GDP and Its Determinants: Investigating the Impact of FDI, Inflation, Unemployment, and Exchange Rates

A Project report submitted for partial fulfillment of the Degree of Bachelor of Science

School of Statistics
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FORWARD

I feel immense pleasure to forward the project entitled "GDP and Its Determinants: Investigating the Impact of FDI, Inflation, Unemployment, and Exchange Rates" submitted by Nishant Deshmukh (VI semester) for fulfilment of the requirements for the degree Bachelor of Science (Hons.) in Applied Statistics and Analytics at the School of Statistics, DAVV, Indore.

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CERTIFICATE

The research work embodied in the present project entitled "GDP and Its Determinants: Investigating the Impact of FDI, Inflation, Unemployment, and Exchange Rates" has been carried out in the supervision of Dr. Arpita Lakhre. The work reported herein is original and does not form part of any other report or dissertation based on which a degree or award was conferred on an earlier or to any other scholar. I understand the University's policy on plagiarism and declare that the project and publications are my own work, expect where specifically acknowledged as has not been copied from other sources or been previously submitted for award of assessment.

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Special thanks go to my friends and family for their unwavering support and understanding during the demanding phases of the project. Their encouragement kept me motivated and focused, even in challenging times.

Lastly, I want to acknowledge the participants and respondents who generously contributed their time and insights, making this project more comprehensive and meaningful.

Thank you to everyone who played a part, no matter how big or small, in bringing this project to fruition.

Nishant Deshmukh

DECLARATION

I, Nishant Deshmukh, a student of B.Sc.(Hons) Applied Statistics & Analytics at the School of Statistics, Devi Ahilya Vishwavidyalaya, declare that the project report titled "GDP and Its Determinants: Investigating the Impact of FDI, Inflation, Unemployment, and Exchange Rates " is my original work under the guidance of Dr. Arpita Lakhre.

I affirm that this project has not been submitted elsewhere for any other degree or diploma, and the sources of information used in this report have been duly acknowledged. Any contribution from other individuals or sources has been appropriately credited.

I also declare that the project work complies with the academic standards and guidelines provided by the university. The data, analysis, and conclusions presented in this report are authentic and reflect my efforts in exploring the topic.

I understand the consequences of providing false information and plagiarism, and I take full responsibility for the content presented in this project report.

Date:

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GDP and Its Determinants: Impact of FDI, Inflation, Unemployment, and Exchange Rates on GDP

Abstract:

In the world of economics, understanding the intricate relationships between various macroeconomic indicators is crucial for policymakers, investors, and researchers alike. This research project, titled "GDP and Its Determinants," endeavors to provide a thorough study of exploring the dynamics between Gross Domestic Product (GDP) and a cluster of other key variables: Foreign Direct Investment (FDI), inflation, unemployment, and exchange rates. These variables collectively influence and reflect the economic health and performance of a nation, making their interplay a subject of significant interest and importance.

GDP serves as a fundamental measure of a country's economic output over a specific period, encapsulating the total value of goods and services produced within its borders. Foreign Direct Investment, on the other hand, represents capital invested by foreign entities into domestic enterprises, often indicative of economic confidence and growth prospects. Inflation, a measure of the general rise in prices over time, impacts consumer purchasing power and economic stability. Unemployment rates reflect the portion of the workforce actively seeking but unable to find employment, offering insights into labor market conditions. Exchange rates, determining the value of one currency relative to another, influence trade balances and international competitiveness.

This project uses a method called multiple regression to study how these factors work together to impact GDP. By analyzing their relationships, we can understand better how FDI, inflation, unemployment, and exchange rates affect a country's economic growth. The study utilizes secondary data from reliable sources, including the World Bank and GitHub, covering Indonesia from 1983 to 2012. To ensure the accuracy and validity of the results, various statistical methods were employed, including t-tests, chi-square tests, ANOVA, and correlation analyses. These methods were used to identify patterns and relationships within the data, providing a comprehensive understanding of how these economic variables interact with GDP growth.

Such insights are crucial for policymakers, economists, and stakeholders involved in economic planning, providing empirical evidence to support informed decision-making and strategic interventions. The study provides valuable insights that can guide efforts to enhance economic performance and address challenges such as inflation and unemployment.

Introduction:

In today's globalized world, numerous factors influence a nation's economic well-being, as reflected by its Gross Domestic Product (GDP). Factors such as open economies and digital transaction/payment gateways strengthen economic relations between countries, fostering trade and investment flows. Foreign Direct Investment (FDI) and exchange rates also play pivotal roles, influencing a nation's economic stability and growth trajectory. Additionally, variables like unemployment and inflation directly impact domestic consumer spending and production costs, thus affecting overall economic health.

These factors, including the effects of FDI, unemployment rates, exchange rate fluctuations, and inflation, collectively shapes a nation's GDP by influencing consumption, investment, and export competitiveness. Ultimately, these dynamics ripple through the entire economy, affecting a country's overall economic growth and socio-economic development.

- **Problem and Motivation:**

With the explosive growth of social media in everyday communication, there has been a corresponding surge in its incorporation into teaching and learning in higher education. By analyzing these interdependencies through multiple regression analysis and employing rigorous statistical methods, this study seeks to provide empirical insights that can guide informed decision-making and policy interventions aimed at enhancing economic performance and addressing challenges like inflationary pressures and unemployment.

Understanding the factors influencing a nation's GDP is crucial, but it's not always straightforward. Policymakers often struggle to understand how these factors work together to design the best economic plans.

- **Purpose of the Study:**

This research aims to illuminate the intricate relationship between Gross Domestic Product (GDP) and key economic determinants, namely Foreign Direct Investment (FDI), inflation, unemployment, and exchange rates. By systematically examining both the individual and combined impacts of these factors on GDP, the study seeks to uncover patterns and trends that elucidate how different economic conditions and policies influence overall economic growth. These insights are intended to facilitate the development of informed, data-driven strategies aimed at fostering sustainable economic growth and prosperity.

- **Research Question:**

The primary research question guiding this study is, "What is the impact of FDI, Inflation, Unemployment, and Exchange Rates on GDP?" To delve deeper into this inquiry, the following questions are considered:

1. How does foreign direct investment (FDI) and exchange rate collectively/individually influence a nation's gross domestic product (GDP)?
2. How does unemployment rate and inflation impact Gross Domestic Product (GDP) in various economic scenarios?
3. What is the effect of exchange rate fluctuations on a country's Gross Domestic Product (GDP) and how do these factors interact with each other to collectively shape economic growth and stability?

- **Significance of the Study:**

Understanding how FDI, Inflation, Unemployment, and Exchange Rates influences GDP is of great relevance to economist, researchers, policymaker, and various stakeholders in the economy. The outcomes of this study can inform strategies and attitudes towards the economic forecasting by identifying trends and patterns that can guide strategic decision-making for businesses and investors. In the context of global economic integration, understanding these dynamics helps elucidate how international economic trends impact domestic GDP and vice versa. Academically, this research enriches the literature by contributing empirical evidence that substantiates and extends existing economic theories.

Review of the Related Literature:

- **Econometrics:**

Econometrics bridges the gap between economic theory and the messy world of real data. It uses statistical methods and mathematics to transform economic theories into tools for analysis and policymaking. The core technique is regression analysis, which helps quantify how changes in one variable, like FDI, Inflation, Unemployment, and Exchange Rates, affect another, like GDP. This literature review aims to synthesize existing research on how these determinants interact with GDP, utilizing econometric techniques to analyze empirical studies and theoretical frameworks. By identifying gaps and inconsistencies, this review seeks to contribute to a deeper understanding of how these factors collectively shape economic performance and inform policy decisions.

- **Regression Analysis:**

Regression is a statistical method used to model the relationship between a dependent variable and one or more independent variables. In simple linear regression, a single independent variable predicts the dependent variable based on a linear relationship. Multiple regression extends this by incorporating multiple independent variables to predict the dependent variable, accounting for complex interactions and influences among variables. Each independent variable in multiple regression has its own coefficient, indicating the strength and direction of its impact on the dependent variable while holding other variables constant. This technique is valuable across various disciplines, allowing researchers to analyze and predict outcomes based on several contributing factors simultaneously. It's widely applied in fields like economics, social sciences, business, and more, providing insights into how different variables collectively influence and explain phenomena of interest.

"Regression Analysis is a Statistical technique that actually explains the change in dependent variable due to movement in other independent variables. It is a technique of predicting the unknown variable through the known variables."

- **Economic Terms Used in Project:**

This project covers various economic terms such as GDP, FDI, inflation, unemployment, and exchange rates, which are explained in detail below.

- **Gross Domestic Production**

Gross domestic product (GDP) is the total monetary or market value of all the finished goods and services produced within a country's borders in a specific time period. As a broad measure of overall domestic production, it functions as a comprehensive scorecard of a given country's economic health. Gross Domestic Product is one of the most important indicators of the economic status of a country. GDP or Gross Domestic Product is referred to by the economists as the size of an economy.

- **Foreign Direct Investment**

Foreign Direct Investment (FDI) refers to the investment made by a company or individual from one country in another country with the aim of establishing a lasting interest in the business of the host country. In other words, it is a cross border investment where a company or individual in one country invests in another country with the objective of establishing a long-term business relationship. FDI is an important driver of economic growth. Foreign Direct Investment (FDI) can bring many advantages to the host country, including:

1. Increased capital inflows and investment opportunities.
2. Creation of new job opportunities and skill development.
3. Transfer of technology and knowledge spillovers.
4. Improved infrastructure and economic growth

- **Inflation**

Inflation refers to a sustained and general increase in the prices of goods and services in an economy over time. Inflation occurs when there is too much money chasing too few goods, leading to an imbalance between supply and demand. The main causes of inflation include an increase in the money supply, rising production costs, and high demand for goods and services. Inflation can have both positive and negative effects on the economy, depending on the level and duration of the inflationary pressures. Moderate inflation can stimulate economic growth and investment, while high or unpredictable inflation can reduce consumer purchasing power, erode savings, and lead to economic instability.

- **Unemployment**

Unemployment refers to the state of being without a job but actively seeking Employment. It is a measure of the number of people in the workforce who are willing and able to work but are unable to find employment. Unemployment is a key indicator of the health of an economy, and high levels of unemployment can indicate an underutilization of resources and a decline in economic growth.

- **Exchange Rate**

Exchange rate refers to the value of one currency in terms of another currency. It represents the price at which one currency can be exchanged for another currency in the foreign exchange market. Exchange rates are determined by market forces of supply and demand, and they fluctuate constantly depending on a variety of factors, including trade flows, investment flows, geopolitical events, and monetary policy decisions. Exchange rates can affect the economy in multiple ways, including:

1. International trade: Exchange rates can influence the competitiveness of exports and imports.
2. Inflation: Exchange rates can affect the prices of imported goods and services, which can impact domestic inflation.
3. Capital flows: Exchange rates can influence the inflow or outflow of foreign investment.
4. Government finances: Exchange rates can impact government finances through their effects on exports, imports, and capital flows.

Research Methodology:

- **Scope:**

The main aim of this project is to finding the relationship among foreign direct investment, inflation rate, unemployment rate, and exchange rate toward the economic growth based on the multiple linear regression analysis. The study aims to explore how these macroeconomic variables affect GDP and each other, and to identify the factors that contribute to economic growth and development. The analysis will be based on empirical data and will utilize various econometric techniques to measure the causal relationships between the variables.

- **Survey Method:**

The analysis and regression analysis of the relationship between gross domestic product and foreign direct investment, inflation, unemployment, and exchange rate of India is a complex task that requires a significant amount of time, effort, and resources. To ensure the accuracy and validity of the results, I have decided to use secondary data from reputable sources, such as World Bank and GitHub.

- **Statistical Analysis:**

Descriptive statistics, including mean, median, and frequency distributions, will be employed to provide a concise summary of the data on GDP, Foreign Direct Investment (FDI), inflation, unemployment, and exchange rates. These measures offer a clear snapshot of central tendencies and distribution characteristics within the dataset. For inferential statistics, the focus will be on multiple regression analysis and appropriate statistical tests to explore relationships between variables. Multiple regression analysis will help uncover potential associations and quantify the impact of FDI, inflation, unemployment, and exchange rates on GDP. Additionally, statistical tests, such as t-tests or ANOVA, will be utilized to assess the significance of observed differences and interactions among these economic determinants.

- **Data Collection:**

Conducting a comprehensive analysis and regression examination of the relationship between Gross Domestic Product (GDP) and key factors such as Foreign Direct Investment (FDI), inflation, unemployment, and exchange rates in India is an intricate task that demands considerable time, effort, and resources. To ensure that the findings are both accurate and reliable, I will utilize secondary data from esteemed sources like the World Bank and GitHub. This strategy allows us to benefit from the expertise of other researchers and access high-quality datasets, thereby enhancing the rigor and credibility of our study. By relying on secondary data, we can concentrate on interpreting and contextualizing the results effectively.

- **Conceptual Paradigm:**

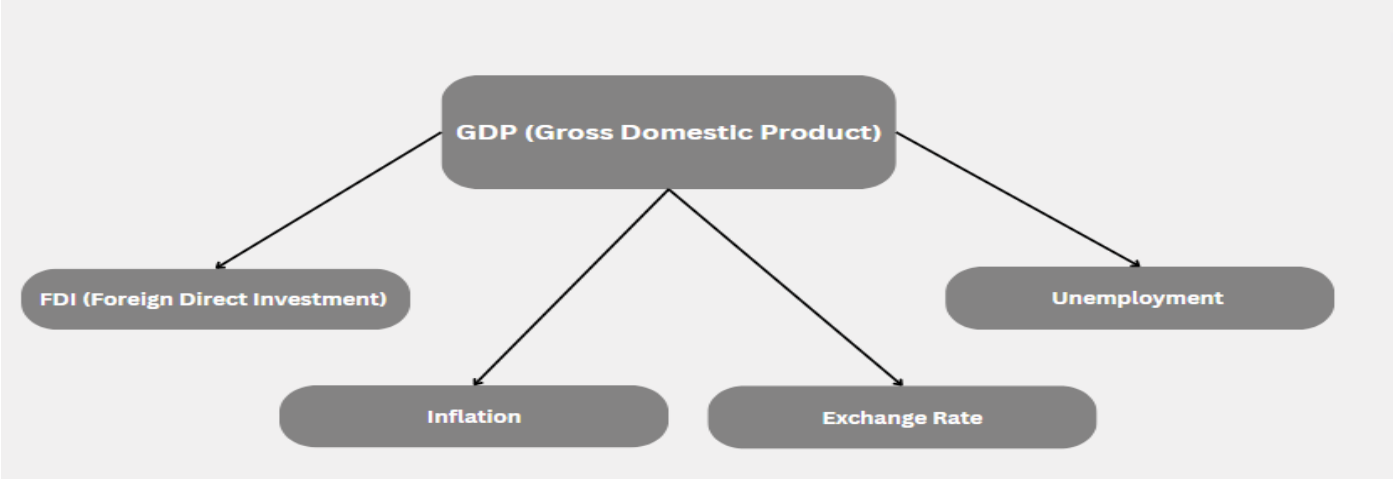


Fig. 01 Fisher-Bone Diagram.

Limitations:

While this research aims to provide valuable insights into the relationships between social media use, academic performance, and sleep patterns among students, it is essential to acknowledge certain limitations that may impact the interpretation of findings:

- The data used in this study pertains to Indonesia, a relatively developed country, which may limit the generalizability of the findings to other nations with different economic contexts and levels of development.
- **Data Limitations:** The quality and availability of data from secondary sources like the World Bank and GitHub may vary, potentially impacting the accuracy and reliability of the analysis.
- **Assumption of Linearity:** The regression model assumes linear relationships between GDP and the independent variables (FDI, inflation, unemployment, exchange rates). In reality, these relationships may be non-linear or exhibit time-varying dynamics.
- **Endogeneity:** There is a possibility of endogeneity, where GDP and the independent variables (e.g., FDI) influence each other simultaneously. This can bias the regression results if not properly addressed.
- **Model Specification:** The simplicity of the regression model may overlook interactions or nonlinear effects among the variables, which are common in economic systems.
- **External Shocks:** Economic shocks such as financial crises or natural disasters can significantly impact GDP independently of the variables studied, affecting the validity of the model's predictions.

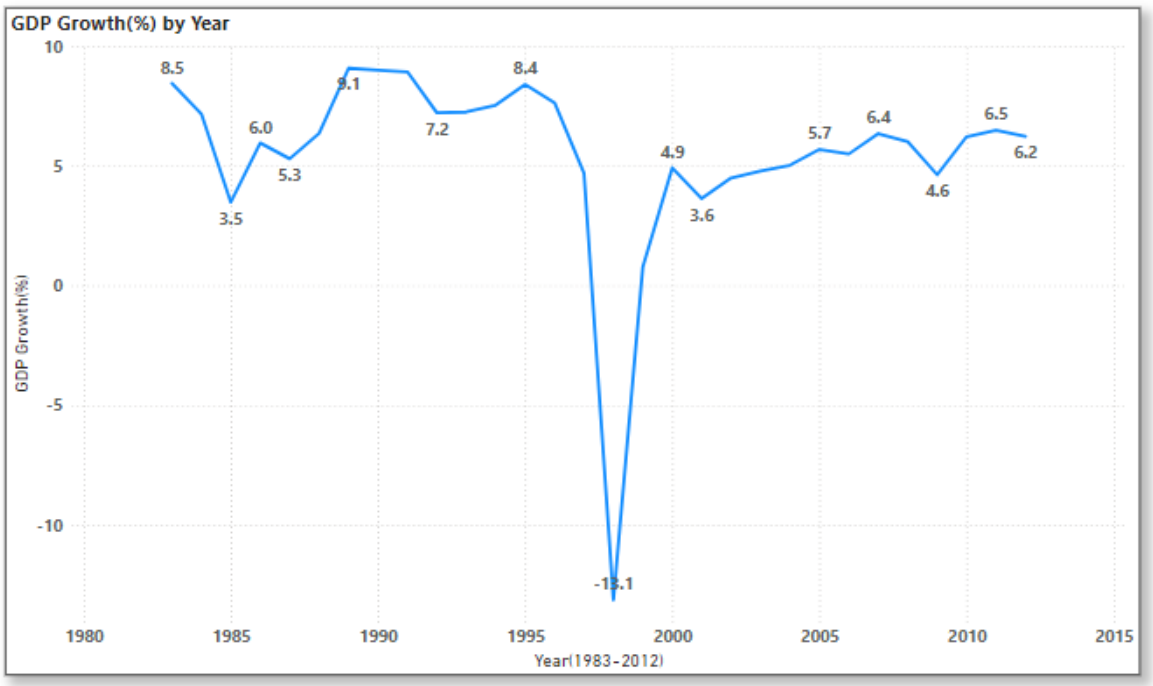
Data Visualization and Analysis:

To understand data better, data was collected and carefully looked into involving careful sorting and exploration to extract important details. Utilizing Power BI and various visualization tools such as pie charts, histograms, and bar charts, the data was transformed into clear and informative visuals. This approach aimed at conducting Exploratory Data Analysis (EDA) to uncover meaningful insights and patterns within the dataset. Through this process, a comprehensive understanding of the data was achieved, providing valuable insights for further analysis.

- **Trend Chart GDP Growth:**

The Trend chart visually depicts the GDP distribution over years (1983 to 2012). The average value of GDP Growth in the given time frame was 5.47, with the highest recorded value of 9.08 in 1989 and the lowest recorded value of -13.13 in 1998. This chart offers a glimpse into the ever-fluctuating nature of economic growth.

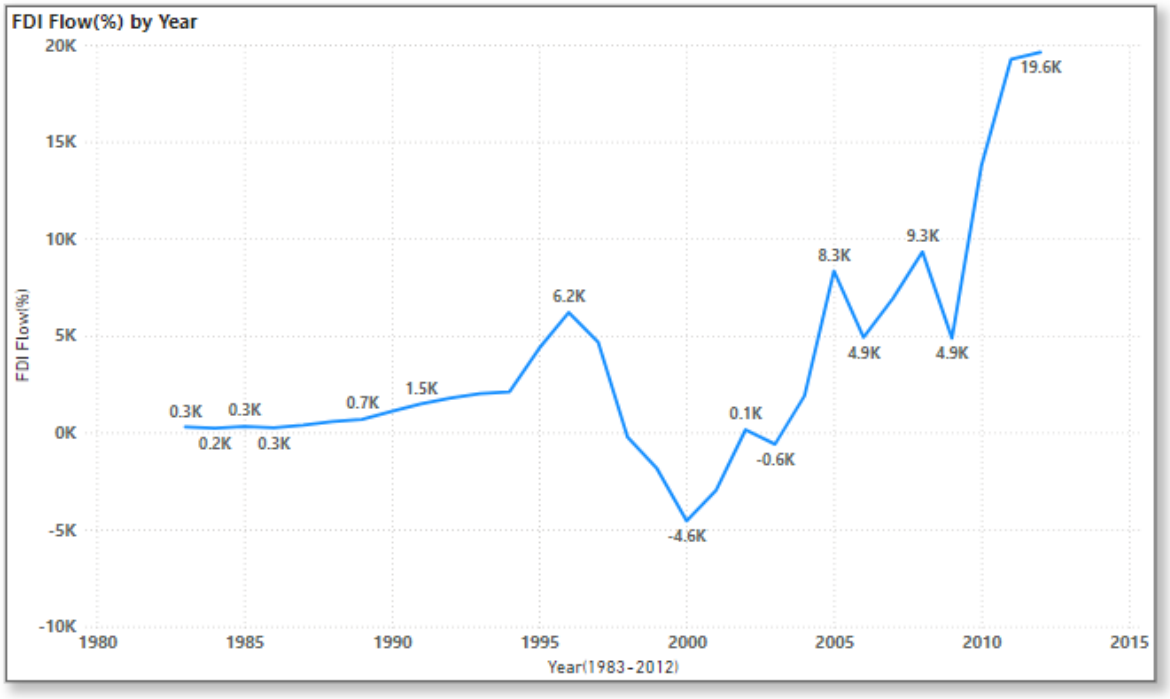
The year 1989 stands out as a period of exceptional economic prosperity, with a peak growth rate of 9.08%. Conversely, the data demonstrates a substantial decline in 1998, registering a nadir of -13.13%. This pronounced volatility underscores the inherent cyclical nature of economic growth and the importance of implementing policies that promote stability while capitalizing on periods of high growth.



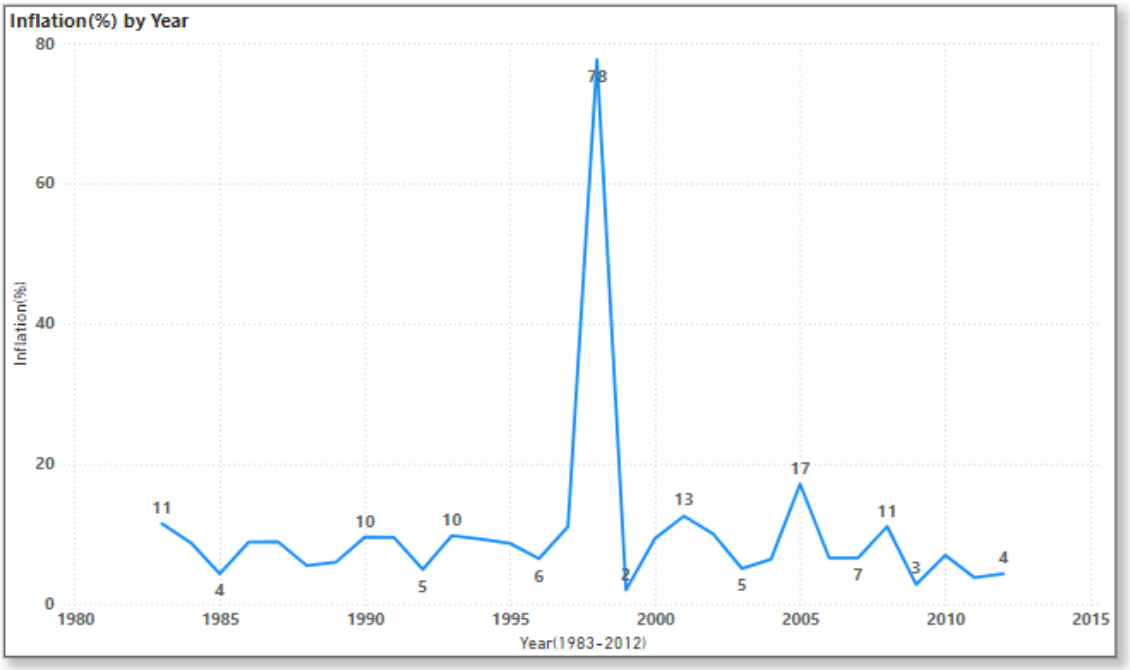
The substantial disparity between the peak and trough years highlights the need for robust economic frameworks that can mitigate the negative impacts of downturns while fostering sustainable growth over the long term.

- **Trend Chart FDI Flow:**

The average FDI was 3,507,390,693 with the highest recorded value of 19,618,049,398 in 2012 this suggests a period of strong investor confidence, potentially driven The Trend chart visually depicts the FDI inflow over years (1983 to 2012) by factors like political stability, attractive business environments, or lucrative market opportunities. Conversely, the data dips in 2000, recording a low of 4,550,355,286.



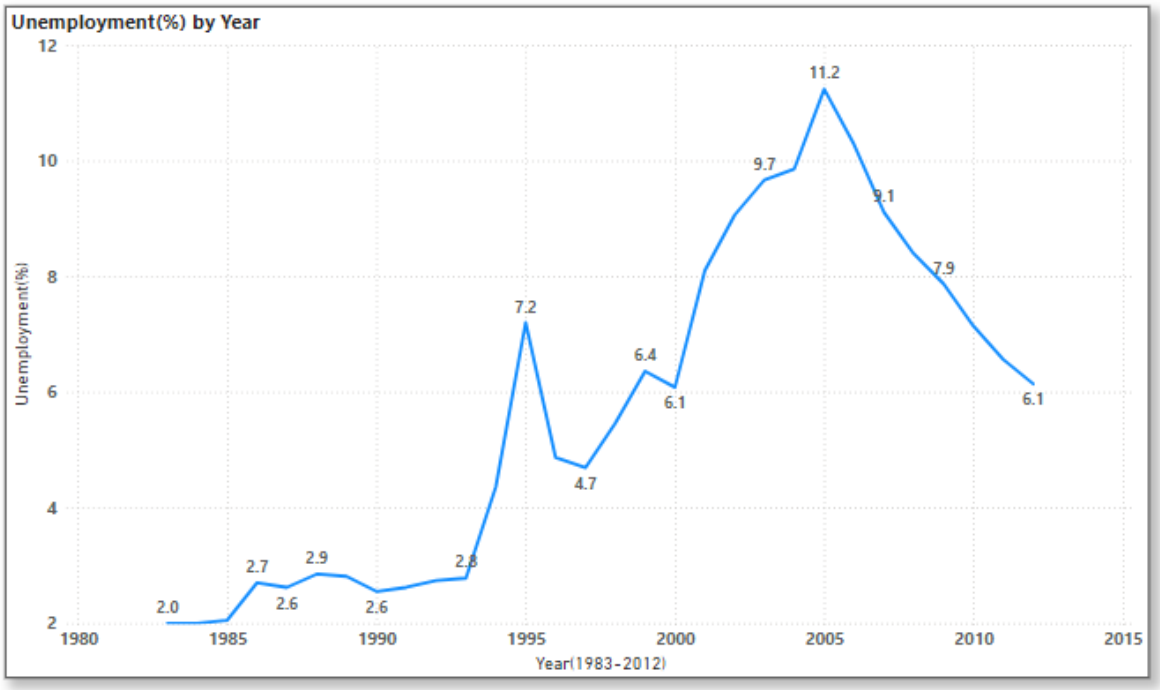
- **Trend Chart Inflation:**



The trend of inflation over the years exhibits considerable variability, with an average rate of 10.17%. The inflation rate peaked at 77.63% in 1998, potentially attributable to economic instability and external shocks. Conversely, the lowest recorded value of 2.01% occurred in 1999, likely resulting from successful stabilization policies. These extremes underscore the difficulties in achieving price stability and emphasize the necessity for adaptive economic management to mitigate the adverse effects on the economy and the general population.

- **Trend Chart Unemployment:**

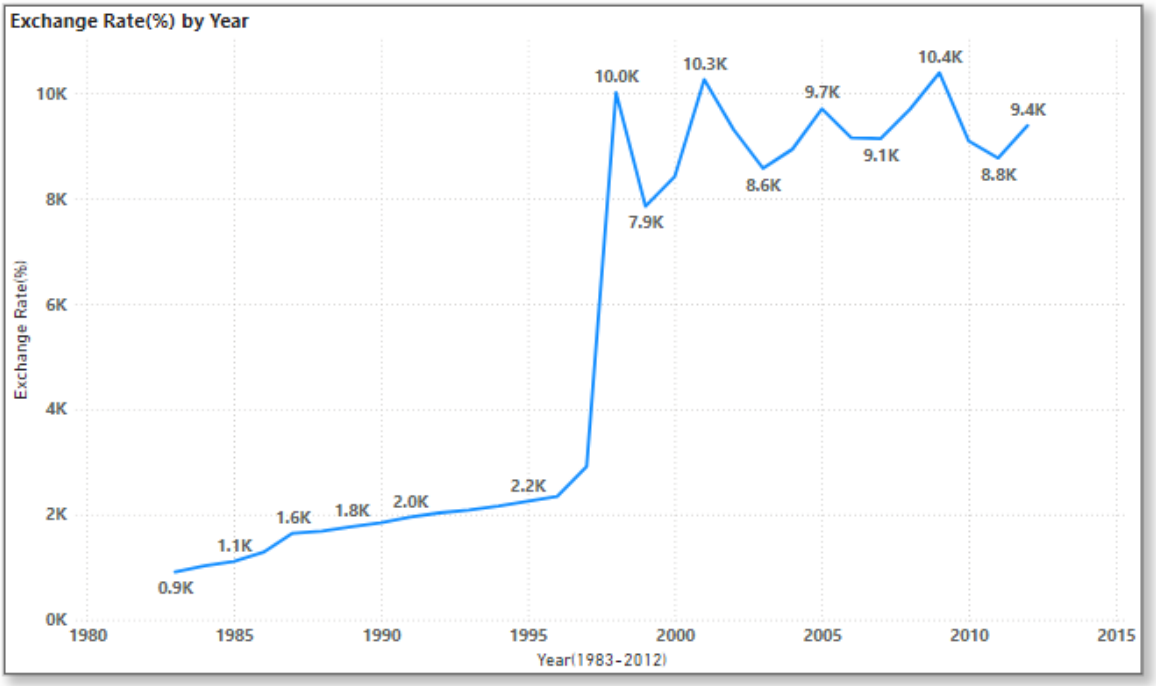
The trend of unemployment over the years demonstrates notable variability, with an average rate of 5.67%. The unemployment rate reached its peak at 11.24% in 2005, potentially due to economic downturns and structural adjustments. Conversely, the lowest recorded value of 2.00% occurred in 1983-1984, likely reflecting robust economic conditions and effective employment policies. These extremes highlight the challenges in maintaining stable employment levels and emphasize the importance of adaptive economic management to mitigate the adverse impacts on the labor market and overall economic stability.



- **Trend Chart Exchange Rates:**

The trend of the exchange rate over the years reveals significant fluctuations, with an average rate of 5523.97. The exchange rate peaked at 10389.94 in 2009, likely due to economic instability and shifts in global market dynamics. In contrast, the lowest

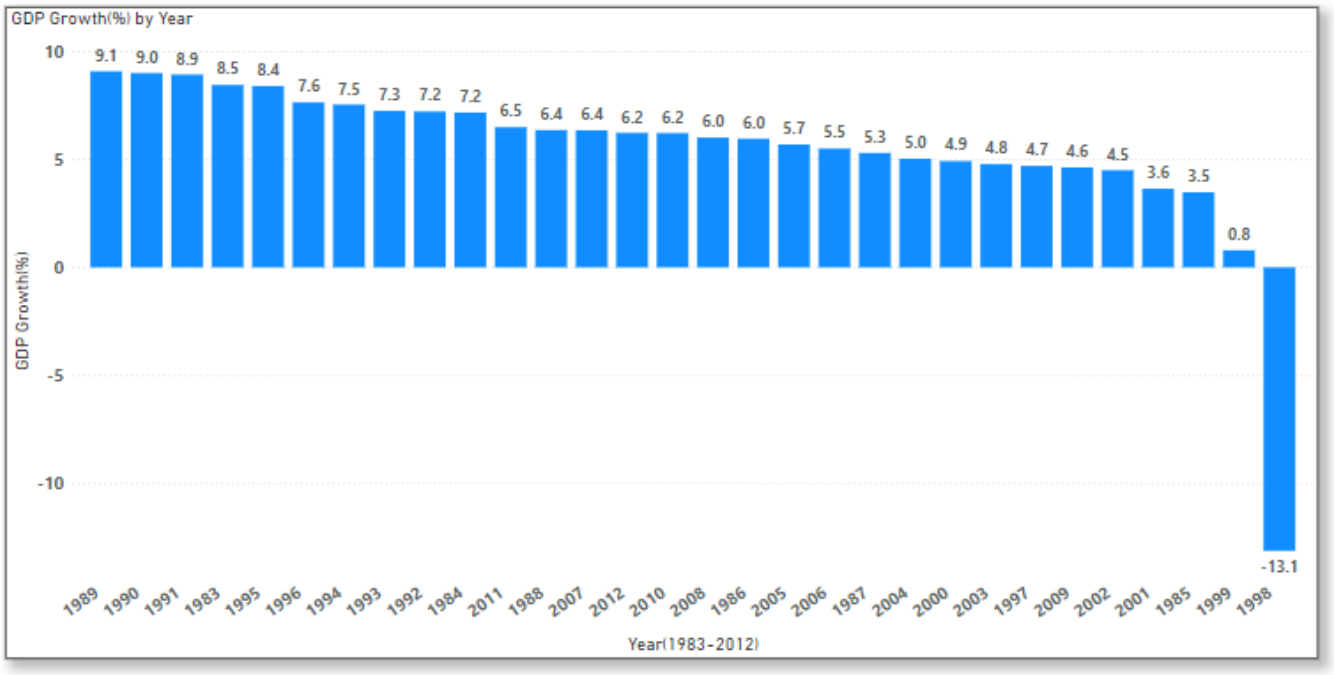
recorded value of 909.26 occurred in 1983, reflecting stronger economic conditions and more favorable trade balances. These extremes underscore the complexities of maintaining exchange rate stability and highlight the necessity for adaptive economic policies to mitigate adverse impacts on the economy and international trade.



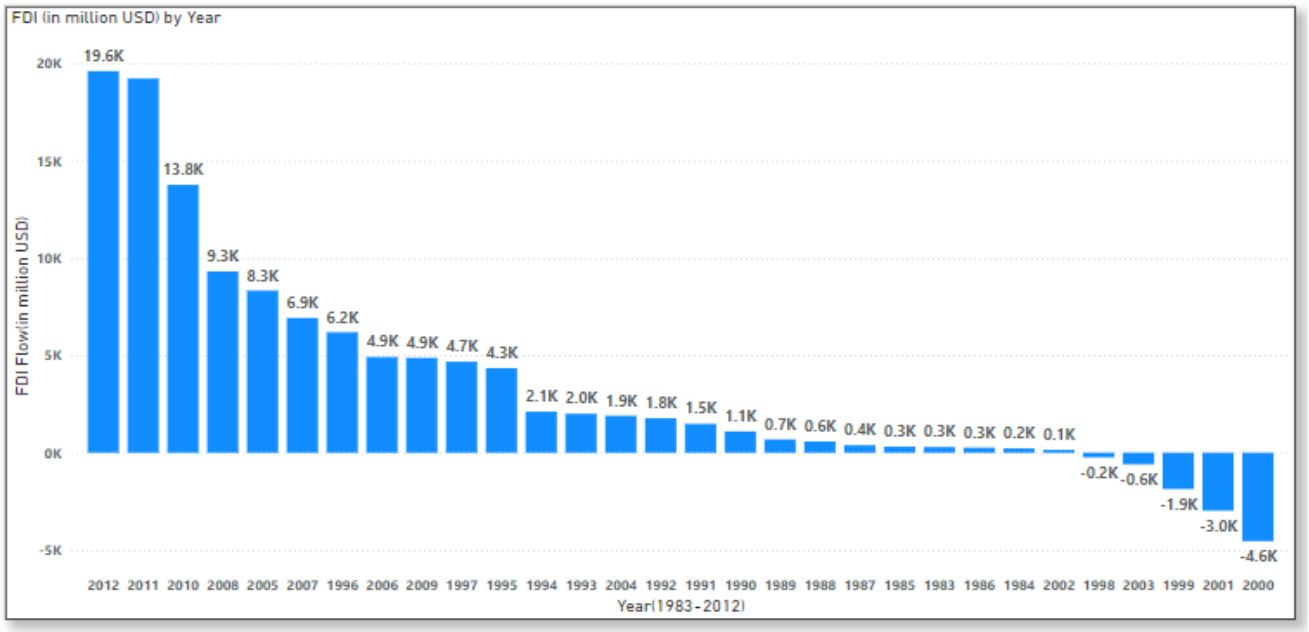
- **Bar Graph:**

To aid visualization and exploratory data analysis (EDA), I plotted bar graphs for various economic indicators. These include GDP growth by year, FDI inflow by year, exchange rates by year, inflation by year, and unemployment by year. These visualizations help to identify trends, patterns, and anomalies over time, providing a clearer understanding of the economic landscape and facilitating more informed analysis and decision-making.

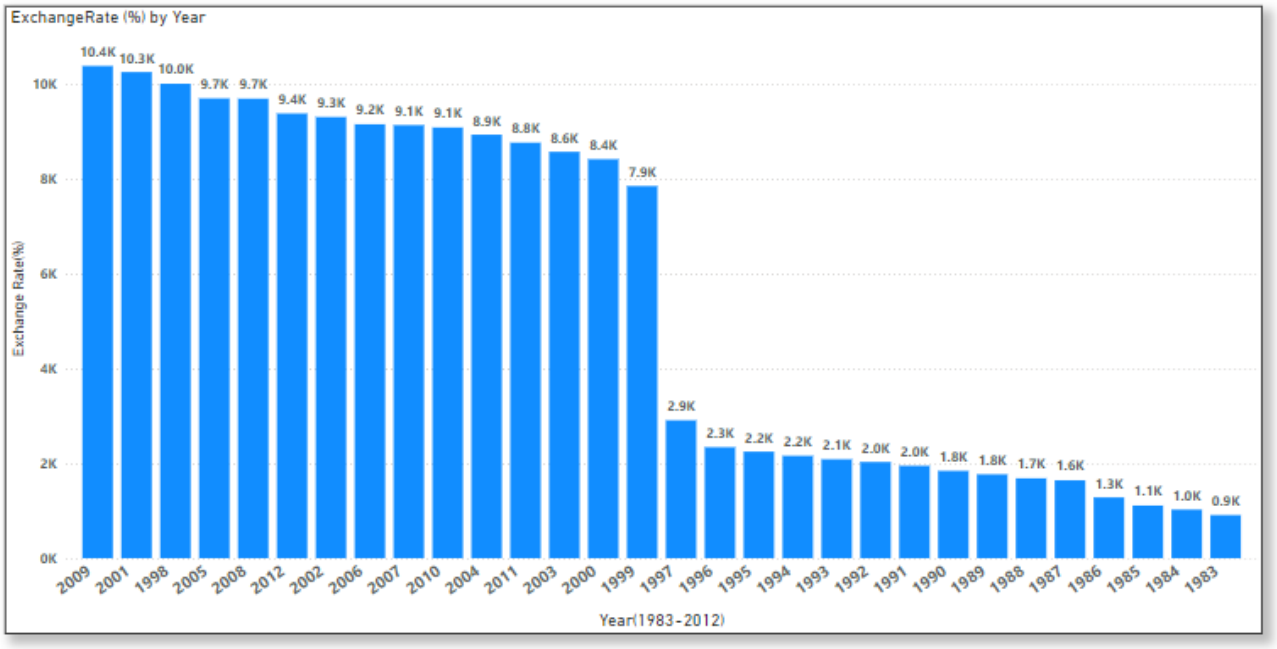
- Bar chart of GDP Growth (in percentage) by year:



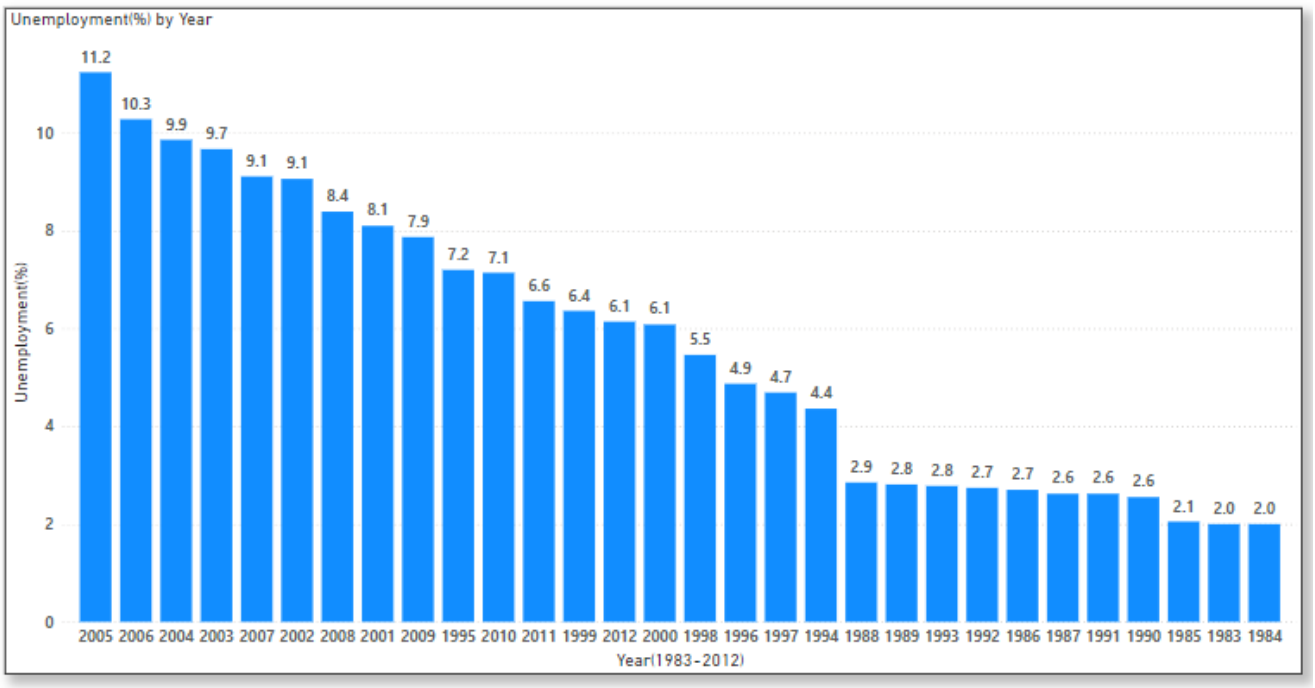
- Bar chart of FDI inflow (in million USD) by year:



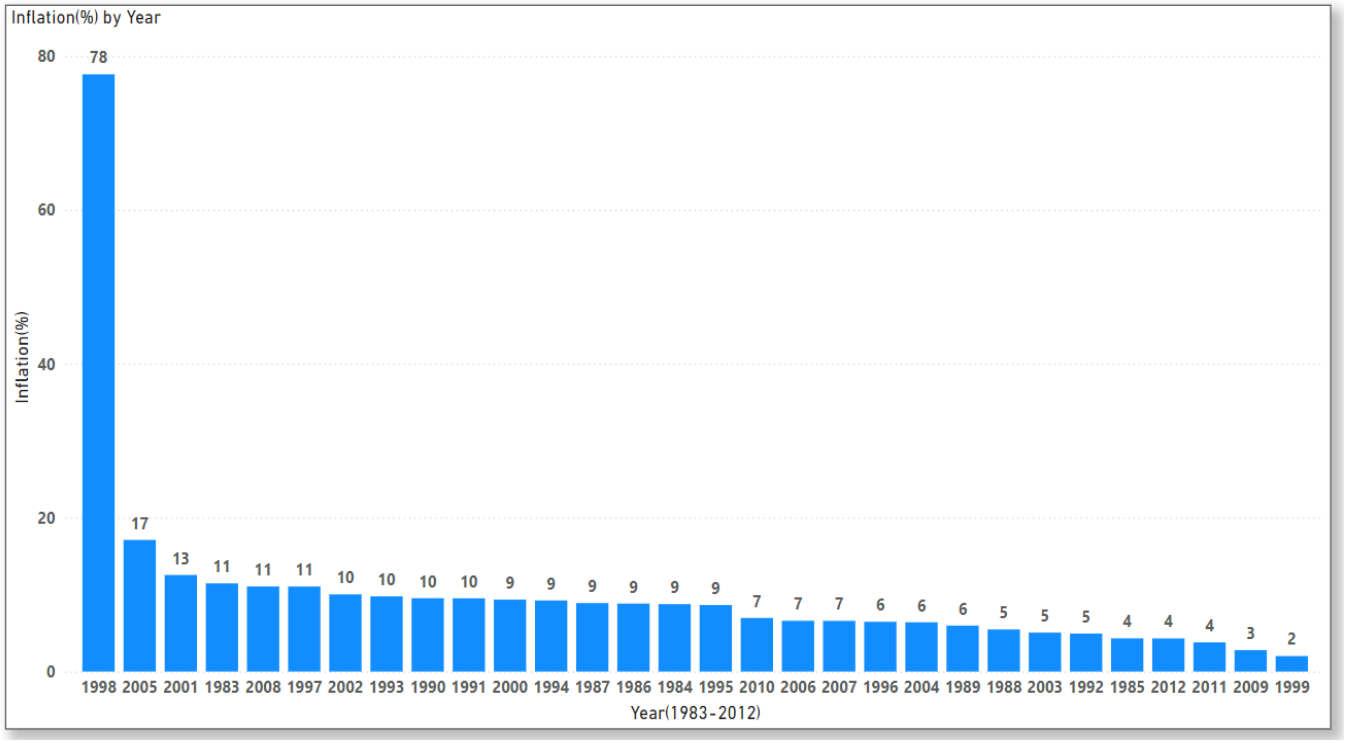
- Bar chart of Exchange Rates (in percentage) by year:



- Bar chart of Unemployment (in percentage) by year:



- Bar chart of Inflation (in percentage) by year:



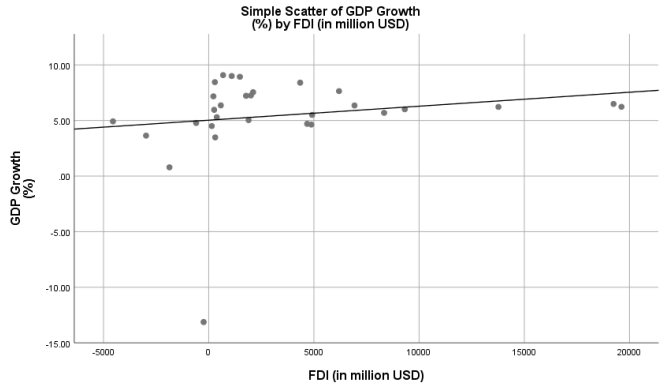
Correlation Analysis: Unravelling Associations among GDP Growth, FDI Inflow, Inflation, Unemployment and Exchange Rates.

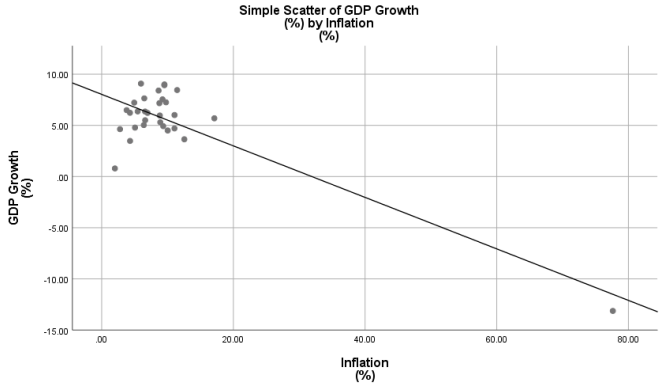
To explore the relationships between GDP, FDI, unemployment, exchange rates, and inflation, I utilized Pearson correlation coefficients, which quantify the strength and direction of the linear relationships among these variables. To aid in visualizing these relationships, I plotted scatter plots with fitted lines. The scatter plot between GDP and FDI, accompanied by a fitted line, reveals the trend and potential correlation between economic growth and foreign direct investment. Similarly, the scatter plot between GDP and unemployment, with a fitted line, illustrates the relationship between economic growth and employment levels. The scatter plot between GDP and inflation, featuring a fitted line, highlights the trend and correlation between GDP growth and price stability. Lastly, the scatter plot between GDP and exchange rates, also with a fitted line, indicates the relationship between economic growth and currency value. These visual tools, along with Pearson correlation coefficients, provide a comprehensive understanding of the interactions between key economic indicators.

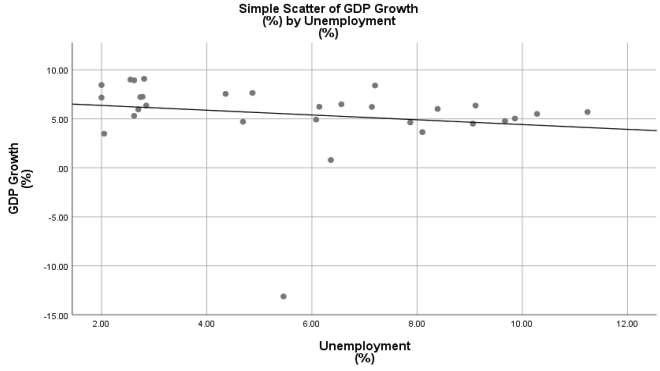
Correlations

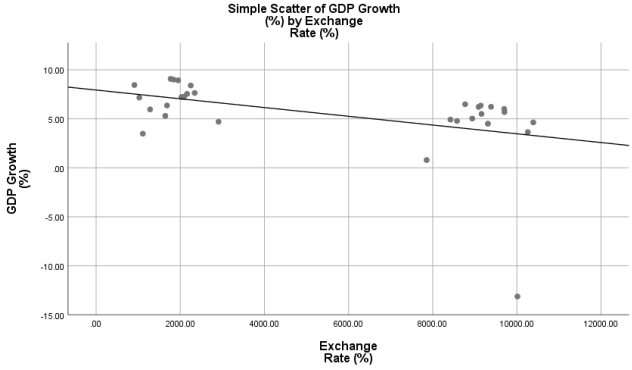
		GDP Growth (%)	FDI (in million USD)	Inflation (%)	Unemployment (%)	Exchange Rate (%)
GDP Growth (%)	Pearson Correlation	1	.182	-.834**	-.180	-.432*
	Sig. (2-tailed)		.335	.000	.342	.017
	N	30	30	30	30	30

- **Scatter Plots:**









The Pearson correlation analysis between GDP and various economic indicators yielded the following results:

1. **Correlation between GDP and FDI**: The correlation value is 0.182, with a significance level (2-tailed) of 0.05. This indicates a weak positive relationship between GDP and FDI. However, the p-value of 0.335 suggests that this correlation is not statistically significant, meaning we cannot confidently conclude a relationship exists between GDP and FDI based on this data.
2. **Correlation between GDP and Inflation**: The correlation value is -0.834, with a significance level (2-tailed) of 0.05. This indicates a strong negative relationship between GDP and inflation, implying that higher GDP levels are associated with lower inflation rates. The p-value of 0.000 indicates that this correlation is statistically significant, confirming a reliable inverse relationship between GDP and inflation.
3. **Correlation between GDP and Unemployment**: The correlation value is -0.180, with a significance level (2-tailed) of 0.05. This indicates a weak negative relationship between GDP and unemployment. However, the p-value of 0.342 suggests that this correlation is not statistically significant, meaning we cannot confidently conclude a relationship exists between GDP and unemployment based on this data.
4. **Correlation between GDP and Exchange Rates**: The correlation value is -0.432, with a significance level (2-tailed) of 0.05. This indicates a moderate negative relationship between GDP and exchange rates, suggesting that higher GDP levels are associated with lower exchange rates. The p-value of 0.017 indicates that this correlation is statistically significant, confirming a reliable inverse relationship between GDP and exchange rates.

In summary, the data suggests a statistically significant and strong negative correlation between GDP and inflation, and a statistically significant moderate negative correlation between GDP and exchange rates. The correlations between GDP and FDI, and between GDP and unemployment, are weak and not statistically significant.

Ordinary Least Square Method and Its Assumption:

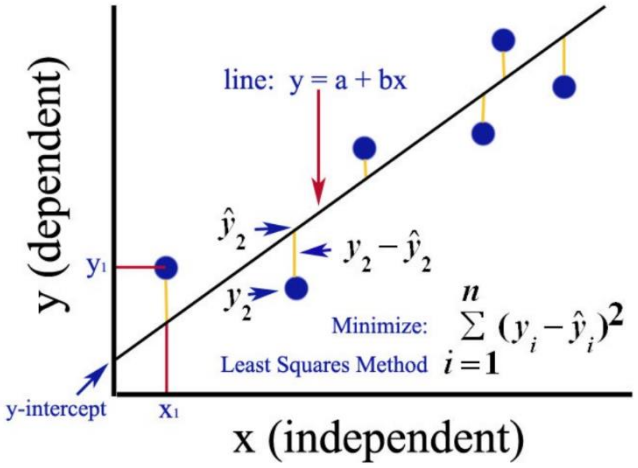
The Ordinary Least Squares (OLS) method is a fundamental technique in statistical regression analysis, commonly used to estimate the parameters in a linear regression model. The primary objective of OLS is to find the best-fitting line through a set of data points by minimizing the sum of the squares of the vertical distances (residuals) between the observed values and the values predicted by the linear model.

The OLS Regression Model Consider the simple linear regression model:

$$\boldsymbol{y_i = \beta_o + \beta_1 x_i + \epsilon_i}$$

Where:

- y_i *is the dependent variable.*
- x_i *is the independent variable.*
- β_o *and* β_1 *are the partial regression coeffcients (parameters)to be estimated.*
- ϵ_i *is the error term (i.e., residual).*



The goal of OLS is to estimate the coefficients β_o *and* β_1 such that the sum of the squared residuals is minimized:

$$Minimize \sum_{i=1}^{n} (y_i - \hat{y_i})^2 = \sum_{i=1}^{n} \left(y_i - (\beta_o + \beta_1 x_i)\right)^2$$

Ordinary Least Squares (OLS) method is a commonly used approach in econometrics to estimate the parameters of a linear regression model. OLS estimators minimize the sum of the squared errors between observed values and predicted values, making it a computationally efficient and easily implementable method for regression analysis. However, it is crucial to understand the underlying assumptions of OLS regression, as these assumptions play a critical role in ensuring the reliability and validity of the results. Failing to meet the OLS assumptions can lead to biased and inconsistent estimates, which can ultimately result in inaccurate conclusions and decisions. Therefore, it is imperative to pay close attention to the OLS assumptions in any econometric analysis.

- **Assumption of OSL:** For the OLS estimators to be the Best Linear Unbiased Estimators (BLUE), certain assumptions must be satisfied. These assumptions are known as the Gauss-Markov assumptions.

1. **Linearity in Parameters**: The model should be linear in parameters. This means the relationship between the dependent variable and the independent variables should be expressible in a linear form.

$$y_i = \beta_o + \beta_1 x_i + \epsilon_i$$

2. **Random Sampling**: The data should be collected through a process of random sampling, ensuring each observation is randomly selected and thus representative of the population.

3. **Independence:** Fixed X values or X values independent of the error term. Here, this means we require zero covariance between ui and each X variables.

$$cov(u_i, X_{2i}) = cov(u_1, X_{3i}) = 0$$

4. **Zero Conditional Mean**: The expected value of the error term, conditional on the independent variables, should be zero. Mathematically, $E(u_i|X_{2i}, X_{3i}) = 0$ this implies that the error term does not systematically vary with the independent variables.

5. **Homoscedasticity**: The variance of the error terms should be constant across all levels of the independent variables. This assumption means that the errors have the same spread (variance) for all values of the independent variables. $var(u_i) = \sigma^2$

6. **No Autocorrelation**: The error terms should not be correlated with each other. This means the residuals from one observation should not be systematically related to the residuals from another observation. This assumption is particularly important in time series data. $cov(u_i, U_j) = 0 \qquad for\ i \neq j$

7. **No Perfect Multicollinearity**: The independent variables should not be perfectly correlated. Perfect multicollinearity implies that one independent variable can be perfectly predicted from the others, which makes it impossible to estimate the unique effect of each variable.

8. **Normality of Errors:** (Optional for large samples): For hypothesis testing and constructing confidence intervals, it is often assumed that the error terms are normally distributed. However, with large samples, the Central Limit Theorem ensures that the sampling distribution of the OLS estimators will be approximately normal even if the errors are not normally distributed.

- **Violation of Assumptions and Their Consequences**

    - **Violation of Linearity**: If the relationship is not linear, OLS estimates may be biased and inefficient. Nonlinear relationships require alternative estimation techniques.

    - **Violation of Random Sampling**: If the sample is not random, the OLS estimates may not be representative of the population, leading to biased results.

    - **Perfect Multicollinearity**: This situation makes it impossible to estimate the regression coefficients uniquely. Partial multicollinearity can inflate the variance of the coefficients.

    - **Non-zero Conditional Mean**: If the error term has a non-zero mean, the OLS estimators will be biased and inconsistent.

    - **Heteroscedasticity**: If the error terms have non-constant variance, the OLS estimators are still unbiased but no longer efficient (they do not have the minimum variance). This leads to unreliable standard errors and hypothesis tests.

    - **Autocorrelation**: When residuals are auto correlated, the OLS estimators remain unbiased but are inefficient, and the standard errors of the estimates are incorrect, leading to unreliable hypothesis tests.

    - **Non-Normality of Errors**: For small samples, non-normality can lead to incorrect confidence intervals and significance tests. For large samples, due to the Central Limit Theorem, this is less of an issue.

The Ordinary Least Squares method is a powerful tool for estimating the parameters of a linear regression model. Its reliability depends on the satisfaction of key assumptions. When these assumptions are violated, alternative methods or corrections must be applied to obtain valid results. Understanding and checking these assumptions is crucial for ensuring the robustness of the regression analysis.

Checking the Assumption of Ordinary Least Square (OLS):

Checking the assumptions of Ordinary Least Squares (OLS) regression in SPSS involves a series of diagnostic tests and visual inspections.

- **Linearity in Parameters:** In multiple linear regression econometrics, it is generally assumed that the relationship between the dependent variable and the independent variables is linear. However, it is important to note that this assumption of linearity is just an assumption, and it may not always hold true in practice. Therefore, while it is generally assumed that the relationship between the dependent variable and the independent variables is linear in multiple linear regression, it is important to examine the data and assess whether this assumption holds true.

Correlations

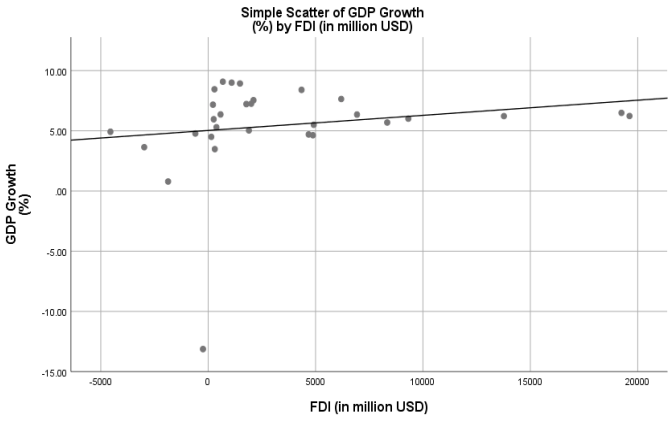
		GDP Growth (%)	FDI (in million USD)	Inflation (%)	Unemployment (%)	Exchange Rate (%)
GDP Growth (%)	Pearson Correlation	1	.182	-.834**	-.180	-.432*
	Sig. (2-tailed)		.335	.000	.342	.017
	N	30	30	30	30	30

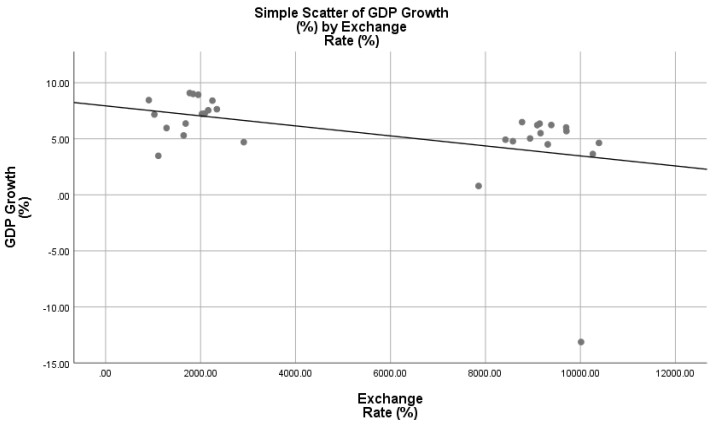
The Pearson correlation analysis between GDP and various economic indicators shows diverse relationships. GDP and FDI have a weak, insignificant positive correlation (0.182, p=0.335). Conversely, GDP and inflation exhibit a strong, significant negative correlation (-0.834, p=0.000), indicating higher GDP is associated with lower inflation. The relationship between GDP and unemployment is weak and insignificant (-0.180, p=0.342). GDP and exchange rates also have a very weak but significant negative correlation (-0.0432, p=0.017). Overall, GDP is significantly influenced by inflation, while its associations with FDI, unemployment, and exchange rates are weak or insignificant.

The linearity assumption appears to be fulfilled for GDP with Inflation and Exchange Rates, as there are significant correlations indicating linear relationships:

- **GDP and Inflation**: Strong linear relationship.
- **GDP and Exchange Rates**: Moderate linear relationship.

Conversely, the linearity assumption does not seem to be fulfilled for the relationships between GDP and both Foreign Direct Investment (FDI) and Unemployment, given the weak and statistically insignificant correlations. However, scatter plot analyses between GDP and FDI, as well as GDP and Exchange Rates, suggest that while the relationships are weak, they exhibit some degree of linearity.

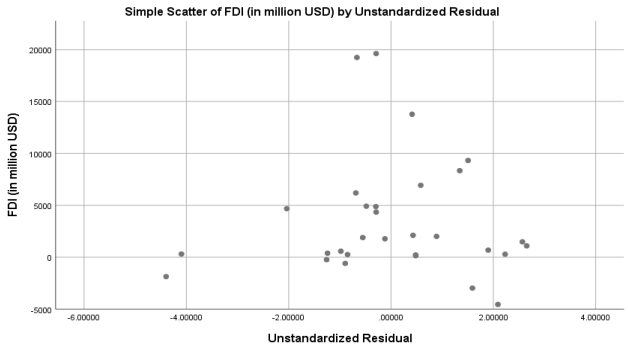


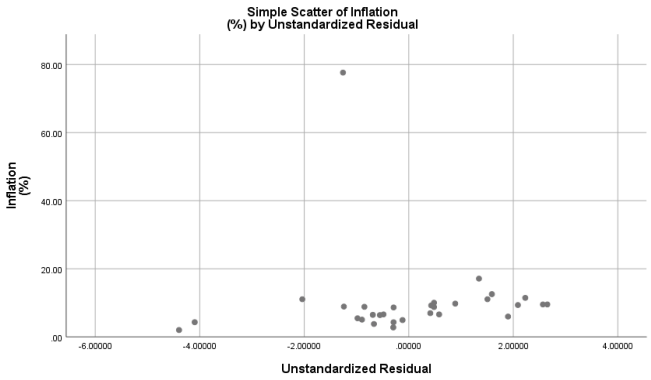


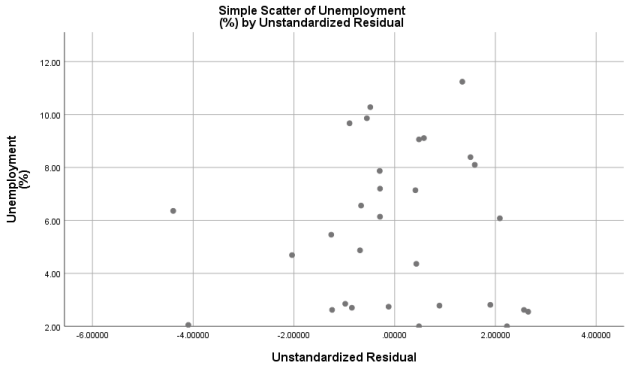
- **Random Sampling:** The data is collected through a process of random sampling, ensuring each observation is randomly selected and thus representative of the population.

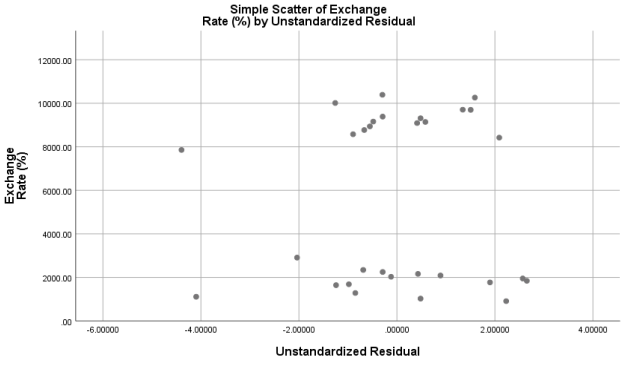
- **Zero Conditional Mean:** The expected value of the error term, conditional on the independent variables, should be zero. Inspecting scatter plots and checking correlations between the residuals and independent variables can help evaluate whether the zero conditional mean assumption holds in your regression model by revealing systematic patterns or relationships that should not exist if the assumption is true.

Inspecting Scatter Plots: Scatter plots (between Unstandardized Residual and Independent Variables) allow you to visually inspect whether the residuals are randomly distributed around the zero line, indicating no systematic pattern with the independent variables.









Interpretation:

Random Distribution: If the residuals are randomly scattered around the zero line (no clear pattern), this suggests that the residuals do not systematically vary with the independent variable, supporting the zero conditional mean assumption.
Systematic Pattern: If you see a clear pattern (e.g., a funnel shape, curve, or clustering), this indicates that the residuals may vary systematically with the independent variable, suggesting a violation of the assumption.

Checking Correlations: Calculating the correlation between unstandardized residuals and independent variables provides a quantitative measure to check if there is a systematic relationship.

Correlations

		Unstandardized Residual	FDI (in million USD)	Inflation (%)	Unemployment (%)	Exchange Rate (%)
Unstandardized Residual	Pearson Correlation	1	.000	.000	.000	.000
	Sig. (2-tailed)		1.000	1.000	1.000	1.000
	N	30	30	30	30	30

Interpretation:

Near Zero Correlation: If the correlation coefficients are close to zero, this suggests that there is no systematic relationship between the residuals and the independent variables, supporting the zero conditional mean assumption.
Significant Correlation: If the correlation coefficients are significantly different from zero, this indicates that the residuals may systematically vary with the independent variables, suggesting a violation of the assumption.

Summary

Scatter Plots: Provide a visual method to identify non-random patterns that indicate systematic variation of residuals with independent variables.

Correlations: Provide a numerical method to quantify the degree of relationship between residuals and independent variables.

Together, these methods help ensure that the residuals (error terms) do not systematically vary with the independent variables, thus verifying the zero conditional mean assumption. This assumption is crucial for unbiased and consistent estimates in Ordinary Least Squares (OLS) regression models.

- **Heteroscedasticity:** The Heteroscedasticity Test is designed to examine whether there is a disparity in the variance of each residual variable. When the variance of each residual remains constant, it is referred to as homoscedasticity.

Modified Breusch-Pagan Test for Heteroscedasticity: The Breusch-Pagan test is a commonly used statistical test to detect heteroscedasticity. The test uses the following null and alternative hypotheses:

Null hypothesis: The variance of the errors (residuals) does not depend on the values of the independent variables i.e., There is no heteroscedasticity/Homoscedasticity is present (FDI in million USD, Inflation, Unemployment, Exchange Rate).

Alternative hypothesis: There is heteroscedasticity, meaning the variance of the errors does depend on the values of the independent variables.

Modified Breusch-Pagan Test for Heteroskedasticity[a,b,c]

Chi-Square	df	Sig.
6.534	4	.163

a. Dependent variable: GDP Growth (%)

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Design: Intercept + FDIinmillionUSD + Inflation + Unemployment + ExchangeRate

With a p-value of 0.163, which is greater than 0.05, we do not have sufficient evidence to reject the null hypothesis. Therefore, based on the Modified Breusch-Pagan test, there is no significant heteroscedasticity in your regression model. This suggests that the variance of the errors does not significantly depend on the values of the independent variables (FDI in million USD, Inflation, Unemployment, and Exchange Rate).

F test for heteroscedasticity: Similar to the Modified Breusch-Pagan test, Test is designed to examine whether there is a disparity in the variance of each residual variable.

Null hypothesis: The variance of the errors (residuals) does not depend on the values of the independent variables i.e., There is no heteroscedasticity/Homoscedasticity is present (FDI in million USD, Inflation, Unemployment, Exchange Rate).

Alternative hypothesis: There is heteroscedasticity, meaning the variance of the errors does depend on the values of the independent variables

With a p-value of 0.173, which is greater than 0.05, we do not have sufficient evidence to reject the null hypothesis. Therefore, based on the F test for heteroscedasticity, there is no significant heteroscedasticity in your regression model.

F Test for Heteroskedasticity[a,b,c]

F	df1	df2	Sig.
1.740	4	25	.173

a. Dependent variable: GDP Growth (%)

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Design: Intercept + FDIinmillionUSD + Inflation + Unemployment + ExchangeRate

- **No Autocorrelation:** One of the critical assumptions of Ordinary Least Squares (OLS) regression is the absence of autocorrelation, also referred to as serial correlation, among the disturbance terms (residuals).

  The Durbin-Watson Test: The Durbin-Watson test is a widely used method for detecting autocorrelation in regression models. It is popularly known as the Durbin–Watson d statistic, which is defined as:

$$d = \frac{\sum_{t=2}^{T}(\epsilon_t - \epsilon_{t-1})}{\sum_{t=2}^{T}\epsilon_t^2}$$

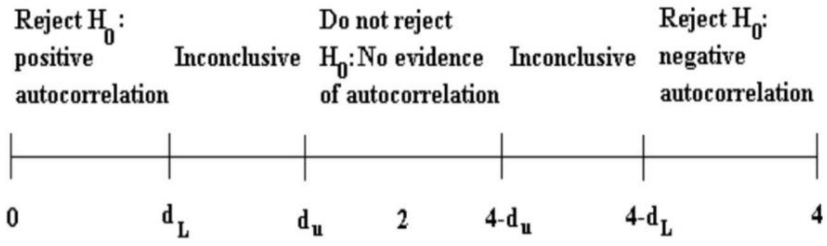
For a sample size of 30, we can use the Durbin-Watson (DW) critical values to determine whether there is evidence of autocorrelation in regression residuals. These critical values are provided in statistical tables, and they vary based on the sample size (n) and the number of predictors (k). Given that sample size is 30, we can refer to Durbin-Watson tables for small sample sizes. These tables provide lower (d_l) and upper (d_u) critical values, which are used to determine the presence of positive or negative autocorrelation. In our case sample size is 30 and the number of predictors is 4. Hence we have the DW critical value to be $d_l = 1.1426$ and $d_u = 1.7386$.

Model Summary[b]

Model	Durbin-Watson
1	1.506

b. Dependent Variable: GDP Growth (%)

The Critical Region for Durbin-Watson Test:



In this case, with a DW statistic of 1.506 and the critical values $d_l = 1.1426$ and $d_u = 1.7386$:

$$\rightarrow 1.1426 \leq 1.506 \leq 1.7386$$

This indicates that DW statistic is within the inconclusive range for positive autocorrelation. Therefore, cannot definitively conclude whether there is positive autocorrelation in your regression residuals based solely on the Durbin-Watson test. Since 1.506 < 2.2614(where 2.2614 is 4 - d_u), there is no evidence of negative autocorrelation. Negative autocorrelation would typically be indicated if DW > 2.2614.

In summary, with a DW statistic of 1.506 and 4 predictors in a sample size of 30, the Durbin-Watson test result is inconclusive, further diagnostic tests can be employed to investigate the presence of autocorrelation.

Run Test for Detecting Autocorrelation: Run Test (also known as the Runs Test) can be used for detecting autocorrelation, particularly for detecting randomness in data sequences. It is particularly useful for detecting runs of consecutive increasing or decreasing values in the data, which can indicate the presence of autocorrelation.

Null Hypothesis: The null hypothesis typically assumes that there is no autocorrelation present in the residuals.

Alternative Hypothesis: The alternative hypothesis suggests that there is autocorrelation in the residuals, indicating a violation of the assumption.

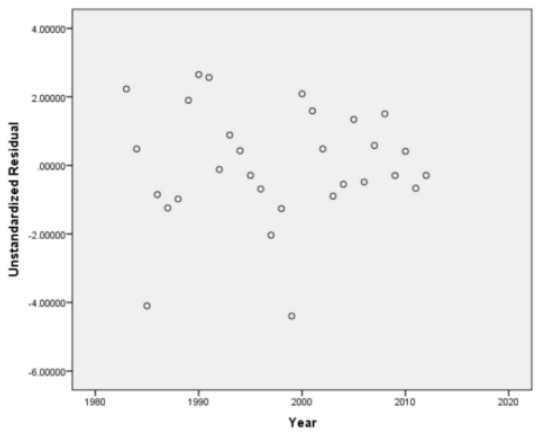
Runs Test

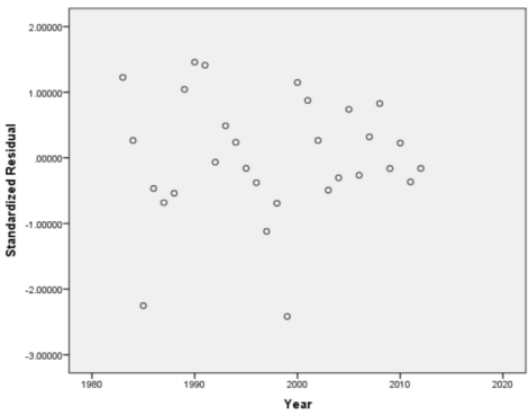
	Unstandardized Residual
Test Value[a]	-.20520
Cases < Test Value	15
Cases >= Test Value	15
Total Cases	30
Number of Runs	12
Z	-1.301
Asymp. Sig. (2-tailed)	.193

a. Median

The Runs Test conducted on the unstandardized residuals of the model indicates that there is no statistically significant evidence of autocorrelation at the conventional significance level of 0.05. With a Z-score of -1.301 and a corresponding two-tailed p-value of 0.193, we fail to reject the null hypothesis of randomness in the residuals. Since 0.193 is greater than 0.05, there is no significant evidence to conclude that there is autocorrelation in the residuals at the 5% significance level. Which implies there are no autocorrelation problem in the model.

Scatter Plot between Unstandardized Residual, Standardized Residual and Year:





- **No Perfect Multicollinearity**: There are no perfect linear relationships among the X variables. One way to detect multicollinearity is by using a metric known as the variance inflation factor (VIF), which measures the correlation and strength of correlation between the predictor variables in a regression model.

VIF Test for Detecting Multicollinearity: VIF stands for Variance Inflation Factor, and it is used to detect multicollinearity in regression analysis. Multicollinearity occurs when predictor variables in a regression model are highly correlated with each other, which can lead to unreliable estimates of regression coefficients.

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	FDI (in million USD)	.828	1.208
	Inflation (%)	.796	1.256
	Unemployment (%)	.228	4.384
	Exchange Rate (%)	.205	4.884

a. Dependent Variable: GDP Growth (%)

Since all VIF values are less than 5, we can confidently state that there is no significant multicollinearity among the predictor variables in our regression model. Specifically:

1. **FDI (Foreign Direct Investment)**: With a VIF of 1.208, there is minimal inflation of the standard error, indicating very low correlation with other predictors.

2. **Inflation (%)**: Similarly, the VIF of 1.256 suggests that inflation is not highly correlated with the other variables, further affirming the absence of multicollinearity.

3. **Unemployment (%)**: Although the VIF is 4.384, it remains below the critical threshold of 5. This indicates that, while there is some multicollinearity, it is not severe enough to warrant concern.

4. **Exchange Rate (%)**: The VIF of 4.884, although close to 5, is still below this threshold. Therefore, we can conclude that the exchange rate does not introduce significant multicollinearity into the model.

In conclusion, since all VIF values are below 5, our regression model does not suffer from significant multicollinearity. This ensures that the estimates of our regression coefficients are reliable and not unduly influenced by correlations among the predictor variables.

- **Normality of Error:** In multiple linear regression econometrics, a fundamental assumption is that the error term (also referred to as the disturbance term or the residual term) is normally distributed. Specifically, this assumption posits that the error term follows a normal distribution with a mean of zero.

Kolmogorov-Smirnov and Shapiro-Wilk Tests: The Kolmogorov-Smirnov (K-S) test and the Shapiro-Wilk (S-W) test are both statistical tests used to determine whether a sample comes from a population with a specific distribution, often the normal distribution.

Kolmogorov-Smirnov (K-S) Test:

- **Null Hypothesis:** The sample data come from a specified theoretical distribution (e.g., normal distribution).
- **Alternative Hypothesis:** The sample data do not come from the specified theoretical distribution.

Shapiro-Wilk (S-W) Test:

- **Null Hypothesis:** The sample data come from a normally distributed population.
- **Alternative Hypothesis:** The sample data do not come from a normally distributed population.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Unstandardized Residual	.128	30	.200*	.937	30	.075

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Kolmogorov-Smirnov Test Interpretation:
The Kolmogorov-Smirnov test yields a significance value (Sig.) of 0.200, which is greater than the common alpha level of 0.05. This result indicates that we fail to reject the null hypothesis that the residuals are normally distributed.

Shapiro-Wilk Test Interpretation:
Similarly, the Shapiro-Wilk test produces a significance value (Sig.) of 0.075. Since this value is also greater than 0.05, we fail to reject the null hypothesis, suggesting that the residuals are normally distributed.

Conclusion:
Based on both the Kolmogorov-Smirnov and Shapiro-Wilk tests, there is no significant evidence to suggest that the residuals deviate from a normal distribution. Thus, we can conclude that the residuals meet the assumption of normality, a key requirement for multiple linear regression.

- **Multiple Regression Analysis**

Multiple Linear Regression Analysis is a statistical technique employed to examine the influence of multiple independent variables on a dependent variable. In this specific analysis, we are investigating the impact of four variables, namely Foreign Direct Investment (FDI), Inflation, Unemployment, and Exchange Rate on the Gross Domestic Product (GDP) Growth. We can represent Dependent variable by Y and Independent variables by X_1, X_2, X_3 *and* X_4 such that-

Y = Gross Domestic Production (GDP).

X_1 = Foreign Direct Investment.

X_2 = Inflation.

X_3 = Unemployment.

X_4 = Exchange Rate.

β_o = Intercept Constant.

$\beta_1, \beta_2, \beta_3$ *and* β_4 *are Regression Coefficients*.

By incorporating these variables and regression coefficients, our model can be expressed as:

$$Y = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4$$

Multiple Regression Analysis Results: The multiple regression analysis was conducted to examine the impact of Foreign Direct Investment (FDI), inflation rate, unemployment rate, and exchange rate on GDP growth. The results of the regression analysis are summarized in the table below:

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	8.268	.838		9.862	.000
	FDI (in million USD)	.000	.000	.196	2.091	.047
	Inflation (%)	-.205	.029	-.678	-7.105	.000
	Unemployment (%)	.427	.242	.315	1.763	.090
	Exchange Rate (%)	-.001	.000	-.633	-3.360	.003

a. Dependent Variable: GDP Growth (%)

The above table, yields the following multiple linear regression equation:

$$Y = 8.268 + 0.000135X_1 - 0.205X_2 + 0.427X_3 - 0.001X_4$$

Interpretation:

Intercept (8.268):
This is the estimated GDP when all independent variables (FDI, Inflation, Unemployment, and Exchange Rate) are zero. In practical terms, it represents the baseline level of GDP in the absence of these factors. However, note that having all these variables at zero simultaneously may not be realistic in real-world scenarios.

FDI (0.000135):
The coefficient of FDI is 0.000135. This means that for each additional unit of FDI, the GDP is expected to increase by 0.000135 units, holding all other variables constant. While this effect might seem small, it's important to consider the scale of FDI in real-world terms.

Inflation (-0.205):
The coefficient of Inflation is -0.205. This indicates that for each one-unit increase in the inflation rate, the GDP is expected to decrease by 0.205 units, holding all other variables constant. This negative relationship suggests that higher inflation is associated with lower GDP.

Unemployment (0.427):
The coefficient of Unemployment is 0.427. This implies that for each one-unit increase in the unemployment rate, the GDP is expected to increase by 0.427 units, holding all other variables constant. This positive relationship might seem counterintuitive, so it would be useful to investigate this further, possibly considering the nature of your data or the specific economic context.

Exchange Rate (-0.001):
The coefficient of the Exchange Rate is -0.001. This means that for each one-unit increase in the exchange rate, the GDP is expected to decrease by 0.001 units, holding all other variables constant. This negative relationship suggests that a higher exchange rate (possibly indicating a weaker domestic currency) is associated with a lower GDP.

Understanding these relationships can help in formulating economic policies and strategies to optimize GDP growth by managing these variables effectively.

- **Test the Significance of the Coefficients or Partial Hypothesis Testing**

Before testing hypotheses in the multiple regression model, we are going to offer a general overview on hypothesis testing. Hypothesis testing allows us to carry out inferences about population parameters using data from a sample. In order to test a hypothesis in statistics, we must perform the following steps:

Step 1 - Formulate a null hypothesis and an alternative hypothesis on population parameters.
Step 2 - Build a statistic to test the hypothesis made.
Step 3 - Define a decision rule to reject or not to reject the null hypothesis.

Formulation of the null hypothesis and the alternative hypothesis:

The T-Test is utilized to examine the partial hypotheses and determine the significant impact of each independent variable on the dependent variable.

Formulating Hypotheses:

Constant (Intercept) Hypothesis:

- Null Hypothesis (H_0): The constant coefficient (β_0) is equal to 0.
- Alternative Hypothesis (H_1): The constant coefficient (β_0) is not equal to 0.

FDI (Foreign Direct Investment) Hypothesis:

- Null Hypothesis (H_0): The coefficient of FDI (β_1) is equal to 0 (FDI has no effect on GDP growth).
- Alternative Hypothesis (H_1): The coefficient of FDI (β_1) is not equal to 0 (FDI has an effect on GDP growth).

Inflation Hypothesis:

- Null Hypothesis (H_0): The coefficient of Inflation (β_2) is equal to 0 (Inflation has no effect on GDP growth).
- Alternative Hypothesis (H_1): The coefficient of Inflation (β_2) is not equal to 0 (Inflation has an effect on GDP growth).

Unemployment Hypothesis:

- Null Hypothesis (H_0): The coefficient of Unemployment (β_3) is equal to 0 (Unemployment has no effect on GDP growth).
- Alternative Hypothesis (H_1): The coefficient of Unemployment (β_3) is not equal to 0 (Unemployment has an effect on GDP growth).

Exchange Rate Hypothesis:

- Null Hypothesis (H_0): The coefficient of Exchange Rate (β_4) is equal to 0 (Exchange Rate has no effect on GDP growth).
- Alternative Hypothesis (H_1): The coefficient of Exchange Rate (β_4) is not equal to 0 (Exchange Rate has an effect on GDP growth).

These hypotheses enable us to test whether each independent variable has a significant impact on GDP Growth, based on the estimated regression coefficients.

Coefficients[a]

Model		t	Sig.
	(Constant)	9.862	.000
	FDI (in million USD)	2.091	.047
	Inflation (%)	-7.105	.000
	Unemployment (%)	1.763	.090
	Exchange Rate (%)	-3.360	.003

a. Dependent Variable: GDP Growth (%)

The intercept represents the estimated GDP growth when all independent variables (FDI, Inflation, Unemployment, and Exchange Rate) are zero. In this case, it is significantly different from zero, indicating that even in the absence of the independent variables, there is some baseline GDP growth.

For FDI the significance level (Sig) is less than 0.05. Consequently, we reject the null hypothesis Ho and conclude that FDI ($X1$) has a significant influence on GDP Growth at the partial level.

For inflation the significance level is less than 0.05. This leads to rejecting Ho and concluding that Inflation ($X2$) has a significant impact on GDP Growth at the partial level.

For unemployment the significance level is greater than 0.05. Hence, we fail to reject Ho and conclude that there is no significant influence from Unemployment ($X3$) on GDP Growth at the partial level.

For exchange rate the significance level is greater than 0.05. As a result, we reject Ho and determine that there is no significant influence from Exchange Rate ($X4$) on GDP Growth at the partial level.

These conclusions are derived by comparing the calculated significant value with 0.05 significant level allowing us to assess the partial impact of each independent variable on GDP Growth.

- **Overall Test of Significance (F-Test) or ANOVA.**

The F-Test is employed to determine if the independent variables collectively have a significant influence on the dependent variable.

Hypothesis:

Null Hypothesis (H_0): There is no significant linear relationship between the predictors (Exchange Rate, Inflation, FDI, and Unemployment) and the dependent variable (GDP Growth).

Alternative Hypothesis (H_1): There is a significant linear relationship between the predictors (Exchange Rate, Inflation, FDI, and Unemployment) and the dependent variable (GDP Growth).

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	373.073	4	93.268	28.191	.000[b]
	Residual	82.712	25	3.308		
	Total	455.784	29			

a. Dependent Variable: GDP Growth (%)

b. Predictors: (Constant), Exchange Rate (%), Inflation (%), FDI (in million USD), Unemployment (%)

The F-Statistic value of 28.191 obtained from the analysis, along with a p-value of 0.000, indicates that the overall model is statistically significant. Therefore, we reject the null hypothesis (Ho) and conclude that the model has a significant influence on the dependent variable. This implies that the combination of the independent variables (FDI, Inflation, Unemployment, and Exchange Rate) collectively contributes to explaining the variability in GDP Growth.

In summary, based on the ANOVA results, we reject the null hypothesis and conclude that there is a significant linear relationship between the set of predictors (Exchange Rate, Inflation, FDI, and Unemployment) and the dependent variable (GDP Growth). This implies that these predictors collectively explain a significant portion of the variation in GDP Growth.

- **Calculation of R-Square and Adjusted R-Square:**

R-squared is a statistical measure that represents the proportion of the variance for a dependent variable that's explained by an independent variable or variables in a regression model. R-squared explains to what extent the variance of one variable explains the variance of the second variable. Adjusted R-squared is a modified version of R-squared that has been adjusted for the number of predictors in the model.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.905[a]	.819	.789	1.81892

a. Predictors: (Constant), Exchange Rate (%), Inflation (%), FDI (in million USD), Unemployment (%)

b. Dependent Variable: GDP Growth (%)

Model Interpretation:

R: The correlation coefficient (R) between the predicted values and the observed values of GDP Growth (%) is 0.905. This indicates a strong positive linear relationship between the predictors (Exchange Rate, Inflation, FDI, and Unemployment) and the dependent variable (GDP Growth).

R Square: R Square, or the coefficient of determination, is 0.819. This means that approximately 81.9% of the variance in GDP Growth (%) can be explained by the linear regression model with the predictors included.

Adjusted R Square: Adjusted R Square adjusts the R Square value for the number of predictors in the model. It is 0.789, which is slightly lower than R Square. This adjustment penalizes the R Square for including additional predictors that may not significantly improve the model's explanatory power.

Std. Error of the Estimate: This is the standard error associated with the estimate of the dependent variable (GDP Growth). It is 1.81892, which represents the average amount that the predicted GDP Growth (%) values deviate from the actual observed values.

Overall, the model appears to fit the data well, as indicated by the high R Square value (0.819). The predictors (Exchange Rate, Inflation, FDI, and Unemployment) collectively contribute significantly to explaining the variability in GDP Growth (%), as suggested by the high R value (0.905) and the significant F-test (previously discussed).

- **Conclusion:**

Based on the regression analysis conducted to explore the relationship between Gross Domestic Product (GDP) and the independent variables of Foreign Direct Investment (FDI), Inflation, Unemployment, and Exchange Rate, the following findings emerge:

Firstly, Foreign Direct Investment (FDI) (X1) demonstrates a significant positive association with GDP Growth. This implies that an increase in FDI leads to a proportional rise in GDP Growth.

Secondly, Inflation (X2) exhibits a significant negative correlation with GDP Growth. Higher inflation levels are linked to a reduction in GDP Growth.

Thirdly, Unemployment (X3) does not exhibit a statistically significant relationship with GDP Growth based on the analysis. Consequently, changes in unemployment levels are not found to substantially impact GDP Growth.

Lastly, Exchange Rate (X4) shows a significant negative relationship with GDP Growth. This indicates that fluctuations in the exchange rate negatively influence GDP Growth.

In summary, the regression analysis highlights FDI and inflation as the primary drivers influencing GDP Growth. However, unemployment and the exchange rate demonstrate limited influence on GDP Growth. It is crucial to consider additional factors beyond FDI, inflation, unemployment, and exchange rate to comprehensively understand and explain the variations observed in GDP Growth.

These findings underscore the nuanced interplay between economic variables and GDP Growth, offering valuable insights for policymakers and stakeholders aiming to formulate strategies that foster economic growth and stability.

- **Appendix:**

Dataset:

Year	GDP Growth (%)	FDI (in million USD)	Inflation (%)	Unemployment (%)	Exchange Rate (%)
1983	8.45	292	11.46	2.00	909.26
1984	7.17	222	8.76	2.00	1025.94
1985	3.48	310	4.31	2.05	1110.58
1986	5.96	258	8.83	2.70	1282.56
1987	5.30	385	8.90	2.62	1643.85
1988	6.36	576	5.47	2.85	1685.70
1989	9.08	682	5.97	2.81	1770.06
1990	9.00	1,093	9.53	2.55	1842.81
1991	8.93	1,482	9.52	2.62	1950.32
1992	7.22	1,777	4.94	2.74	2029.92
1993	7.25	2,004	9.77	2.78	2087.10
1994	7.54	2,109	9.24	4.36	2160.75
1995	8.40	4,346	8.64	7.20	2248.61
1996	7.64	6,194	6.47	4.87	2342.30
1997	4.70	4,677	11.05	4.69	2909.38
1998	-13.13	-241	77.63	5.46	10013.62
1999	0.79	-1,866	2.01	6.36	7855.15
2000	4.92	-4,550	9.35	6.08	8421.78
2001	3.64	-2,977	12.55	8.10	10260.85
2002	4.50	145	10.03	9.06	9311.19
2003	4.78	-597	5.06	9.67	8577.13
2004	5.03	1,896	6.40	9.86	8938.85
2005	5.69	8,336	17.11	11.24	9704.74
2006	5.50	4,914	6.60	10.28	9159.32
2007	6.35	6,928	6.59	9.11	9141.00
2008	6.01	9,318	11.06	8.39	9698.96
2009	4.63	4,877	2.78	7.87	10389.94
2010	6.22	13,771	6.96	7.14	9090.43
2011	6.49	19,241	3.79	6.56	8770.43
2012	6.23	19,618	4.30	6.14	9386.63

- **Reference and Bibliography**

"D.N. Gujarati and D.C. Porter, Essentials of Econometrics, 4th Edition, McGraw Hill International Edition, 2010."

"Miranda House University of Delhi Introductory Economics Research Project by Komal Yadav, Disha Bhardwaj, Punya Madan, Ananya Singh."

"A Practical Guide to Using Econometrics, AH Studenmund, Seventh Edition 2017 Pearson India Education Services Pvt. Ltd."

"IBM SPSS Statistics 28 Brief Guide."

"Dr. Brijesh Awasthi, A Handbook of Statistical Analyses Using SPSS."