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Exploring the Nexus between Macroeconomic Variables and Stock Market Returns in Nepal: An ARDL Bounds Testing Approach

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Abstract

Background: Investors and policymakers must understand how macroeconomic variables (MEVs) affect stock market behavior to maximize portfolios and maintain economic stability. Hence, it is crucial to establish a nexus between MEVs and stock market returns (SMRs).

Objectives: This study seeks to assess the effects of MEV on SMRs in the long and short run.

Methods: This paper analyzed the cointegrating relationship between MEVs and SMRs using a time series data set from 1994 to 2023. This study used the ARDL bounds testing approach.

Results: The results confirm a cointegrating association between MEVs and SMRs in the Nepalese stock market. The error correction (ECT -1) term is significantly negative, suggesting a persistent correlation between the variables. The study also shows that interest rates negatively affect SMRs over time. Real GDP (LRGDP), inflation (LINFR), and exchange rate (LEXR) have negative but statistically insignificant associations with SMRs. However, the money supply (LMS) positively correlates with SMRs.

Conclusion: The study's findings provide practical advice for policymakers. For instance, lower interest rates increase the appeal of stocks by reducing the opportunity costs of holding bank deposits and credit costs. Therefore, policymakers are advised to maintain lower interest rates to cultivate a more appealing investment environment. Furthermore, policymakers should prioritize regulating inflation and preserving a robust foreign exchange rate to boost investors' SMRs.

Keywords: ARDL bounds testing, interest rate, macroeconomic variables, Stock market returns

JEL Classification: E44, G10

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Introduction

The nexus between MEVs and stock SMRs has captivated the attention of scholars in finance literature, leading to extensive exploration and analysis. Delving into how indicators like inflation, interest rates, exchange rates, and GDP growth shape stock market behavior is not merely an academic exercise but a critical pursuit for investors aiming to fine-tune their portfolios and policymakers striving to uphold economic stability. These MEVs act as vital signposts, offering a comprehensive snapshot of an economy's overall health and performance. Interest rates, M2, Real GDP, inflation, and exchange rates are pillars in the intricate understanding of economic dynamics. They provide essential guidance to policymakers, businesses, and analysts alike, navigating the complexities of the economy and forecasting emerging trends (Barro, 1997; Khatri, 2019; McDermott, 1996).

The influence of MEVs in shaping SMRs has remained a central focus within financial economics (Ahmed et al., 2017; Shrestha, 2019). Michael (2014) uncovered a fascinating dichotomy, revealing a solid link between inflation and SMRs in the short run, which unexpectedly transforms into a favorable connection over the long run. Various macroeconomic indicators - GDP, CPI, M2, FDI, exchange rates, interest rates, and industrial production - demonstrably sway the stock market's behavior (Alam & Rashid, 2015). Adding to this discourse, Khan (2019) emphasized the detrimental influence of exchange rates on SMRs while highlighting the adverse effects of inflation and interest rates.

Furthermore, Aremo et al. (2020) identified a negligible influence of FDI and external debt on the Nigerian stock market over the long term while noting a positive effect from M2 and trade openness. Kengatharan and Ford (2021) revealed a considerable negative effect of interest rates and inflation on SMRs. Similarly, Balagobei and Bandara (2022) added to this discourse by highlighting the positive contributions of GDP and M2, juxtaposed with the adverse effects of interest and exchange rates on SMRs. These varied findings underscore the intricate and context-dependent relationship between MEVs and SMRs.

In the Nepalese context, Phuyal (2016) uncovered a long-term equilibrium among MEVs, such as CPI, interest rates, remittance flows, and stock market performance. Conversely, Devkota and Dhungana (2019) posited that interest rates are the primary driver of the NEPSE index. Moreover, Mishra and Pokhrel (2020) found that while interest rates affect stock prices in the short-run, they do not exert influence over the long-run. In contrast, Shrestha and Lamichhane (2021) argued for a favorable sustained effect of economic expansion on stock market outcomes, counterbalanced by Karki (2018) and Khatri (2019) both claimed that MEVs fail to explain stock price fluctuations in the long run. Further, Rana (2021) introduced another dimension, emphasizing that a controlled and stable interest rate environment could expand Nepal's stock market trading depth and breadth, attracting potential investors and fueling more significant market investment. This insight focused on the possible impact of macroeconomic policies, particularly interest rate management, on the dynamics of the NEPSE.

Thus, in-depth empirical research is needed to provide concrete evidence of how MEVs impact SMRs in Nepal. This research aims to furnish empirical findings, enhance comprehension of the Nepalese stock market dynamics, and provide valuable insights for investors, policymakers, businesses, and academic scholars.

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Review of Literature

Alam and Rashid (2015) explored the long-term dynamics between the Karachi stock market and MEVs, including inflation, IPI, M2, exchange, and interest rates. Their findings indicated that CPI, M2, exchange rates, and interest rates negatively correlated with SMRs, while IPI was positively correlated. Complementing this, Ahmed et al. (2017) identified a prolonged linkage between stock market prices and monetary variables. Conversely, Eldomiaty et al. (2019) established a favorable association between interest rates and equity prices while confirming an adverse effect of inflation on stock market performance (SMP). Expanding on this, Michael (2014) utilized the ARDL approach to assess the inflation-stock market nexus. The study revealed a significant long-term association between inflation and SMRs, juxtaposed with a short-term negative and statistically significant connection.

Similarly, Temuhale and Achugbu (2019) revealed insignificant positive effects of inflation, interest rates, and market capitalization on short-term SMRs while identifying a considerable negative consequence of M2 and historical exchange rate figures on short-term SMRs. In alignment with this, Aremo et al. (2020) demonstrated that M2 and trade openness substantially influence SMRs in the long term. Conversely, FDI inflows and external debt were found to have no measurable effect on SMRs in Nigeria. LIR and LEXR negatively impact SMP, while inflation has no effect (Balagobei & Bandara, 2022). Dao et al. (2022) indicated a positive influence of M2 and the exchange rate on the VN-Index but revealed that interest rates and oil prices did not affect SMRs over the long term. Similarly, Kengatharan and Ford (2021) discovered a substantial adverse effect of LINFR and LIR on stock SMP across short and long terms, noting no effect from LEXR and LMS. Khan (2019) revealed that exchange rates negatively impact stock returns, alongside adverse effects from interest rates and inflation in the Shenzhen Stock Exchange. Similarly, Neifar (2022) highlighted a dynamic adjustment process in the short-term and a stable long-term consistent correlation between SMRs and MEVs, except for LEXR in the Suisse Stock Market.

In the Nepalese context, Phuyal (2016) established a sustained equilibrium connection between the NEPSE and MEVs, including inflation, interest rates, and remittance flows. Likewise, Karki (2018) found that LRGDP, LINFR, and M2 positively influence SMRs, while LIR has a negative effect. Devkota and Dhungana (2019) identified a long-term association between the SMRs and MEVs and revealed that LIR is the most significant determinant of the SMRs. In contrast, the real exchange rate was deemed insignificant in impacting SMRs. Additionally, Khatri (2019) revealed that MEVs do not significantly influence stock prices in Nepal. However, it was noted that M2 has a positive and significant nexus with SMRs. In contrast, FDI, CPI, and exchange rates were found to have a favorable but negligible effect on the stock market. Meanwhile, LRGDP and LIR were observed to have a minimal and adverse effect on SMRs. Panta (2020) indicated that fluctuations in stock market prices are influenced by M2, interest rates, inflation, and exchange rates in the long run. While GDP, M2, and exchange rates were positively correlated with stock market prices in the short term, only M2 maintained a positive relationship over the long term. Mishra and Pokhrel (2020) found that interest rates did not substantially impact stock prices over the long term. This implies that short-term fluctuations in interest rates can impact stock prices, whereas other factors may influence long-term market behavior.

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Shrestha and Lamichhane (2021) confirmed a cointegrating relationship, highlighting that economic growth significantly impacts stock market performance. Conversely, LMS and LIR were found to affect the Nepalese stock market substantially over the long run. Bhattarai et al. (2021) suggested a persistent directional influence from stock market growth to economic development. Further, Rana (2021) explored the persistent linkage between MEVs and SMRs in Nepal from 1995 to 2020, confirming a significant positive effect of LRGDP growth on SMRs while highlighting adverse effects from exchange rates and inflation.

Materials and Methods

Data Collection and Sources

This paper is grounded in an extensive analysis of time series data from 1994 to 2023, incorporating a spectrum of MEVs alongside SMRs. The MEVs examined include LIR, LRGDP, LMS, LINFR, and the LEXR between the Nepalese Rupees (NRs) and the US Dollar. Data for this comprehensive analysis is sourced from authoritative publications, specifically the Nepal Stock Exchange's official reports and the Nepal Rastra Bank's quarterly economic reports. To ascertain the stock market returns, the following methodology is employed:

$$SMR = Ln\left(\frac{Index_t}{Index_{t-1}}\right) \quad \ldots\ldots (1)$$

"$Index_t$ is the year-end NEPSE index; $Index_{t-1}$ is the NEPSE index of the previous year-end; and Ln refers to the natural log."

Description of Variables

Table 1

Interpretation of Variables

Indicators	Variables	Interpretations
SMRs	Stock Market Returns	Natural log of stock market returns
LRGDP	Real Gross Domestic Product	Natural log of real GDP
LINFR	Inflation Rate (CPI)	Natural log of inflation rate
LMS	Money Supply	Natural log of broad money supply (M_2)
LIR	Interest Rate	Natural log of weighted average 91-days T-bills rate
LEXR	Exchange Rate	Natural log of NRS/$ exchange rate

Model Specification

The general model of this study was as follows:

"SMRs = f (LRGDP, LINFR, LMS, LIR, LEXR)" …… (2)

The equation was arranged in a linear form as follows:

$$\text{"SMRs} = \beta_0 + \beta_1 \text{ LRGDP} + \beta_2 \text{ LINFR} + \beta_3 \text{ LMS} + \beta_4 \text{ LIR} + \beta_5 \text{ LEXR"} \ldots\ldots (3)$$

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"Where variables LNEPSERT, LRGDP, LINFR, LMS, LIR, and LEXR denote log values of Nepal stock exchange index returns, real gross domestic product, consumer price index, broad money supply, 91-days Treasury bill rate, and NRs/US dollar exchange rate."

The ARDL bounds testing model was:

$$"\alpha_0 + \sum_{t-1}^{n} \alpha_1 \Delta SMR_{t-1} + \sum_{t-1}^{n} \alpha_2 \Delta L(RGDP)_{t-1} + \sum_{t-1}^{n} \alpha_3 \Delta L(INFR)_{t-1} + \sum_{t-1}^{n} \alpha_4 \Delta L(MS)_{t-1} + \sum_{t-1}^{n} \alpha_5 \Delta L(IR)_{t-1} + \sum_{t-1}^{n} \alpha_6 \Delta L(EXR)_{t-1} + \theta_1 SMR_{t-1} = + \theta_2 L(RGDP)_{t-1} + \theta_3 L(INFR)_{t-1} + \theta_4 L(MS)_{t-1} + \theta_5 L(IR)_{t-1} + \theta_6 L(EXR)_{t-1} + \varepsilon_t" \quad (4)$$

SMRt represents stock market returns in year t, RGDP denotes real GDP, and INFRt indicates the inflation rate. LMSt captures the M2 for year t, IRt reflects the interest rate through the 91-day Treasury bill, and EXRt measures the exchange rate between the NRS and the $. Δ signifies the first difference, 'n' is the optimum lag length, and L represents the natural logarithm. α0 is the intercept term, with α1 through α6 capturing short-run dynamics and θ1 through θ6 representing long-run coefficients, while εt stands for the residual error. Following the ARDL bounds test, which identifies a cointegrating relationship between MEVs and SMRs, Equation 5 estimates the long-run relationship between them, unraveling both short-run adjustments and long-run equilibriums.

$$"SMRt = \theta_1 L(RGDP)_{t-1} + \theta_2 L(INFR)_{t-1} + \theta_3 L(MS)_{t-1} + \theta_4 L(IR)_{t-1} + \theta_5 L(EXR)_{t-1} + \varepsilon_t" \ldots\ldots\ldots (5)$$

Ultimately, the Error Correction Model (ECM), represented by Equation 6, has been employed to estimate the short-run nexus between MEVs and SMRs and the speed of adjustment in this context.

$$"\alpha_0 + \sum_{t-1}^{n} \alpha_1 \Delta SMR_{t-1} + \sum_{t-1}^{n} \alpha_2 \Delta L(RGDP)_{t-1} + \sum_{t-1}^{n} \alpha_3 \Delta L(INFR)_{t-1} + \sum_{t-1}^{n} \alpha_4 \Delta L(MS)_{t-1} + \sum_{t-1}^{n} \alpha_5 \Delta L(IR)_{t-1} + \sum_{t-1}^{n} \alpha_6 \Delta L(EXR)_{t-1} + \varepsilon_t" = \quad (6)$$

Result and Discussion

Unit Root Results

Before any test is conducted on time series data, ensuring the stationarity of the data is critical. This study analyzes MEVs impact on SMRs through the ARDL bound testing approach, which necessitates that the variables exhibit an order of integration no higher than one, meaning they should be either I(0) or I(1). To verify this condition, the "ADF Unit Root Test" and the "Phillip-Perron Unit Root Test" were utilized, both at the original level and at the first difference, to assess and verify the data's stationarity.

Table 2

Stationarity and Integration Test through ADF Unit Root

Variables Name	At level		At first Diff.		
	T-stat.	Prob.	T-stat.	Prob.	Order of Integration
SMR	-4.4425	0.0021			
			---	---	I (0)
LRGDP	-0.2824	0.9160			
			-5.7356	0.0001	I (1)

LINFR	-2.7789	0.0737			
			-6.2300	0.0000	I (1)
LMS	0.3089	0.9747			
			-3.5792	0.0130	I (1)
LIR	-2.3201	0.1727			
			-5.9557	0.0000	I (1)
LEXR	-0.4893	0.8796			
			-5.2663	0.0002	I (1)

"Source: Author's Computation by using EViews 12"

Table 3

Stationarity and Integration Test Phillip-Perron Unit Root

	At level		At first Diff.		
Variables Name	T-stat.	Prob.	T-stat.	Prob.	Order of Integration
SMR	-7.1753	0.0000	---	---	I (0)
LRGDP	-0.4149	0.8938	-12.1250	0.0000	I (1)
LINFR	-2.7863	0.0726	-6.3781	0.0000	I (1)
LMS	0.9163	0.9676	-3.3689	0.0115	I (1)
LIR	-2.4333	0.1419	-6.0479	0.0000	I (1)
LEXR	-0.5104	0.8753	-5.2921	0.0002	I (1)

"Source: Author's Computation by using EViews 12"

Tables 2 and 3 show that the SMR is stationary at the level. In contrast, following first-order differentiation, the remaining variables, LRGDP, LINFR, LMS, LIR, and LEXR, are stationary. Importantly, none of the variables exhibit an order of integration of I(2). So, the study utilized the "ARDL Bound Testing" for further analysis.

ARDL Bounds Testing

Table 4

ARDL Bounds Testing

Test Stat.	Value	K
F-stat.	4.5469	5
	Threshold Critical Values	
Significance level	Lower Bounds I(0)	Upper Bounds I(1)

10%	2.08	3
5%	2.39	3.38
2.50%	2.7	3.73
1%	3.06	4.15

"Source: Author's Computation by using EViews 12"

The F-statistic value of 4.5469 surpasses the critical I(1) value of 4.15 at a 1 percent significance level (see Table 4). This finding indicates that LRGDP, LINFR, LMS, LIR, LEXR, and SMR exhibit a co-integrated relationship. Given this co-integration, the study explores the short-run and long-run nexus between the MEVs and SMRs, shedding light on their interconnected dynamics.

Error Correction Model Estimation

Table 5

ECM Representation (1, 0, 0, 0, 0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.0228	0.0946	-0.2408	0.8121
D(LRGDP)	-2.9033	2.9691	-0.9778	0.3393
D(LINFR)	-0.1766	0.1661	-1.0630	0.2999
D(LMS)	1.2620	1.1924	1.0584	0.3019
D(LIR)	-0.2368	0.0791	-2.9920	0.0069
D(LEXR)	-0.6695	1.1273	-0.5939	0.5589
ECT (-1)	-0.9035	0.2234	-4.0438	0.0006

"Source: Author's Computation by using EViews 12"

"R-squared = 0.6284, Adjusted R-squared = 0.5222, S. E. of regression = 0.1307, The sum of squared resid = 0.3589, Log-likelihood = 21.2676, Durbin-Watson stat = 1.8508, Mean dependent var = 0.0029, S. D. dependent var = 0.1891, Akaike info criterion = -1.0191, Schwarz criterion = -0.6861, and Hannan-Quinn criter. = -0.9173."

Table 5 indicates the ARDL model's Error Correction Representation. The lagged ECT for SMR is negative and statistically significant. An ECT value of -0.9035 and a p-value of 0.0006 (less than 0.01) suggests that 90.35 percent of any disequilibrium observed in the short run is corrected annually, indicating a rapid adjustment toward long-run equilibrium. The model reveals that the speed at which short-term imbalances are rectified is 90.35 percent yearly.

ARDL Long-run Relationship

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Table 6

Long-Run Equilibrium Estimation for the Model

Variables	Coeff.	Std. Error	t-Stat.	Prob.
LRGDP	-1.6830	2.8923	-0.5819	0.5668
LINFR	-0.1101	0.1666	-0.6612	0.5157
LMS	0.4986	0.8128	0.6134	0.5462
LIR	-0.1972	0.0705	-2.7954	0.0108
LEXR	-0.5258	0.9227	-0.5698	0.5749
C	8.0721	13.6744	0.5903	0.5613

"Source: Author's Computation by using EViews 12"

The findings reveal a statistically significant negative relationship between the LIR and SMR at a 5% significance level (see Table 6). LRGDP, LINFR, and LEXR exhibit negative but statistically insignificant relationships with SMR, confirming the result of (Rana, 2021). Conversely, the LMS demonstrates a positive and statistically insignificant association with SMRs.

Finally, the long-run SMR function is estimated as follows:

SMRs = (-1.6830*LGDP - 0.1101*LINFR + 0.4986*LMS - 0.1972*LIR - 0.5258*LEXR + 8.0721)

ARDL Model Diagnostic Assessments

The study evaluated the model's robustness using the "Breusch-Pagan-Godfrey Test" for heteroscedasticity, the "Breusch-Godfrey Serial Correlation LM Test" for serial correlation, the "Jarque-Bera Test" for normality, and the "Recursive CUSUM Test" for stability.

Table 7

Breusch-Pagan-Godfrey Test Results

F -statistic	1.1512	Prob. F (6, 21)	0.3685
Obs*R-squared	6.9303	Prob. Chi-square (6)	0.3273
Scaled explained SS	2.6571	Prob. Chi-square (6)	0.8505

"Source: Author's Computation by using EViews 12"

The "Breusch-Pagan-Godfrey" test's P-value is greater than 5 percent, suggesting that the model's disturbance term is homoscedastic and does not exhibit heteroscedasticity.

Table 8

LM Test Results for Serial Correlation

F -statistic	1.1683	Prob. F (1, 20)	0.2926
Obs*R-squared	1.5454	Prob. Chi-square (2)	0.2138

"Source: Author's Computation by using EViews 12"

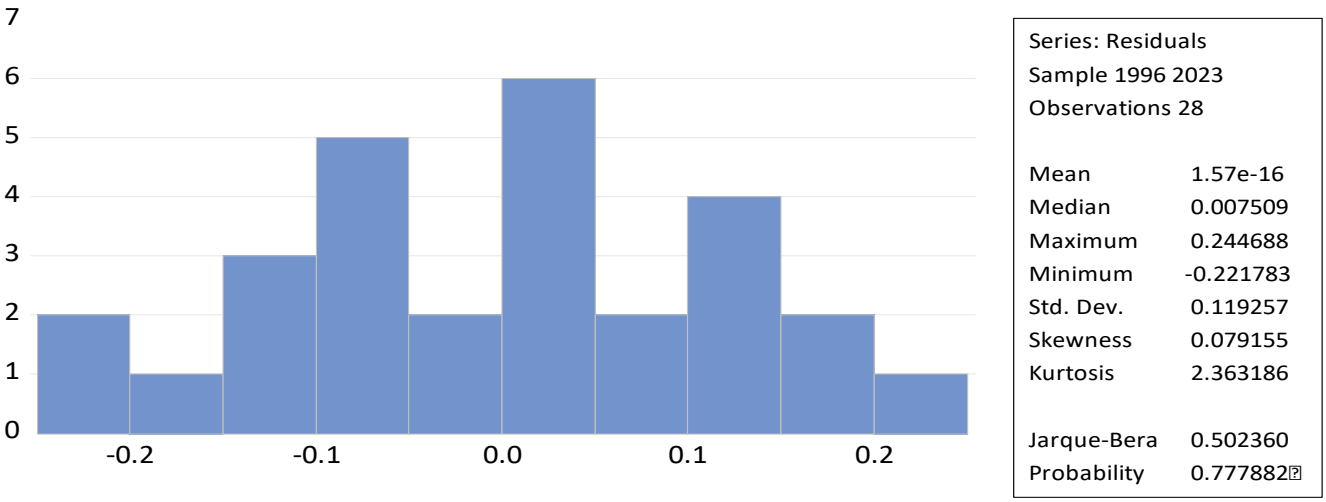
Table 8 shows a P-value greater than 5 percent, which rejects the null hypothesis of serial correlation and indicates the absence of serial correlation in the data.

Assessment of Normality

The Jarque-Bera statistics are employed to assess the normality of the residual terms in the model. The results illustrated in Figure 1 confirm this.

Figure 1

Visualization of Residual Terms



The figure presents a "Jarque-Bera Test" statistic of 0.5024 with a "p-value" of 0.7779 (greater than 0.05). This result does not provide sufficient evidence to reject the null hypothesis, suggesting that the residuals follow a normal distribution. Hence, the ARDL model is confirmed to have no issues with normality.

Model Stability Assessment

The model's stability was examined using the CUSUM of the recursive residuals test at a 5 percent significance level. Stability is confirmed if the CUSUM plots remain within the critical bounds at this significance level. The results of this stability assessment are visually depicted in Figure 2.

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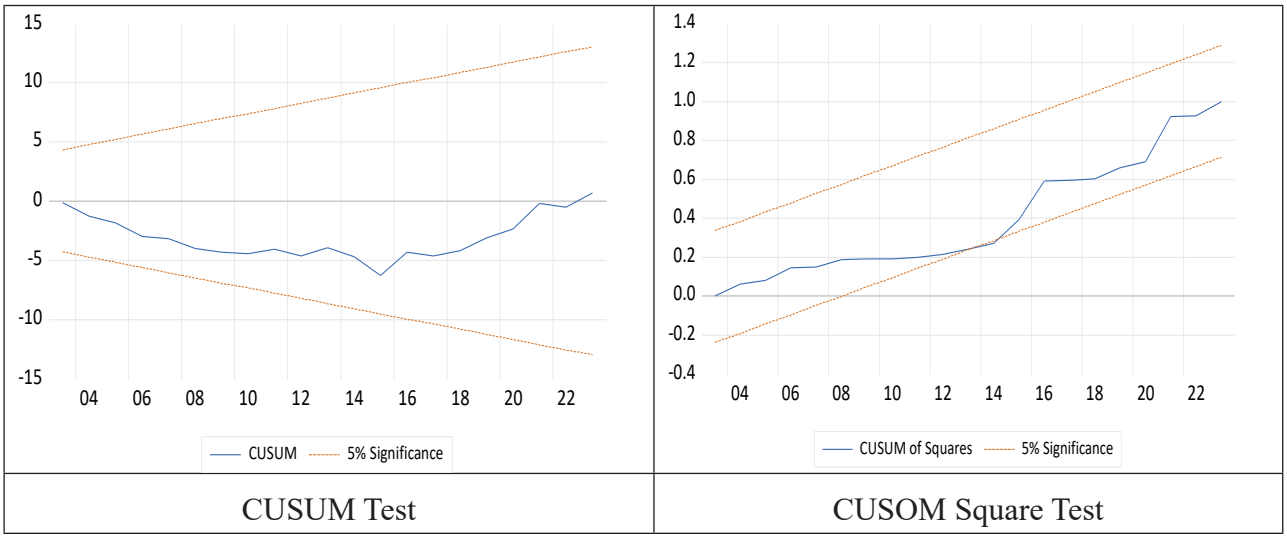
Figure 2

CUSUM and CUSUM Squared Diagnostic Tests



CUSUM Test | CUSOM Square Test

Figure 2 displays the plots of the "CUSUM Test" and the "CUSUM of Squares Test" along with the critical bounds at a 5 percent significance level. The plots are confined within these critical bounds, validating that the estimated model demonstrates stability throughout the investigation.

This study uses "ARDL Bounds Testing" to illuminate the complicated link between Nepalese SMRs and MEVs. The study results reveal a statistically significant negative nexus between the LIR and SMRs, revealing a web of relationships. This discovery not only supports the previous research of Shrestha and Lamichhane (2021), Kengatharan and Ford (2021), Devkota and Dhungana (2019), and Karki (2018) but also reinforces the prevailing belief that high interest rates discourage investment in the stock market, which is likely due to the increased cost of borrowing. In contrast, the complex relationships between real GDP, inflation rate, exchange rate, and SMRs, while negative, are statistically insignificant. This result is consistent with the study by Rana (2021) and Shrestha (2023), suggesting that the immediate impact of these variables on SMRs might be negligible. The study also uncovers a positive yet statistically insignificant correlation between the LMS and SMRs. This result echoes the observations of Balagobei and Bandara (2022), Dao et al. (2022), Aremo et al. (2020), and Panta (2020). This indicates that although an increase in the M2 could theoretically enhance SMRs by boosting liquidity, its actual effect might be tempered by prevailing economic conditions and other factors that influence it.

The relationships between LRGDP, LINFR, LEXR, and LMS with SMRs are negative but statistically insignificant. This insignificance may stem from several factors. The perceived insignificance might arise from a multitude of circumstances. The NEPSE is relatively immature and not closely connected to the economy, making it unlikely to respond immediately to GDP changes. Inflation, driven by limited supply and external forces, may reduce its immediate impact on stock returns. The limited exposure of Nepalese firms to international markets could explain the minimal effect of exchange rate fluctuations. The changing financial system and other economic factors may limit the money supply's effectiveness. Future studies might explore these links further by examining extended periods or using different research methods to uncover more detailed insights.

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Conclusion and Suggestions

The empirical findings confirmed a long-run equilibrium among the examined variables, indicating a cointegrating relationship between essential MEVs and SMRs. It highlights the significance of considering MEVs to better understand and predict stock market movements. Additionally, the results highlighted the adverse and statistically significant association between LIR and SMRs. This inverse correlation suggests that lower interest rates increase the appeal of stocks by diminishing credit costs and reducing the opportunity costs of holding bank deposits. Furthermore, although LRGDP, LINFR, and LEXR exhibited negative correlations with SMRs, these associations were statistically insignificant. Conversely, the money supply positively correlated with SMRs, but this relationship is also statistically insignificant. Given the significant negative impact of LIR on SMRs observed in both the short and long term, policymakers should aim to keep interest rates low whenever feasible. Similarly, investors are advised to invest in the capital market when interest rates are low to maximize returns. Additionally, the study identifies a negative association between LINFR and LEXR. Therefore, policymakers should focus on controlling inflation and stabilizing foreign exchange rates to enhance returns for stock market investors.

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