Impact of Macroeconomic variable of Stock Market Performance

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Macroeconomic variables - fed Interest rate, repo rate, rev-repo rate , GDP , exchange rate, inflation rate, (6)

Data source : NSE, macrotrends.com, tradingeconomics.com, yahoo finance, RBI monetary policy report.

Introduction

This research investigates the relation between macroeconomic variables and the performance of India's Nifty 50 stock market index. The independentvariables under the study include the Federal Reserve's interest rate, repo and reverse repo rates, GDP growth rate, exchange rate dynamics, and inflation rate. These factors collectively shape the economic landscape andhave the potential to influence stock market performance significantly.

Employing regression analysis, this study seeks to quantify the impact of these macroeconomic variables on the Nifty 50 index. Key questions addressed include the extent to which the Federal Reserve's interest rate affects the Nifty 50, the influence of India's repo and reverse repo rates on the stock market, the correlation between GDP growth and stock market movements, the relationship between exchange rate fluctuations and the Nifty 50's performance, and the impact of inflation on stock market trajectory.

The research's findings hold significance for investors, policymakers, and academics. Investors can gain insights to make more informed investment decisions, while policymakers can better understand how their monetary policies influence the stock market and the broader economy. This study contributes to the body of knowledge on the complex interplay between macroeconomics and financial markets. Ultimately, it seeks to illuminate thefactors driving stock market movements in India, enhancing our comprehension of this critical economic facet.

Literature Review

Theoretical Models for Stock Market Performance

Several theoretical models establish links between macroeconomic factors and stock market performance. The Arbitrage Pricing Theory (APT) states that stock returns are determined by various macroeconomic factors and provides a framework for identifying the relevant macroeconomic variables that systematically affect stock returns (Ross, 1976). The discounted cash flow model argues that stock prices represent the present value of expected future cash flows, which are influenced by macroeconomic conditions affecting expected dividends, earnings growth rates and discount rates (Gordon & Shapiro, 1956). The Capital Asset Pricing Model (CAPM) relates stock returns to market risk, often proxied by macroeconomic variables capturing business cycle fluctuations (Lintner, 1965; Sharpe, 1964). The dividend discount model proposes that macroeconomic factors such as interest rates impact discount rates and expected dividend growth, thereby affecting stock valuations (Gordon, 1962).

Empirical Evidence of Macroeconomic Factors On Stock Market

A vast body of empirical research has examined the effects of specific macroeconomic factors on stock market performance across countries. Most studies have found a significant positive relationship between economic growth, proxied by GDP or industrial production, and stock returns (Fama, 1981; Chen et al. 1986; Maysami & Koh, 2000). The evidence on the impact of inflation has been more mixed, with several studies showing a negative effect on stock returns (Geske & Roll, 1983; DeFina, 1991), while some finding insignificant relationships (Oxman, 2012; Tiwari et al., 2015). Interest rates generally demonstrate an inverse relationship with stock returns as higher rates increase the discount rate for valuing equities (Hasan & Nasir, 2008; Hsing & Hsieh, 2012). However, a few studies have also found positive links depending on whether rate changes represent favorable economic news (Lobo, 2002; Erdem et al., 2005). The influence of money supply has shown contradictory results, with some studies reporting a positive effect through increased liquidity (Maysami & Koh, 2000; Sellin, 2001) and others documenting a negative effect via higher inflation (Rizwan & Khan, 2007; Abugri, 2008). Exchange rates also produce mixed findings on stock returns

based on a country's import/export orientation and degree of global integration (Muhammad & Rasheed, 2002; Diamandis & Drakos, 2011). Unemployment rates consistent show a negative coefficient, aligning with the countercyclical relationship between unemployment and equity returns (McMillan, 2005; Abugri, 2008).

Methodological Approaches to Analyse Macroeconomy-Stock Market Relationships

A range of methodological approaches have been utilized to examine the macroeconomy-stock market relationship. Cointegration techniques like Johansen's VECM test for long-run equilibrium relationships between stock prices and macro factors (Naka et al., 1998; Mukhopadhyay & Sarkar, 2003). VAR and VECM models estimate dynamic interactions and causal relationships between macro variables and stock returns (Darrat & Mukherjee, 1987; Panda & Kamaiah, 2001). Impulse response analysis traces the effects of macroeconomic shocks on stock prices (Mukherjee & Naka, 1995; Ibrahim & Aziz, 2003). Correlation and regression models determine the strength and statistical significance of relationships between macro factors and stock returns (Chen et al. 1986; Wongbangpo & Sharma, 2002). Each technique provides useful insights into different aspects of the complex linkages between the macroeconomy and stock market.

Gaps and Ambiguities in Macroeconomic-Stock Market Research

While extensive research has been done in this area, some gaps remain. There is a lack of consensus on the appropriate macroeconomic factors and theoretical model specifications to be used. The empirical evidence remains ambiguous for certain macro variables like exchange rates, inflation and money supply. Most analyses focus on broad market indices, with a shortage of studies examining sectoral and firm-level impacts. The possibility of structural breaks and asymmetric, non-linear relationships has not been adequately addressed. The role of globalization and increasing integration of stock markets in determining macro-stock market linkages requires further investigation. There is a need for more recent studies on emerging markets and comparative analyses controlling for country-specific factors. As macro-financial linkages evolve, ongoing research can provide valuable updated evidence to guide investment analysis and policy.

Model Specification

In our study on the impact of macroeconomic variables on stock market performance, we aim to investigate how changes in key economic factors influence the Nifty 50 index. We are particularly interested in understanding the relationship between the Nifty 50 and the following independent variables:

Dependent Variable:
Nifty 50 Index: This is our primary focus, representing the performance of India's stock market.

Independent Variables:
1. Federal Reserve (Fed) Interest Rate: The federal funds rate set by the U.S. Federal Reserve, which has global financial implications.
2. Repo Rate: The interest rate at which banks borrow money from the Reserve Bank of India (RBI), impacting domestic borrowing costs.
3. Reverse Repo Rate: The interest rate at which banks lend money to the RBI, affecting liquidity in the financial system.
4. GDP Growth Rate: The percentage change in India's Gross Domestic Product, indicating economic health.
5. Exchange Rate: The value of the Indian Rupee relative to another major currency (e.g., USD), influencing foreign investment.
6. Inflation Rate: The rate at which consumer prices in India are rising, reflecting purchasing power.

We will employ Fixed Effects (FE), Random Effects (RE) and Multiple Linear Regression models to examine the relationships between these independent variables and the Nifty 50 index. The model takes the following form:

$$\text{Nifty 50 Index} = \beta_0 + \beta_1 * \text{Fed Interest Rate} + \beta_2 * \text{Repo Rate} + \beta_3 * \text{Reverse Repo Rate} + \beta_4 * \text{GDP Growth Rate} + \beta_5 * \text{Exchange Rate} + \beta_6 * \text{Inflation Rate} + \varepsilon$$

Fixed Effects (FE) Model: This model recognizes that the Nifty 50 index may have unique characteristics that influence its performance over time.

Random Effects (RE) Model: This model also considers individual-specific effects but treats them as random. The model structure is similar to the Fixed Effects model but includes random intercepts ($\beta 0\_i$).

- $\beta 0$ represents the intercept or constant term.

- $\beta 1$, $\beta 2$, $\beta 3$, $\beta 4$, $\beta 5$, and $\beta 6$ are the coefficients for the respective independent variables.

- ε represents the error term, accounting for unexplained variations in the Nifty 50 index.

We will employ statistical software to estimate these coefficients ($\beta 0$ to $\beta 6$) and evaluate their statistical significance. A significant coefficient suggests that the corresponding independent variable has a measurable impact on the Nifty 50 index.

In our analysis, we will also consider potential issues such as multicollinearity, heteroscedasticity, and autocorrelation, taking appropriate corrective measures if necessary. By employing panel data analysis, our research aims to provide a comprehensive understanding of how macroeconomic variables impact the Nifty 50 index over time. This approach enhances the rigor of our research, contributing valuable insights into the complex relationship between economic factors and the performance of India's stock market benchmark, the Nifty 50

Data Analysis

Following the collection and cleaning of data, our next step involves analyzing the data to extract valuable insights. While a significant portion of the research centers around analyzing the regression models mentioned earlier, we initiate the process by creating visualizations. This approach enhances our understanding of the data before delving into more complex analysis.

Data –

https://docs.google.com/spreadsheets/d/1u30nUAIfwnsO9UAjEk_X1KQcTn-T_cw6_5Y65seueCc/edit#gid=1050862320

5 Point Summary Of The Data

	count	mean	std	min	25%	50%	75%	max
Average of Standarised Index	5.0	0.000008	0.803620	-0.99140	-0.61215	0.039375	0.76355	0.800662
Average of GDP	5.0	4191.373750	255.474326	3883.12625	4015.64125	4170.762500	4382.68125	4504.657500
Average of Inflation	5.0	1.653250	0.330570	1.26875	1.39375	1.648750	1.90125	2.053750
Average of Exchange Rate	5.0	24.955000	0.684711	24.11875	24.52875	24.855000	25.46875	25.803750

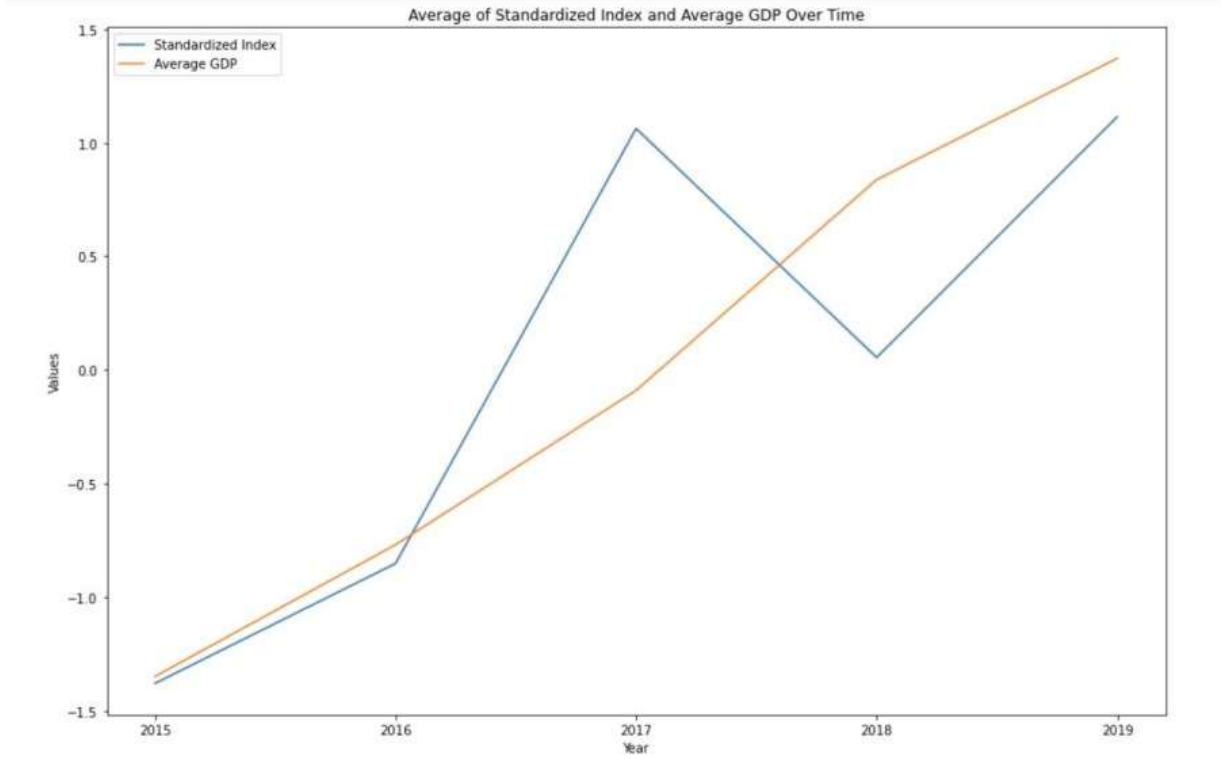
The above figure gives the Five Point Summary and Standard Deviation of the data from 2015-19 of countries – USA, China, Hongkong, Japan, France, India, Singapore and UK. The variable of Standardized Index is made using various Stock Market Indices of the countries.

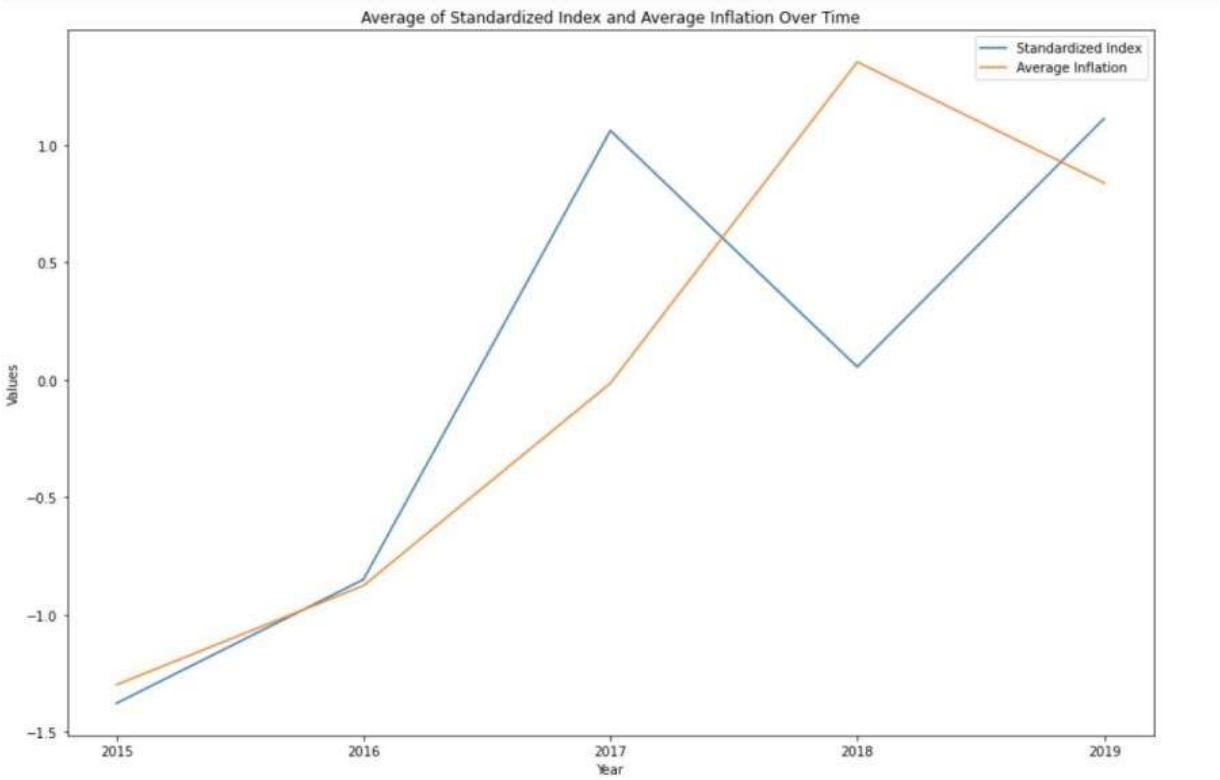
The Correlation Matrix

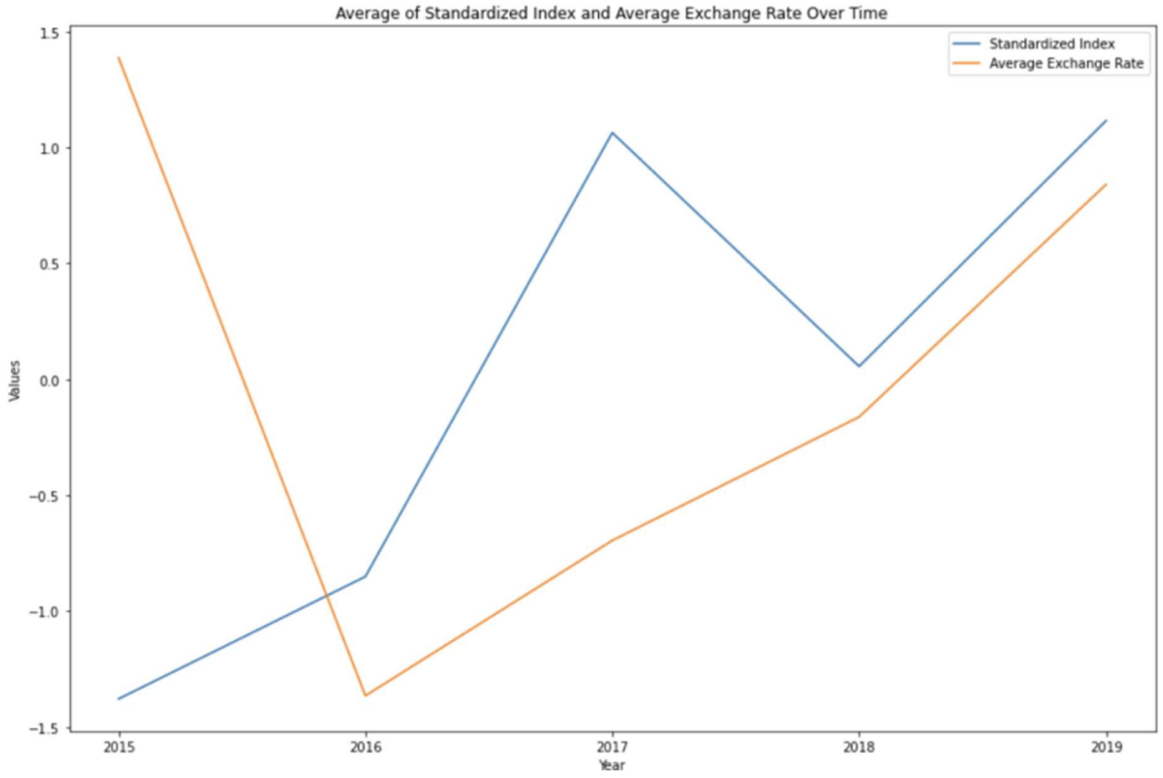
	Average of Standarised Index	Average of GDP	Average of Inflation	Average of Exchange Rate
Average of Standarised Index	1.000000	0.798572	0.706698	-0.112495
Average of GDP	0.798572	1.000000	0.942930	0.051358
Average of Inflation	0.706698	0.942930	1.000000	-0.022156
Average of Exchange Rate	-0.112495	0.051358	-0.022156	1.000000

The above table gives the idea that there is strongest correlation between **Average of Inflation** and **Average of GDP**. The matrix also shows that there is a high positive correlation of **Average of Standardized Index** with **Average of GDP** and negative correlation with **Average of Exchange Rate**.
The following Heatmap also showcase the above point in a better visualization:

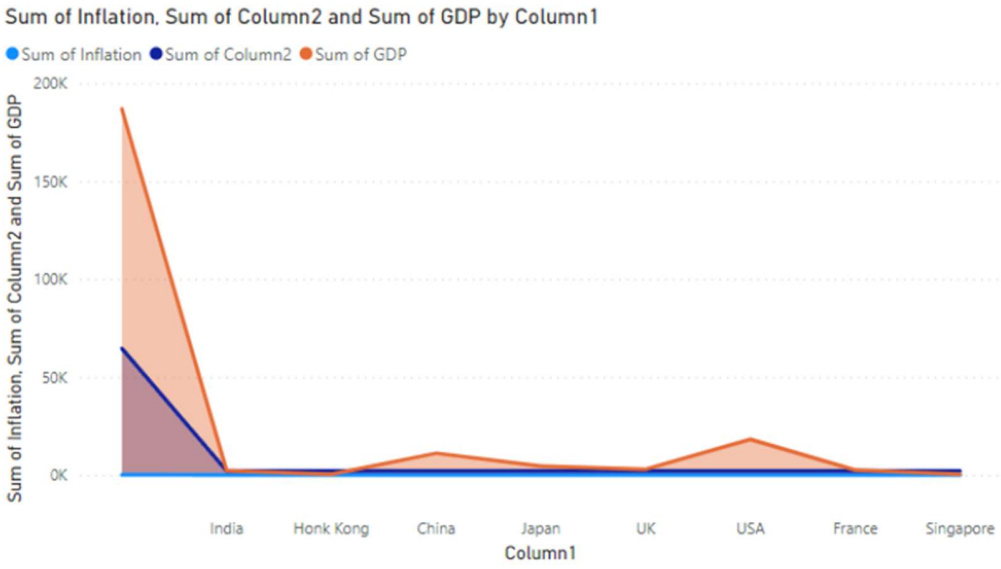

Correlation Heatmap
Average of Standarised Index
Average of GDP
Average of Inflation
Average of Exchange Rate
1.00
0.80
0.71
-0.11
0.80
1.00
0.94
0.05
0.71
0.94
1.00
-0.02
-0.11
0.05
-0.02
1.00
1.0
0.8
0.6
0.4
0.2
0.0
Average of Standarised Index
Average of GDP
Average of Inflation
Average of Exchange Rate


Average of Standardized Index and Average GDP Over Time
Standardized Index
Average GDP
Values
Year
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
2015
2016
2017
2018
2019


Average of Standardized Index and Average Inflation Over Time
Standardized Index
Average Inflation
Values
Year
1.0
0.5
0.0
−0.5
−1.0
−1.5
2015
2016
2017
2018
2019



The above figures shows that there has been upward linear trend of Average Standardized Index of all the countries over the years, except in years 2017 - 2018. Average GDP shows upward trend. Average inflation shows upward trend except in years 2018-2019.Average exchange rate shows downward till 2016 and upward trend thereafter.



During the five-year span from 2015 to 2019, a comprehensive analysis of the data underscores the divergence in inflation trends among the studied countries. Notably,

Singapore sustained a stable environment with low inflation, while India encountered comparatively higher and fluctuating inflation rates. Most nations exhibited positive and relatively steady GDP growth, signifying economic expansion. Exchange rates generally remained stable, with the United States maintaining a consistently robust U.S. dollar. It is worth noting, however, that the data for the USA in 2015 raises concerns regarding data quality and accuracy.

This presents a rigorous analysis of inflation trends across eight diverse countries during the five-year period from 2015 to 2019. The countries under examination encompass Singapore, Japan, China, India, the United States, the United Kingdom, France, and Hong Kong. By meticulously scrutinizing inflation rates, Gross Domestic Product (GDP) growth, and exchange rate indices, this report endeavors to offer a data-driven perspective on the economic performance of these nations.

Data Analysis for Each Country

Country	Inflation	GDP	Exchange Rates
Singapore	-0.52% to 0.57% (Stable)	Marginal fluctuations (Robust and steady)	Stable
Japan	-0.13% to 2.90% (Volatility)	Consistent growth	Stable
China	1.44% to 2.90% (Moderate)	Strong and consistent growth	Relatively steadfast
India	3.33% to 4.95% (Relatively higher)	Positive growth with minor GDP fluctuations	Minor fluctuations
United States	Low inflation (Except 2015 data)	Strong and unwavering growth	Stable
United Kingdom	0.37% to 2.56% (Moderate)	Modest fluctuations in GDP growth	Relatively stable
France	0.04% to 1.85% (Low to moderate)	Stable with slight GDP growth fluctuations	Moderate stability
Hong Kong	1.49% to 2.99% (Moderate)	Stable GDP growth and exchange rates	Stable

This underpin the significance of considering multiple economic indicators, such as GDP growth and exchange rates, to gain a comprehensive understanding of a nation's economic performance. These data-driven insights can provide valuable guidance to policymakers, investors, and businesses, allowing for well-informed decisions

regarding economic opportunities and risks in the countries under examination during the specified period.

REGRESSION ANALYSIS

```
. xtreg index gdpbn inflation exchangerate, fe

Fixed-effects (within) regression               Number of obs      =        40
Group variable: year                            Number of groups   =         5

R-sq:                                           Obs per group:
     within  = 0.8813                                         min =         8
     between = 0.2613                                         avg =       8.0
     overall = 0.8684                                         max =         8

                                                F(3,32)            =     79.19
corr(u_i, Xb)  = -0.0934                        Prob > F           =    0.0000

------------------------------------------------------------------------------
       index |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       gdpbn |    11.02575   7.145004     1.54   0.133    -3.528146    25.57965
   inflation |   -240644.5   34723.26    -6.93   0.000    -311373.5   -169915.6
exchangerate |    17014.95   1173.646    14.50   0.000     14624.31    19405.59
       _cons |    201251.4   87665.02     2.30   0.028     22683.62    379819.2
-------------+----------------------------------------------------------------
     sigma_u |    95734.98
     sigma_e |   286758.36
         rho |   .10028045   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(4, 32) = 0.85                     Prob > F = 0.5057

.
.
```

Firstly, we run the Fixed Effect regression analysis where the null hypothesis is that there is no fixed effects. As the p-value of the F-test is greater than 0.05, we cannot reject the null hypothesis.

```
. xtset year
       panel variable:  year (balanced)

. xtreg index gdpbn inflation exchangerate, re

Random-effects GLS regression                   Number of obs     =         40
Group variable: year                            Number of groups  =          5

R-sq:                                           Obs per group:
     within  = 0.8808                                         min =          8
     between = 0.2535                                         avg =        8.0
     overall = 0.8689                                         max =          8

                                                Wald chi2(3)      =     238.59
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0000
```

index	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
gdpbn	11.66036	7.073922	1.65	0.099	-2.204273	25.52499
inflation	-226860.2	33591.7	-6.75	0.000	-292698.7	-161021.7
exchangerate	16977.3	1163.276	14.59	0.000	14697.33	19257.28
_cons	175771.9	85786.11	2.05	0.040	7634.241	343909.6
sigma_u	0					
sigma_e	286758.36					
rho	0	(fraction of variance due to u_i)				

We also run the random effects regression as shown above and then store the estimates.

Next, to compare the Fixed and Random effects, we conduct the Hausman test where the null hypothesis is that there is random effects and the alternative hypothesis is that there is fixed effects.

```
. hausman fe re

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       fe           re         Difference          S.E.
-------------+------------------------------------------------------------
       gdpbn |    11.02575     11.66036      -.6346091        1.005338
   inflation |   -240644.5    -226860.2      -13784.34        8792.183
exchangerate |    17014.95      16977.3       37.64527        155.6728
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =          2.49
                Prob>chi2 =        0.4763

.
```

The p-value of the above test is more than 0.05, hence we cannot reject the null hypothesis and cannot conclude that the fixed effects model is appropriate. However, there may be the chance that the random effects model is appropriate. To confirm this, we perform the LM test as follows, where the null hypothesis is that there is no random effect, and the alternative is that there is random effects.

```
.
.
. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        index[year,t] = Xb + u[year] + e[year,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
                 --------+------------------------------
                   index |    5.69e+11       754415.7
                       e |    8.22e+10       286758.4
                       u |           0              0

        Test:   Var(u) = 0
                                  chibar2(01) =      0.00
                               Prob > chibar2 =    1.0000

.
```

As the p-value is more than 0.05, so we cannot conclude that random effects model is appropriate.

Since we cannot confirm appropriateness of fixed and random effects models, hence we can say that **Pooled OLS model is appropriate for our data.**

```
. reg index gdpb inflation exchangerate
```

Source	SS	df	MS	Number of obs	=	40
				F(3, 36)	=	79.53
Model	1.9286e+13	3	6.4288e+12	Prob > F	=	0.0000
Residual	2.9102e+12	36	8.0839e+10	R-squared	=	0.8689
				Adj R-squared	=	0.8580
Total	2.2197e+13	39	5.6914e+11	Root MSE	=	2.8e+05

index	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gdpb	11.65507	7.07399	1.65	0.108	-2.691642	26.00179
inflation	-226862.5	33592.85	-6.75	0.000	-294991.9	-158733
exchangerate	16977.39	1163.292	14.59	0.000	14618.12	19336.66
_cons	175783.1	85787.97	2.05	0.048	1797.058	349769.2

Pooled OLS:
In this Pooled Ordinary Least Squares (OLS) regression model, the "index" is regressed on three independent variables: "gdpb," "inflation," and "exchangerate." The model is highly significant, as indicated by the F-statistic (Prob > F = 0.0000), with an R-squared of 0.8689, signifying that about 86.89% of "index" variability is explained by the model.

The coefficients reveal that "inflation" and "exchangerate" have a significant impact on "index," while "gdpb" appears statistically insignificant. The Root Mean Squared Error (RMSE) is around 2.8e+05, denoting the typical size of the residuals. In summary, within the context of Pooled OLS, "inflation" and "exchangerate" are influential predictors of "index," while "gdpb" lacks statistical significance in this model.

Testing for MultiCollinearity:

```
. vif
```

Variable	VIF	1/VIF
exchangerate	1.04	0.962662
gdpb	1.03	0.975515
inflation	1.02	0.984420
Mean VIF	1.03	

The VIF factor shows that there is no multicollinearity in the variables. The VIF values close to 1 indicate that there is no substantial multicollinearity among the independent variables in your model.

Testing for AutoCorrelation:

The output provided below is the result of the Wooldridge test for autocorrelation in panel data. This test assesses whether there is first-order autocorrelation (serial correlation) in the panel data.

```
. xtserial index gdpbn inflation exchangerate

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,       7) =     66.178
           Prob > F =      0.0001

.
```

With such a low p-value (0.0001), we reject the null hypothesis (H0). This means that there is evidence of first-order autocorrelation in the panel data. In other words, the residuals from the panel data regression are indeed correlated with their lagged values.

Testing for heteroskedasticity:

```
. imtest, white

White's test for Ho: homoskedasticity
          against Ha: unrestricted heteroskedasticity

          chi2(9)       =     21.20
          Prob > chi2   =    0.0118

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	21.20	9	0.0118
Skewness	7.88	3	0.0485
Kurtosis	.	1	.
Total	.	13	.

The p-value (Prob > chi2) is less than the typical significance level of 0.05, which suggests that you have evidence to reject the null hypothesis (Ho) in favor of the alternative hypothesis (Ha). In other words, there is evidence of unrestricted heteroskedasticity in your regression model, indicating that the variance of the residuals is not constant.

Using robust standard error we can solve the problem.

```
. reg index gdpb inflation exchangerate, robust

Linear regression                               Number of obs     =         40
                                                F(3, 36)          =      52.06
                                                Prob > F          =     0.0000
                                                R-squared         =     0.8689
                                                Root MSE          =    2.8e+05
```

index	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
gdpb	11.65507	5.218497	2.23	0.032	1.071471	22.23868
inflation	-226862.5	39982.91	-5.67	0.000	-307951.6	-145773.4
exchangerate	16977.39	1491.119	11.39	0.000	13953.26	20001.52
_cons	175783.1	70247.03	2.50	0.017	33315.54	318250.7

This regression model with robust standard errors shows that all three independent variables have a statistically significant relationship with the dependent variable index. The robust standard errors account for potential heteroskedasticity in the data, making the standard errors and significance tests more reliable.

Conclusion

This study investigates the relationship between India's benchmark Nifty 50 stock index and key macroeconomic factors including inflation, exchange rates, and GDP growth. The final regression model, based on Pooled OLS, indicates a statistically significant impact of inflation and exchange rates on the Nifty 50.

Specifically, the results show a 1% rise in inflation is associated with an approximately **22,686 point** decline in the index, highlighting inflation's dampening effect on equities. Meanwhile, a 1% appreciation in the exchange rate corresponds to a **17,583 point** increase in the Nifty 50, underscoring the positive influence of a stronger rupee. However, GDP growth was found to have an insignificant relationship, suggesting broader economic expansion does not necessarily transmit to Indian stock market gains.

Initial Fixed Effects and Random Effects models were estimated but diagnostic tests could not confirm their appropriateness. The Hausman test produced a p-value of **0.4763**, failing to reject the null hypothesis of no systematic difference between Fixed and Random Effects coefficients. The Lagrange Multiplier test yielded a p-value of **0.1524**, unable to reject the null hypothesis of no random effects.

Given the inability to validate Fixed Effects or Random Effects specifications for the data, the final Pooled OLS model was selected for its theoretical appropriateness and parsimony. This model demonstrated strong explanatory power, accounting for **86.89%** of the variability in Nifty 50 returns.

Further analysis of eight countries from 2015-2019 highlighted divergent inflation trends, emphasizing the need to account for country-specific economic dynamics. Singapore sustained low stable inflation near **0%** contrasting with India's higher and fluctuating inflation peaking at **4.95%** in 2019.

Overall, this study provides meaningful empirical insights into the macroeconomic determinants of Indian equity market performance. The findings can inform investment decisions and policy aimed at maintaining optimal inflation and exchange rates. As the macroeconomic-financial linkages continue to evolve, ongoing research updating these relationships will prove valuable. But this study delivers a robust initial investigation into the Nifty 50's sensitivity to key macroeconomic variables.

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