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Cointegration between Macroeconomic Variables and Stock Market Returns in Nepal

Surya B. Rana[1]
Assistant Professor
Faculty of Management, Butwal Multiple Campus, Tribhuvan University

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Abstract

This paper examines the long-run relationship between selected macroeconomic variables and the stock market returns in Nepal over 1995-2020 periods. Based on the ARDL bounds testing approach, the study reveals significant long-run positive impact of real GDP growth, and negative impact of exchange rate and inflation on stock market returns in Nepal. The result of error correction representation shows that any short-run disequilibrium among the variables tends to return to their long-run equilibrium with speed of adjustment of 47.57 percent in a year. The study results imply that policy makers should come up with policies to accelerate the pace of economic growth and should initiate export stimulating policies to ensure the positive impact on stock market. Finally, the study results also suggest that controlled and stabilised interest rate environment enhances depth and breadth of stock market trading by attracting significant number of prospective investors demanding more investments in stock market of Nepal.

1. Introduction and Study Objectives

The asset pricing implication has drawn considerable academic interest since the inception of mean-variance portfolio theory of Markowitz (1952). Based on this theory, Sharpe (1964), Linter (1965), and Black (1972) proposed comprehensively argued asset pricing theory- the Capital Asset Pricing Model (CAPM). However, the basic CAPM version is only confined to the unique role of market risk factor in explaining stock market returns. As a result, multifactor Arbitrage Pricing Theory (APT) proposed by Ross (1976) came into existence. The APT model asserts that

[1] Dr. Rana holds a PhD degree from the Faculty of Management, Tribhuvan University, Nepal. He has published dozens of research papers in various journals. He can be reached at surryabrana@ gmail.com

stock market returns are determined by many unnamed factors in the economy as opposed to single market risk factor of the CAPM. But APT even did no longer stay independent of criticism. One major criticism is that APT does not propose a specific set of macroeconomic variables.

In the later period, to evaluate the stock market return as a function of macroeconomic variables, Chen, Roll and Ross (1986) employed specific set of macroeconomic variables as proxies for those not defined in the APT. Since then, several studies have attempted to observe whether macroeconomic forces (such as level of interest rates, inflation rate, GDP, industrial production, saving, investment and consumption, among others) affect stock market returns significantly. For example, Chen (1991); Clare and Thomas (1994); Mukherjee and Naka (1995); Gjerde and Saettem (1999); Adel (2004); Gan, Lee, Yong, and Zhang (2006) are some of the major studies, which have exhibited significant relationship between stock market returns and macroeconomic variables in the context of developed stock markets around the world. Some of these studies have shown that the rate of inflation, money supply, interest rates and exchange rates predict stock market returns significantly while others have documented that real sector activities in the economy such as real GDP growth and industrial production growth explain stock market returns.

Stock market transaction in Nepal has no long history. The secondary market transaction officially started for public investors since 1994 after the establishment of Nepal Stock Exchange in 1993. The sole stock market index in Nepal, the NEPSE index, has witnessed considerable ups and down over the years reaching an all-time high of 1881.45 points as on July 27, 2016, which later on declined to 1362.4 points as on mid-July, 2020. Many firm specific and macroeconomic factors are responsible for considerable fluctuations in stock market index in Nepal. Earnings, dividends, and firm's profile are some of the firm specific factors (Thapa, 2019), while money supply, interest rate, inflation, exchange rate and GDP, among others, are macroeconomic factors affecting stock returns in Nepal (Panta, 2020). In recent period, it has been well recognised that stock markets cannot determinedly function in isolation from the macroeconomic movements. As a result, the dynamic relationship between macroeconomic variables and stock market return has been widely discussed and debated in literatures in the context of developed capital market.

However, studies in the context of Nepal are still lower in terms of number to provide a robust conclusion on this relationship Therefore, this study, as an additional effort, attempts to examine the relationship between macroeconomic variables and stock market returns in Nepal using more recent dataset. Generally, the underlying theoretical constructs and empirical evidence establish a link between stock market returns and key macroeconomic variables such as inflation, money supply, interest rate, exchange rate, industrial production growth, gross domestic product (GDP), among others. This study, however, does not consider the role

of vast majorities of macroeconomic variables due to the small length of annual data points available for stock market return in Nepal. The effort simply confines to the predictive power of selected macroeconomic variables namely, real GDP growth, inflation, interest rates, and exchange rates that have been established as most prominent variables by empirical literatures in explaining stock market returns in the context of developed and emerging economies. In particular, this study makes an effort to examine the short-run and long-run dynamics of the cointegration between selected macroeconomic variables and stock market returns in Nepal.

The rest of this study is organised as follows: second section presents a brief review of theoretical and empirical literatures; third section describes the research methods; fourth section deals with study results and the discussion on the findings; and finally, fourth section concludes and presents main implications of the study.

2. Literature Review

The relationship between the macroeconomic movements and stock market returns are well advocated in both theoretical and empirical literatures. As observed in the literatures, GDP is one of the most prominent macroeconomic variables used in previous studies to examine the macroeconomic effects on stock market returns. GDP represents the value crated by productive sector of a nation. Stock market returns are largely influenced by real and productive sector activity in a country. A country with higher GDP is economically prosper, which affects common stock returns positively. However, the empirical studies suggest mixed evidence about GDP influence on stock market return. For example, Gjerde and Saettem (1999) observed a significant and positive relationship between the growth in real sector activity and stock market returns. The positive relation exists, since an increase in the real sector activity increases the future cash flows, which in turn creates a higher dividend on stock in future. As a result, inventors tend to buy shares of common stock even at higher price with the hope of earning higher dividend. Similarly, Ibrahim and Aziz (2003) also demonstrated long-run positive relationship between GDP and stock market returns in case of Malaysia. Nasseh and Strauss (2000) and McMillan (2005) are some other earlier studies, and Singh, Mehta, and Varsha (2011); Aziz and Obalade (2019) and Demir (2019) are some recent studies which observed similar results. On the other hand, Flannery and Protopapadakis (2002) observed no impact of GDP on stock returns. Kandir (2008) also revealed no significant effect of real sector activity on the common stock returns. Despite of the empirical contradiction, theoretical constructs advocate on behalf of positive impact of GDP on stock market. Therefore, this study hypothesises a positive relation between real GDP growth and stock market returns and attempts to identify whether there is significant predictive power of real GDP growth in the context of Nepalese stock market.

The rate of inflation is another important macroeconomic variable influencing stock market returns. There are three dominant hypotheses explaining the inflation effects on stock market returns: tax effect hypothesis, proxy effect hypothesis, and the reverse causality hypothesis. The tax effect hypothesis (Feldstein, 1980) argues that inflation introduces a corporate tax liability. As a result, it reduces real after-tax corporate earnings thereby dropping down common stock returns. The proxy effect hypothesis (Fama, 1981) asserts that real sector activity positively affects common stock returns, but negatively to inflation through the effect of demand for money. As a result, negative relation exists between common stock returns and inflation. Finally, reverse causality hypothesis (Geske & Roll, 1983) proclaims that expected increase in future economic activities also results into an increase in domestic borrowing and money supply in the economy. This, in turn, yields inflationary effects thereby inhibiting real activity. As a result, stock market returns also fall demonstarting the negative relationship between stock returns and inflation. In the empirical front, however, many studies have shown mixed evidence on inflation effects. For example, to investigate the relation between common stock returns and inflation in twenty-six countries over 1974-1979 periods, Gultekin (1983) observed no reliable and stable relation between stock returns and inflation.

On the other hand, Chen, Roll, and Ross (1986) and Schwert (1989) revealed that unanticipated inflation can significantly explain the stock market returns. In later period, Flannery and Protopapadakis (2002) reported the significant effect of inflation on stock market returns. In case of Malaysia, Ibrahim and Aziz (2003) also demonstrated the positive relationship between stock returns and inflation. On the contrary, Coleman and Tettey (2008) revealed adverse effect of inflation on stock returns in the context of Ghana. Similarly, Liu and Shrestha (2008) exhibited a negative relationship between inflation and stock retunrs in case of China. Despite of these contradictory empirical backgrounds, the present study, in case of Nepal, hypothesises that an increase in inflation is likely to result into tight economic policies that pushes up interest rate level causing the common stock price to decline.

Besides inflation and GDP, the interest rate is another prominent macroeconomic factor affecting the stock market returns. The volatility transfer hypothesis places the reason why stock market responds to the change in interest rate. According to this hypothesis, stock market only serves as an alternative investment vehicle to other financial assets. A random shock encourages the volatility in stock market, and the infection of random shock is higher in more volatile market. As a result, investors are likely to search alternative to stock market for investment. Hence, greater exposure of stock market to the change in interest rate level affects the stock market returns more. With respect to interest rate effect, studies basically argue in favour of negative relationship between stock market returns and interest rates. For example, Thorbecke (1997) and Smal and Jager (2001) demonstrated that liquidity in the economy increases with

reduction in interest rates. As a result, more liquidity is injected to the stock market thereby driving up the stock returns. Similarly, Gan, Lee, Yong, and Zhang (2006) and Kandir (2008) also showed a negative relationship between stock market returns and interest rate. In a more recent period, in an attempt to investigate the impact of exchange rate on stock returns in case of Shenzhen Stock Exchange, Khan (2019) observed significant negative impact of interest rate, inflation and exchange rate on stock returns. The negative relationship implies that when interest rates go up, investors tend to sell common stocks to shift their investments to other alternatives, which causes common stock price to fall.

However, in the state of equilibrium, the changes in stock market returns vary according to their sensitivity to interest rates. In this line, Reily and Brown (2002) argue that cash flows from stocks fluctuate along with interest rates and it is not certain whether such fluctuations expand or offset the change in interest rates. Thus, controversies exist about exact relationship between interest rates and stock market returns. However, this study, in the context of Nepal, particularly hypothesises a negative relationship between interest rates and stock prices basically for two reasons. First, most companies finance their assets through borrowings. An increase in interest rates pushes up the cost of borrowing, which in turn will have a negative effect on future expected returns for the firm. Thus, stock price declines with an increase in interest rate. Second, considerable common stock investments are financed with borrowed money. Therefore, an increase in interest rates makes common stock transactions more costly. With the increase in interest rate level, investors require a higher rate of return before investing. This, in turn, results into a decline in demand for common stock investment thereby reducing the stock prices.

Finally, this study considers the exchange rate as another leading macroeconomic variable affecting stock prices and hence stock market returns. It is the integration of world stock market that has directed many studies to uncover the relationship between movements in exchange rate and stock market returns. The relationship between exchange rate and stock market is generally argued along two hypotheses: flow-oriented hypothesis and stock-oriented hypothesis. According to flow-oriented hypothesis (for example, Dornbusch & Fischer, 1980), the degree to which exchange rate changes affect stock market returns is largely determined by the foreign trade balance of the country. For example, if a country is primarily import-oriented like Nepal, depreciation in domestic currency makes import of goods expensive resulting into a decline in importers' profits and hence the stock market returns. Similarly, the stock-oriented hypothesis of Branson (1983) articulates that the return on foreign currency increases if domestic currency depreciates against the foreign currency-. This induces the investors to shift their funds from domestic to foreign stock investment. As a result, the depreciation of domestic currency in comparison to foreign currency causes negative impact on the stock market returns.

Many of the empirical findings confirmed these two hypotheses in relation to the impact of exchange rate on stock market returns. For example, to examine the role macroeconomic factors in explaining Turkish stock return, Kandir (2008) revealed significant negative effects of exchange rate and on stock market returns. Similarly, Liu and Shrestha (2008) investigated the relationship between stock market returns and macroeconomic variables in the context of China. Using heteroscedastic cointegration analysis and monthly data covering January 1992 to December 2001 with 120 observations, the results demonstrated a negative relationship between stock prices and exchange rate. However, the empirical evidence also present contrary documentations. For example, Gay (2008) attempted to make a cross country analysis of the effects of exchange rates on stock returns in the context of Brazil, Russia, India and China. The study observed positive relationship between exchange rates and stock returns meaning that an appreciation of the domestic currency exchange rate in terms of US dollar causes unfavourable impact on the domestic stock market. Moreover, to investigate the performance of APT model in the Istanbul Stock Exchange (ISE), Rjoub, Tursoy, and Gunsel (2009) observed statistically insignificant effect of exchange rate on stock market returns. In more recent period, Amado and Choon (2020) examined the effect of exchange rate changes on stock market of Indonesia. Using the ARDL model, the study demonstrated a long-run relationship between exchange rate changes and stock market returns. Indeed, the direction of exchange rate effect is largely determined by the relative dominance of import and export sectors of the economy. Nepal is predominantly an import-oriented economy and is experiencing deficit trade balance. This study, therefore, hypothesises a negative relation between exchange rate and stock prices. The study particularly postulates that depreciation in Nepalese currencies relative to U.S. dollar leads to costly imports. This, in turn, reduces the corporate profitability resulting into decline in stock returns in Nepalese stock market.

Though the empirical literatures produce mixed results, it is clear from the review of most of the cited literatures that macroeconomic variables do influence stock market returns. However, studies give varying conclusions with respect to which a particular set of macroeconomic variables are more prominent in explaining stock market return. Mostly, studies establish GDP, interest rate, exchange rate, and interest rate as major macroeconomic variables holding significant impact on stock market returns. However, the role of these macroeconomic variables in predicting stock market returns is yet inconclusive in case of Nepal. Besides, studies in the context of Nepal have mainly focused on understanding the macroeconomic impact on stock market without considering the shot-run and long-run dynamics of the relationship between them. Therefore, this study basically attempts to examine the short-run and long-run dynamics of the relationship between selected macroeconomic variables and stock market returns using more recent dataset.

3. Research Methods

This section presents different aspects of research methodology adopted in this study.

Data Source

This study uses annul time series data over the period mid-July 1995-2020 consisting of 26 annual observations. The data on annual real GDP series, national consumer price index, exchange rate, and weighted average interest rate on 91-day Treasury bills were obtained from 'Quarterly Economic Bulletin Vol. 55, No. 1, Mid-October 2020' published by Nepal Rastra Bank. Similarly, the data on all share NEPSE index were obtained from annual reports available in official website of Nepal Stock Exchange Limited. Though the data on other macroeconomic time series were available since earlier date, the study period in this study has been confined to 1995-2020 period. The Nepal Stock Exchange Limited started its secondary market transaction only since 1994. The year-end NEPSE index for the year 1994 has been used as the base period to calculate market return series. Therefore, study period begins from mid-July 1995.

Definition and Measurement of Variables

The main purpose of this study is to examine the cointegration relationship between stock market returns and selected macroeconomic variables such as real GDP growth, inflation rate, interest rate and exchange rate over the period 1995-2020. The study also attempts to examine the long-run and short-run impact of selected macroeconomic variables on stock market returns. Hence, stock market return has been used as the dependent variable and real GDP growth, inflation rate, interest rate and exchange rate have been used as independent variables. GDP growth represents the growth rate in real and productive sector activities of the economy, which has been measured as the rate of annual growth in real GDP. There are other proxies of productivity sector activities such as industrial production and agriculture output growth. However, GDP represents the aggregate of all productive sectors and hence this study has considered the GDP growth as one of the important macroeconomic variables. The interest rate, one of the independent variables in this study, may have many proxies such as average interest rate on deposit and lending, average Treasury bill rate, long-term bond rate, among others. Among these proxies of interest rate, the weighted average T-bill rates serve as the good benchmark and proxy of short-term risk-free rate. Therefore, this study particularly uses weighted average T-bills rate as the proxy of interest rate. There was a gap in the annual data for 364-day T-bills rate during 1995-2020 periods, and therefore 91-day weighted average T-bills rates have been used in this study. Moreover, Nepal is basically the net importer of goods and services, and therefore the depreciation of Nepalese currency relative to U. S. dollar is expected to cause stock market to decline. Therefore, this study also uses exchange rate of Nepalese rupee per unit of U. S. dollar as

one of the independent variables. The definition of dependent and independent variables and their measurements are as described in Table 1.

Table 1
Definition of Variables and their Measurement

Variables	Definition and Measure
NEPSE	the dependent variable used as a proxy of stock market return in Nepal and measured as year-on-year percentage change in all share value-weighted NEPSE index.
GDP	a proxy of growth in real sector activity in economy measured as the annual growth rate of real GDP.
EXR	the natural logarithm of the average annual exchange rate of Nepalese rupees per unit of U. S. dollar.
INF	the inflation rate measured as year-on-year percentage change in national consumer price index.
INT	the proxy of interest rate measured as the weighted average of 91-day Treasury bills rate.

Empirical Model and Diagnostic Checking

This study employs ARDL bounds testing approach to cointegration developed by Pesaran, Shin, and Smith (2001) for empirical verification of the long-run and short-run dynamics of the relationship between selected macroeconomic variables and stock market returns in Nepal over the period 1995-2020. The ARDL bounds testing approach is an efficient method for testing cointegration due to several reasons. First, this method can be efficiently used even for smaller sample and provides parsimonious estimates of the long-run and short-run relationship. Second, this method does not require the variables to be integrated of the same order. It can efficiently be applied even if all variables are purely stationary at level, I(0), or stationary at first difference, I(1), or mixture of both.But none of the variables should be integrated of second order. Third, this method estimates only a single reduced form equation representing both long-run and short-runrelationship (Pesaran & Shin, 1995). Finally, ARDL bounds testing procedure offers unbiased estimates of long-run relationship even in the presence of some endogenous regressors (Odhiambo, 2011). The basic ARDL representation is stated as in Equation (1).

$$\Delta NEPSE_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} NEPSE_{t-i} + \sum_{i=0}^{n} \beta_{2i} GDP_{t-i} + \sum_{i=0}^{n} \beta_{3i} EXR_{t-i} + \sum_{i=0}^{n} \beta_{4i} INF_{t-i} + \sum_{i=0}^{n} \beta_{5i} INT_{t-i} + \lambda_1 NEPSE_{t-1} + \lambda_2 GDP_{t-1} + \lambda_3 EXR_{t-1} + \lambda_4 INF_{t-1} + \lambda_5 INT_{t-1} + \varepsilon_t \quad \ldots(1)$$

In Equation (1), parameters β_{1i}, β_{2i}, β_{3i}, β_{4i}, and β_{5i} are the short-run coefficients indicating the direction and magnitude of the short-run dynamics of the model. Similarly, parameters λ_1, λ_2, λ_3, λ_4 and λ_5 are the long-run coefficients representing

long-run dynamic relationship of the variables. The model tests the null hypothesis of no long-run relationship, where the null (H0) is: $\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = 0$. If calculated F-statistic is greater than upper bounds critical value, the null hypothesis of no cointegration is rejected, which simply implies that a long-run relationship exists among the variables irrespective of the order of integration. The results of ARDl bounds test are sensitive to the lag order. So, the lag order in this study has been selected using automatic lag selection based on Akaike Information Criterion (AIC). and OLS has been used to estimate the selected ARDL model. Upon the detection of long-run relationship among the variables, the long-run estimates are provided using Equation (2).

$$NEPSE_t = \beta_0 + \sum_{j=1}^{n} \beta_{1j} NEPSE_{t-j} + \sum_{j=0}^{n} \beta_{2j} GDP_{t-j} + \sum_{j=0}^{n} \beta_{3j} EXR_{t-j} + \sum_{j=0}^{n} \beta_{4j} INF_{t-j} + \sum_{j=0}^{n} \beta_{5j} INT_{t-j} + \upsilon_t \quad \ldots(2)$$

In the next step, the error correction representation (ECM) of the ARDL model is estimated to examine the short-run dynamics of the long-run relationship among the variables. The coefficient of error correction term (ECT) should be negative (usually less than -1) and statistically significant. It shows the speed of adjustment of the system towards long-run equilibrium if any disequilibrium is exhibited in short-run. The error correction representation of the ARDL model is given by Equation (3).

$$\Delta NEPSE_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} NEPSE_{t-i} + \sum_{i=0}^{n} \beta_{2i} GDP_{t-i} + \sum_{i=0}^{n} \beta_{3i} EXR_{t-i} + \sum_{i=0}^{n} \beta_{4i} INF_{t-i} + \sum_{i=0}^{n} \beta_{5i} INT_{t-i} + \lambda ECT_{t-1} + \varepsilon_t \ldots \quad \ldots(3)$$

In the final step, the estimated ARDL model should pass through the process of diagnostic checking for the validity and stability of estimated model. The diagnostic checking goes through the examination of the normality, serial correlation, and heteroscedasticity of the model residuals. Similarly, the study employs Ramsey RESET test to confirm the correctness of model specification. Finally, the study uses cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) tests to confirm the model stability.

4. Study Results and Discussion

This section presents and discusses the study results in line with the research objectives.

Descriptive Statistics

Table 2 presents the results of descriptive analysis using descriptive statistics of the variables of interest consisting of 26 annual observations over 1995-2020 periods. As reported in Table 2, stock market return measured as the annual return on NEPSE index over the study period ranges between minimum -36.23

percent to maximum 99.90 percent with an average of 12.32 percent and standard deviation of 36.49 percent. The growth rate in real sector activity measured by annual growth rate of real GDP over the same period recorded a high 8.22 percent and a low 0.12 percent with an average annual growth of 4.39 percent and standard deviation of 1.84 percent.

Table 2
Descriptive Statistics, 1995-2020 periods

Descriptive Statistics	NEPSE	GDP	EXR	INF	INT
Mean	0.1232	0.0439	4.3573	0.0699	0.0396
Median	0.0022	0.0451	4.3066	0.0744	0.0334
Maximum	0.9990	0.0822	4.7563	0.1258	0.1093
Minimum	-0.3623	0.0012	3.9108	0.0243	0.0013
Std. Dev.	0.3649	0.0184	0.2257	0.0272	0.0276
Skewness	0.8626	-0.3083	0.1359	0.0910	0.9532
Kurtosis	2.8651	3.2612	2.3116	2.1024	3.4363
Jarque-Bera	3.2439	0.4858	0.5934	0.9088	4.1434
p-value	0.1975	0.7844	0.7433	0.6348	0.1259
Observations	26	26	26	26	26

Note. From Author's calculation using the data derived from sources described in section 2.

The exchange rate (EXR) measured as the natural logarithm of average annual exchange rate of Nepalese rupee per U. S. dollar over the same period recorded an average value of 4.3573 with the maximum and minimum value of 4.7563 and 3.9108, respectively. Similarly, the rate of inflation (INF) measured as year-on-year percentage change in national consumer price index increased from the minimum 2.43 percent to the maximum 12.58 percent with average annual inflation rate of 6.99 percent over the period 1995-2020. Finally, the interest rate level in the economy measured as weighted average of 91-day Treasury bill rate recorded a high of 10.93 percent and a low of 0.13 percent with an average rate of 3.96 percent. Table 2 also reports the Jarque-Bera (JB) test statistics with corresponding p-values. As p-values of JB statistics associated with each of the time series are greater than 5 percent, they do not reject the null of normality. This implies that all the time series variables are normally distributed.

Results of Unit Root Test

This section presents the results of unit root test. Before performing ARDBL bounds test, it is necessary to confirm the order of integration of each of the time series variables. The ARDL approach requires that all time series variables should either be integrated at level, I(0), or at first difference, I(1), or the mixture of both I(0) and I(1), but none of them should be integrated at second order, I(2).

The study employs two popular approaches of unit root tests, namely Augmented Dickey-Fuller (ADF) test developed by Dickey and Fuller (1979), and Phillips-Perron (PP) test developed by Phillips and Perron (1988). Both approaches test the alternative hypothesis of no unit root against the null hypothesis of unit root. If the null of unit root is rejected, it implies that times series data do not contain unit root, or they are stationary. The results of unit root tests are reported in Table 3 considering intercept only, and both trend and intercept.

Table 3
The Results of ADF and PP Unit Root Tests

Panel A: The Results of ADF Test				
Variables	Intercept Only		Trend and Intercept	
	Level	First Difference	Level	First Difference
NEPSE	-4.3090*	-4.8999*	-4.2589**	-4.6916*
GDP	-4.1792*	-4.4517*	-4.5835*	-4.6316*
EXR	-1.0206	-4.9893*	-1.8849	-4.8627*
INF	-2.7901	-6.4062*	-2.7327	-6.2529*
INT	-3.8295*	-4.9474*	-3.9046**	-5.0069*
Panel B: The Results of PP Test				
Variables	Intercept Only		Trend and Intercept	
	Level	First Difference	Level	First Difference
NEPSE	-3.8571*	-6.7532*	-3.7683**	-6.6234*
GDP	-5.5807*	-16.5673*	-6.1439*	-14.5285*
EXR	-1.0205	-4.9893*	-1.9351	-4.8627*
INF	-2.7901	-6.8761*	-2.7327	-6.6889*
INT	-2.2109	-4.9447*	-2.6700	-5.0353*

Note. Reported values are test statistics under each of the unit root tests. "" signs indicate that results are significant at 1 percent level; and "**" signs indicate that results are significant at 5 percent level.*

Note. From author's calculation using the data derived from sources described in section 2.

In Table 3, Panel A reports the results of ADF unit root test and Panel B reports the results of PP unit root test. As per the ADF approach, NEPSE, GDP and INT are stationary at level, and EXR and INF are stationary only after getting their first differences. Hence, according to ADF test, using intercept only and using both trend and intercept, NEPSE, GDP and INT are integrated at level, that is, they are I(0). On the other hand, EXR and INF are integrated at first difference, that is, they are I(1). As reported in Panel B of Table 3, the PP unit root test results show that NEPSE and GDP are integrated at level, that is they are I(0), and EXR, INF and INT are integrated at first order, that is, they are I(1) considering intercept only

and both intercept and trend. All the results are significant at either 1 percent or 5 percent level. Thus, the results of both unit root tests confirm that none of the times series variables are of order I(2), and hence ARDL bounds test can be performed.

Results of ARDL Bounds Test

This section presents the results of the ARDL bounds test conducted to confirm the possibility of cointegration among time series variables, namely NEPSE, GDP, EXR, INF and INT, in the framework of multivariate ARDL. Using AIC automatic lag selection with the maximum lag of 3 for both dependent and independent variables, the criterion proposes ARDL(1, 3, 0, 0, 3) model that has no serial correlation. The maximum lag length has been limited to 3 due to the possibility of losing greater degree of freedom in small sample size. Table 4 repoprts the results of the ARDL bounds F-test.

Table 4
ARDL Bounds Test

Test Statistic	Value	K
F-statistic	5.85	4
Critical Bound Value		
Significance	I(0) Bound	I(1) Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

Note. Author's calculation using the data derived from sources described in section 2.

The results of ARDL bounds tst report the value of F-statistic of 5.85. It is greater than upper bound critical value even at 1 percent level (3.74, 5.06). It presents the sufficient evidence to reject the null hypothesis. Thus, the test results demonstrate a possible long-run relationship between dependent variable NEPSE, and independent variables GDP, EXR, INF and INT together over the period mid-July 1995-2020. However, this result is simply a preliminary result indicating the likelihood of long-run relationship among variables. We should now proceed ahead with ARDL(1, 3, 0, 0, 3) model in order to estimate the long-run and short-run dynamics of the relationship between NEPSE and selected macroeconomic variables.

Results of Long-run Estimates and Error Correction Representation

This section reports the estimate of the long-run results and error correction representation of the selected ARDL(1, 3, 0, 0, 3) model. The long-run results are shown in Table 5. As reported in Table 5, the coefficient of GDP (0.4496) is positive and statistically significant at 5 percent level. This indicates that a

1 percentage increase in real GDP results into a 0.4496 percentage increase in stock market return in the long run. The long-run results associated with the relationship between GDP and stock market returns in this study is consistent to the theoretical notion that higher GDP represents economic prosperity of the country, which in turn positively affects the stock market. Similarly, this finding is also consistent with previous documentations of Nasseh and Strauss (2000); Ibrahim and Aziz (2003); McMillan (2005), among others who observed long-run positive relationship between GDP and stock market return.

The long-run results associated with the effects of EXR shows a negative coefficient of 0.1141 and the result is significant at 1 percent level. The negative EXR coefficient implies that there is long-run negative relationship between the exchange rate and stock market return in Nepal as such that a 1 percentage increase in exchange rate of Nepalese rupee per U. S. dollar leads to a 0.1141 percentage decline in return on NEPSE index. It means that as the Nepalese rupee weakens relative to US dollars, it negatively impacts the stock market return in Nepal. The long-term negative impact of exchange rate on stock market returns recorded in this study supports the flow-oriented hypothesis of Dornbusch and Fischer (1980). Nepal is predominantly an import-oriented economy. Therefore, depreciation of Nepalese currencies relative to U. S. dollar weakens the purchasing power of Nepalese currencies leading to an adverse effect of corporate profitability and hence on the stock market return. This finding is also consistent with previous empirical results of Kandir (2008); Liu and Shrestha (2008), among others.

Table 5
Long-run Results of the ARDL (1, 3, 0, 0, 3) Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	6.9936*	2.0343	3.4379	0.0055
GDP	0.4496**	0.2007	2.2401	0.0467
EXR	-0.1141*	0.0354	-3.2242	0.0081
INF	0.4325	0.3949	1.0952	0.2968
INT	-.2042*	0.0478	-4.2683	0.0013

*Note. *" signs indicates that results are significant at 1 percent level, and "**" signs indicate that results are significant at 5 percent level.*

Note. From author's calculation using the data derived from sources described in section 2.

Further, the results in Table 5 also reveal that the level of interest rate has negative impact on stock market return in Nepal as INT coefficient is negative 0.2042. It simply implies that a 1 percentage increase in interest rate level in the economy causes 0.2042 percentage decline in stock market return in the long-run. The interest rate coefficient is negative as hypothesised in this study and consistent to the presumption of volatility transfer hypothesis. It implies that when interest rate level declines in the economy, investors find other investment

opportunities in financial market not much profitable. As a result, more cash flows are injected to the stock market leading to higher demand for stocks investment and hence higher stock market returns. The empirical result associated with long-run relationship between interest rate and stock market returns observed in this study also supports the earlier observations of Thorbecke (1997) and Smal and Jager (2001), and more recent studies of Gan, Lee, Yong, and Zhang (2006) and Kandir (2008), who recorded negative long-term relationship between interest rate and stock market returns.

The results further show that inflation has no significant impact on stock market return because INT coefficient, though positive, is not statistically significant. Thus, the study results in the context of Nepal support none of the hypotheses explaining the inflation effect on the stock market returns. This simply implies that rate of inflation and stock market returns in Nepal are not cointegrated, and the stock market investment does not offer a hedge against inflation.

Table 6
Error Correction Representation of the ARDL (1, 3, 0, 0, 3) Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP)	0.3607	0.3301	1.0926	0.2979
D(GDP(-1))	-0.8083	0.4349	-1.8587	0.0900
D(GDP(-2))	-0.7193	0.4479	-1.6060	0.1366
D(EXR)	-0.3819**	0.1637	-2.3333	0.0396
D(INF)	0.1139	0.1054	1.0807	0.3030
D(INT)	-0.5869**	0.1939	-3.0270	0.0115
D(INT(-1))	0.7419*	0.2264	3.2771	0.0074
D(INT(-2))	-0.3070	0.2016	-1.5229	0.1560
ECT(-1)	-0.4757*	0.1292	-3.6810	0.0001

Note. From author's calculation using the data derived from sources described in section 2.

Table 6 shows the short-run dynamics of error correction representation of the ARDL (1, 3, 0, 0, 3) model. As the results reveal, the coefficient (-0.4757) of ECT (-1), is statistically significant at 1 percent level and has correct negative sign. The coefficient of ECT(-1) shows the speed of adjustment with which any short-term disequilibrium moves toward the long-run equilibrium. Such speed of adjustment is 47.57 percent each year. This implies that any short-run disequilibrium on the relationship between return on NEPSE index and selected macroeconomic variables have the tendency to return to its long-run equilibrium within the average of 2.1 years of period. Considering 26 years of annual data points used in this study, 2.1 years of average correction period toward long-run equilibrium can be considered somewhat reasonable because of lower size of GDP growth and no extensive expansion of export trades leading to significant foreign currencies

inflow. Based on long-run results, it can be referred that higher rate of GDP growth along with policies directed to strengthen Nepalese currencies relative to U. S. dollar and more stable interest rate environment in the country can stimulate the stock market returns in Nepal.

The short-term results in Table 6 shows that GDP and inflation have no short-run impact on stock market returns because all the lagged coefficients of GDP and the coefficient of inflation are not significant. On the other hand, exchange rate and interest rate again exhibit the significant short-run negative impact on stock market returns as their lagged coefficients are jointly significant.

Results of Residuals Diagnostic and Stability Check of the Model

This section shows the results of residual diagnostic check and stability test of the estimated ARDL (1, 3, 0, 0, 3) model. As exhibited in Table 7, the Breusch-Godfrey serial correlation LM test shows that the residuals are free from the problem of serial correlation as both F-version and Chi-square version of test statistic are not statistically significant. Similarly, Breusch-Pagan-Godfrey heteroscedasticity test statistics are also not significant meaning that there is no problem of heteroscedasticity in the model.

Table 7
Residual Diagnostic and Stability Tests for the ARDL(1, 3, 0, 0, 3) Model

Serial Correlation LM Test: Breusch-Godfrey			
F-statistic	1.2772	p-value F(3,8)	0.3462
Obs*R-squared	7.4485	p-value Chi-Square(3)	0.0589
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.5000	p-value F(11,11)	0.2562
Obs*R-squared	13.8001	p-value Chi-Square(11)	0.2442
Jarque-Bera	0.5848	p- value	0.7465
Functional Form: Ramsey RESET Test			
t-statistic	0.9782	p-value (10)	0.3509
F-statistic	0.9573	p-value (1, 10)	0.3509

Note. From author's calculation using the data derived from sources described in section 2.

Moreover, Jarque-Bera test statistic is not statistically significant indicating that residuals from the model are normally distributed. Finally, the Ramsey RESET test validates that the model is correctly specified as p-values of the test statics are not significant. These results suggest that long run and short-run estimates are free from the problem of serial correlation in model residuals, have no heteroscedasticity, and non-normality problem in the residuals, and there is no specification error in the functional form of the model.

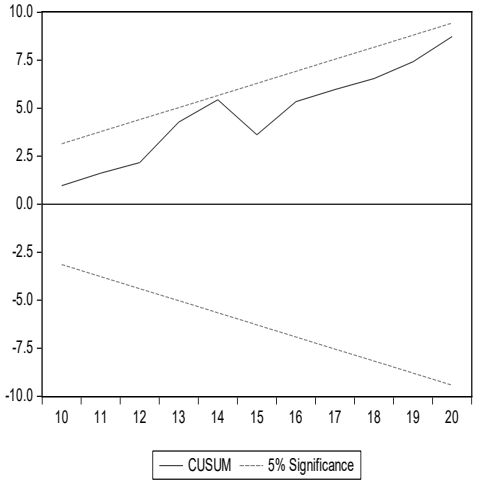

Figure 1: *Plot of CUSUM test*

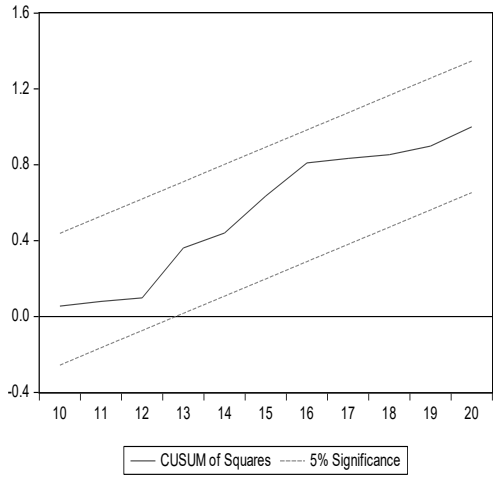

Figure 2: *Plot of CUSUMSQ test*

Further, the stability of the ARDL parameters has been tested by using CUSUM and CUSUMSQ tests proposed by Brown, Durbin and Evans (1975). Figure 1 and Figure 2 show plots of the CUSUM and CUSUMSQ tests, respectively. The test results show the stability of ARDL parameters because estimated CUSUM and CUSUMSQ lines are within 5 percent critical bounds.

5. Conclusions and Implications

This study investigated the cointegration relationship between selected macroeconomic variables (namely, real GDP growth, exchange rate, inflation and interest rate) and the stock market returns in Nepal over the period 1995-2020. Based on multivariate ARDL bounds testing approach, the study results suggested that there exists long-run relationship between selected macroeconomic variables and stock market returns in Nepal. Particularly, the study revealed that growth rate in real GDP has significant long-run positive impact, and exchange rate and inflation have both significant long-run and short-run negative impact on stock market returns in Nepal. The results of error correction model used to capture long-run and short run dynamics of the relationship between selected macroeconomic variables and stock market returns showed that any short-run disequilibrium among the variables tend to return to their long-run equilibrium with the speed of adjustment of 47.57 percent in a year. The results documented in this study are consistent to previous studies of Thorbecke (1997); Nasseh and Strauss (2000); Smal and Jager (2001); Ibrahim and Aziz (2003); Gan, Lee, Yong, and Zhang (2006); Kandir (2008), and Liu and Shrestha (2008), among others, who demonstrated long-run relationship between stock market returns and a set of macroeconomic variables.

The positive and significant long-run impact of GDP implies that stock market responds positively to the size of economy. Therefore, government and policy

makers should come up with growth enhancing policies to accelerate the pace of economic growth, and to reach the higher economic prosperity in Nepal. The study also reported negative and significant effect of exchange rate on stock market returns both in long-run and short-run periods. The effect of exchange rate is sensitive to the balance of payment in country's foreign trade. Nepal is primarily an import-oriented economy, and therefore depreciation of Nepalese currency relative to U. S. dollar weakens the purchasing power of the Nepalese rupees resulting into costly buying of goods. This, in turn, is reflected as adverse effect in corporate profitability affecting stock market returns negatively. Thus, the policy implication of this finding in case of Nepal is that the government should initiate export stimulating policies to ensure the positive impact of exchange rate on stock market. Finally, the significant negative impact of interest rate in both short-run and long-run periods observed in this study implies that stock market is sensitive to the interest rate changes in the economy. Therefore, if interest rate can be controlled and stabilised significantly, this will benefit the Nepalese stock market through the entry of more investors demanding more investment in shares thereby increasing the depth and breadth of stock market trading.

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Conflict of interest

The author declared having no conflict of interest in the research work.