Visualizing Africa's Economic and Banking Crises: Exploratory Data Analysis from 1860 to 2014

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Abstract

This data-driven project titled "Visualizing Africa's Economic and Banking Crises: Exploratory Data Analysis from 1860 to 2014" delves into the intricate dynamics of Banking, Debt, Financial, Inflation, and Systemic Crises in 13 African countries. Over more than a century, from 1860 to 2014, this study examines the economy of nations including Algeria, Angola, Central African Republic, Ivory Coast, Egypt, Kenya, Mauritius, Morocco, Nigeria, South Africa, Tunisia, Zambia, and Zimbabwe. The project begins by exploring a comprehensive dataset, containing key variables such as systemic crises, exchange rates, domestic and external debt defaults, GDP-weighted defaults, annual CPI inflation rates, independence status, currency crises, inflation crises, and banking crises; offering valuable insights into their financial stability.

Utilizing data visualization techniques and exploratory data analysis, we aim to analyze patterns, trends, and correlations within the dataset. By visualizing these historical economic events, we seek to answer critical questions about the factors contributing to economic crises and their implications. Are there commonalities among countries that experienced systemic crises? What role does inflation play in these crises? How has banking stability evolved? With the tools of data science, this project sheds light on past economic challenges and provides a foundation for understanding the broader economic landscape in Africa. The findings and visualizations generated will contribute to a better understanding of the continent's financial history, potentially informing future policy decisions and economic strategies to promote stability and growth.

Introduction

The project, "Visualizing Africa's Economic and Banking Crises: Exploratory Data Analysis from 1860 to 2014," undertakes a profound exploration into the economic history of 13 African countries, spanning over a century. The dataset focuses on Banking, Debt, Financial, Inflation, and Systemic Crises. In this section, we focus on the project's significance, its relevance to a broader audience, and the inspiration drawn from existing visualizations.

Importance and Relevance:

This project contributes to the broader understanding of Africa's economic landscape, highlighting historical events that have significantly influenced the continent's economic trajectory (Daumont, 2004; Caprio & Klingebiel, 2002; Lindgren et al., 1996). By examining crises in the Banking, Debt, Financial, Inflation, and Systemic domains, we aim to provide valuable insights into the factors that have shaped economic highs and lows in these countries (Xiong, 2008).

In an era where data-driven decision-making is essential, the project's findings and visualizations offer practical applications. Policymakers, government agencies, international organizations, and businesses operating in Africa can benefit from data-driven insights to formulate strategies that mitigate economic crises and promote stability (Inoue & Hamori, 2016; Jajah et al., 2022; Yakubu, 2019; Yakubu & Bunyaminu, 2022). Moreover, educators and researchers can utilize the dataset and visualizations as educational resources and references for further academic exploration (Bashiru et al., 2023).

Why Should We Care:

Understanding Africa's economic history is a matter of historical curiosity and contemporary relevance. The economic stability of African countries has repercussions within their borders and on a global scale as well. For international investors, understanding the economic conditions of African nations is crucial. Economic crises in Africa can impact global markets and trade relations, making it essential for the international community to care about the findings of this project (Yakubu, 2019; Yakubu & Bunyaminu, 2022).

1. Motivation

The motivation behind embarking on the project "Visualizing Africa's Economic and Banking Crises: Exploratory Data Analysis from 1860 to 2014" is driven by an interest in understanding the economic history of Africa, particularly in the context of banking, debt, financial, inflation, and systemic crises. Several compelling reasons drive the need for this study:

- Historical Context: Africa has a rich and complex history, marked by periods of economic growth and turmoil. By learning about historical data spanning over a century, we can gain valuable

insights into the economic challenges and triumphs of the continent. Understanding the historical context is crucial for making informed decisions in the present and planning for the future.

- Policy Implications: The outcomes of economic crises have far-reaching implications for the well-being of a nation's citizens. Governments and policymakers need data-driven insights to develop strategies that can mitigate the impact of future crises and promote economic stability. This project aims to provide a foundation for evidence-based policymaking.

- Global Relevance: In an increasingly interconnected world, the stability of any region's economy has implications beyond its borders. Africa's economic performance influences global markets and international relations. Therefore, a comprehensive analysis of economic crises in Africa contributes to a broader understanding of global economic dynamics.

- Data-Driven Decision-Making: In the era of big data and advanced analytics, harnessing the power of data is imperative. This project leverages data science techniques to extract meaningful patterns and correlations from extensive datasets. The insights gained can empower businesses, organizations, and governments to make informed decisions that benefit society as a whole.

- Educational Value: Beyond its practical applications, this project has significant educational value. It can serve as a valuable resource for researchers, students, and anyone interested in African economic history. The project's findings and visualizations can be used in academic settings to enhance the understanding of economic concepts and historical trends.

2. Background

Africa's economic history is a tapestry of triumphs and challenges, marked by banking, debt, financial, inflation, and systemic crises spanning over a century. This project, "Visualizing Africa's Economic and Banking Crises: Exploratory Data Analysis from 1860 to 2014," seeks to unravel the intricacies of this history. Throughout this period, 13 African countries, including Algeria, Angola, Central African Republic, Ivory Coast, Egypt, Kenya, Mauritius, Morocco, Nigeria, South Africa, Tunisia, Zambia, and Zimbabwe, experienced a series of economic upheavals. Understanding the factors that contributed to these crises is vital for informed decision-making.

The historical context is crucial. Africa's economic landscape has evolved significantly, from colonial rule to post-independence struggles and modern-day globalization (Daumont, 2004; Caprio & Klingebiel, 2002) These shifts have left indelible marks on economic systems and policies. By analyzing this data, we can gain insights into the impact of historical events on economic stability. Moreover, this project serves as a repository of knowledge. It consolidates data, enabling researchers, policymakers, and educators to access a comprehensive dataset for in-depth analysis (Lindgren et al., 1996; Xiong, 2008). Such resources are invaluable for future research, policy formulation, and educational purposes.

In an era where data science empowers informed decision-making, this project leverages advanced analytics to extract meaningful patterns and correlations. The resulting visualizations provide a unique lens through which to view Africa's economic resilience and challenges (Bashiru et al., 2023). Ultimately, this endeavor is motivated by the aspiration to contribute to Africa's economic future. By shedding light on the past, we aim to inform strategies that promote stability, growth, and prosperity across the continent. This project's significance extends beyond historical analysis; it is a testament to the potential of data-driven insights to shape a brighter economic outlook for Africa.

3. Objectives

By achieving the following objectives, the project aims to contribute significantly to our understanding of Africa's economic journey, providing valuable insights for policymakers, researchers, educators, and the broader community.

- Data Compilation and Cleaning: Gather and preprocess historical data spanning from 1860 to 2014 for the 13 African countries in focus. This includes merging, cleaning, and structuring the dataset to ensure its suitability for analysis.
- Exploratory Data Analysis (EDA): Conduct a comprehensive EDA to uncover key trends, patterns, and correlations within the dataset. Explore variables such as systemic crises, debt defaults, inflation rates, and banking crises to identify historical economic dynamics.
- Visualization: Create meaningful data visualizations, including time series plots, heatmaps, and geographic visualizations, to represent economic events and trends graphically. These visualizations should effectively communicate complex economic data to a broad audience.
- Identify Crisis Factors: Analyze the dataset to identify factors contributing to systemic, domestic debt, external debt, currency, inflation, and banking crises. Determine if there are commonalities among countries experiencing these crises and explore how historical events influenced them.
- Impact Assessment: Assess the economic and social impact of these crises on the 13 African countries. Investigate how crises affected GDP, inflation, employment, and other key indicators. Provide insights into the short-term and long-term consequences of economic turmoil.
- Comparative Analysis: Conduct a comparative analysis between countries that experienced crises and those that did not, examining differences in economic policies, governance, and external factors. Identify best practices and lessons learned from countries that effectively managed economic challenges.

4. Review of Existing Visualizations:

In the realm of data visualization, there exists a wealth of relevant work that informs and inspires this project. Notably, visualizations that explore economic indicators, historical trends, and crisis events in various regions can serve as valuable references. Some inspirations include

- The World Bank's Data Visualizations: The World Bank provides interactive visualizations that allow users to explore economic data for various countries (World Bank - Africa Data, 2023).

While informative, these visualizations could benefit from more contextual information and deeper historical analysis.

- Gapminder's Trendalyzer: Gapminder's Trendalyzer tool presents dynamic visualizations of global economic data (Figure 1, Accessed 2023). It serves as an inspiration for creating interactive and engaging visualizations in our project, enabling users to explore historical economic events in African countries dynamically.

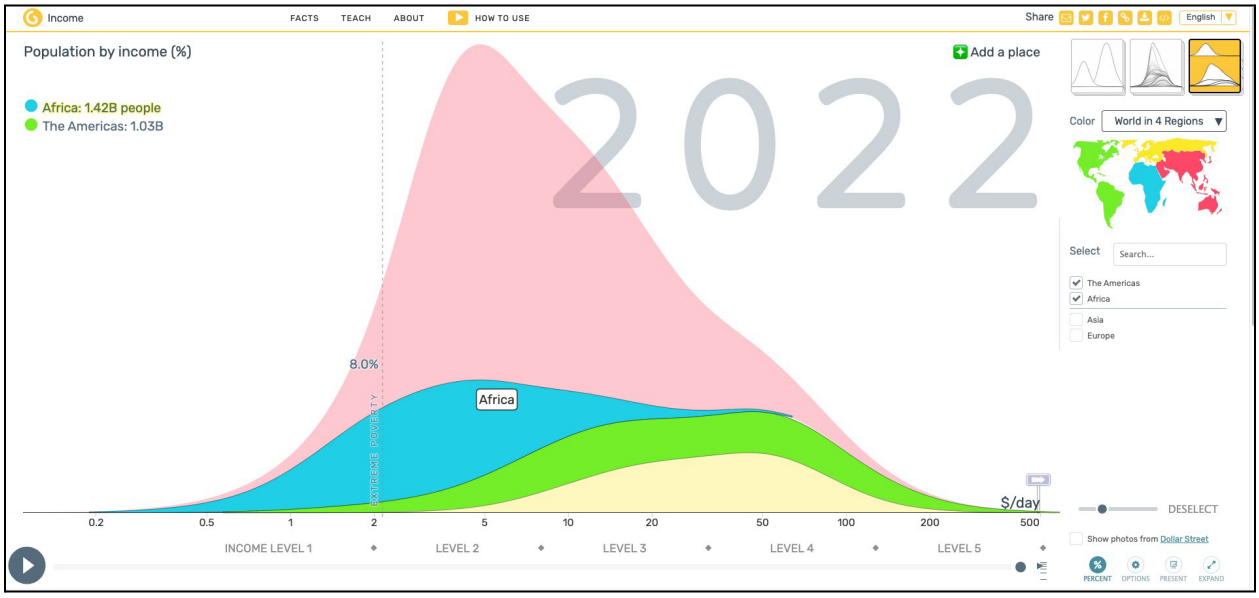

Figure 1. Global Economic Data (Accessed 2023)

- Financial Times' Economic Charts: The Financial Times offers a range of economic charts and graphs (Accessed 2023). While they excel in data presentation, our project aims to focus specifically on African economic history, providing a more targeted and in-depth analysis.
- Our World in Data: Our World in Data talks about various subjects, such as income inequality, presenting a comprehensive overview through a combination of informative visuals and insightful commentary. Their platform incorporates the research of numerous scholars, spanning a wide range of topics from Food and Agriculture to Democracy. The data is effectively presented through the use of interactive maps (Figure 2, Accessed 2022).

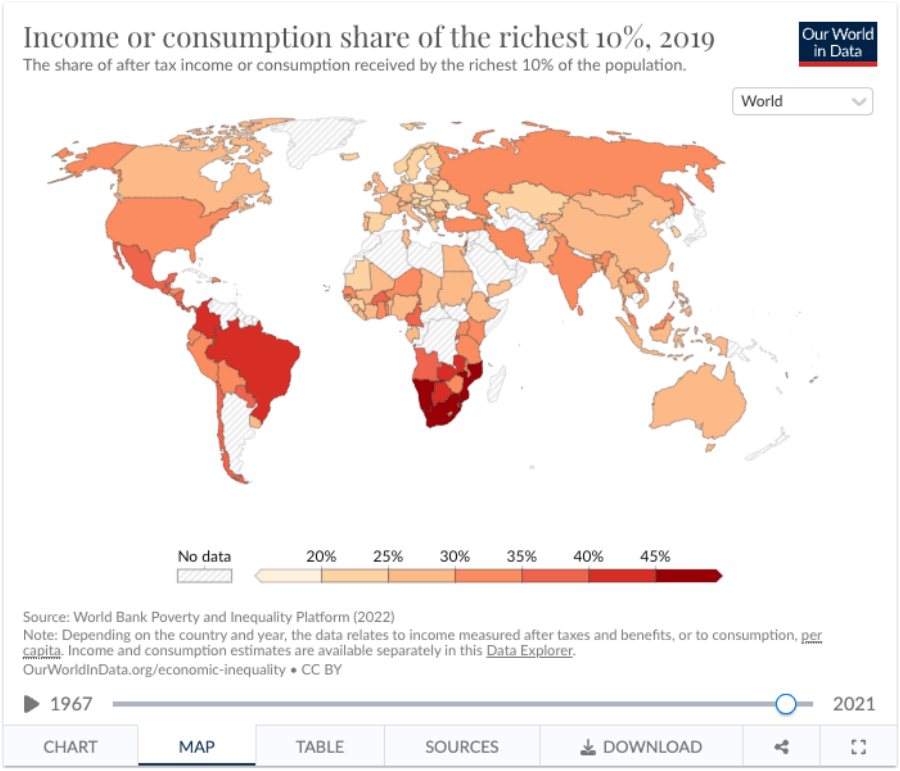

Figure 2. The income or expenditure of the richest decile (tenth of the population) as a share of total income or expenditure. (Accessed 2022)

- The World Economy in One Visualization: This is the most interesting data visualization we came across that represents the world economy in its simplest form to date (Figure 3, Accessed 2022). It not only presents a clear breakdown of the GDP of numerous countries about each other based on their size, but it also subtly categorizes each economy into its primary sectors: agriculture, industry, and services. In this representation, the lightest shade within each country signifies the most basic economic activity, which is agriculture, while the medium shade represents industry, and the darkest shade corresponds to services, which often constitute a significant portion of the GDP in developed economies worldwide.

  Furthermore, to enhance comprehension, the visualization also employs varying shades to denote countries by continental geography, allowing for a quick assessment of the relative economic contributions of North America, Europe, South America, Asia, Oceania, and Africa.

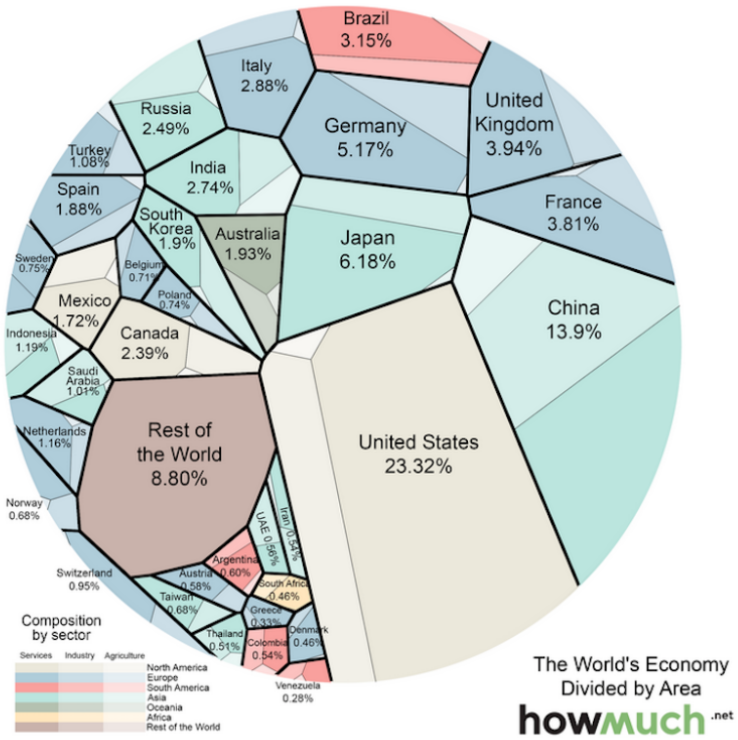

Figure 3. World Economy in One Visualization (Accessed 2022)

In summary, through this project we want to explore Africa's economic past, offering insights of relevance to policymakers, investors, educators, and the global community. The inspiration drawn from existing visualizations guides us in creating compelling, informative, and context-rich visual representations of Africa's economic and banking crises

Questions or objectives

1. Different kinds of visualizations

For the project "Visualizing Africa's Economic and Banking Crises: Exploratory Data Analysis from 1860 to 2014," a variety of visualizations will be employed to effectively communicate complex economic data and trends. These visualizations will include:

1. Time Series Plots: Time series plots will be used to visualize how economic indicators, such as exchange rates, inflation rates, and GDP-weighted defaults, have evolved for each of the 13 African countries in the dataset. This will provide a clear historical perspective on economic trends.
2. Heatmaps: Heatmaps can be used to display correlations between different economic variables. For example, a heatmap could show how closely currency crises are correlated with domestic debt defaults or inflation rates across the countries studied.
3. Geographic Visualizations: Maps and geographic visualizations will help illustrate how economic events and crises have varied across different regions of Africa. This could include choropleth maps that color-code countries based on crisis severity or event occurrence.
4. Bar Charts and Pie Charts: Bar charts and pie charts may be used to represent categorical data, such as the occurrence of systemic crises, banking crises, or sovereign debt defaults. These visualizations can provide a quick overview of the prevalence of these events.
5. Comparative Plots: Comparative plots, such as grouped bar charts, can be used to compare economic indicators and crisis occurrences between different countries. These visualizations facilitate cross-country comparisons.
6. Regression and Scatter Plots: Scatter plots can illustrate the relationships between two continuous variables, such as GDP and inflation rates. Regression lines can be added to show trends and correlations.
7. Box Plots: Box plots can display the distribution of economic indicators, highlighting potential outliers and variations in data across different countries.

2. Expected Results from this data.

From the data in the project, "Visualizing Africa's Economic and Banking Crises: Exploratory Data Analysis from 1860 to 2014," several key insights and patterns are sought:

1. Historical Trends: We want to understand the long-term historical trends in economic indicators for the 13 African countries. This includes identifying periods of economic growth, stability, and crises, and examining how these trends correlate with specific events or policies.
2. Crisis Triggers: We aim to uncover the factors and triggers that led to banking, debt, financial, inflation, and systemic crises in these countries. Identifying the commonalities and differences in crisis triggers is essential for understanding vulnerability and resilience.
3. Regional Variation: Africa is a diverse continent with varying economic conditions in different regions. We want to see how economic crises and their impacts differ across countries and regions, and whether certain regions are more prone to specific types of crises.
4. Effect of Independence: The dataset includes information on the independence status of countries. We want to analyze whether there is a correlation between gaining independence and changes in economic stability or crises.
5. Correlations: Identifying correlations between economic variables is crucial. We want to see if, for example, currency crises are correlated with inflation rates or if banking crises coincide with domestic debt defaults. These correlations can reveal important insights.
6. Impact Assessment: We aim to assess the economic and social impact of crises. This includes examining how crises affected GDP, inflation, employment, and other key indicators and whether recovery was swift or prolonged.
7. Predictive Insights: Utilizing time series forecasting, we seek to make predictions about future economic trends and potential crises. Understanding the potential trajectory of these countries can inform proactive policy decisions.

Dataset and methods

The dataset, featuring 1059 rows and 14 columns, is well-suited for our project, “Visualizing Africa's Economic and Banking Crises” (Table 1). It encompasses a mix of numerical, categorical, and binary data, carefully selected to explore financial stability in Africa. This dataset spans over a century, from 1860 to 2014, and covers 13 African nations, including Algeria, Angola, Central African Republic, Ivory Coast, Egypt, Kenya, Mauritius, Morocco, Nigeria, South Africa, Tunisia, Zambia, and Zimbabwe. Derived from Reinhart et. al's Global Financial Stability dataset, it carries credibility.

The columns encompass a variety of economic indicators and crisis-related variables, including country-specific details such as 'case' and 'country,' temporal data represented by 'year,' and binary indicators denoting systemic crises, domestic debt defaults, sovereign external debt defaults, independence status, currency crises, inflation crises, and banking crises. Additionally, continuous variables like 'exch_usd,' 'gdp_weighted_default,' and 'inflation_annual_cpi' offer valuable insights into exchange rates, GDP-weighted defaults, and annual CPI inflation rates (Table 1). These columns collectively serve as the foundation for our data exploration and visualization, facilitating a comprehensive understanding of financial stability dynamics across African countries.

Importantly, the dataset contains no missing values, ensuring data completeness. Our project will employ diverse data visualization techniques—time series plots, heatmaps, geographic visualizations, bar and pie charts, interactive dashboards, comparative plots, regression plots, box plots, network diagrams, and stacked area charts—to explore historical economic patterns. These techniques are chosen to answer key questions about financial stability factors, inflation, banking stability, and regional disparities across Africa.

As for the dataset's adequacy, it appears well-suited for the project's objectives. The dataset covers a wide temporal range (from 1860 to 2014) and includes 13 African countries, providing a rich historical context for economic analysis. It contains diverse economic variables, including indicators related to crises, debt, inflation, and more, allowing for comprehensive exploratory data analysis. The inclusion of multiple countries enables comparative analysis, while the time series data facilitates trend identification.

Additionally, the dataset's size and scope align with the project's goals of understanding economic and banking crises in Africa. Proper data cleaning and preprocessing will be performed to ensure data quality. The dataset's structure lends itself to various visualization methods, allowing for a holistic exploration of the economic history of the selected countries.

In conclusion, the dataset's comprehensive nature, historical coverage, and variety of economic variables make it suitable for conducting exploratory data analysis and creating a range of informative visualizations to gain insights into Africa's economic and banking crises.

Kinds of visualization methods plan to apply

Time Series Plots: Time series plots will be applied to illustrate how economic indicators, such as exchange rates, inflation rates, and debt levels, have evolved over time for each of the 13 African countries in the dataset. These plots are ideal for showing temporal trends and identifying patterns or cycles.

Heatmaps: Heatmaps will be used to visualize correlations between different economic variables. This method is valuable for identifying relationships, such as whether currency crises are correlated with inflation rates or if banking crises coincide with domestic debt defaults.

Geographic Visualizations: Maps and geographic visualizations will help illustrate how economic events and crises have varied across different regions of Africa. Choropleth maps can provide a clear view of crisis severity or event occurrence by country.

Bar Charts and Pie Charts: Bar charts and pie charts will be employed to represent categorical data, such as the occurrence of systemic crises, banking crises, or sovereign debt defaults. These visualizations offer a quick, easy-to-understand overview of event prevalence.

Comparative Plots: Comparative plots, such as grouped bar charts, will be used to compare economic indicators and crisis occurrences between different countries. These visualizations are valuable for cross-country comparisons and trend analysis.

Regression and Scatter Plots: Scatter plots will be employed to illustrate the relationships between two continuous variables, such as GDP and inflation rates. Regression lines can be added to show trends and correlations, providing a statistical perspective.

1. Dataset sample

case	cc3	country	year	systemic_crisis	exch_usd	domestic_debt_in_default	sovereign_external_debt_default	gdp_weighted_default	inflation_annual_cpi	independence	currency_crises	inflation_crises	banking_crisis
1	DZA	Algeria	1870	1	0.052	0	0	0	3.441	0	0	0	crisis
1	DZA	Algeria	1871	0	0.053	0	0	0	14.149	0	0	0	no_crisis
1	DZA	Algeria	1872	0	0.052	0	0	0	-3.719	0	0	0	no_crisis
1	DZA	Algeria	1873	0	0.052	0	0	0	11.204	0	0	0	no_crisis
1	DZA	Algeria	1874	0	0.051	0	0	0	-3.849	0	0	0	no_crisis
1	DZA	Algeria	1875	0	0.052	0	0	0	-20.924	0	0	0	no_crisis
1	DZA	Algeria	1876	0	0.052	0	0	0	-1.770	0	0	0	no_crisis
1	DZA	Algeria	1877	0	0.052	0	0	0	29.116	0	0	1	no_crisis
1	DZA	Algeria	1878	0	0.052	0	0	0	-1.493	0	0	0	no_crisis

Table 1. Sample of the dataset

2. Methodology

Data Preparation: Acquire and preprocess the dataset, ensuring completeness and handling missing values.
Exploratory Data Analysis (EDA): Understand dataset characteristics, compute summary statistics, and identify correlations.
Data Visualization Techniques: Utilize various visualizations like time series plots, heatmaps, geographic maps, bar/pie charts, interactive dashboards, and more to answer research questions.
Interpretation and Insights: Analyze visualizations to extract insights on economic stability, crises, and trends.
Reporting and Conclusion: Communicate and summarize findings clearly through reports and visualizations.

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