THE DYNAMIC CAUSALITY BETWEEN STOCK PRICES AND MACROECONOMIC VARIABLES: EVIDENCE FROM NEPAL

MITRA LAL DEVKOTA, PHD
ASSISTANT PROFESSOR OF BUSINESS STATISTICS
MIKE COTTRELL COLLEGE OF BUSINESS
UNIVERSITY OF NORTH GEORGIA, DAHLONEGA, GA 30597, USA
e-mail: mldevkota@ung.edu

Abstract

This paper investigates the dynamic causality between the Nepalese Stock Exchange (NEPSE) index and selected macroeconomic variables in Nepal. The findings suggest that, in the long-run, consumer price index, exchange rate, Treasury bill rate, and money supply are positively related to the NEPSE Index, while the gross domestic product is negatively related to the NEPSE Index. The vector error correction model (VECM) results indicate that there are unidirectional long-run Granger causalities running from both the consumer price index and the money supply to the NEPSE Index. In addition, there is a unidirectional short-run Granger causality running from the exchange rate to the NEPSE Index. Finally, there are feedback relationships between the gross domestic product and the NEPSE Index, and between the Treasury bill rate and the NEPSE Index. The Variance Decomposition (VDC) analysis shows that most of the variation in the NEPSE Index is captured by its own innovation, although all the macroeconomic variables in the study seem to have some effect on the NEPSE Index in the short-run. These findings have important implications for decision making by investors, stock market regulators, and national policymakers.

Keywords: *Cointegration, Granger Causality, Gross Domestic Product, Money Supply, NEPSE Index*

JEL Classification: *C22, E00, E44*

1. Introduction

Stock market indicators are said to reflect the degree of preference for investment in an economy. As the stock index is closely linked with the performance of the economy, it is also called the barometer of the economic and business conditions of the economy. When investors see expansionary prospects in the economy, stock index is believed to rise. Similarly, expectations of economic stagnation are generally associated with falling stock index. So, the identification and measurement of relationships between the Nepal stock exchange (NEPSE) index and the macroeconomic variables such as consumer price index (CPI), exchange rate (ER), gross domestic product (GDP), Treasury bill rate (TBR), and money supply (M1) would be crucial in the pursuit of attaining higher rate of economic development along with maintaining macroeconomic stability. Besides, the investors, government agencies, researchers, and other stockholders can better predict future trends in these variables by understanding their relationships to the other variables. Hence, the dynamic relationships among these variables hold significant importance and attract the attention of researchers.

Exploring the causal relationship between the NEPSE index and the macroeconomic variables would not only guide the investors in making informed decisions by evaluating the expected benefits in relation to the potential costs and risks involved but also prompt the stock market regulators to foster its trust and confidence by making appropriate regulatory reforms for mitigating the emerging problems and challenges. Further, the relationships would provide valuable information that will help in making the macroeconomy efficient, stable, and favorable. The macroeconomy, based on such sound foundations, would, in turn, contribute to vibrant growth of stock market.

The impact of macroeconomic variables on the stock prices is a well-known theory in the financial economics literature. However, most of the studies in this area focus either on developed

economies such as USA, UK, and Japan ([6], [16], [22], [24]), or on large economy such as India [25]-[26]. Emerging markets such as Nepal tend to have variating features from those of the developed markets. Risks and returns in the emerging stock markets appear to be higher relative to the developed stock markets [12]. There is empirical evidence to suggest that emerging markets are segmented from the developed markets [4].

To the best of our knowledge, there does not exist any published literature that has studied the dynamic causality between the stock prices and macroeconomic variables such as consumer price index, exchange rate, gross domestic product, Treasury bill rate, and the money supply in the Nepalese context. In addition, most existing studies have certain weaknesses in the adapted methodologies. For instance, the unit root tests applied in most previous studies are outdated and therefore, result in incorrect conclusions.

This paper differs from the existing literature in the Nepalese context in several ways. First, this paper has adopted the recently developed Ng-Perron unit root test that has better size and power properties than the more commonly used Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) tests. Second, this paper uses more variables and data that cover a longer time period than in the existing studies in the Nepalese context. Finally, we investigate both short-run and long-run causalities between the stock prices and macroeconomic variables.

The remainder of this study is organized as follows. A review of previous empirical studies is carried out in section 2. A detailed description of the data and the variables used in the study are presented in section 3. Section 4 contains the econometric methodology used in the study, the empirical results, and their interpretations. Finally, the last section concludes the paper with concluding remarks and policy implications.

2. Literature review

There are a number of empirical studies examining the relationship between stock prices and macroeconomic variables. These studies have used different sets of variables from both developed and developing countries. In this section, we provide a brief review of some of the relevant literatures on the macroeconomic determinants of stock prices as follows.

In Sri Lankan context, [10] examine the influence of macroeconomic variables on stock market equity values in Sri Lanka. They used the Colombo All Share price index to represent the stock market index, and considered the four macroeconomic variables, namely the money supply, the Treasury bill rate, the consumer price index, and the exchange rate. With monthly data from January, 1985 to December, 2001, and employing the cointegration test, vector error correction model (VECM), variance decomposition analysis (VDC), and impulse response analysis (IRF), they examined both long and short-run relationships between the stock market index and the macroeconomic variables. The VECM analysis provided some support for the argument that the lagged values of macroeconomic variables such as the consumer price index, the money supply, and the Treasury bill rate have a significant influence on the stock market. Nevertheless, they found no evidence to support that the share price index has influence on macroeconomic variables except the Treasury bill rate. Similarly, [28] examine, using the error correction mechanism, variance decomposition analysis, and impulse response analysis, the causal relationship between Sri Lankan stock exchange (ASPI) and six macroeconomic variables using monthly data from January 1985 to December 2004. The macroeconomic variables considered in the study include the USD exchange rate (USD), three-month fixed deposit rate (FDR), consumer price index (CPI), US stock market index (USSP), narrow money (M1), and the GDP of Sri Lanka. Their empirical findings indicate that feedback relationships exist between stock price index and fixed deposit rate, stock price index and US Share price, and stock price index and GDP. In addition, they found unidirectional causality running from stock price index to consumer price index, money supply, and exchange rate. Results of variance decomposition analysis suggest that GDP and M1 play an important role in longer horizon to forecast variance in stock prices.

In Saudi Arabian context, [3] investigated the effect of macroeconomic variables on equity securities market index in Saudi Arabia. They employed cointegration test and the VECM using monthly data from January 1993 to December 2009. The variables considered in the study include monthly Tadawul All-share Index (TASI), money supply (M1 and M2), inflation (CPI), short-term interest rate, nominal effective exchange rate, oil price, and the S &P 500 index. Their analyses revealed that M2 and the price of oil had a positive long-run effect on the TASI index. By contrast, M1, short-term interest rate, inflation, and the S &P 500 index had a negative long-run effect on the TASI index. They found no statistically significant effect of exchange rate on the TASI index. The negative effect of inflation on TASI index suggests that equity securities are not a good hedge against inflation. The co-movement between the S & P 500 index and TASI index suggest that Saudi Arabia's equity securities market is integrated with the USA's equities market. The empirical findings from the estimated VECM indicated that unidirectional short-run causal relationships exist from the TASI index to both the money supply, and the inflation. Additionally, the estimated speed of adjustment indicates that the Saudi stock market converges to an equilibrium within half a year.

In Indian context, [20] examine, using Johansen's (14) cointegration test and Granger causality test based on VECM framework, the impact of five macroeconomic variables on the Indian stock index (BSE Sensex) using monthly data from April 1994 to June 2011. The macroeconomic variables considered in the study include the industrial production index, wholesale price index, money supply (M2), Treasury bill rate, and exchange rate. Based on their empirical findings, they document that the BSE Sensex index had a long-run positive relationship with money supply and industrial production index. In contrast, they found a long-run negative relationship between BSE Sensex Index and wholesale price index (proxy for inflation). In addition, they found no long run relationship of Treasury bill rate and exchange rate with the BSE Sensex Index. The macroeconomic variables had no statistically significant short-run relationships with the BSE index. The Granger causality test revealed a bidirectional causality between industrial production and BSE Sensex, and a unidirectional causality from BSE Sensex to wholesale price index, and from money supply to the BSE Sensex. This indicates that the growth rate of real output is important in pricing equity securities. Another study by [25] employed the Autoregressive Distributed Lag (ARDL) bounds testing approach and the Granger causality test to investigate the causal nexus between the gold price, stock price, and the exchange rate using monthly time series data from June 1990 to April 2014. The ARDL technique was employed because it had an advantage of not requiring all variables to be integrated of order one. The results indicated that the gold price and stock price tend to have a long-run relationship with the exchange rate. However, they found no evidence of a stable long or short-run causal relationship between the stock price and gold price in India. In addition, [26] examine, using the VEC Granger causality test, variance decomposition analysis, and impulse response functions, the relationship between the stock price index (represented by Bombay stock exchange index) and five macroeconomic variables using monthly data from January 2006 to March 2016. The macroeconomic variables considered in the study include national output (as measured by the index of industrial production), the M1 money supply, the price level (as measured by the wholesale price index), the nominal interest rate (as measured by the 10-year Treasury rate), and the exchange rate. The empirical findings suggest that in the long run, output growth and the exchange rate are positively related to stock prices, while money supply is negatively related to stock prices. The variance decomposition analysis exhibits that, in the short-run, most of the variation in the stock prices is captured by its own innovation, although the exchange rate, the price level and the interest rate seem to have some effect on stock price variation in the short-run.

In Latin American context, [2] studies, using the vector autoregressive (VAR) model, the effect of macroeconomic volatility on stock returns in four countries, namely Argentina, Brazil, Chile and Mexico. The variables considered in the study include exchange rates, interest rates, industrial production, and money supply. In addition to these country variables, they also include

the MSCI world index and the U.S. three-month treasury yield to proxy the effects of global variables. Their findings suggest that country variables influence the stock markets at varying significance and magnitudes. They further document that the global factors are consistently significant in explaining returns in the markets.

In the context of the United States, [22] examined the short and long-run relationship between the US stock price index and macroeconomic variables using quarterly data from 1975 to 1999. Their results revealed that stock prices positively relate to industrial production, inflation, money supply, short-term interest rate, and exchange rate, but negatively relate to the long-term interest rate.

In Nepalese context, [23] examined causal relationship between NEPSE Index and economic growth using monthly data from mid-August 2000 to mid-July 2014. Employing unit root test, cointegration, and VECM techniques, they found that there exists a feedback relationship between NEPSE Index and economic growth for the study period.

3. Variables and the data

This study is based on secondary data for the period between 1994 and 2016. Nepalese stock market was started in 1994, and hence, we choose 1994 as the start of the sampling period of our study. These data are collected from various sources, including the Current Macroeconomic and Financial Situation database from the Nepal Rastra Bank (NRB), the central bank of Nepal; and reports from Nepalese Stock Exchange (NEPSE) Limited. It consists of annual time series data with the variables NEPSE Index (NI), consumer price index (CPI), exchange rate (ER), gross domestic product (GDP), Treasury bill rate (TBR), and money supply (M1). NI is the transaction index published by the Nepal Stock Exchange Limited. CPI, which is a proxy for inflation, represents the aggregate price level. The ER is the amount of Nepalese rupees per unit of USD. The GDP is used as a measure of economic activity. The short-term interest rate is represented by the TBR. Since the quarterly data On CPI, GDP, TBR, and M1 are not available for Nepal, we constructed the quarterly series to these variables using spline interpolation method. All series are transformed into logarithmic scales prior to the empirical analysis. Statistical software packages R and EViews are used for arranging the data and conducting econometric analyses.

4. Methodology and Empirical Results

The econometric methodology adopted in this paper consists of Ng-Perron unit root test, Johansen's multivariate cointegration test, Granger causality test based on Vector error correction model, and variance decomposition analysis. These are briefly explained below, and the interested readers are referred to the relevant literature in the references and the endnotes.

4.1 Ng-Perron Unit Root Test

Since macroeconomic time series data are usually non-stationary and thus conducive to spurious regression, first the stationarity of each series is examined by using the Ng-Perron unit root test. According to [19], the widely used Augmented Dickey-Fuller (ADF) test suffers from low power, especially when the moving-average polynomial of the first differenced series has a large negative root. To overcome this issue, they proposed the Ng-Perron test, which has better power and size properties, so its results are more reliable when applied to small data sets [13]. The Ng-Perron test has the null hypothesis of non-stationarity of the time series. There are four test statistics, $(\mathrm{MZ}_\alpha, \mathrm{MZ}_t, \mathrm{MSB}, \mathrm{MPT})$ associated with this test. The first two test statistics (MZ_α and MZ_t) are usually reported more often for interpretation of empirical results ([7]-[9], [21]).

The Ng-Perron unit root test was conducted in EViews for each variable in logarithmic scales and the results for these two statistics at levels and their first differences are reported in Table 1. As indicated there, all the six variables are non-stationary in their levels. The unit root test results conducted on their first differences of these variables indicate that the variables NI, CPI, E, TBR, and M1 are stationary. However, the GDP does not become stationary even when its first differences are considered. According to [12], it is possible to find cointegration between non-stationary variables if at least two of the variables considered in the cointegration system are stationary. As the unit root tests reported in Table 1 satisfy this requirement, it is possible to proceed to conduct the cointegration test among the NEPSE Index and the macroeconomic variables.

Table No. 1. Ng-Perron Unit Root Test Results

Variables	Levels		First Differences	
	MZ_α	MZ_T	MZ_α	MZ_T
NI	0.044	0.018	-41.421*	-4.493*
CPI	-6.030	-1.604	-31.764*	-3.974*
ER	1.720	1.720	-43.948*	-4.686*
GDP	-1.360	-1.501	-1.167	-0.714
TBR	-5.070	-1.539	-39.098*	-4.410*
M1	-1.169	-1.457	-38.957*	-4.413*
Critical value	-8.100	-1.980	-8.100	-1.980

Notes: (*) denotes statistical significance at 0.05 level of significance; lag lengths in the Ng-Perron tests were selected using the spectral GLS-detrended based on Schwarz Information Criterion (SIC); NI, CPI, ER, GDP, TBR, and M1 denote the logarithmic values of the NEPSE Index, consumer price index, exchange rate, gross domestic product, Treasury bill rate, and money supply respectively.

4.2 The Johansen's Multivariate Cointegration Test

After establishing the order of integration of each variable, we employed Johansen's cointegration test [15] in order to test for the long-run equilibrium relationship among the NEPSE Index and the macroeconomic variables. We used the optimum lag length of 2 as determined by using the likelihood ratio test. We conducted the Johansen's cointegration test with all the variables in their logarithmic scales and considered both λ-trace and λ-max statistics options in EViews.

The results for both the λ-trace and λ-max statistics are reported in Table 2. The results indicate that both the statistics identified one cointegrating relationship among the NEPSE Index and the five macroeconomic variables. In other words, there exists a long run equilibrium relationship between the NEPSE Index and macroeconomic variables in Nepal. Furthermore, the residual analysis based on Bruesch-Godfrey Serial correlation LM Test results in a chi-square test statistic with a p-value greater than 0.05 level of significance. This indicates that the null hypothesis of no serial correlation is not rejected at 5% level of significance, and thus, confirms the adequacy of the model for cointegration analysis.

Table No. 2. Johansen Cointegration Test Results (Trace and Maximum eigen value)

Null Hypotheses	λ-Trace statistic	5% critical value	p-value	λ-Max statistic	5% critical value	p-value
$r = 0$	110.746	95.754	0.0031*	43.377	40.078	0.0205*
$r \leq 1$	67.370	69.819	0.0772	28.889	33.877	0.1755
$r \leq 2$	38.481	47.856	0.2815	21.740	27.584	0.2340
$r \leq 3$	16.741	29.797	0.6591	11.751	21.132	0.5724
$r \leq 4$	4.990	15.495	0.8099	4.340	14.265	0. 8219
$r \leq 5$	0.650	3.841	0.4200	0.650	3.841	0.4200

Notes: (*) denotes statistical significance at 0.05 level of significance; $r =$ hypothesized number of cointegrating equations; the cointegration model is based on the vector autoregression model (VAR) with 2 lags as identified by the likelihood ratio test criterion. The critical values for λ-trace and λ-max statistics are calculated by Eviews (10).

After normalizing the coefficient of NEPSE Index to one, the restricted long run equilibrium relationship between the NEPSE Index and the macroeconomic variables can be expressed as follows. (Note: The figures in the parentheses represent the corresponding t-statistics.)

$$NI = -10.47 + \underset{(6.31)}{4.89CPI^*} + \underset{(1)}{4.56ER} - \underset{(-12.18)}{4.67GDP^*} + \underset{(1.9)}{2.26TBR^*} + \underset{(1.99)}{1.37\,M1^*} \qquad (1)$$

The equation (1) suggests that the coefficient of CPI, which is a proxy for inflation, is positive and statistically significant. This suggests that equities serve as a hedge against inflation. This result is consistent with the findings of [1] and [22]. The positive coefficient of ER indicates a positive effect of the exchange rate on stock prices. This coefficient is, however, not statistically significant at a conventional level. The coefficient of GDP, which is proxy for overall economic activity, is negative. This suggests that increase in GDP decreases the stock prices, which is inconsistent to most research ([22], [26]). The coefficient of TBR, which is a proxy for the interest rate, is positive and statistically significant. The positive relationship between stock prices and TBR could be explained in the sense that an improvement in the profit outlook increases the aggregate demand and the investment, and consequently, raises the interest rates. This result is consistent to that of [22] who found a positive long run effect of interest rate on stock prices for the USA. The coefficient of M1 is positive and statistically significant. A possible explanation could be that an increase in money supply increases the stock prices by creating an excess supply of money balances. This result is empirically supported by [1], among others, for the USA and by [18] for Japan.

4.3 Granger Causality and Vector Error Correction Model (VECM)

After establishing one cointegrating relationship between the NEPSE Index and the macroeconomic variables in (1) above, we proceeded to estimate the vector error correction models (VECM). The VECM includes lags of the dependent variables, in addition to its own lags. In addition to indicating the direction of causality amongst the variables, the VECM allows one to distinguish between short-run and long-run Granger causality because it can capture both the short-run dynamics between time series and their long-run equilibrium relationship [17]. The long run Granger causality is tested by examining the statistical significance of the t-test of the lagged error correction term while the short-run Granger causality is tested by the joint significance of the coefficients of the differenced explanatory variables by using Wald chi-squared test. To the best of our knowledge, previous Nepalese studies have not examined both short and long-run causal relationships between the NEPSE Index and all the macroeconomic variables included in our study.

Table No. 3. Causality Results based on Vector Error Correction Model

Causality		χ^2-test	ECT	Nature of	Direction of
From	To	Statistic	(t-statistic)	causality	causality
CPI	NI	1.116	3.292*	Long-run	Unidirectional
NI	CPI	0.530	1.503	No causality	
ER	NI	7.115*	1.1114	Short-run	Unidirectional
NI	ER	0.763	0.3614	No causality	
GDP	NI	4.285**	-2.224**	Short and long-run	Feedback
NI	GDP	1.112	2.828*	Long run	
TBR	NI	8.690*	1.999**	Short and long-run	Feedback
NI	TBR	1.144	3.254*	Long-run	

M1	NI	0.899	2.997*	Long-run	Unidirectional
NI	M1	0.818	0.4568	No causality	

Notes: (*) and (**) respectively indicate the rejection of the null hypothesis at the 1% and 5% level of significance; number of lags in the VECM was determined using the likelihood ratio test.

The results of both short and long-run Granger causality relationships are reported in Table (3). The results indicate that there are four long-run causal relationships between the variables. These causalities run from the CPI to NI, NI to GDP, NI to TBR, and from M1 to NI. There is a short-run casual relationship running from ER to NI. There are two feedback or bidirectional relationships. These are between NI and GDP and NI and TBR. Thus, CPI, ER, GDP, TBR, and M1 Granger cause NI, which suggests that stock prices in Nepal can be predicted from selected macroeconomic variables.

4.4 Variance Decomposition (VDC) Analysis

A limitation of Granger causality test based on VECM framework is that it can only examine the causality among the variables within the sample period. However, the VDC can examine the causality out of the sample period as well. The results of the VDC analysis are reported in Table 4 and 5. These results exhibit the percentage of the forecast error variance of each variable that is accounted for by each of the other variables including itself. As such, the VDC enables us to determine the relative importance of each variable in generating fluctuations in other variables [22].

Table No. 4. Forecast variance in NI explained by innovations in

Steps ahead	NI	CPI	ER	GDP	TBR	M1
1	100	0.00	0.00	0.00	0.00	0.00
5	87.85	0.78	8.18	0.06	0.23	2.90
10	82.42	2.70	9.64	0.92	0.45	3.87
20	72.39	4.19	9.75	4.54	4.98	4.15

Notes: NI, CPI, ER, GDP, TBR, and M1 denote the first differences of the logarithmic values of the NEPSE Index, consumer price index, exchange rate, gross domestic product, Treasury bill rate, and money supply respectively; the steps ahead refer to the quarters (three months) after a once-only shock; Cholesky ordering for the variance decomposition was NI, ER, TBR, CPI, GDP, M1. The ordering of the variables is based on the correlation between the NEPSE Index and the individual macroeconomic variable (i.e. NI, ER, TBR, CPI, GDP, M1).

Table No. 5. Forecast variance explained by innovations in NI

Steps ahead	NI	CPI	ER	GDP	TBR	M1
1	100	0.03	13.14	0.01	1.56	0.08
5	87.85	0.10	3.14	2.23	0.24	2.86
10	82.42	0.49	1.66	6.96	0.20	3.75
20	72.39	0.46	1.17	4.56	0.22	4.31

Note: See Table 4 for details of notations.

The results tend to support the argument that the movements in the stock prices can be explained by some of the macroeconomic variables analyzed. In the first step (i.e., three months), 100% of the variability in the stock prices is explained by its own shocks while after five steps, 87.85% of the variability is explained by its own shocks, 0.78% by the shocks of CPI, 8.18% by the shocks of ER, 0.06% by the shocks of GDP, 0.23% by the shocks of TBR, and 2.9% by the shocks

of M1. After 20 steps (i.e., 5 years), the figures are 72.39%, 4.19%, 9.75%, 4.54%, 4.98%, and 4.15% respectively. Among five macroeconomic variables, the exchange rate can mostly explain the stock prices (about 10%) in this period. In other words, the movement of the exchange rate seems to have the most powerful impact on the stock prices. This result is also consistent with the earlier explanation of the positive relation between the stock prices and exchange rates in 4.2. The VDC analyses revealed that a major proportion of the variability in the stock price was explained by its own innovations, while a small proportion of the variability was explained by other macroeconomic variables. A possible explanation could be that the macroeconomic variables used in this study represent only a subset of variables available in studies of developed markets. Future studies can benefit by including other variables such as unemployment rate, long-term interest rate, M2 money supply, etc. Also, the results for the percentages of forecast variances explained by innovations in NI are given in Table 5. The results there indicate that the innovations in NI have explained a very little forecast variances of the CPI, ER, and TBR. For example, at step 20 (i.e., 5 years), the NI explains a 0.46% of variance of the consumer price index, 1.17% of variance of exchange rate, and 0.22% of variance of the Treasury bill rate. The innovations in NI have explained the forecast variances of the GDP and M1 significantly. For example, at step 20 (i.e., 5 years), the NI has explained 4.56% and 4.31% of variances in GDP and M1, respectively. We found from the Granger causality results in Table 3 that CPI, ER, GDP, TBR, and M1 Granger cause NI. Thus, we can conclude that stock prices in Nepal can be predicted from selected macroeconomic variables.

5. Conclusions and discussions

This paper examined the dynamic causality between the stock prices and macroeconomic variables in Nepal. Variables such as the consumer price index, exchange rate, gross domestic product, Treasury bill rate, and money supply were used to represent the macroeconomic forces while the NEPSE Index was used to represent the stock prices. The econometric methodologies adopted include the Ng-Perron unit root tests that are more powerful than the widely used ADF and PP tests, Johansen's multivariate cointegration test, the Granger causality test in the vector error correction model, and the variance decomposition analysis. We used the quarterly data for the period from January, 1994 to December, 2016. To the best of our knowledge, no previous study has investigated the impact of all these variables on stock prices in the context of Nepalese macroeconomic research.

The cointegration test revealed that there is one cointegrating relationship between the stock prices and the macroeconomic variables. It is observed that in the long-run, the NEPSE Index is positively related to consumer price index, exchange rate, Treasury bill rate, and money supply and negatively related to the GDP. The finding from the Granger causality based on the VECM indicate that there are unidirectional long-run Granger causalities running from both the consumer price index and the money supply to the NEPSE Index. In addition, there is a unidirectional short-run Granger causality running from the exchange rate to the NEPSE Index. Finally, there are two feedback relationships, which are between the gross domestic product and the NEPSE Index, and the Treasury bill rate and the NEPSE Index. The evidence of reverse causalities from stock prices to GDP and the Treasury bill rate supports the typical view that stock market is an important factor among leading economic indicators. The findings of unidirectional causality and feedback relationships verify the fundamental and theoretical linkages between stock prices and macroeconomic variables in Nepal.

The results from out of sample causal relationships using the VDC analysis suggest that most of the variation in the NEPSE Index is captured by its own innovation, and a small proportion of the variability was explained by other macroeconomic variables. This may be because the macroeconomic variables used in this study represent only a subset of variables available in studies

of developed countries. As far as the macroeconomic variables are concerned, the stock prices are able to capture little variation in CPI, ER, and TBR and significant variation in GDP and M1.

The findings of the presence of cointegration and causalities suggest that the past values of these macroeconomic variables can predict the future changes in the stock prices. These findings may have important implications for decision making by investors, stock market regulators, and national policymakers.

The limitations of the study, however, should not be overlooked. The present study is limited to only five selected macroeconomic variables. Inclusion of more variables such as a broader measure of money supply, unemployment rate, and long-term interest rates with a longer period of time may improve the results. In addition, as our study relates to Nepal, where capital account transactions are not open, these results are more pertinent in countries where capital account transactions are not open.

Notes:

(1) Interpolation techniques are widely used in econometric literature. See, for example, Wongbangpo (2002) [27] and Wickermasinghe (2011) [28].

(2) For consistency, we have logged all the series, including the Treasury bill rate and the exchange rate. However, in applied research, some authors do not log the Treasury bill rate and the exchange rate series.

(3) Our methodology in vector error correction model and Granger causality test are consistent with other similar studies. See, Wickermasinghe (2011) [28], for example.

(4) See, for example, Cheung and Ng (1998) [5] and Wickremasinghe (2011) [28] for details on vector error correction models.

(5) We are well aware of the fact that our dataset does not cover a long enough time period for cointegration analysis. As Ratanapakorn and Sharma (2007) [22] notes, one should have at least 30 years of data for such analysis. Hence, the results should be viewed with caution.

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