Impact of Macroeconomic Determinants on Stock Market Performance in Nepal: A Vector Error Correction Model Analysis

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Astract

This study explores the long-term and short-term relationships between the Nepal Stock Exchange (NEPSE) and key macroeconomic variables, including liquidity, reserve money, the Consumer Price Index (CPI), and foreign exchange rates. It employs the Vector Error Correction Model (VECM) with the time series data. The study aims to explore how these macroeconomic factors influence, to examine the long-run relationship, and assess the causal direction on the stock market movements in Nepal. The Johansen Cointegration Test reveals a long-term equilibrium relationship between these variables. The reserve money and foreign exchange rates show positive effects on NEPSE, while CPI and liquidity exhibit negative impacts. Specifically, reserve money and foreign exchange rates have a significant positive correlation with NEPSE. Conversely, higher CPI and increased liquidity are found to negatively affect the stock market in the long-run. The Granger Causality

Test indicates that reserve money and foreign exchange rates Granger cause NEPSE, while the stock market itself Granger causes consumer price index.

Key words**:** *nepal stock exchange (nepse), macroeconomic variables, vector error correction model (vecm), cointegration, and granger causality test*

Introduction

The stock market is an essential part of a country's financial system, influencing investment, economic growth, and financial stability. In Nepal, the Nepal Stock Exchange (NEPSE) serves as the main platform for trading securities, impacting both short-term investment decisions and long-term economic stability. However, NEPSE's performance is subject to fluctuations influenced by various macroeconomic factors, including reserve money, liquidity, the Consumer Price Index (CPI), and foreign exchange rates. Understanding how these variables interact with NEPSE is essential for policymakers, investors, and financial analysts to ensure stability and growth in the financial market. Fama (1970) introduced the Efficient Market Hypothesis (EMH), weak, semi-strong, and strong, and explored macroeconomic influences on stock markets, emphasizing factors such as industrial production, GDP, and interest rates.

Macroeconomic variables such as Reserve Money, Liquidity, Consumer Price Index (CPI), and Foreign Exchange Rates significantly impact stock market movements. Reserve Money represents the total money supply in an economy, influencing market liquidity and investment capacity. Liquidity, which refers to the availability of cash and liquid assets, affects investor confidence and market stability. Naik & Reddy (2024) analyzed Indian stock market liquidity, and revealed the significant macroeconomic influences, including gold prices and foreign investment inflows. The Consumer Price Index (CPI) measures inflation, which can reduce purchasing power and increase economic uncertainty. Shrestha & Bhatta (2018) linked NEPSE movements to CPI, broad money, and Treasury bills. The study suggests that inflation has a significant effect on the stocks market performance. Foreign Exchange Rates play a role in determining investment inflows and profitability for businesses, especially those engaged in international trade.

In Nepal, limited research has explored the relationship between NEPSE and these macroeconomic factors. The existence of long-term and short-term relationships between these variables needs to be examined using advanced econometric models. This study employs the Vector Error Correction Model

(VECM) to analyze these relationships. Naka et al. Naka et al. (1991) applied the Vector Error Correction (VEC) model, and revealed long-run equilibrium associations with inflation, industrial production, and stock prices. The Johansen Cointegration Test is used to determine whether a long-term equilibrium exists among the variables, while the Granger Causality Test examines cause-and-effect relationships between them. Pesaran et al. (2001) prolonged this by proposing a likelihood-based estimation for multiple co-integration vectors in Gaussian VAR models. Despite the importance of these macroeconomic factors, there is limited empirical evidence in the Nepalese context that comprehensively analyzes their impact on stock market movements. Thapa (2023a) studied that exchange rates significantly impact stock market, while factors such as consumer prices, money supply, and remittances have an insignificant influence in the Nepalese context. Furthermore, the existence of cointegration among these variables suggests an interdependent relationship that must be examined through advanced econometric models. The selection of an appropriate lag length and modeling approach is crucial for accurate forecasting and policy recommendations. This study, therefore, seeks to address these research gaps by employing a Vector Error Correction Model (VECM) to explore the long-term and short-term dynamics between NEPSE and key macroeconomic indicators.

The main objective of this study is to explore the causal and long-run relationship between equity market and macroeconomic variables. The specific objectives are: To examine the long-term and short-term relationships between NEPSE and key macroeconomic variables, namely Reserve Money, Liquidity, CPI, and Foreign Exchange Rates. Additionally, the aim is to test for cointegration among the variables using the Johansen Cointegration Test and identify the number of cointegrating relationships, and to analyze the causal relationships between NEPSE and the macroeconomic variables through Granger causality tests.

Fama (1970) introduced the Efficient Market Hypothesis (EMH). The researcher classifies market efficiency into weak, semi-strong, and strong forms based on how stock prices reflect information. The research explored macroeconomic influences on stock markets, emphasizing factors such as industrial production, GDP, and interest rates. Engle & Granger (1987) presented co-integration and error correction models to analyze long-term equilibrium relationships among non-stationary variables. Naka et al. (1991) applied the Vector Error Correction (VEC) model to assess the Indian stock market performance. This study revealed long-run equilibrium associations with inflation, industrial production, and stock prices. AL- Shubiri (2010) examined the Amman Stock Exchange to identify a long-term equilibrium between stock prices and

macroeconomic variables. Rahman et al. (2009) employed a VAR framework for Malaysian stocks market. The finding exhibits co-integration with interest rates money supply, and reserves money. Thapa (2019) studied Nepal stock market performance, highlighting interest rates, dividends, earnings per share, and liquidity as key stock market drivers while identifying inverse relationships with liquidity, P/E ratios and interest rates. Shrestha & Bhatta (2018) linked NEPSE movements to CPI, broad money, and Treasury bills. The study suggests that inflation has a significant effect on the stocks market performance.

Muthike and Sakwa (2012) examined the Nairobi Stock Exchange, the Kenya National Bureau of Statistics, and the Central Bank of Kenya. The results show positive coefficients for foreign exchange rates, money supply, and treasury bills. Whereas the inflation rate and GDP have negative coefficients. The 91-day Treasury bills and inflation rate are significant leading indicators for the NSE 20-Share Index. However, the real exchange rates and money supply are inappropriate as share price proxies. The research exhibited that significant correlations exist between the Kenyan stock market and most macroeconomic indicators, except for gross domestic product.

The study of (Thapa, 2023) revealed that while GDP has no long-term impact on the Nepalese Stock Market performance. It does influence stock market movements in the short term. Naik & Padhi (2012) examined the relationship between BSE Sensex and macroeconomic factors. The study disclosed a long-run equilibrium with positive correlations to money supply and industrial production, but negative ones with inflation.

By analyzing the previous review of literatures, the researcher concluded the following null hypotheses: there is no long-term relationship between NEPSE and the selected macroeconomic variables. There is no causal relationship between NEPSE and the selected macroeconomic variables.

Research Materials and Methods

This study employs quantitative research methodology with the time series data. It uses Vector Error Correction Model (VECM) model to analyze the long-run relationship between the Nepal Stock Exchange (NEPSE) index. The data collection from NEPSE, NRB, SEBON, World Bank, and listed company financial statements. The study used monthly data spanning from January 2005 to December 2024, total 203 observations after adjustments. The data gathered by applying a judgmental sampling method. It ensures relevance and significance of selected macro variables. This study employed quantitative analysis to understand the factors that affect the performance of the stock market. Data analysis employed on the Excel, and Eviews- 12 for time series regression analyses. The study used inferential statistics to explore long-term and impact between macroeconomic variables and the stock market performance. Through an econometric model, it examines how selected macroeconomic indicators influence stock prices, aiming to gauge their impact and their relationship. The VECM approach was chosen due to its flexibility in handling variables of different integration orders.

The optimal lag length is determined using multiple criteria, including Log-Likelihood (LogL), Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Criterion (SC), and Hannan-Quinn Criterion (HQ). Based on these indicators, lag 2 is identified as the optimal selection. To examine the long-term relationships among the variables, the Johansen Cointegration Test is applied, confirming the existence of cointegration. Given the presence of cointegration, the Vector Error Correction Model (VECM) is selected over the Vector Autoregression (VAR) model to capture both short-term fluctuations and long-term equilibrium relationships. Furthermore, several econometric tests are conducted to validate the relationships between the variables. The Johansen Cointegration Test is used to determine the number of cointegrating equations among the variables, ensuring that a meaningful long-term association exists. The VECM framework is then implemented to analyze both the short-term and long-term linkages between NEPSE and macroeconomic variables. Additionally, the Granger Causality Test is employed to investigate the causal relationships between NEPSE and macroeconomic factors, helping to establish the direction of influence among the variables.

RESULTS AND DISCUSSIONS

The lag length selection table shows several lag order selection criteria, such as Log-Likelihood (LogL), LR (Likelihood Ratio), FPE (Final Prediction Error), AIC (Akaike Information Criterion), SC (Schwarz Criterion), and HQ (Hannan-Quinn Criterion) for each possible lag order.

Endogenous variables: NEPSE, Reserve Money, Liquidity, CPI, Foreign Exchange Rates Exogenous variables: C

Lag	LogL	LR	FPE	AIC	SC	HQ
0	333.1481	NA	1.29E-08	-3.977552	-3.883433	-3.939346
1	1261.702	1789.576	2.26E-13	-14.92972	-14.36500	-14.70048
2	1356.367	176.7085	9.71e-14*	-15.77415*	-14.73883*	-15.35388*
3	1375.891	35.26122	1.04E-13	-15.70777	-14.20186	-15.09647
4	1402.391	46.25550*	1.03E-13	-15.72596	-13.74945	-14.92362
5	1415.299	21.74804	1.19E-13	-15.57939	-13.13228	-14.58602
6	1427.288	19.47204	1.41E-13	-15.42167	-12.50396	-14.23727
7	1451.224	37.42792	1.45E-13	-15.40878	-12.02048	-14.03335
8	1474.087	34.36377	1.51E-13	-15.38288	-11.52397	-13.81641

* indicates lag order selected by the criterion

The optimal lag length for the variables (NEPSE, Reserve Money, CPI, and Liquidity) is lag 2, as indicated by the selection criteria. It minimizes the Akaike Information Criterion (AIC), Schwarz Criterion (SC), Hannan-Quinn Criterion (HQ), and Final Prediction Error (FPE), all suggesting better model fit and predictive performance at lag 2. From the table, Lag 2 has the lowest AIC value of -15.77, which suggests that it strikes the best balance between fit and simplicity for the data. Despite a higher Likelihood Ratio (LR) at lag 1, lag 2 is preferred for balancing model complexity and accuracy across multiple criteria.

The cointegration test table presents that there are 3 cointegrating equations among the variables: NEPSE (stock market), Reserve Money, CPI (inflation), and Liquidity. Both the Trace and Maximum Eigenvalue tests reject the null hypothesis of no cointegration at the 0.05 significance level, with p-values of 0.00 and 0.0003, respectively. The results suggest strong evidence of a long-term equilibrium

relationship between these variables. Furthermore, the tests reject the hypothesis of at most 1 and 2 cointegrating equations, further supporting the existence of three cointegrating relationships. This suggests that while the variables may exhibit short-term fluctuations, they are connected in the long run, and their movements are interdependent. These findings highlight the need for a Vector Error Correction Model (VECM). Which can capture both short-term dynamics and long-term equilibrium among these variables. Given this cointegration, a Vector Error Correction Model (VECM) is preferred over a Vector Autoregression (VAR) model.

Linear deterministic trend, Series: (NEPSE, Reserve Money Liquidity, Consumer Price Index, Foreign Exchange Rate) Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.25	114.52	69.82	0.00
At most 1 *	0.17	64.79	47.86	0.00
At most 2 *	0.11	32.05	29.80	0.03
At most 3	0.05	10.76	15.49	0.23
At most 4	0.01	2.04	3.84	0.15
Maximum Eigenvalue				
None *	0.25	49.73	33.88	0.00
At most 1 *	0.17	32.74	27.58	0.01
At most 2 *	0.11	21.28	21.13	0.05
At most 3	0.05	8.72	14.26	0.31
At most 4	0.01	2.04	3.84	0.15

Max-eigenvalueand Trace Value test indicates 3 cointegrating eqn(s) at the 0.05 level

Furthermore, the tests reject the hypothesis of at most 1 and 2 cointegrating equations, further supporting the existence of three cointegrating relationships. This suggests that while the variables may exhibit short-term fluctuations, they are connected in the long run, and their movements are interdependent. These findings highlight the need for a Vector Error Correction Model (VECM). Which can capture both short-term dynamics and long-term equilibrium among these

variables. Given this cointegration, a Vector Error Correction Model (VECM) is preferred over a Vector Autoregression (VAR) model.

The analysis of Nepal Stock Exchange (NEPSE), Consumer Price Index (CPI), Reserve Money, Liquidity, and Foreign Exchange Rates (ER) in the context of the Vector Error Correction Model (VECM) results reveals valuable insights into the interactions between these economic variables. The Nepal Stock Exchange (NEPSE), as a major indicator of the country's financial market, shows a mix of long-term and short-term relationships with other variables.

Vector Error Correction Estimates Standard errors in () & t-statistics in []

Cointegrating Eq:	**CointEq1**				
LOGNEPSE(-1)	1.000000				
LOGRESE(-1)	10.52319 (3.23878) [3.24912]				
LOGLIQ(-1)	-22.77663 (3.43307) [-6.63448]				
LOGCPI(-1)	-2.719846 (0.82063) [-3.31435]				
LOGER(-1)	22.67069 (5.72658) [3.95885]				
C	-186.1393				
Error Correction:	**D(LOGNE...**	**D(LOGRE..)**	**D(LOGLIQ)**	**D(LOGCPI)**	**D(LOGE)**
CointEq1	-0.010538 (0.00346) [-3.04930]	0.002188 (0.00269) [0.81458]	0.009909 (0.00211) [4.68626]	0.019668 (0.00603) [3.26260]	-0.0010 0.0009 [-1.192]
D(LOGNEPSE(-1))	0.063782 (0.07879) [0.80954]	-0.099223 (0.06123) [-1.62051]	0.094755 (0.04821) [1.96547]	0.412711 (0.13744) [3.00287]	-0.0203 0.0207 [-0.982]
D(LOGNEPSE(-2))	0.034954 (0.08095) [0.43180]	0.079023 (0.06291) [1.25614]	0.107752 (0.04953) [2.17536]	0.004036 (0.14121) [0.02858]	-0.0001 0.0213 [-0.005]
D(LOGRESE(-1))	0.302275	-0.241358	1.193587	0.145339	0.0057

	(0.10986)	(0.08538)	(0.06723)	(0.19165)	0.0289
	[2.75138]	[-2.82688]	[17.7551]	[0.75837]	[0.1984]
D(LOGRESE(-2))	0.015581	-0.128648	0.202518	0.111958	0.0711
	(0.17265)	(0.13417)	(0.10564)	(0.30117)	0.0454
	[0.09025]	[-0.95882]	[1.91700]	[0.37174]	[1.5651]
D(LOGLIQ(-1))	-0.080299	-0.063329	-0.109599	0.066747	-0.0455
	(0.12585)	(0.09780)	(0.07701)	(0.21953)	0.0331
	[-0.63806]	[-0.64752]	[-1.42323]	[0.30404]	[-1.374
D(LOGLIQ(-2))	0.016397	0.024132	0.140580	0.186977	-0.0182
	(0.06671)	(0.05185)	(0.04082)	(0.11638)	0.0175
	[0.24578]	[0.46544]	[3.44368]	[1.60662]	[-1.040]
D(LOGCPI(-1))	-0.014269	-0.085042	-0.044941	0.128375	-0.0003
	(0.04350)	(0.03381)	(0.02662)	(0.07588)	0.011
	[-0.32803]	[-2.51558]	[-1.68837]	[1.69176]	[-0.027]
D(LOGCPI(-2))	0.012229	0.035284	0.023354	-0.066355	-0.0079
	(0.04379)	(0.03403)	(0.02680)	(0.07640)	0.0115
	[0.27922]	[1.03672]	[0.87149]	[-0.86857]	[-0.692
D(LOGER(-1))	0.022171	0.118760	0.039723	-1.169205	0.1760
	(0.29802)	(0.23161)	(0.18236)	(0.51987)	0.0784
	[0.07440]	[0.51277]	[0.21783]	[-2.24901]	[2.2430]
D(LOGER(-2))	-0.197570	0.259554	-0.212837	0.049145	-0.0487
	(0.30277)	(0.23529)	(0.18526)	(0.52815)	0.0797
	[-0.65255]	[1.10311]	[-1.14884]	[0.09305]	[-0.611]
C	0.006343	0.011323	-0.005534	-0.009551	0.0027
	(0.00547)	(0.00425)	(0.00335)	(0.00954)	0.0014
	[1.15973]	[2.66390]	[-1.65336]	[-1.00107]	[1.8830]

The long-term relationship between NEPSE and reserve money is positive and significant (coefficient of 10.52 with a t-statistic of 3.25). The results suggests that an increase in reserve money is positively related to the performance of the stock market. This means, as higher reserve money can lead to increased liquidity in the financial system, providing more capital for investment, including in the stock market. Additionally, the short-term dynamics also show a positive effect, with reserve money having a significant positive coefficient (0.32) and a t-statistic of 2.75138, which further supports the idea that reserve money influences market liquidity and investment activity.

The long-term relationship between NEPSE and CPI is negative (coefficient of -2.719 with a t-statistic of -3.31435). It indicates that higher inflation, represented by the CPI, negatively affects stock market performance. This is because inflation decreases the purchasing power of money and can increase uncertainty, which negatively impacts investor sentiment. However, in the short run, the effect of CPI on NEPSE is weaker (with a coefficient of -0.014 and a t-statistic of -0.32). It suggests that while inflation impacts the stock market in the long term, its short-term impact is less pronounced.

Liquidity, represented by LIQ, also has a negative long-term relationship with NEPSE (coefficient of -22.77 with a t-statistic of -6.63). This may appear counterintuitive, but it could be due to the fact that liquidity often leads to lower interest rates, which can make other assets more attractive compared to equities, thus dampening stock market returns. In the short term, however, the coefficient for liquidity is not significant, suggesting that the short-term effects of liquidity on the stock market are weaker.

Foreign exchange rates have a positive long-term relationship with NEPSE (coefficient of 22.67 with a t-statistic of 3.95). This suggests that an appreciation of the exchange rate (i.e., a strengthening of the domestic currency) can have a favorable impact on the stock market. This could be because stronger currency lowers import costs, boosts business profitability, and increases investor confidence in the local economy. The short-term dynamics are more complex, with showing a positive but weak coefficient. However, the relationship is negative but not statistically significant. This implies that in the short term, changes in the foreign exchange rate may not have a significant impact on the stock market. Nonetheless, in the long run, exchange rate stability or appreciation plays a vital role in influencing stock market performance.

The relationship between the Nepal Stock Exchange (NEPSE) and the macroeconomic variables such as CPI, reserve money, liquidity, and foreign exchange rates is complex. Reserve money and exchange rates have positive effects, particularly in the long run, while CPI (inflation) and liquidity have negative long-term effects on the stock market. Policymakers aiming to boost stock market performance should focus on maintaining stable inflation, ensuring adequate reserve money, and fostering a stable exchange rate, as these factors have the most significant long-term impacts.

The Johanson Granger causality test table exhibits the causality direction between the dependent and independent variables. It supports to determine whether one time series can predict another, meaning if changes in one variable precede and thus help explain changes in another.

Pairwise Granger Causality Tests, Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
Reserve Money does not Granger Cause LOGNEPSE	180	11.72	2.E-05
NEPSE does not Granger Cause Reserve Money		2.24	0.11
Liquidity does not Granger Cause NEPSE	231	2.04	0.13
NEPSE does not Granger Cause Liquidity		0.06	0.94
CPI does not Granger Cause NEPSE	200	0.19	0.82
NEPSE does not Granger Cause CPI		3.46	0.03
Foreign Exchange Rate does not Granger Cause NEPSE	231	3.55	0.03
NEPSE does not Granger Cause Foreign Exchange Rata		0.77	0.47

The F-statistic between reserve money and NEPSE is 11.7155, and the p-value is 2.E-05, which is highly significant. This suggests that reserve money does Granger cause the stock market, meaning changes in reserve money help to predict future movements in the stock market. Though, there is inverse causal relationship between NEPSE and reserve money. The F-statistic is 2.23, and the p-value is 0.1098, which is not statistically significant at the 5% level. This indicates that the stock market does not Granger cause reserve money, meaning the stock market does not help predict future movements in reserve money.

The F-statistic of liquidity and NEPSE is 2.043, and the p-value is 0.13, which is not significant at the 5% level. This means liquidity does not Granger cause the stock market, suggesting liquidity alone is not a predictor of stock market performance. The F-statistic of NEPSE and liquidity is 0.058, and the p-value is 0.94, which is also not significant. This suggests the stock market does not Granger cause liquidity either, meaning there is no predictive relationship in either direction.

The F-statistic of CPI (Consumer Price Index) and Stock Market is 0.19, and the p-value is 0.82, which is not significant. This indicates that CPI does not Granger cause the stock market, meaning inflation does not predict future stock market movements. The F-statistic is of NEPSE and CPI is 3.46, and the p-value is 0.03, which is statistically significant at the 5% level. This suggests that the stock

market Granger causes CPI, meaning that stock market performance may help predict inflation levels in the future.

The F-statistic of foreign exchange rates and NEPSE is 3.55, and the p-value is 0.03, which is statistically significant at the 5% level. This suggests that exchange rates Granger cause the stock market, meaning changes in exchange rates help predict stock market performance. The F-statistic of NEPSE and exchange rates is 0.76, and the p-value is 0.46, which is not significant. This indicates that the stock market does not Granger cause exchange rates, meaning the stock market does not predict exchange rate movements.

The current findings of this study reveal valuable understandings into the relationship between macroeconomic variables and the Nepal Stock Exchange (NEPSE). The results show that foreign exchange rates and reserve money have a positive long-term relationship with stock market, while CPI (inflation) and liquidity negatively impact stock market performance. These findings are in line with past studies, such as Shrestha & Bhatta (2018), who found a significant link between inflation and NEPSE, as well as Naik & Reddy (2024), who highlighted the role of liquidity in stock market movements in India. The positive long-term relationship between reserve money and NEPSE aligns with the work of Naka et al. Naka et al. (1991), who found similar results in the Indian market, emphasizing the importance of liquidity in supporting market performance.

However, some differences exist when comparing short-term dynamics. While the long-term effects of reserve money and foreign exchange rates on NEPSE are significant, the short-term relationships are less pronounced, particularly for CPI and liquidity. This finding contrasts with Naik & Padhi (2012), who suggested that inflation had an insignificant short-term effect on the Nepalese stock market. The Granger causality tests further support these results, showing that reserve money and exchange rates Granger cause NEPSE, while CPI and liquidity do not have a significant predictive relationship with the stock market, which is consistent with findings from Rahman et al. (2009) and Muthike & Sakwa (2012), who observed similar causal relationships in other markets.

Conclusions

The study explores the impact of key macroeconomic variables on the Nepal Stock Exchange (NEPSE). The major factors analyzed include: Reserve Money, Liquidity, Consumer Price Index (CPI), and Foreign Exchange Rates. Understanding these relationships is crucial for policymakers, investors, and financial analysts to ensure economic stability and growth. The research uses time-series data from January 2005 to December 2024 and applies the Vector Error Correction Model (VECM) to examine long-term and short-term relationships. The Johansen Cointegration Test confirms that these variables share long-term equilibrium, while the Granger Causality Test helps determine cause-and-effect relationships. Reserve Money has a positive long-term impact on NEPSE, increasing liquidity and investment. CPI (Inflation) negatively affects the stock market by reducing purchasing power and increasing uncertainty. Liquidity has a negative long-term impact, possibly due to lower interest rates making other investments more attractive. Foreign Exchange Rates positively influence NEPSE, as a stable currency boosts investor confidence and business profitability. The Granger Causality Test shows that Reserve Money and Exchange Rates significantly predict stock market movements, whereas Inflation and Liquidity have weaker predictive power.

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