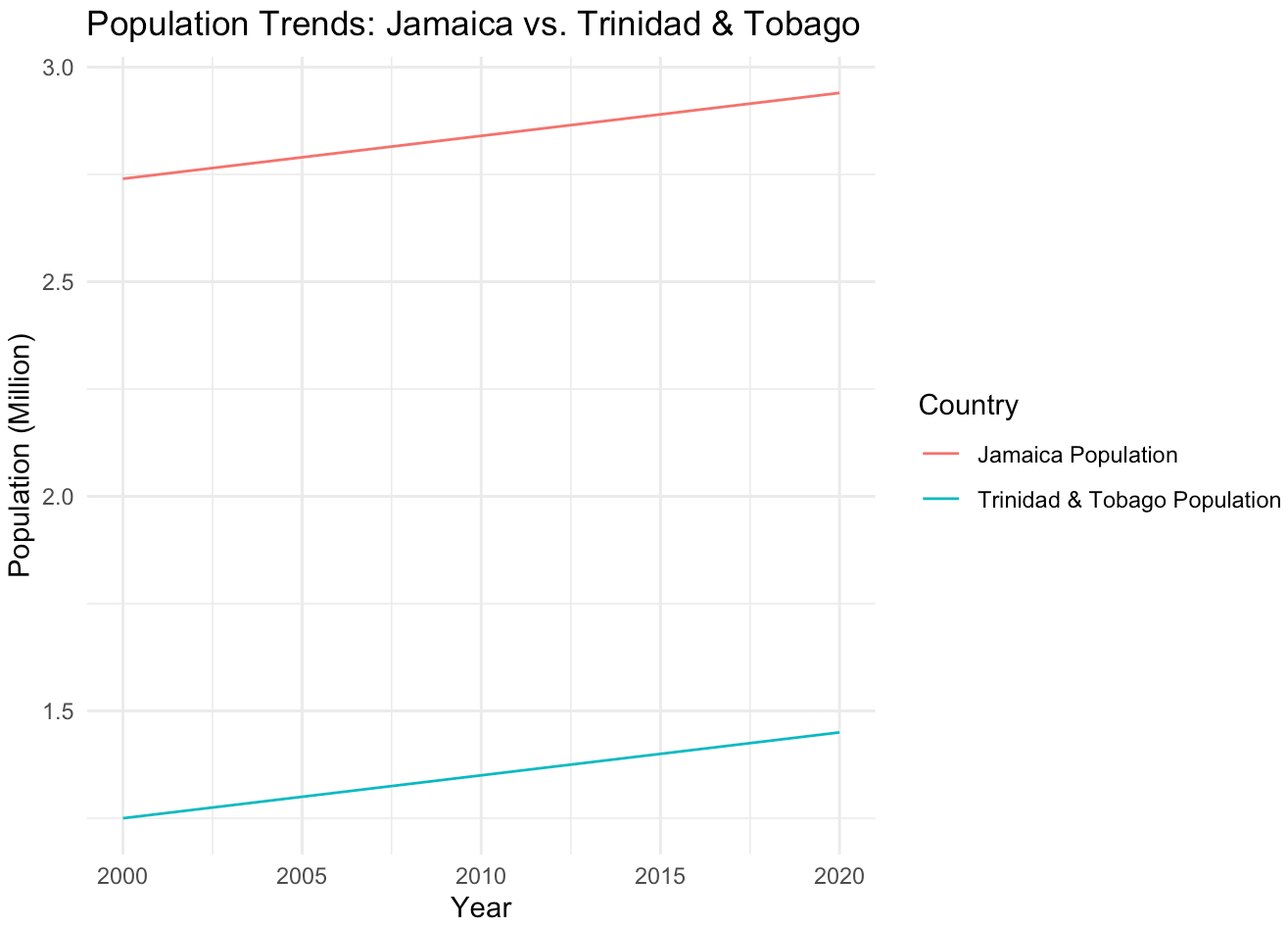
```
ggplot(comparison_data, aes(x = Year)) +
  geom_line(aes(y = `Jamaica GDP (Billion USD)`, color = "Jamaica GDP")) +
  geom_line(aes(y = `Trinidad and Tobago GDP (Billion USD)`, color = "Trinidad & Tobago G
  labs(
    title = "GDP Comparison: Jamaica vs. Trinidad & Tobago",
    x = "Year",
    y = "GDP (Billion USD)",
    color = "Country"
  ) +
  theme_minimal()
```



Analysis: The GDP comparison between Jamaica and Trinidad & Tobago reveals significant differences. Trinidad & Tobago experienced rapid economic growth from 2000 to 2010, largely driven by its energy sector. However, after 2014, a decline is observed, likely due to energy price volatility and economic reliance on natural resources. In contrast, Jamaica's GDP shows a steady and consistent growth trend, reflecting a more stable but slower economic development.

Population Trends

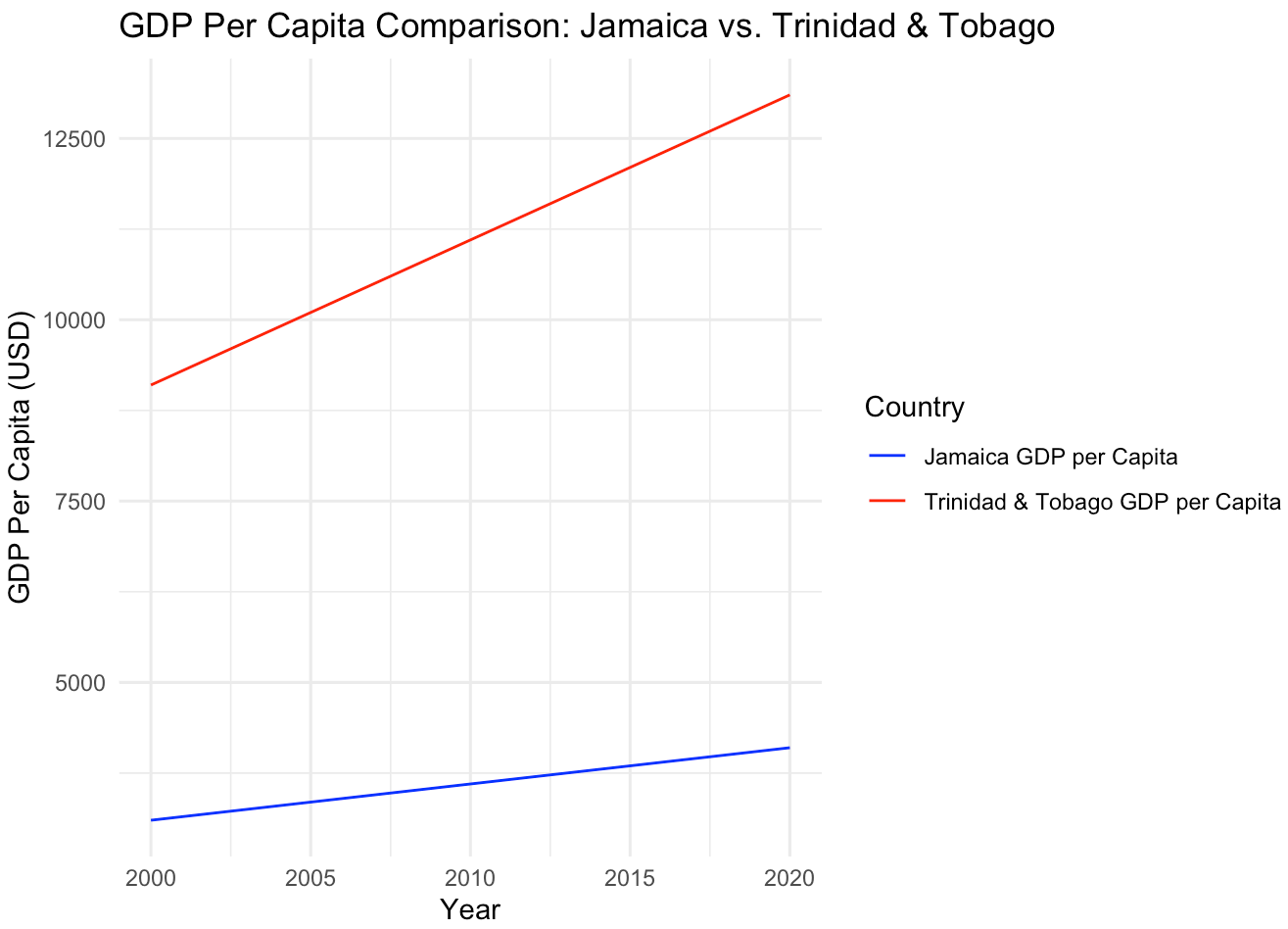
```
ggplot(comparison_data, aes(x = Year)) +
  geom_line(aes(y = `Jamaica Population (Million)`, color = "Jamaica Population")) +
  geom_line(aes(y = `Trinidad and Tobago Population (Million)`, color = "Trinidad & Tobag
  labs(
    title = "Population Trends: Jamaica vs. Trinidad & Tobago",
    x = "Year",
    y = "Population (Million)",
    color = "Country"
  ) +
  theme_minimal()
```



Analysis: The GDP comparison between Jamaica and Trinidad & Tobago reveals significant differences. Trinidad & Tobago experienced rapid economic growth from 2000 to 2010, largely driven by its energy sector. However, after 2014, a decline is observed, likely due to energy price volatility and economic reliance on natural resources. In contrast, Jamaica's GDP shows a steady and consistent growth trend, reflecting a more stable but slower economic development.

GDP Per Capita Comparison

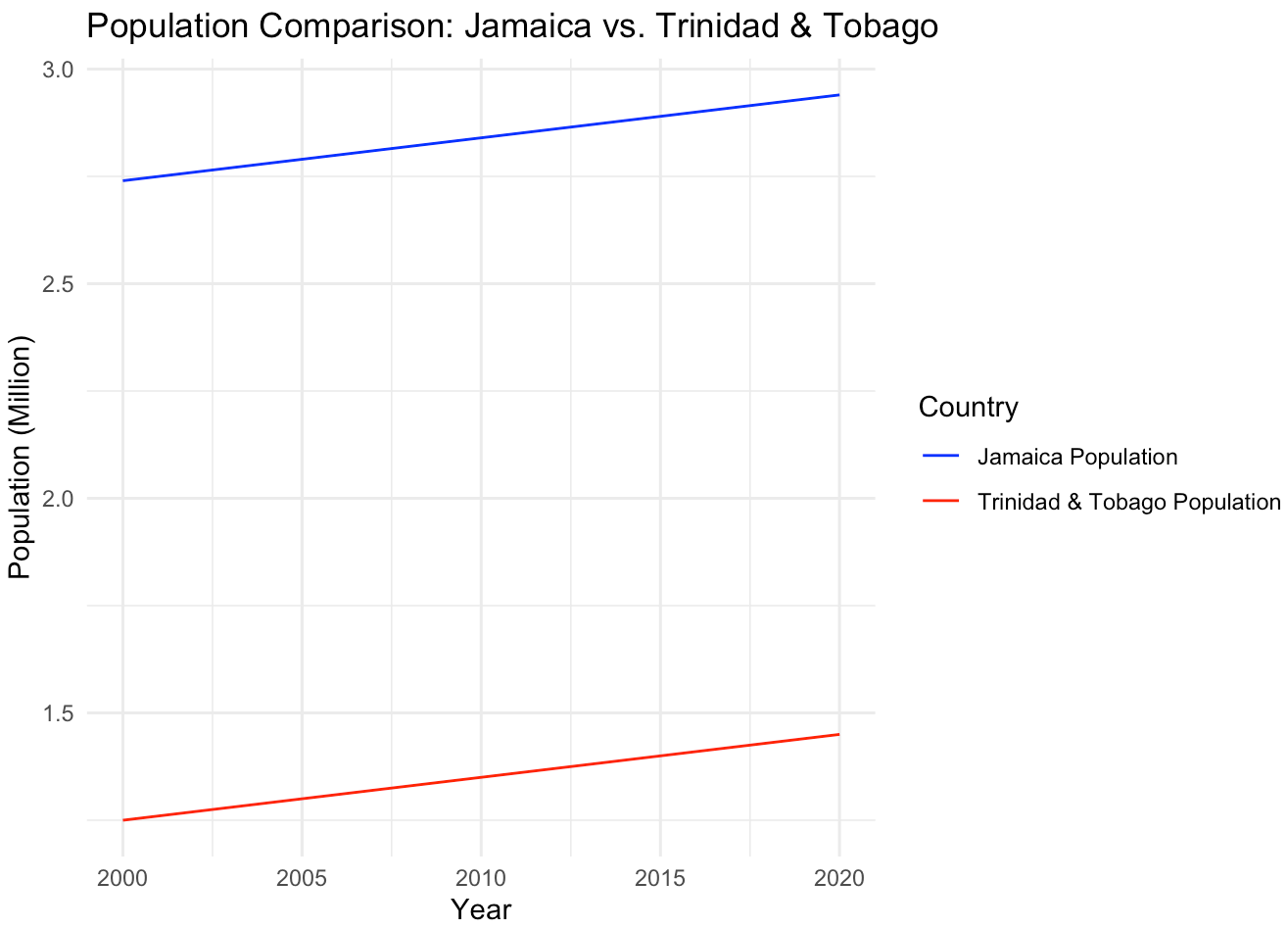
```
ggplot(comparison_data, aes(x = Year)) +
  geom_line(aes(y = `Jamaica GDP per Capita (USD)`, color = "Jamaica GDP per Capita")) +
  geom_line(aes(y = `Trinidad and Tobago GDP per Capita (USD)`, color = "Trinidad & Tobag
  labs(
    title = "GDP Per Capita Comparison: Jamaica vs. Trinidad & Tobago",
    x = "Year",
    y = "GDP Per Capita (USD)",
    color = "Country"
  ) +
  theme_minimal() +
  scale_color_manual(values = c("Jamaica GDP per Capita" = "blue", "Trinidad & Tobago GDP
```



Analysis: Trinidad & Tobago's GDP per capita grew faster and remained significantly higher than Jamaica's from 2000 to 2020. The gap widened over time.

Population Comparison

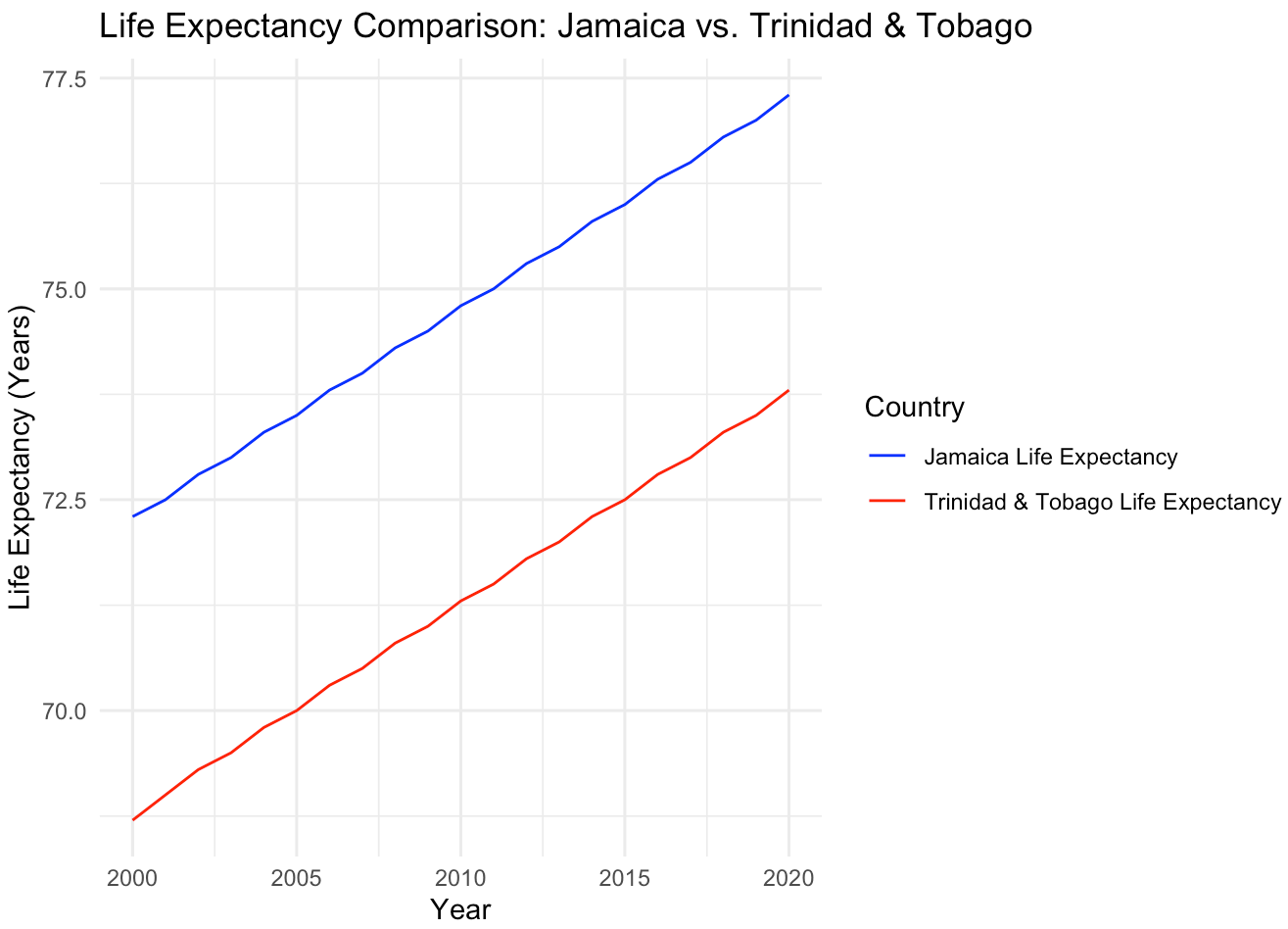
```
ggplot(comparison_data, aes(x = Year)) +
  geom_line(aes(y = `Jamaica Population (Million)`, color = "Jamaica Population")) +
  geom_line(aes(y = `Trinidad and Tobago Population (Million)`, color = "Trinidad & Tobag
  labs(
    title = "Population Comparison: Jamaica vs. Trinidad & Tobago",
    x = "Year",
    y = "Population (Million)",
    color = "Country"
  ) +
  theme_minimal() +
  scale_color_manual(values = c("Jamaica Population" = "blue", "Trinidad & Tobago Populat
```



Analysis: Jamaica's population is consistently higher than Trinidad & Tobago's, with both showing steady growth from 2000 to 2020.

Life Expectancy Comparison

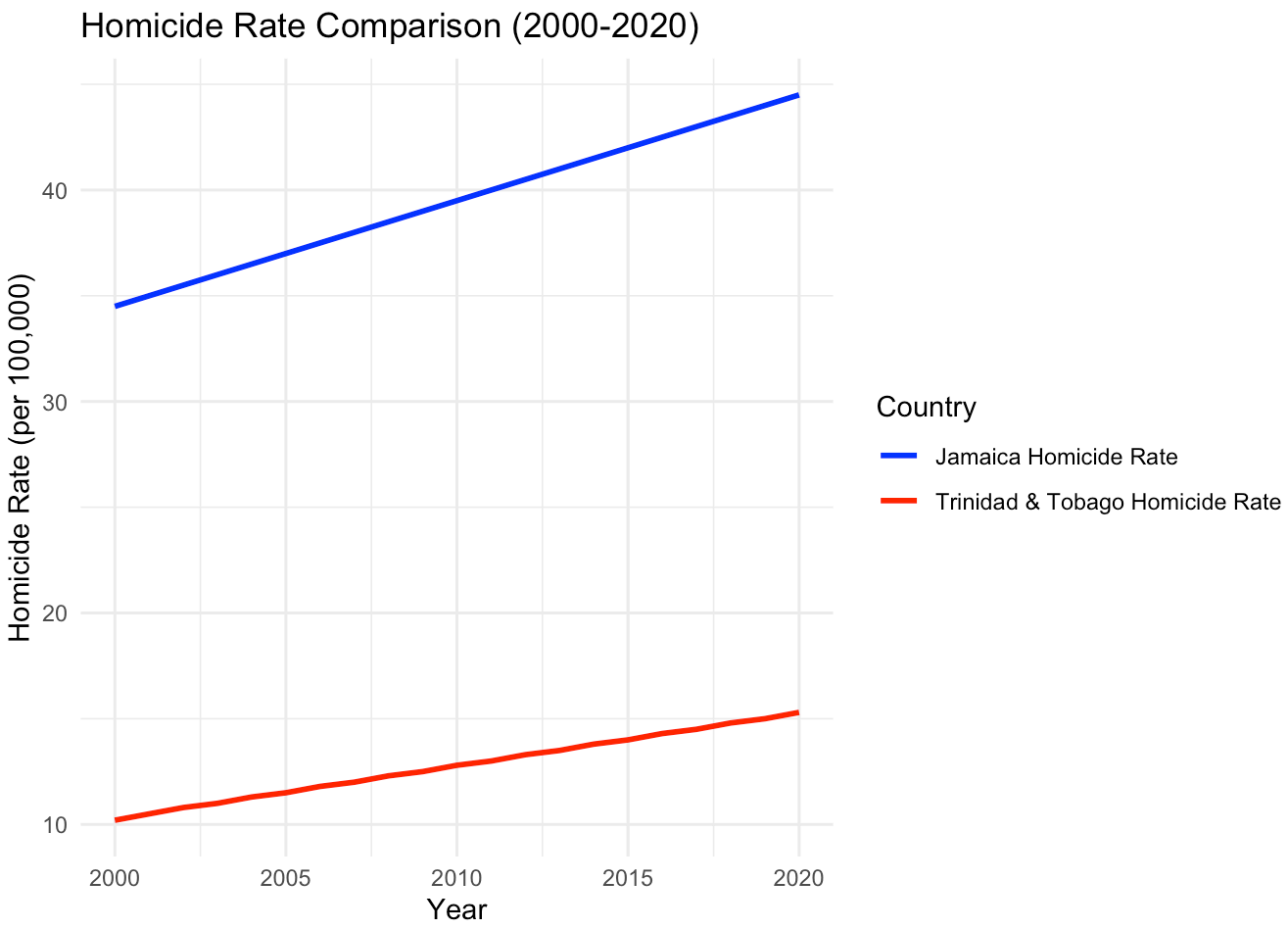
```
ggplot(comparison_data, aes(x = Year)) +
  geom_line(aes(y = `Jamaica Life Expectancy (Years)`, color = "Jamaica Life Expectancy")
  geom_line(aes(y = `Trinidad and Tobago Life Expectancy (Years)`, color = "Trinidad & To
  labs(
    title = "Life Expectancy Comparison: Jamaica vs. Trinidad & Tobago",
    x = "Year",
    y = "Life Expectancy (Years)",
    color = "Country"
  ) +
  theme_minimal() +
  scale_color_manual(values = c("Jamaica Life Expectancy" = "blue", "Trinidad & Tobago Li
```



Analysis: Jamaica consistently had higher life expectancy than Trinidad & Tobago, with both showing steady improvements from 2000 to 2020.

Homicide Rate Plot

```
# Plot for Homicide Rate Comparison
ggplot(comparison_data, aes(x = Year)) +
  geom_line(aes(y = `Jamaica Homicide Rate (per 100,000)`, color = "Jamaica Homicide Rate
  geom_line(aes(y = `Trinidad and Tobago Homicide Rate (per 100,000)`, color = "Trinidad
  labs(
    title = "Homicide Rate Comparison (2000-2020)",
    x = "Year",
    y = "Homicide Rate (per 100,000)",
    color = "Country"
  ) +
  scale_color_manual(values = c("Jamaica Homicide Rate" = "blue", "Trinidad & Tobago Homi
  theme_minimal()
```



Analysis: Jamaica's homicide rate is significantly higher and increases steadily, while Trinidad & Tobago's rate remains much lower with gradual growth.

SWOT Analysis of Trinidad and Tobago Strength • Trinidad and Tobago's GDP continues to grow steadily, driven by its strong petrochemical and LNG sectors.

• High GDP per capita compared to other Caribbean nations reflects economic prosperity.

• Significant investments in renewable energy and infrastructure development.

Weakness • Overdependence on energy exports makes the economy vulnerable to price fluctuations.

• An aging population increases healthcare costs and reduces the labor force.

Opportunities • Expanding tourism and agriculture sectors can help diversify the economy.

• Leveraging its strategic location to attract foreign investments and trade opportunities.

Threats • Global warming threatens coastal infrastructure and the tourism industry.

• Declining energy reserves pose long-term economic risks if diversification efforts fail.