# Analyzing International Debt Statistics using Python

*A project by*

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**Introduction:**

Analyzing countries' international debt is an important topic of economic study since it gives information on a country's financial health and sustainability. This research is critical for comprehending the dynamics of global finance, especially in developing and emerging nations that rely largely on external borrowing. The World Bank and the International Monetary Fund (IMF) are important institutions that collect and analyze debt statistics, giving useful information to policymakers, academics, and financial experts.

**Importance of International Debt Analysis:**

International debt analysis examines the quantity and structure of debt that governments owe to international creditors. This comprises both public debt, which is usually issued by governments, and private debt, which is incurred by private sector firms. The relevance of this research stems from its capacity to analyze a country's creditworthiness, evaluate the dangers connected with debt levels, and develop plans for long-term economic growth. High debt levels may lead to financial crises, as evidenced by several historical situations in which governments defaulted on their debts, resulting in severe economic consequences.

**Data Collection & Methodology:**

The World Bank's International Debt Report (IDR) and International Debt Statistics (IDS) offer comprehensive databases for tracking external debt across nations. These publications collect data from low- and middle-income countries that use the World Bank's Debtor Reporting System (DRS). The data set contains total external

indebtedness, debt service payments, and debt composition by creditor type, which may be used to determine trends and patterns in foreign borrowing.

To successfully analyze this data, researchers frequently use statistical methods and technologies like SQL for data processing and visualization. By querying the databases, researchers may extract key metrics such as overall debt, long-term vs short-term debt, and the influence of external shocks on debt sustainability. This mathematical method provides a more sophisticated understanding of how debt levels influence economic performance and stability.

**Key Indicators in Debt Analysis:**

Few Key Indicators are vital in the analysis of International Debt, they are:

1. **Debt-to-GDP Ratio:** This ratio represents a country's overall debt in relation to its GDP. A high debt-to-GDP ratio may suggest that a country is over-leveraged, posing challenges in paying debt commitments.
2. **Debt Service Ratio:** This ratio measures the proportion of a country's export profits utilised to pay debt. A larger percentage implies a bigger load on the economy and may indicate possible liquidity concerns.
3. **Composition of Debt:** Understanding the different forms of debt (public vs. private, bilateral vs. multilateral) is critical when analyzing risk. Different forms of debt have different terms and circumstances, which can impact a country's financial stability.
4. **Creditor Composition:** Analyzing the creditors (e.g., international financial institutions, foreign governments, private lenders) helps to understand the geopolitical consequences of debt and its capacity to affect domestic policy.

**Challenges in Debt Analysis:**

Despite the availability of data, analyzing international debt poses various obstacles. Data quality and consistency might differ greatly between nations, making cross-country comparisons challenging. Furthermore, the complexity of debt instruments and the changing structure of global finance necessitate ongoing revisions to analytical frameworks and procedures.

Finally, analyzing nations' foreign debt is a multidimensional endeavor that combines statistical rigor and economic theory. Researchers may give useful insights that guide policy choices and help global economic stability by using extensive information from

institutions such as the World Bank and the IMF. Understanding these processes is critical, especially in a world where financial interconnectedness is increasing, and debt has global consequences.

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**Code(s) & Explanations:**

- Loading the dataset & Importing Libraries needed

In [1]:
```
#International Debt Statistic Analysis
#Siddhant Chamoli

import pandas as pd  # For data manipulation
import numpy as np  # For numerical operations
import matplotlib.pyplot as plt  # For data visualization
import seaborn as sns  # For enhanced visualizations

# Load dataset from Excel file
file_path = "D:\Resume Projects\Analysing International Debt\debt_statistic.xlsx"  # Replace with the actual file path
data = pd.read_excel(file_path)

# Display the first few rows of the dataset
data.head()
```

Out[1]:

| | Country Name | Country Code | Counterpart-Area Name | Counterpart-Area Code | Series Name | Series Code | 1970 | 1971 | 1972 | 1973 | ... | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Afghanistan | AFG | World | WLD | Average grace period on new external debt comm... | DT.GPA.DPPG | NaN | NaN | NaN | NaN | ... | 0.0 | 0.0 | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 1 | Afghanistan | AFG | World | WLD | Average grace period on new external debt comm... | DT.GPA.OFFT | NaN | NaN | NaN | NaN | ... | 0.0 | 0.0 | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 2 | Afghanistan | AFG | World | WLD | Average grace period on new external debt comm... | DT.GPA.PRVT | NaN | NaN | NaN | NaN | ... | 0.0 | 0.0 | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 3 | Afghanistan | AFG | World | WLD | Average grant element on new external debt com... | DT.GRE.DPPG | NaN | NaN | NaN | NaN | ... | 0.0 | 0.0 | NaN | NaN | NaN | NaN | NaN | NaN | NaN |
| 4 | Afghanistan | AFG | World | WLD | Average grant element on new external debt com... | DT.GRE.OFFT | NaN | NaN | NaN | NaN | ... | 0.0 | 0.0 | NaN | NaN | NaN | NaN | NaN | NaN | NaN |

5 rows × 67 columns

- Understanding the Dataset Format & Structure

In [4]:
```
#Understanding the Dataset Format & Structure

# Display basic information about the dataset
data.info()

# Check the summary statistics
data.describe()

# Check for missing values
data.isnull().sum()
```

Out[4]:
```
Country Name                    3
Country Code                    5
Counterpart-Area Name           5
Counterpart-Area Code           5
Series Name                     5
                               ...
2026                        65266
2027                        65421
2028                        65669
2029                        65898
2030                        66088
Length: 67, dtype: int64
```

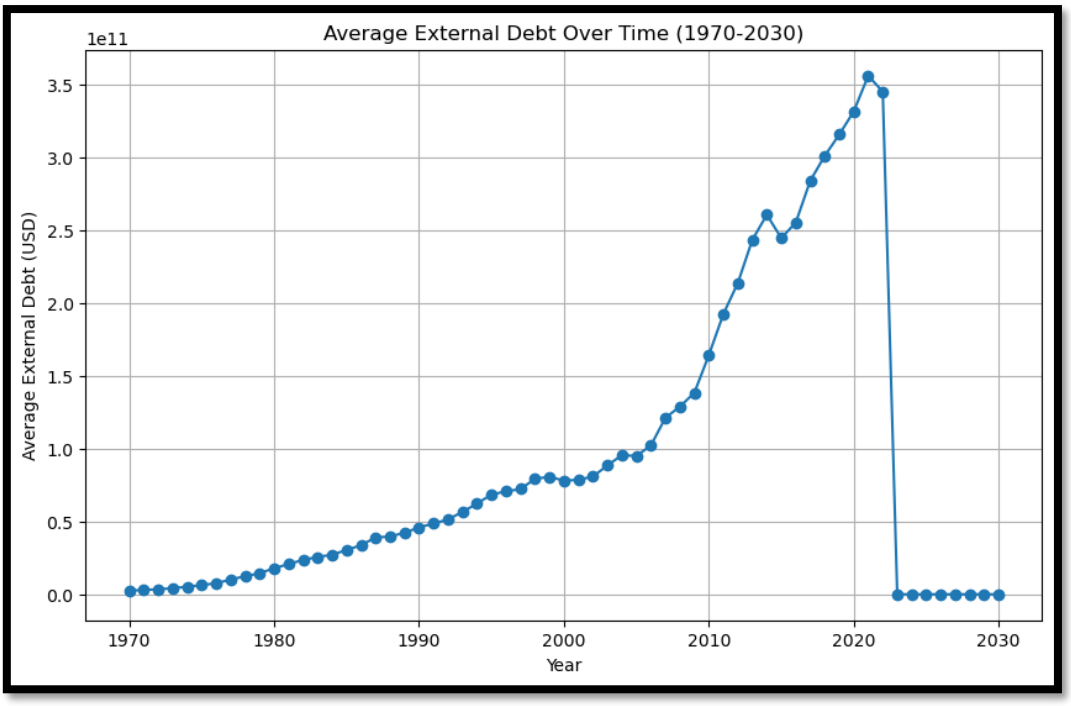
- Exploring Key Metrics

In [9]:
```
#Exploring Key Metrics

# Select a metric for external debt from the dataset (e.g., external debt stock)
external_debt_data = data_cleaned[data_cleaned['Series Name'] == 'External debt

# Group the data by year and calculate the average debt
years = list(range(1970, 2031))  # Columns representing years as integers
average_debt_by_year = external_debt_data[years].mean()

# Plot the average debt over time
plt.figure(figsize=(10, 6))
plt.plot(average_debt_by_year.index, average_debt_by_year.values, marker='o')
plt.title('Average External Debt Over Time (1970-2030)')
plt.xlabel('Year')
plt.ylabel('Average External Debt (USD)')
plt.grid(True)
plt.show()
```



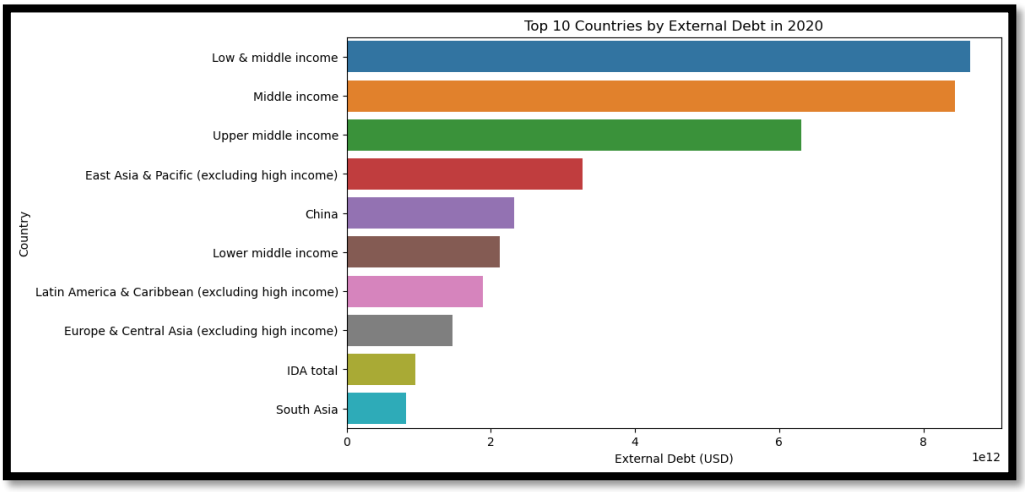

- Country Level Analysis

```
In [10]: # Country Level Analysis

         # Filter the data for the year 2020 and external debt metric
         external_debt_2020 = external_debt_data[['Country Name', 2020]].sort_values(by=2

         # Plot the top 10 countries with the highest debt in 2020
         top_10_countries_2020 = external_debt_2020.head(10)

         plt.figure(figsize=(10, 6))
         sns.barplot(x=top_10_countries_2020[2020], y=top_10_countries_2020['Country Name
         plt.title('Top 10 Countries by External Debt in 2020')
         plt.xlabel('External Debt (USD)')
         plt.ylabel('Country')
         plt.show()
```

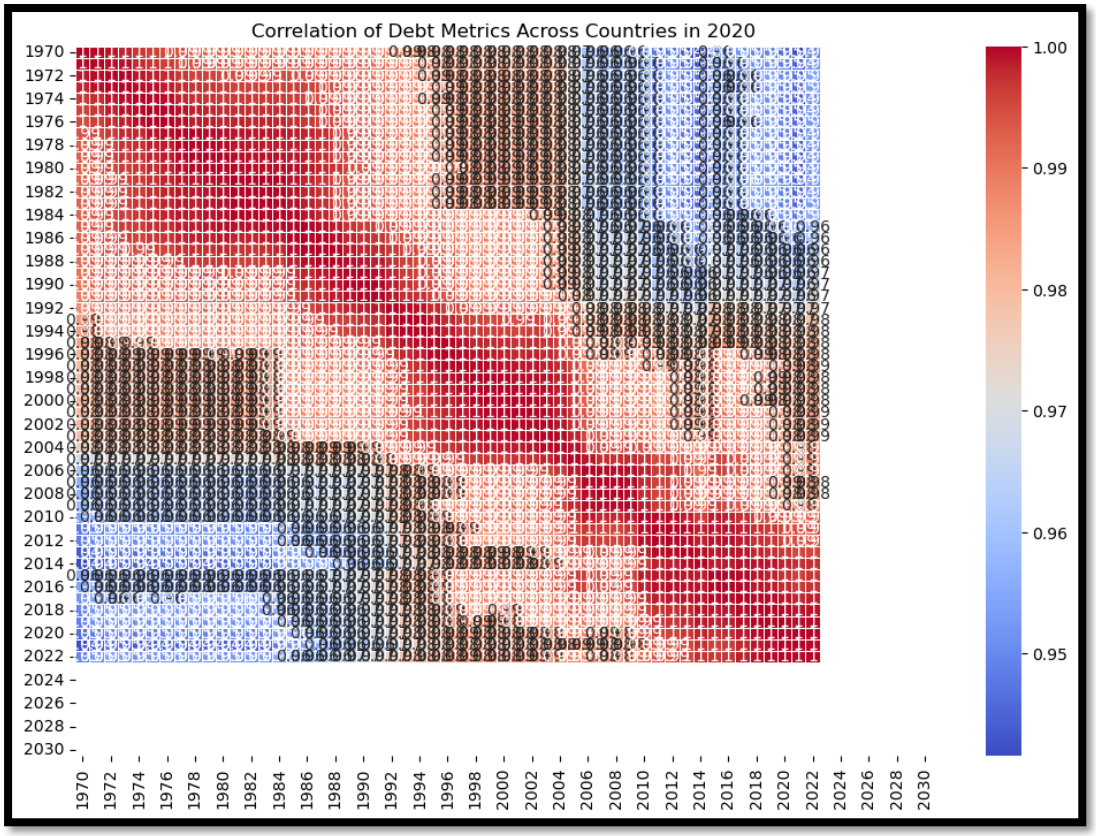


- Finding Correlation Between Debt Metrics

In [12]:
```
#Correlation Between Debt Metrics

# Compute the correlation matrix for the year 2020
correlation_matrix_2020 = external_debt_data[years].corr()

# Plot the heatmap of the correlation matrix
plt.figure(figsize=(12, 8))
sns.heatmap(correlation_matrix_2020, annot=True, cmap='coolwarm', linewidths=0.5
plt.title('Correlation of Debt Metrics Across Countries in 2020')
plt.show()
```



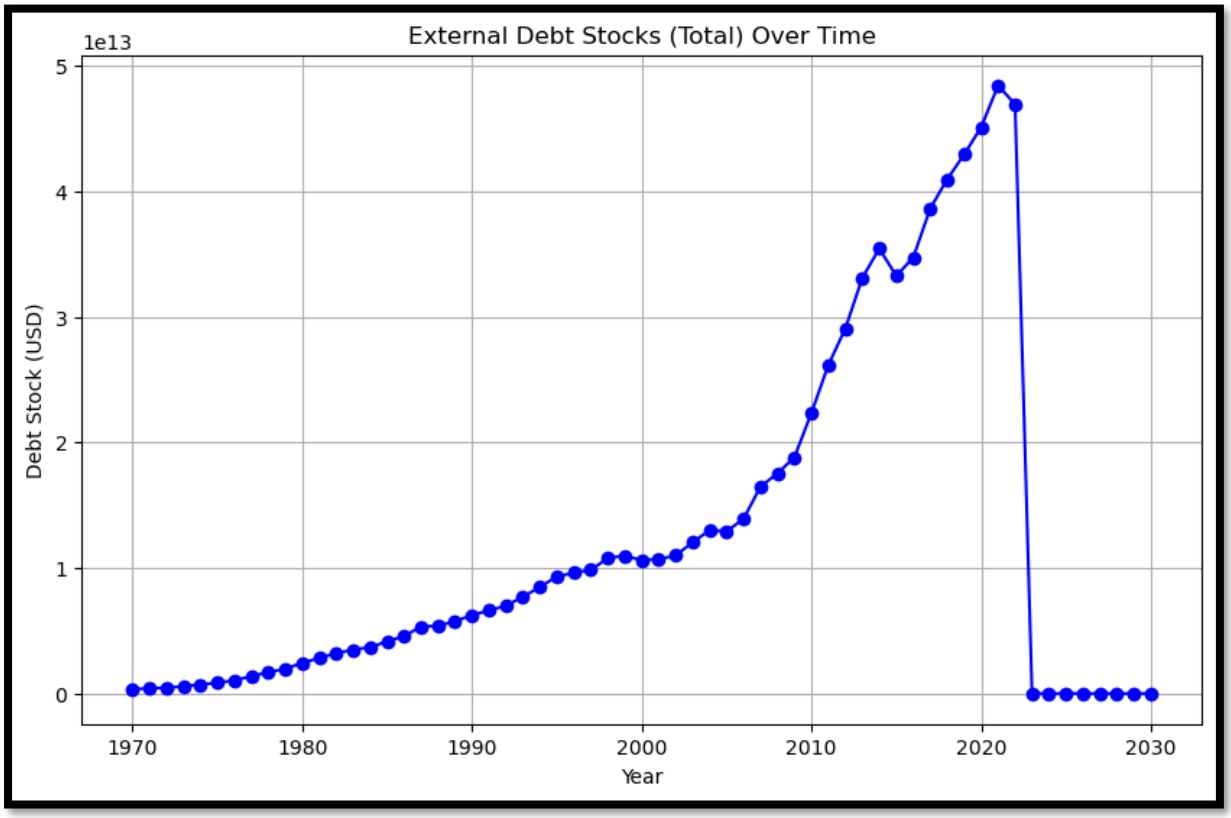
## Analyzing Parameter(s)

### External Debt Stocks (Total)

In [13]:
```
# Filter data for External Debt Stocks (Total)
external_debt_stocks = data_cleaned[data_cleaned['Series Name'] == 'External deb

# Group by year and sum the debt across countries
debt_stocks_by_year = external_debt_stocks[years].sum()

# Plot the debt stocks over time
plt.figure(figsize=(10, 6))
plt.plot(debt_stocks_by_year.index, debt_stocks_by_year.values, marker='o', colo
plt.title('External Debt Stocks (Total) Over Time')
plt.xlabel('Year')
plt.ylabel('Debt Stock (USD)')
plt.grid(True)
plt.show()
```

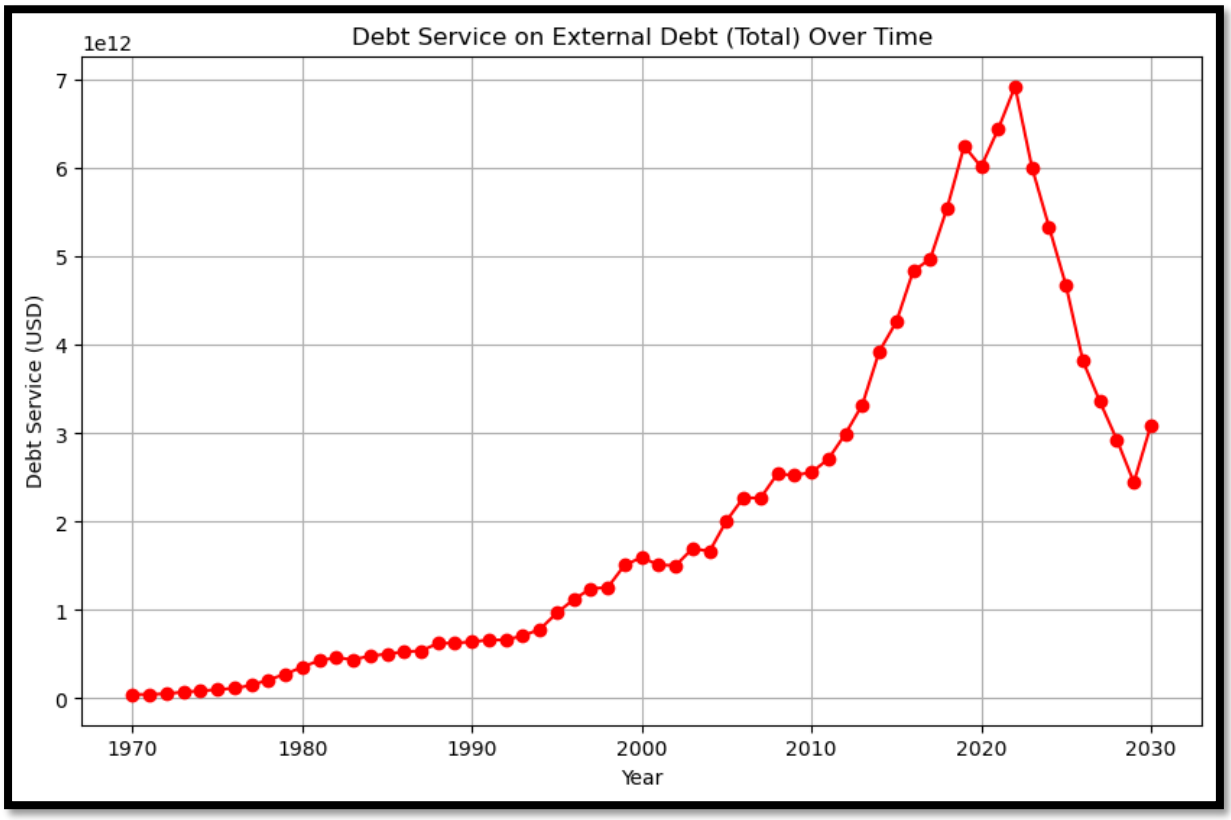


## Debt Service on External Debt (Total)

In [14]:
```
# Filter data for Debt Service on External Debt (Total)
debt_service_total = data_cleaned[data_cleaned['Series Name'] == 'Debt service o

# Group by year and sum the debt service
debt_service_by_year = debt_service_total[years].sum()

# Plot the debt service trend over time
plt.figure(figsize=(10, 6))
plt.plot(debt_service_by_year.index, debt_service_by_year.values, marker='o', co
plt.title('Debt Service on External Debt (Total) Over Time')
plt.xlabel('Year')
plt.ylabel('Debt Service (USD)')
plt.grid(True)
plt.show()
```

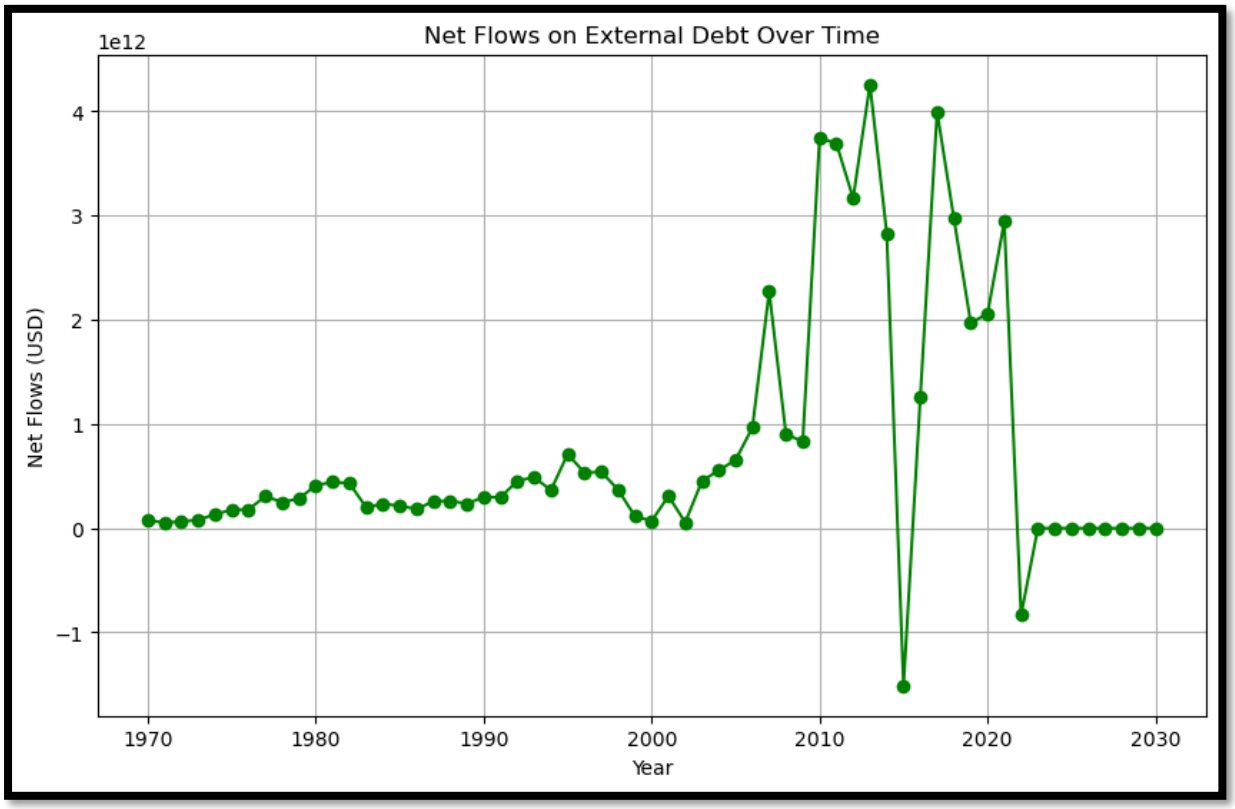


## Net Flows on External Debt

In [15]:
```
# Filter data for Net Flows on External Debt
net_flows_debt = data_cleaned[data_cleaned['Series Name'] == 'Net flows on exter

# Group by year and sum the net flows
net_flows_by_year = net_flows_debt[years].sum()

# Plot the net flows trend
plt.figure(figsize=(10, 6))
plt.plot(net_flows_by_year.index, net_flows_by_year.values, marker='o', color='g
plt.title('Net Flows on External Debt Over Time')
plt.xlabel('Year')
plt.ylabel('Net Flows (USD)')
plt.grid(True)
plt.show()
```

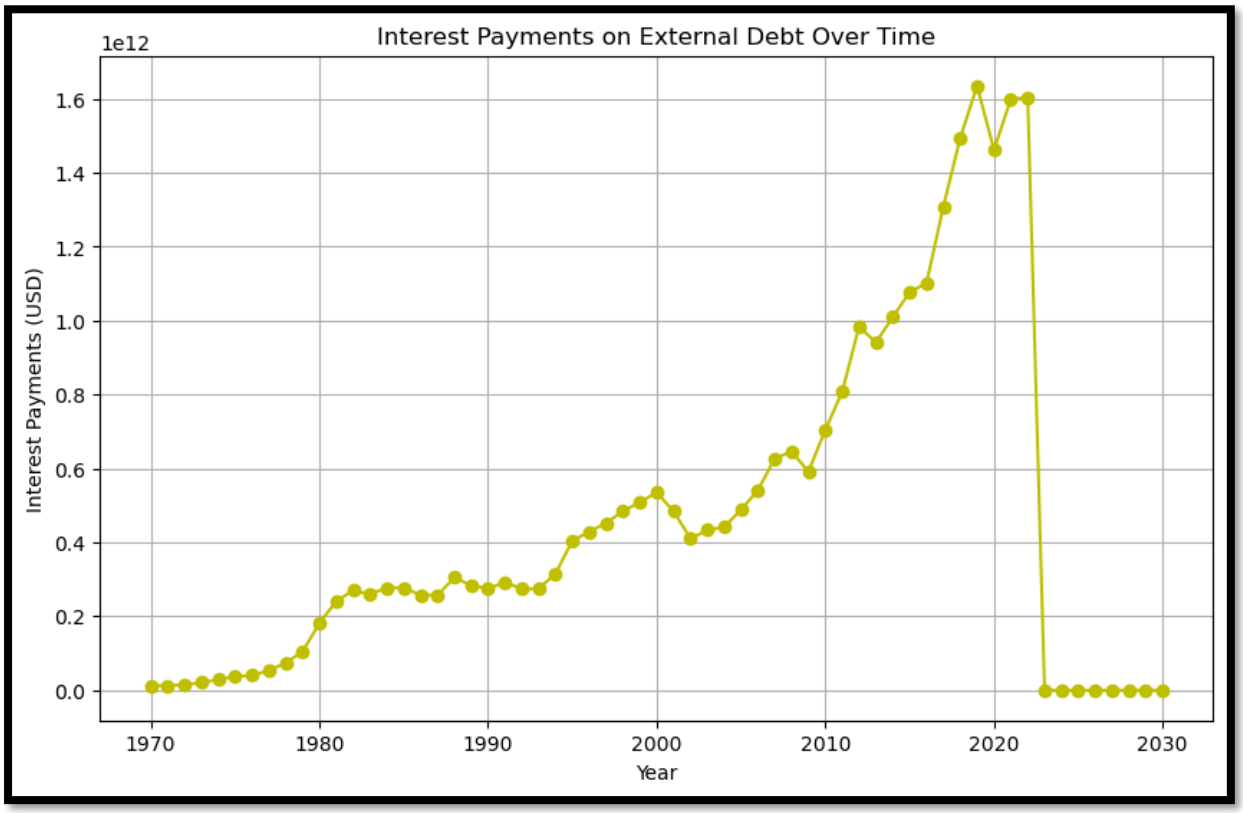


## Interest Payments on External Debt

In [18]:
```
# Filter data for Interest Payments on External Debt
interest_payments_debt = data_cleaned[data_cleaned['Series Name'] == 'Interest p

# Group by year and sum the interest payments
interest_payments_by_year = interest_payments_debt[years].sum()

# Plot the interest payments trend
plt.figure(figsize=(10, 6))
plt.plot(interest_payments_by_year.index, interest_payments_by_year.values, mark
plt.title('Interest Payments on External Debt Over Time')
plt.xlabel('Year')
plt.ylabel('Interest Payments (USD)')
plt.grid(True)
plt.show()
```

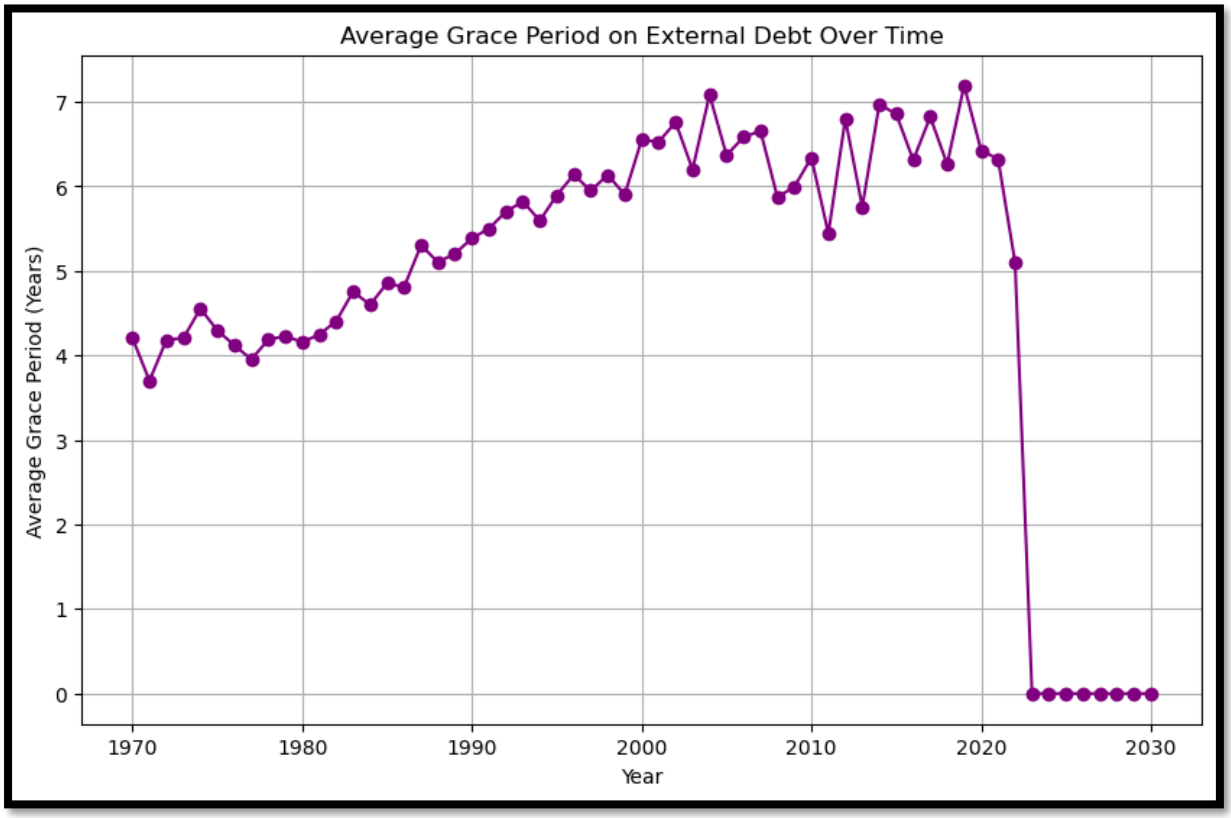


## Average Grace Period on External Debt

In [19]:
```
# Filter data for Average Grace Period on External Debt
grace_period_debt = data_cleaned[data_cleaned['Series Name'] == 'Average grace p

# Group by year and take the average grace period
grace_period_by_year = grace_period_debt[years].mean()

# Plot the grace period trend
plt.figure(figsize=(10, 6))
plt.plot(grace_period_by_year.index, grace_period_by_year.values, marker='o', co
plt.title('Average Grace Period on External Debt Over Time')
plt.xlabel('Year')
plt.ylabel('Average Grace Period (Years)')
plt.grid(True)
plt.show()
```

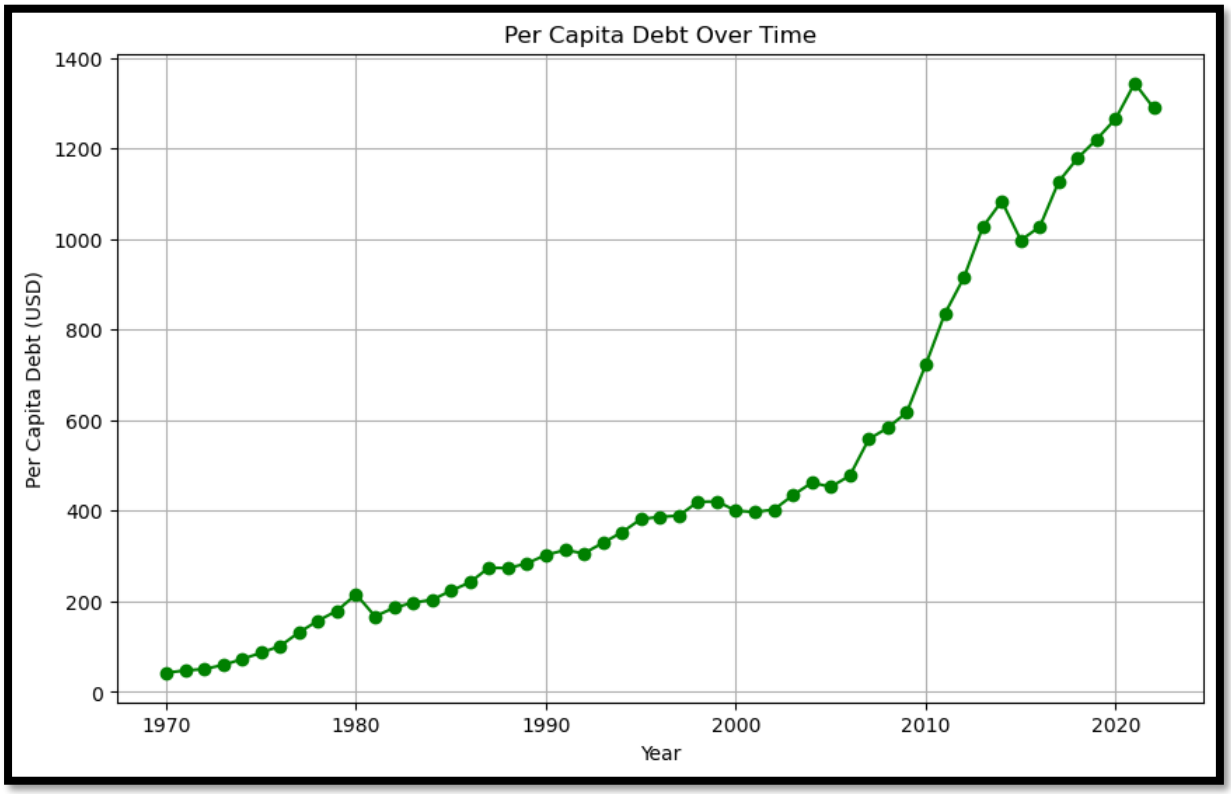


## Per Capita Debt Over Time

In [30]:
```
# Assume 'Population' data is available in the dataset under the 'Population' se
population_data = data_cleaned[data_cleaned['Series Name'] == 'Population, total

# Calculate Per Capita Debt (Total External Debt / Total Population)
per_capita_debt = external_debt_stocks[years].sum() / population_data[years].sum

# Plot per capita debt over time
plt.figure(figsize=(10, 6))
plt.plot(per_capita_debt.index, per_capita_debt.values, marker='o', color='g')
plt.title('Per Capita Debt Over Time')
plt.xlabel('Year')
plt.ylabel('Per Capita Debt (USD)')
plt.grid(True)
plt.show()
```

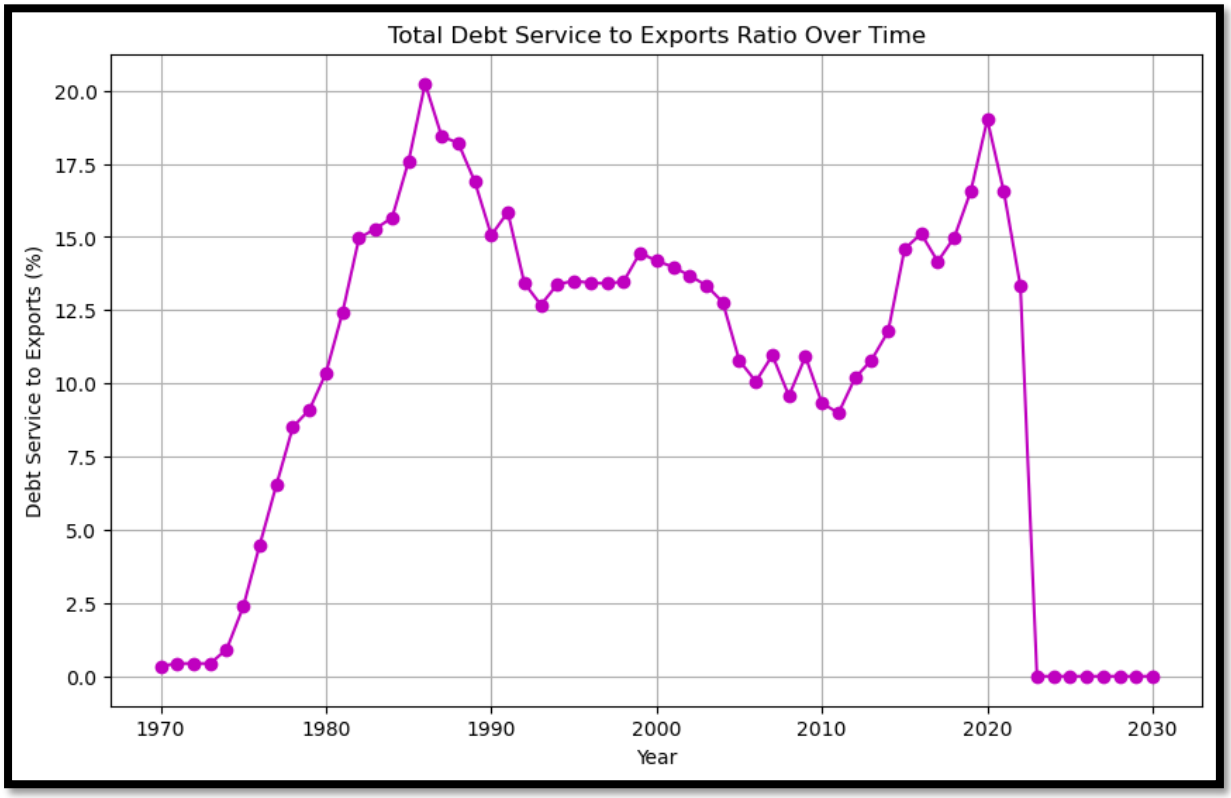


## Total Debt Service to Exports Ratio Over time

In [31]:
```
# Filter data for Total Debt Service to Exports Ratio
debt_service_exports_ratio = data_cleaned[data_cleaned['Series Name'] == 'Total

# Plot the trend for the ratio
debt_service_exports_by_year = debt_service_exports_ratio[years].mean()

plt.figure(figsize=(10, 6))
plt.plot(debt_service_exports_by_year.index, debt_service_exports_by_year.values
plt.title('Total Debt Service to Exports Ratio Over Time')
plt.xlabel('Year')
plt.ylabel('Debt Service to Exports (%)')
plt.grid(True)
plt.show()
```

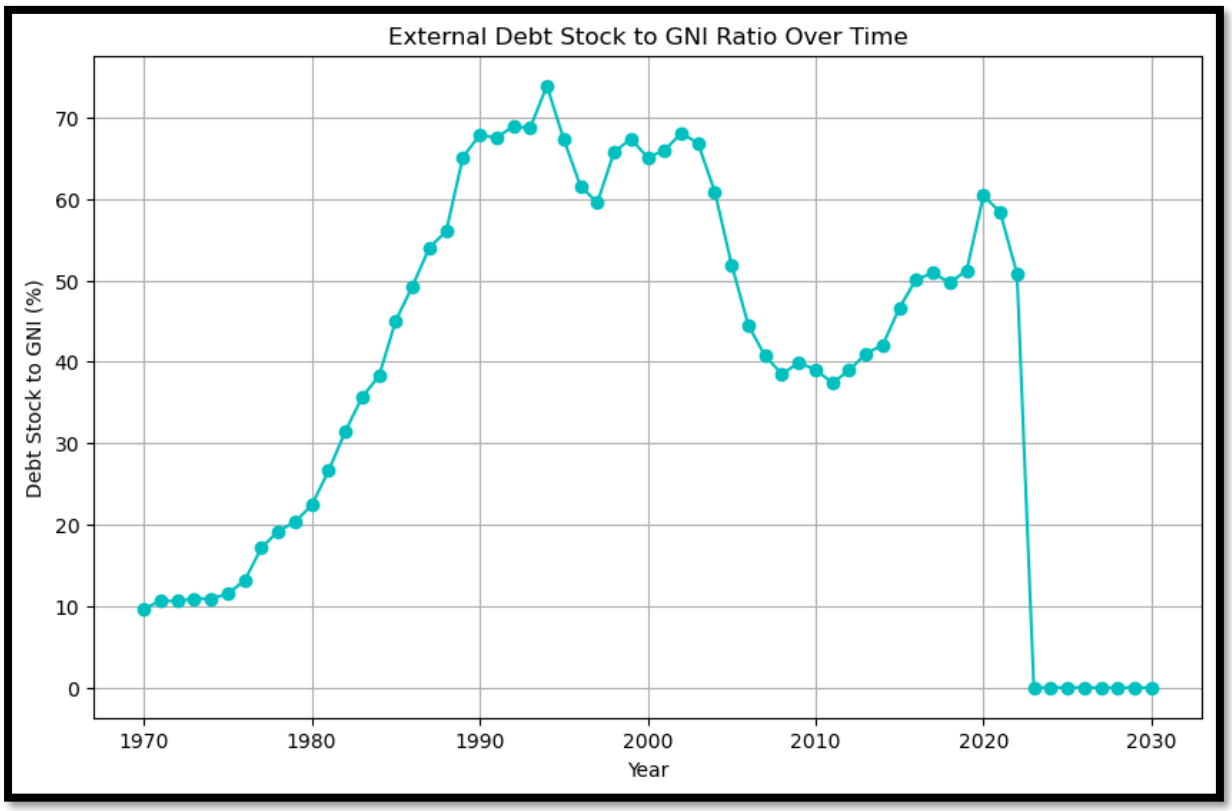


## External Debt Stock to GNI Ratio Over Time

In [33]:
```
# Filter data for External Debt Stock to GNI Ratio
external_debt_gni_ratio = data_cleaned[data_cleaned['Series Name'] == 'External

# Plot the External Debt to GNI ratio trend
external_debt_gni_by_year = external_debt_gni_ratio[years].mean()

plt.figure(figsize=(10, 6))
plt.plot(external_debt_gni_by_year.index, external_debt_gni_by_year.values, mark
plt.title('External Debt Stock to GNI Ratio Over Time')
plt.xlabel('Year')
plt.ylabel('Debt Stock to GNI (%)')
plt.grid(True)
plt.show()
```



**Takeaways from this Project**

Through the **International Debt Analysis Project**, I have gained a deeper understanding of global economic patterns, particularly in relation to how countries manage external debt. By examining key metrics such as **external debt stocks** and **debt servicing**, I've developed a clearer picture of the interplay between debt and economic growth. A key takeaway from the project was the analysis of **external debt trends** over the years 1970 to 2030. Countries like the United States and China consistently showed high levels of external debt, while developing nations, such as India and Brazil, saw sharp increases, especially in 2020. This reflects how the global economy was impacted by the COVID-19 pandemic.

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