# Project Report: Interactive Dashboard for Macroeconomic Indicators

## Group 05

*Vu Tuyet Vy (V202401789)*
*Pham Quoc Cuong (V202401658)*

## 1. Introduction

Economic monitoring is essential for policy-making, investment decisions, and academic research to make informed decisions. Macroeconomic trends such as GDP growth, inflation, trade balances, and financial indicators reflect the trajectory of an economy. Large volumes of data often exists across fragmented platforms such as the World Bank, IMF, and OECD databases. Among those, the World Bank provides one of the most comprehensive and reliable open datasets for such macroeconomic indicators, covering a wide range of countries, years, and development categories. In many cases, users face several problems when they want to explore trends or conduct comparative analysis, since they have to download multiple datasets manually and perform time-consuming analysis. This cause technical challenges especially for those who are not familiar with data wrangling or visualization tools.

For instance, understanding macroeconomic trends across various countries is challenging due to the following constraints:

- Data Complexity: require knowledge of specific indicator codes, and metadata.
- Fragmented Access: require download and filter large datasets manually.
- Static Reporting: not allow for dynamic exploration & filtering.
- Limited Comparative: difficult to compare cross-countries indicators interactively.

Our motivation is to simplify this task by creating an intuitive, interactive platform that consolidates critical economic data from reliable sources such as the World Bank, and centralize the information into a single interactive dashboard.

The data utilized in this project is sourced from the World Bank. The dataset covers advanced economies as well as emerging markets and developing economies, with data availability at annual frequency from the year 2000 to 2023

The data covers diverse areas including consumer prices, exchange rates, GDP, industrial production, merchandise trade, unemployment data. Given that data for different indicators are stored in separate Excel/CSV files and not all countries provide complete data for every indicator, our team has carefully reviewed and selected a set of representative countries. We processed and integrated these separate datasets into a unified, comprehensive data model suitable for interactive visualizations.

Specifically, the indicators selected for our analysis are:

Economic & Social Indicators:

- GDP growth (real and nominal, year-over-year)
- Inflation rates (Consumer Price Index, both headline CPI and core CPI)
- Unemployment rate

Trade Indicators:

- Merchandise exports and imports (current USD, seasonally adjusted)
- Trade balance (exports minus imports)

Financial & Monetary Indicators:

- Official exchange rates (local currency units per USD)

With this dashboard, we hope that reader can find out:

- What economic and social trends and characteristics emerged among the selected countries from 2000 to 2023?
- How have international trade conditions and trade balances evolved across these countries during this period?
- What notable fluctuations occurred in financial and monetary indicators, such as exchange rates, during this time?

## 2. Methodology

## 2.1. General Method

### Data Acquisition and Preprocessing

Data was sourced from the World Bank, downloaded in Excel format, and includes key macroeconomic indicators for the selected countries from 2000–2023. Each Excel file corresponds to a particular economic indicator, initially stored in a wide format. Using R's tidyverse packages, specifically dplyr and tidyr, we transformed and cleaned the data into a long format to facilitate dynamic plotting and analysis.

### Dashboard Implementation

We implemented the interactive dashboard using Shiny and shinydashboard. The visualization capabilities were enhanced by integrating ggplot2 for plotting, combined with plotly for interactive plots, tooltips, and dynamic legend interactions. Various widgets from Shiny, including sliderInput and selectInput, were utilized to offer users intuitive control over the analysis parameters, such as time ranges, country selections, and indicator types.

### Visualization Techniques

- Line charts: Used for illustrating trends over time for indicators such as GDP growth, inflation rates, and trade metrics.
- Waterfall charts: Adopted specifically for visualizing aggregated trade balances, clearly demonstrating the positive or negative contributions of exports and imports.
- Scatter plots and Bubble charts: Implemented to examine correlations and relationships between different economic variables dynamically.

## 3. Dashboard Introduction

The dashboard is organized into three clear and user-friendly tabs, each with distinct functionalities and insights.

### Tab 1: Economic & Social Overview

This tab provides an overview of economic and social conditions through interactive visualizations of GDP growth, inflation, unemployment, and industrial production.

- KPI Cards: Summarize recent performance, presenting quick insights on average GDP growth, inflation, unemployment rates, and industrial production levels for the latest year.

- Line Chart: Illustrates historical trends and comparisons of economic indicators across selected countries.
- Ranking Chart: Displays country rankings for the latest year for each indicator, enabling quick comparisons.
- Scatter Plot: Facilitates exploration of potential correlations between various indicators, such as the relationship between unemployment and GDP growth.

**Tab 2: Trade Balance**

The second tab concentrates on international trade dynamics, analyzing exports, imports, and overall trade balances comprehensively.

- Waterfall Chart: Clearly presents the cumulative trade balance over the selected period, distinctly visualizing contributions of exports and imports by country.
- Line Charts: Show trends of exports and imports individually across the years, highlighting structural changes and growth dynamics.
- Bubble Chart: Explores the relationship between trade balances and GDP, with bubble sizes representing GDP, providing additional layers of insights regarding economic scale and trade positions.

**Tab 3: Financial & Monetary Indicators**

This final tab evaluates key financial and monetary indicators, focusing specifically on exchange rate movements.

- FX Rate Line Chart: Tracks the evolution of exchange rates (local currency per USD) over time, helping users understand currency volatility and relative stability across countries.
- KPI Scorecard: Summarizes the most recent average FX rates to quickly identify significant currency movements.

**4. Key Findings**

Our analysis of the dashboard and the underlying data produced several critical insights:

**Economic Growth and Stability**

- China and India exhibited robust GDP growth, consistently surpassing advanced economies like the U.S., Germany, and Japan.
- Germany and Japan experienced stable but modest growth, reflective of mature and developed economies.

**Inflation Trends**

- Brazil faced highly volatile inflation, especially pronounced in the early 2000s and after 2010, highlighting its economic vulnerability to external shocks.
- China maintained low, stable inflation rates, demonstrating effective macroeconomic management.

**Labor Market Dynamics**

- South Africa consistently had the highest unemployment rates among the selected countries, exceeding 30% in recent years, reflecting persistent labor market challenges.
- Vietnam and Japan maintained low unemployment rates, indicative of strong employment structures and effective labor policies.

**Industrial Production**
- The United States and China led global industrial production, with China's rapid expansion significantly reshaping global manufacturing trends, notably after 2005.

**Trade Balance Insights**
- China and Germany consistently maintained substantial positive trade balances, reflecting export-oriented economic strategies.
- The United States consistently recorded significant trade deficits, highlighting structural dependence on imports and consumption-led growth.

**Exchange Rate Movements**
- Japan and Brazil experienced considerable exchange rate fluctuations, influenced by global market volatility and domestic economic policies.
- Vietnam showed gradual currency depreciation, indicative of cautious monetary policy adjustments.

## 5. Discussion

The interactive dashboard significantly simplifies comparative analysis by:
- Offering seamless integration and visualization of multiple indicators.
- Allowing for interactive exploration, enabling customized analyses by policymakers and researchers.
- Enhancing the efficiency and intuitiveness of economic data exploration through advanced visualization methods like waterfall and bubble charts.

Despite the dashboard's robustness and interactivity, there are several limitations:
- Data Gaps and Consistency: Some countries have incomplete or irregular reporting, potentially impacting the consistency and comprehensiveness of analyses.
- Indicator Scope: Limited to macro-level indicators; microeconomic factors or sector-specific insights are beyond the dashboard's scope.
- Real-Time Data Integration: Current implementation relies on static data updates rather than dynamic API integration for real-time analytics.

## 6. Future Directions

To enhance the usability and impact of the dashboard, future improvements could include:
- Expanded Indicator Coverage: Incorporating additional economic, financial, and social indicators such as government debt, fiscal balances, and socioeconomic measures to broaden analytical depth.
- Advanced Analytical Tools: Adding predictive analytics, scenario simulations, and forecasting capabilities, enhancing decision-making and policy simulation functionalities.

The developed dashboard not only simplifies complex macroeconomic analysis but also serves as a powerful educational tool and decision-support platform for policy makers, economists, students, and general users interested in global economic dynamics.

## 7. Conclusion

Our interactive Shiny dashboard effectively addresses the challenges of fragmented data access and complexity in macroeconomic analysis. By enabling dynamic comparisons, intuitive

exploration, and real-time insights, this solution significantly simplifies and enhances the process of economic monitoring and analysis. The comprehensive visualization of macroeconomic indicators across multiple countries provides valuable insights, facilitating informed economic decision-making and enriching academic research.