

STOCK MARKET RESPONSES TO MACROECONOMIC DYNAMICS: TESTING FOR LONG-RUN EQUILIBRIUM IN NEPAL

Dipendra Karki*

Abstract

This study empirically examines the macro-economic factors of the stock market performance in Nepal. It considers the annual data of four macroeconomic variables; real GDP, inflation, interest rate and broad money supply from 1994 to 2016 and attempts to reveal the relative influence of these variables on stock prices represented by 'NEPSE Index' of the Nepalese capital market. In pursuance of this, it analyzes the cointegrating relationship between stock prices and macroeconomic variables. Empirical results obtained from OLS estimations reveal that the performance of stock market is found to respond positively to real GDP, inflation and money supply, and negatively to interest rate. More importantly, cointegrating evidence cannot be found between macroeconomic variables and stock market index which suggests that stock price movements in Nepal are not explained by the macroeconomic variables. It supports random walk hypothesis in Nepali capital market. These findings help to design policies to stabilize or stimulate the capital market in Nepal.

Key Words: Stock Market, Macroeconomy, Long-run Equilibrium

INTRODUCTION

Background of the Study

The overall development of the economy is a function of how well the stock market performs and empirical evidences have proved that development of capital market is indispensable for economic growth (Avadhani, 1996). It is through this segment that the country's exposure to the outer world is most readily felt. The relationship of economy and Stock price has always been a subject matter of controversial debate. The pricing implication has come into attention since the publication of seminal work of Markowitz (1952) – the mean-variance portfolio theory. Since then, the stock prices volatility has received a great attention from both academicians and practitioners as it can be used as a measure of risk in financial markets. Establishing the empirical link between volatility and macroeconomic variable has proven to be very challenging. Some studies find strong evidence that stock volatility increases during economic recessions (Bernanke, 1983). It seems that pricing volatility does not follow any pattern and not affected by economic variable. In some cases, it is closely related with macroeconomic variables and in some cases macroeconomic variables have no impact upon volatility. Varying evidences of relationship between macroeconomic variables with stock prices were widely documented in the existing literature.

Researchers were successful in finding a relationship between stock prices and the different macroeconomic indicators in countries like Lithuania (Pilinkus, 2009), Turkey (Kandir, 2008), and Jordan (Maghayreh, 2003). There is in fact a relationship between stock prices and certain macroeconomic indicators (Fama & Schwert, 1977), those studies were mostly conducted in developed economies. While in the context of less developed economies, like Asian markets macroeconomic factors can't be reliable indicators for stock market price movements because of the inability of stock markets to fully capture information about the change in macroeconomic fundamentals (Fung and Lie, 1990).

The relevance of the studies conducted on the developed economies is yet to be seen in the context of smaller, developing and under-developed capital markets.

The importance of stock markets as financial channels for saving and investment is gaining significant role in Nepalese economy. In general, volatility in the Nepal Stock Market is less than the average volatility of other developing countries (K.C, 2009). The reason is mainly low volume of trading equities due to low demand. However, in recent years pricing volatility has increased due to the increase in the volume of trading triggered by the speculative motives of investors. As evidenced from macroeconomic indicators of Nepal as of mid-July 2016, the ratio of stock market capitalization to GDP is about 94 percent. Macroeconomic stability, therefore, has become an important condition for financial development and economic growth of the country. In the light of these facts, it is necessary to examine how far stock market in Nepal is being influenced by macroeconomic variables.

The relationship between the stock price and macro-economic factors is important to study for many reasons. First, it helps policy makers understand the full effect of prevailing and upcoming policies and regulations. Second, if investors were aware of this relationship and fully understood it, then they will make more informed investment decisions thus reducing their exposure to risk. And third, knowing which factor leads the other can help in reducing the shock factor because the public will be somewhat aware of what might happen in the economy or the financial market and thus will be able to take protective measures. Economic liberalization and financial sector reforms in Nepal have guided in a change in the financial architecture of the economy. This leads to the number of banks and financial institutions come in to operation, widening the scope for a re-examination of the relationship between the stock market and the economic and non-economic variables in Nepal. This study is an endeavour in this direction.

Dipendra Karki
Kathmandu University School of Management (KUSOM), Kathmandu, Nepal
Correspondence and Reprint Requests: Dipendra Karki

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Statement of the Problem

Stock market facilitates the situation of country's economy. Growth in stock market is normally considered as a good sign since it implies the investors are confident about the future prospect of the economy. It helps to promote investment in the economy. However, a rapid increase in the stock market index is always a matter of concern. If the increase in the index is not justified by the country's macroeconomic indicators, such a rise cannot be sustained and eventually the index will plummet endangering the economic and financial stability. Hence, it is essential that the policymakers keep eyes on the stock market development and macroeconomic indicators to take appropriate measures, if needs arise, to prevent the build-up of bubbles and collapse in the market. For this, it is necessary to understand the relationship between the stock market index and the macroeconomic factors that influence it.

Nepalese stock market has passed through different stages. Major political changes occurred during this recent decade and the market has jumped to all time high 1881.45 points on July 31, 2016 from all-time low of 292.31 points on June 15, 2011. What factors are responsible for these changes in volatility? Every individual specially related with stock market in this or that way, tries to get answer to these questions. Graham (1973) pointed out that stocks do well or poorly in the future because the businesses behind them do well or poorly-nothing more, and nothing less. Indeed in some markets, prices exhibit common movements that are hard to explain by movements in fundamentals (Watanabe, 2008). If fundamentals are not influential, then what else is responsible for changing stock prices over time? There are several studies which examined the movement in stock prices. Schwert (1989) correlated these changes to the volatility of macroeconomic variables. Similarly, many others attempted to relate changes in stock prices and economic variables, including Maghayreh (2003), Kandir (2008), and Alagidede and Panagiotidis (2010). Though there is no unanimous conclusion, the majorities of existing literature establish a link between macroeconomic volatility and stock market prices based on transmission mechanism between the key macroeconomic variables, namely, inflation, interest rate, money supply, GDP etc. Thus, to sum up, the study basically deals with following research issues:

- What is the direction and magnitude of causal relationship between stock market prices and macroeconomic variables in Nepal?
- Is there any long-run equilibrium relationship between stock market prices and macro-economy of Nepal?

REVIEW OF LITERATURE

The modern study on the behavior of stock market prices can be traced back to 1930, when Fisher explained how the market rate of interest and inflation affected the stock prices (Fisher, 1930). Several extensions have been made on this model incorporating several macro-economic and other structural variables in determining the stock market prices. There are some models which describes about the stock valuation and its movements. Among them, Dow Theory, Random Walk theory and Efficient Market Hypothesis are important models.

Dow Theory

Dow Theory is considered as the pioneer work in technical analysis of stock pricing. Robert (1932) expounded and refined the original ideas into 3 basic tenets that served as the foundation of the Dow Theory. (a) The Primary Trend is Inviolable (b) The averages discount everything (c) The Dow Theory is not infallible

Random Walk Theory

Malkiel (1973) stated that the past movement or direction of the price of a stock or overall market cannot be used to predict its future movement. It is the occurrence of an event determined by a series of random movements – in other words, events that cannot be predicted. For example, one might consider a drunken person's path of walking to be a random walk because the person is impaired and his walk would not follow any predictable path. Applying the random walk theory to stocks suggests that stock prices change randomly, making it impossible to predict stock prices.

Efficient Market Hypothesis (EMH)

Fama (1970) used the phrase "Efficient Market" to describe the market price that fully reflects all available information. The efficient-market hypothesis (EMH) asserts that financial markets are "informationally efficient". That is, one cannot consistently achieve returns in excess of average market returns on a risk-adjusted basis, given the information publicly available at the time the investment is made. It is important to note, however, that in the empirical work to date, the usual procedure has been to infer market efficiency from the observed independence of successive price changes. There has been very little actual testing of the speed of adjustment of prices to specific kinds of new information.

Review of Empirical Evidences

As regards ongoing debate on what works on stock market pricing, it has been recognized in the recent years that stock markets cannot persistently function in isolation from the macroeconomic conditions. Thus macroeconomic variables that reflect the state of economy serve as the natural candidates for the common factors. Schwert (1981) studied on reaction of stock prices to the new information about inflation. The author extended the evidence on the relationship between stock returns and inflation by examining the daily returns from 1953-1978. The study revealed negative reaction of stock markets to the announcement of unexpected inflation in the CPI, although the magnitude of the reaction was small.

Chen, Roll, and Ross (1986) identified four macroeconomic factors, namely changes in industrial production, changes in expected and unexpected inflation, changes in risk premium, and changes in term structure, as the fundamental macroeconomic forces in affecting stock market returns. They found a long-term equilibrium relationship between stock prices and relevant macroeconomic variables, between 1953 and 1984 in the US stock market. The study demonstrated that the macroeconomic factors could significantly explain cross-section of stock returns.

The empirical testing of the dynamic relationship between macroeconomic variables and the Japanese stock market was made by Mukherjee and Naka (1995). The study used six macroeconomic variables and employed a vector error correction to a model of seven equations. They found that

a long-run equilibrium relationship exists between the Japanese stock market and the six macroeconomic variables such as exchange rate, money supply, inflation, industrial production, long-term government bond rate and call money rate.

Pethe and Karnik (2000) dealt with inter-relationships between stock prices and important macroeconomic variables, namely prime lending rate, exchange rate, narrow money supply, broad money supply, and index of industrial production in the context of Indian stock market. The results indicated that not a single pair of variables tested was cointegrated. The study pointed that the changes in state of economy, as proxied by index of industrial production, could have a bearing on stock prices, but not the other round. There was no evidence to suggest that a revival of the stock market, in the sense of rising share prices, could be a leading indicator of the economy.

Flannery and Protopapadakis (2002) evaluated the effect of macroeconomic variables on the daily returns to a broad equity market index over the 1980-1996 periods. The study included daily returns for the value-weighted NYSE, AMEX, NASDAQ market index obtained from CRSP. It reported the significant effect of consumer price index, PPI, and money supply on market value weighted returns. All three coefficients were significantly negative indicating that higher than anticipated inflation or money supply depressed equity values. The study also demonstrated the significant negative effect of real gross national product on volatility.

Ibrahim and Aziz (2003) in an attempt to establish a dynamic linkage between stock prices and macroeconomic variables in the case of Malaysia, analyzed standard and well-accepted methods of co-integration and vector auto-regression. The study considered the interactions between the Malaysian equity market and four macroeconomic variables including real output, money supply, price level and exchange rate. The study used data from January 1977 to August 1997. The study found a positive long-run relationship between stock prices and industrial production. This result was as per expectation and as such the study reasoned that real industrial production growth affect firm's expected future cash flow positively. It also reported a positive relationship between stock prices and inflation in context of Malaysia.

The existence of long-term equilibrium relationship between stock prices and certain macroeconomic variables was examined by Adel (2004). The macroeconomic variables used in the study were real economic activity, money supply, inflation, and interest rate. The vector error correction model was used to determine the impact of these macroeconomic variables on Amman Stock Exchange (ASEX). The sample period consisted of 92 quarterly observations for each variable from March 1980 to December 2003. The study reported a reliably negative relation between stock prices and inflation; whereas the level of real economic activity affected the stock price positively. The results also showed that the money supply could have positive influence on stock prices. Among other, the study postulated that industrial production was one of the positive determinant factors of stock prices consistent to the findings of Chen, Roll and Rose (1986) and Mukherjee and Naka (1995).

Gan, Lee, Yong and Zhang (2006) examined the relationship between the New Zealand Stock Exchange (NZSE) index and a set of macroeconomic variables during the period of

January 1990 to January 2003 using time series data on inflation, long-term interest rate, short-term interest rate, real gross domestic product, and narrowly defined money supply. The co-integrated test indicated the existence of long run relationship between NZSE index and the macroeconomic variables. The study observed that New Zealand stock returns could be consistently determined by the interest rate, money supply and real GDP.

Kandir (2008) investigated the role of macroeconomic factors in explaining Turkish stock prices. The macroeconomic variables used in the study were growth rate of industrial production index, change in consumer price index, growth rate of narrow money supply, change in exchange rate, and interest rate. The study used data for all non-financial firms for the period from July 1997 through June 2005. Three portfolios were formed according to the rank of the firms by book-to-market equity, earnings yield, and leverage ratio. The study revealed significant effects of exchange rate and interest rate on stock returns. Similarly, inflation rates were found positively related to the stock prices. The study demonstrated a negative relation between stock returns and interest rate meaning that investors tended to invest less in stocks when interest rate rise causing stock prices to fall.

Pilinkus (2009) analyzed relationship between a group of macroeconomic variables and Lithuanian stock market index to investigate whether stock prices serve as a leading indicator for macroeconomic variables in Lithuanian economy or vice versa. The study employed Granger causality tests to estimate the relationship between Lithuanian stock market index and forty macroeconomic variables from 1999 to 2008. The study revealed that some macroeconomic variables, for example, GDP deflator, net export, foreign direct investment, could lead stock market returns, while some variables such as GDP, material investment, construction volume index were led by the stock market index. Finally, other macroeconomic indices such as money supply, payment balance, and stock market returns were found to cause each other.

The study by Abu-Libdeh and Harasheh (2011) investigated the correlation and causality relationships between stock prices and some macroeconomic variables in Palestine. Two methodologies were used in order to determine the relationships. First they used a regression analysis taking market index as dependent variable and five macroeconomic variables (inflation, GDP, exchange rate, Libor rate and balance of trade) as the independent variables. Second, Granger causality test was conducted to assess the causality relationship. The results of the regression analysis as a whole indicated a significant relationship between the macroeconomic variables and stock prices. Moreover, the causality analysis negated any kind of causal relationships between macroeconomic variables and stock prices.

The relationship between macroeconomic variables and the Nigerian capital market index was examined by Osamwonyi and Osagie (2012). The study considered the yearly data of several macroeconomic variables; interest rates, inflation, exchange rates, fiscal deficit, GDP and money supply from 1975 to 2005; and tried to reveal the relative influence of these variables on the 'All Share Index'. In pursuance of this, the Vector Error Correction Model (VECM) was used to study the short-run dynamics as well as long-run relationship between the stock market index and the selected

macroeconomic variables. The major finding was that macroeconomic variables influence stock market index in Nigeria.

These studies have formed a base for the long-run relationship and short-run dynamic interactions among macroeconomic variables and stock market prices. Gross domestic product is one of the fundamental macroeconomic variables employed in the past studies to trace out macroeconomic influences on stock market prices. GDP is used as a proxy of real aggregate economic activity in an economy. The empirical studies associated with macroeconomic influences on stock returns have suggested mixed evidences about GDP influence. For example, Flannery and Protopapadakis (2002) found no role of GDP to explain the common stock returns in USA. On the contrary, Ibrahim and Aziz (2003) found positive long-term relation between GDP and stock returns in Malaysia.

Aggregate money supply in the economy and the rate of inflation are another interrelated macroeconomic variables influencing stock market performances. There are three dominant hypotheses, namely, tax effect, proxy effect, and the reverse causality, explaining the effects of inflation on stock market returns. The tax effect hypothesis argues that inflation introduces a corporate tax liability and reduces real after-tax earnings, thus reducing common stock returns. The proxy effect hypothesis explains that real activity is positively related to common stock returns, but negatively related to inflation through the money demand effect. As a result, there is a negative relation between stock returns and inflation. Similarly, reverse causality hypothesis states that future economic activity is correlated with increased domestic borrowing or increased supply of money. This simply means that an increase in domestic borrowing or issuance of money has inflationary effects that dampen real activity. In the end, stock market returns also fall due to fall in real activity and the inflationary effect and hence the negative relation exists between stock market returns and the inflation. However, the empirical evidences on relationship between inflation and stock returns found that holding of stocks provides a good hedge (Ibrahim & Aziz, 2003, and many others). This study also assumes the positive relationship of inflation and money supply on stock prices.

Besides GDP, money supply and inflation, the interest rate risk is another important financial and economic factor affecting the value of common stocks. There are important reasons why the stock returns can be responsive to interest rate changes. The volatility transfer hypothesis suggests that a random shock can induce higher volatility in financial markets and because of infectivity effect which are the highest in more volatile markets, investors may look to invest in alternative financial assets. Thus, greater exposure to interest rate risk is likely to affect the stock returns. In deed, the stock prices and hence stock returns would differ according to their sensitivity to interest rates in the state of equilibrium. Mukherjee and Naka (1995) observed that changes in both short-and long-term government bond rates would affect the nominal risk-free rate and thus affect the discount rate resulting into a change in stock prices. Reily and Brown (2000), however, argued that cash flows from stocks could change along with interest rates and it would not be certain whether this change in cash flows would augment or offset the change in interest rates. Though controversies exist

about exact relationship between interest rates and stock market returns, this study hypothesizes a negative relationship between interest rates and stock prices basically for two reasons. First, interest rates can influence the level of corporate profits which in turn influence the price that investors are willing to pay for the stock through expectations of higher future dividends payment. A reduction in interest rates reduces the cost of borrowing and thus serves as an incentive for expansion. This will have a positive effect on future expected returns for the firm. Second, as considerable stocks investments are made with borrowed money, hence an increase in interest rates would make stock transactions more costly. Investors will require a higher rate of return before investing. This will reduce the demand for stock investment and thus lead to decline in stock prices.

To sum up, many of these studies have documented that macroeconomic variables do influence stock market prices and hence the stock returns, though the results are not consistent. Some found that inflation has significant effect on stock market returns while others found that real sector activity proxied by GDP captures much of the variation. Though these findings are available in many developed foreign stock markets, the effect of macroeconomic indicators is yet inconclusive in Nepalese stock market.

Review of Nepalese Studies

Though there are number of studies associated with macroeconomic volatility of stock returns and analysis on the impact of major events in context of US and other developed capital markets, there are few empirical works in the context of Nepal

In an attempt to examine the existence of causality relationship, G.C. and Neupane (2006) conducted the study entitled as "Stock Market and Economic Development: a Causality Test". It was based on the time series data for the year 1988 to 2005 using Granger causality test. The study found the empirical evidence of long-run integration and causality of macroeconomic variables and stock market indicators in Nepal. The causality was observed only in real terms but not in nominal variables. In econometric sense, it depicts that the stock market plays significant role in determining economic growth and vice versa. The paper highlighted the importance of stock market development for fostering economic development.

Baskota (2007) considered the NEPSE data during 1994 to 2006 and analyzed the effect of trading days, trading volumes, base money supply, interest rate, inflation and industrial production by means of regression analysis. The study concluded that there is no persistence of volatility in Nepalese Stock Market and stock price movements are not explained by macro-economic variables. Further, the study conducted event analysis for selected political incidents and concluded that the politics is not only the factor that explains the stock price movement in Nepal.

The dynamic relationship among the market indexes and macroeconomic factors was studied by Bhattarai and Joshi (2009) in the context of Nepalese stock market. The study documented both short-run and long-run interdependence among stock index and some macroeconomic variables. The estimated results suggest unidirectional short-run (positive) causal relationship running from consumer price index (CPI) to stock index but reverse causality in the long run (from stock

index to CPI), supporting the widely-held view that stock returns are a hedge against inflation. The multivariate results also confirmed absence of long-run causality but supported positive and unidirectional relationship flowing from money supply to stock index in the short run. Nevertheless, the multivariate results revealed long-run causality running from stock index to treasury bill rate but no short-run linkage. The variance decompositions results showed a strong relative exogeneity of stock index, while the impulse response graphs showed that the response of stock index to shocks in macroeconomic variables didn't persist for long period. The policy implication of the study was that monetary authority in Nepal would be able to influence the stock market only in the short run, but not in the long run, either directly through its intermediate target (money supply) and its impact on the inflation or indirectly through increased access to the financial services.

Shrestha and Subedi (2014) empirically examined the determinants of the stock market performance in Nepal using monthly data for the period of mid-August 2000 to mid-July 2014. Empirical results obtained from OLS estimations of behavioural equations revealed that the performance of stock market is found to respond positively to inflation and broad money growth, and negatively to interest rate. This suggests that, in Nepal, share investors seem to take equity as a hedge against inflation and consider stock as an alternative financial instrument. Further, availability of liquidity and the low interest rates stimulate the performance of the Nepalese stock market.

Many of the studies on the impact of some leading macroeconomic variables on stock prices concluded that one or other macroeconomic variables can predict stock market returns although the results vary among the studies. The findings associated with the studies on macroeconomic influences on stock prices in the context of Nepal also vary across the studies as in the case of developed capital markets. Though much of literatures are available in developed and developing economies, there are only few studies of this type in the context of Nepal. Thus, this study serves as an attempt to identify the cointegrating evidence between macro-economy and stock market performance in Nepal with a different set of variables, events and data of more recent period.

RESEARCH METHODOLOGY

Conceptual Framework

Many researchers have related several macroeconomic variables in existing literature affecting stock prices.

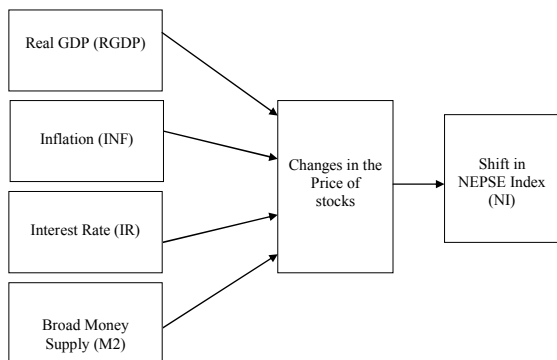


Figure 1 Conceptual Framework for Macroeconomic Factors Influencing Stock Prices

The majorities of them basically focused on the several proxies of macro-economy like; real GDP, Inflation (INF), Interest Rate (IR), and Broad Money Supply (M2), whereas stock price is represented by the market index (measured as NEPSE Index in Nepal). Based on the literature review the conceptual framework of the study is presented as follows:

Research Design

This study adopts descriptive and causal comparative research designs to deal with the macroeconomic factors influencing stock prices in the context of Nepal. The descriptive research design has been adopted for fact-finding and searching adequate information about factors affecting stock market prices. The causal comparative research design has been used to ascertain and understand the directions, magnitudes and forms of observed relationship among the used variables such as real GDP, inflation, interest rate, and money supply. The basic purpose of employing causal comparative research design in this study is to understand and examine whether it is possible to predict common stock returns on the basis of information about macroeconomic variables. This study follows positivism research paradigm. From an ontological stand point, this paradigm assumes that there is universal single truth and reality is out there (Jennings, 2001).

Nature and Sources of Data

This study is an empirical research based on secondary data. Based on the literature review, the stock market price is influenced by several macroeconomic factors and among them inflation, interest rate, broad money supply and real GDP are found to be more important. The necessary annual data related to macroeconomic variables are collected from Central Bureau of Statistics (CBS), and Nepal Rastra Bank (NRB), whereas stock market indices data are collected from Nepal Stock Exchange Ltd. (NEPSE). The study uses the time series data for the total period of 23 years from fiscal year 1994 to 2016. The following data are taken to examine the response of stock market to macroeconomic dynamics in Nepal as shown in Table 1.

Table 1 Variables and their Description

Variable	Description	Unit
NI	NEPSE Index	
GDP	Annual real GDP at basic price (Base year = 2000/01)	Rs in million
Inflation	Annual growth	Percent
Interest Rate	Weighted average 91 days T -bills rate, Annualized	Percent
M2	Broad Money Supply	Rs in million

Population and Sampling

The study uses the time series data of macroeconomic indicators and stock market prices for analysis purpose. Nepal Stock Exchange Ltd (NEPSE) established in 1993 is the only capital market of the country that opened its trading floor from 13 January, 1994. This study attempts to cover the data since the inception of NEPSE to the recent period. During this period, Nepalese stock market passed through different stages. Major social, economic and political changes occurred during this period and the market has plunged to the all-time low of 292.31 points on June 15, 2011 from all time high 1881.45 points on July 31, 2016. Due to this scenario, the aforesaid sample period seems to be comprehensive and appropriate.

Methods of Data Analysis

Zikmund (1997) suggested that the choice of the methods of statistical analysis depends on (a) the type of question to be answered, (b) the number of variables, and (c) the scale of measurement. Thus, based on these criterion descriptive statistics, correlational analysis, and time series econometric models have been applied as the methods of analysis. This study also attempts to identify and analyze the long-run relationship between stock market prices and macroeconomic variables. The methodology used to examine the long-run equilibrium is the cointegration test followed by Error Correction Model (ECM). The modeling strategy in this study is based on the widely used Engle-Granger methodology (Engle & Granger, 1987).

First, the regression (OLS) equation has been estimated;

$$NI = \alpha + \beta_1 RGDP + \beta_2 INF + \beta_3 IR + \beta_4 M_2 + \varepsilon \quad \dots(1)$$

Where,

NI = NEPSE Index, RGDP = Real gross domestic product, INF = Inflation

IR = Interest rate, M₂ = Broad money supply, t = 1994-2016

α = Constant term, assume to be constant over time.

ε = Stochastic error term with the conventional statistical properties and β₁, β₂, β₃ and β₄ are the respective parameters of the explanatory variables to be estimated.

Long-Run Equilibrium Analysis

Following are the steps involved to analyze the long-run equilibrium relationship between stock prices and macroeconomic variables:

Unit Root Test

Running a regression of non-stationary variables may lead to spurious regression problem. To this end, the augmented Dickey-Fuller (ADF) test of stationarity has been performed both on the levels and the first differences of the variables (Dickey & Fuller, 1981). A series is integrated of order *d*, *I*(*d*) if it can be difference *d* times to achieve stationarity.

$$\Delta y_t = \beta + \delta_t + \alpha y_{t-1} + \sum_{i=1}^k \varphi_i \Delta y_{t-i} + \varepsilon_t \quad \dots(2)$$

Where, *y_t* = the level of the variable under consideration, *t*= time term,

ε_{*t*} = normally distributed error term with zero mean and constant variance.

Cointegration Test

Cointegration test is performed to identify the existence of a long-run relationship. According to Engle and Granger (1987), the stationarity of the residuals of the regression implies that the series are cointegrated.

$$Y_t = \beta X_t + \varepsilon_t \quad \dots\dots(3)$$

Where, both *Y_t* and *X_t* are non stationary variables and integrated of order 1 (i.e. *Y_t* ~ *I*(1) and *X_t* ~ *I*(1)). In order for *Y_t* and *X_t* to be cointegrated, the necessary condition is that the estimated residuals from Eq. (3) should be stationary (i.e.

ε_{*t*} ~ *I*(0)). The cointegration implies the existence of a long-run or equilibrium relationship among variables.

Error Correction Model (ECM)

The ECM helps to capture the rate of adjustment taking place among the various variables to restore long-run equilibrium in response to short-term disturbances. According to the Granger representation theorem (Granger, 1983; Engle & Granger, 1987), if a set of variables are cointegrated, then there exists a valid error-correction mechanism. Hence, a necessary and sufficient condition for cointegration is the existence of an error correction mechanism (ECM). If dependent variable *NI* is denoted as *y_t*, and the entire explanatory variables in equation (2) as *x_t*, there exist an error-correction representation of the form:

$$Z_t = y_t - \beta x_t$$

Given that;

$$\Delta y_t = \alpha_1 + \phi_1 (\beta' z_{t-1}) + \sum_{j=1}^k \varphi_j' \Delta z_{t-j} + v_t \quad \dots\dots(4)$$

$$\Delta x_t = \alpha_2 + \phi_2 (\beta' z_{t-1}) + \sum_{j=1}^k \lambda_j' \Delta z_{t-j} + u_t$$

Where, *Z_t* refers to deviation of a variable from its long-run path given by *I*(1) variables and *v_t* and *u_t* are well-behaved error terms and |φ₁| + |φ₂| ≠ 0.

Conditional on finding cointegration between *Y_t* and *X_t*, the estimated residuals (β) from the first step long-run regression (3) may then be imposed in the error correction term (*Y_t* - β*X_t*) in the following equation.

$$\Delta Y_t = \alpha_1 \Delta X_t + \alpha_2 (Y - \beta X)_{t-1} + \varepsilon_t \quad \dots\dots(5)$$

Where, Δ represents first-differences and ε_{*t*} is the error term. Note that the estimated coefficient α₂ in the equation should have a negative sign and be statistically significant. Note also that, to avoid an explosive process, the coefficient should take a value between -1 and 0. According to the Granger Representation Theorem (GRT), negative and statistically significant α₂ is a necessary condition for the variables in hand to be cointegrated.

DATA PRESENTATION AND ANALYSIS

Descriptive Statistics

Descriptive statistics for the NEPSE index and macroeconomic variables over the sample period (1994-2016 A.D.) are reported in Table 2. It shows that the NEPSE index ranges from minimum 163.40 to maximum 1718.2 with a mean value of 480.93 over the sample period. The volatility in NEPSE index indicated by coefficient of variation has been noted at 0.796 during the period, which shows that the price index poses high volatility. The inflation during the period ranges from minimum 2.48 to maximum 11.61 with an average of 7.49 for the period. The coefficient of variation of the inflation is only 0.383. Similarly, interest rate varies within the range of 0.13 to 10.93 percent with the coefficient of variation of 0.686 during the period. The volatility with respect to real GDP and M₂ are 0.252 and 0.332 respectively. The volatility with respect to real GDP is the minimum 0.252 than all other variables.

The table 2 shows the descriptive statistics. The variables are stock prices measured as NEPSE index (NI), real gross domestic product (RGDP), inflation (INF), interest rate (IR) defined as the annualized weighted average 91 days T-bills rate, and broad money supply (M2).

Table 2 Descriptive Statistics of Macroeconomic Variables and Stock Index

Statistics	NEPSE Index	RGDP (billion)	Inflation (INF)	Int. Rate (IR)	M2
Mean	480.93	4.85	7.49	4.25	16.65
Median	360.70	4.63	7.62	3.52	16.10
Std. Deviation	382.71	1.22	2.87	2.92	5.53
Coeff. of variation	0.796	0.252	0.383	0.686	0.332
Skewness	1.743	0.329	-0.480	0.691	-0.149
Kurtosis	2.784	-1.089	-0.921	-0.158	-0.345
Minimum	163.40	3.09	2.48	0.13	4.4
Maximum	1718.2	6.95	11.61	10.93	27.3
JB test	19.07	1.239	1.698	1.853	0.199
p- value	0.007	0.538	0.427	0.396	0.905

Jarque-Bera (JB) test of normality shows that distribution of macroeconomic time series data are normal in all cases. Real GDP (RGDP) has taken log values to smoothen the data. The p-values for JB statistics are greater than 10 percent in all cases except NI, which do not reject the normality hypothesis meaning that time series are normally distributed.

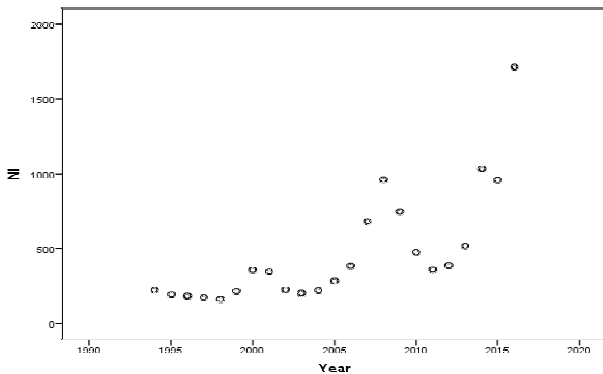


Figure 2 Scatter Plot of NEPSE Index form 1994 to 2016

The figure 2 illustrates the volatility of stock market from 1994 to 2016. It clearly states that the returns which is proxied by NEPSE Index does not remain constant over the period. It changes over time. It is observed that in 1995, NEPSE returns is low whereas in 2016 it seems to be high at a time.

Correlation Analysis

The correlation between the macroeconomic variables and stock market index has been presented in Table 3 which summarizes the correlation matrix with Pearson correlation coefficients in the lower left triangle and Spearman rank correlation coefficients in the upper right triangle that explain the direction and magnitude of relationship among different pairs of macroeconomic variables during the period 1994 to 2016 with market index (NI). It indicates that the stock market prices represented by NEPSE Index has positive relationships with real GDP, inflation, and broad money supply (M2) but has negative correlation with interest rate as expected. The negative relationship with interest rate, as hypothesized, indicates that the stock returns goes on decreasing when market interest rate increases. Investors will be reluctant to have borrowing at higher rate of interest and

use it to stock investing. It validates the results by Kadir (2008) among many others.

Table 3 Pearson and Spearman Correlation Matrix

Variables	NI	I_RGDP	INF	IR	M2
NI	1	0.867***	0.331	-0.540***	0.348
I_RGDP	0.738***	1	0.353	-0.632***	0.156
INF	0.401	0.360	1	0.013	0.517**
IR	-0.501**	-0.629***	-0.067	1	-0.260
M2	0.406	0.208	0.543***	-0.214	1

Note: Bi-variate Pearson correlation coefficients are in the lower left triangle and Spearman rank correlation coefficients are in upper right triangle. I_RGDP is the log value of real GDP. ***, ***, ** sign indicates that correlation is significant at 5 percent level and **** indicates that correlation is significant at 1 percent level.

Both the Pearson and Spearman correlation coefficients indicate the significant relationship between stock market index (NI) and real GDP and interest rate (IR). The statistical significance for the relationship between IR and NI (-0.540) is higher in Spearman rank correlation matrix where it is significant at 1% level compare to 5% level of significance in Pearson correlation matrix. The statistically significance of the result indicates that relationship between interest rate and NEPSE index is negative as it is hypothesized. This result approximately indicates that interest rate level in Nepal plays an important role to predict the stock market returns. The priori expected sign for the relationship of all variables with stock prices are maintained as prior studies by Ibrahim and Aziz (2003), and many others. However, the money supply and inflation has limited ability to explain the variation in stock prices as they do not possess statistical significance. This result contradicts the findings by Flannery and Protopapadakis (2002).

Similarly, the observed significant positive relationship between NEPSE and real GDP is consistent with priori expectation. This result is consistent with Adel (2004), and Pilinkus (2009), among others, who reported reliably positive relationship between stock market returns and real activity proxied by GDP, and inconsistent with earlier studies by Flannery and Protopapadakis (2002) who observed significant negative relationship between real GDP and stock market returns. This result again gives an approximate indication that development in real sector activity may contribute positively to the stock market.

The statistically significant positive correlation has been obtained in between money supply (M2) and inflation in both Pearson (0.543) and Spearman rank correlation matrix (0.517). This indicates that increasing the level of money supply increases the inflation subsequently. Similarly, The observed statistically significant negative relationship between interest rate and GDP on both Pearson (-0.501) and Spearman rank correlation coefficients (-0.632) may give a meaningful conclusion that decrease in interest rate attracts most investors toward real sector investment rather than bank deposit. However, statistical inferences about the causal relationship between different pairs of these macroeconomic variables cannot be drawn simply based on the correlation analysis.

Regression Analysis

The OLS regressions results have been reported in Table 4. The model specifications I through IV report the simple regression, where stock prices represented by NEPSE index (NI) have been regressed on different macroeconomic variables individually. The full version of the model has been

reported in specification V, where all the macroeconomic variables have been used as explanatory variables.

Table 4 Estimated Relationship from Regression of Stock Prices (NI) on Macroeconomic Variables

$$\text{Model: } NI_t = \alpha + \beta_{1t} \text{RGDP}_t + \beta_{2t} \text{INF}_t + \beta_{3t} \text{IR}_t + \beta_{4t} \text{M2}_t + \varepsilon_t$$

Model	Dependent Variable : NEPSE Index (NI)				
	I	II	III	IV	V
Intercept	-	80.56	760.50***	13.83	-12741.8***
	(-3.44)	(0.73)	(3.97)	(0.14)	(-3.18)
L_RGDP	1118.11***				990.02***
	(3.52)				(3.23)
INF		53.45**			3.99
		(2.22)			(0.29)
IR			-65.84**		-4.72
			(-2.32)		(-0.24)
M2				28.05**	16.98***
				(2.75)	(4.46)
F	12.38***	4.94**	5.38**	7.54**	11.94***
Adj. R ²	0.523	0.121	0.216	0.125	0.526
SEE	264.27	358.84	338.90	358.04	263.53
DW					0.927

Note: The reported values are intercepts and slope coefficients of respective explanatory variables with t-statistics in the parentheses. The results also include the values of F-statistics (F), adjusted coefficient of determination (Adj. R²), and standard error of estimates (SEE). The triple asterisk (***) sign indicates that result is significant at 1 percent level, and double asterisk (**) sign indicates that result is significant at 5 percent level.

The priori expected sign of all the variables RGDP (1118.11), INF (53.45), IR (-65.84), and M2 (28.05) holds true for each individual regression model and are statistically significant in their coefficients as well as in terms of model specification. This shows that the selected macroeconomic variables have significant impact on stock prices. In multiple regression model V, only two variables real GDP and broad money supply (M2) have maintained their statistical significance at 1% level. We could explain that 1% change in broad money supply changes the stock index by 16.98 points. The statistical significance implies that real GDP and the broad money supply (M2) among others are the important macroeconomic variables to determine the movement of stock prices.

The full model V also shows the statistical significance in terms of F-statistics (11.94) at 1% level of significance. The inability of the variables; inflation and interest rate to show statistical significance in the full model may be interpreted as the reason of other variables that subsume the effect of them. Though there is no encouraging growth of GDP in Nepal, the earlier studies have documented the positive contribution of GDP in moving stock prices. Similarly, this study also found statistically significant positive relationship of GDP with stock prices in full model, which is consistent with the findings of Chen, Roll and Ross (1986) and many others. However, the result contradicts the findings of Flannery and Protopapadakis (2002) and Baskota (2007).

The simple regression result shows the positive and a significant relationship between inflation and stock prices in line with priori expectation. This results support the findings of Mukherjee and Naka (1995) but contradicts the result of Adel (2004). With respect to interest rate effect, it is believed that a reduction in interest rates (IR) induces an injection of liquidity into the economy as such that this extra liquidity could be channeled to the stock market thus driving up the demand and prices of stocks; with the assumption that an increase in interest rate tends to decrease the prices of

stock. The observed sign in the present study is negative and statistically significant in simple regression model III as presented in the table 4. which is in line with priori expectation. This results support the findings of several studies including; Gan, Lee, Yong and Zhang (2006), and Kandir (2008).

Future economic activity is correlated with increased domestic borrowing or increased supply of money. This simply means that an increase in domestic borrowing or issuance of money has inflationary effects that dampen real activity. In the end, stock market prices also rise due to rise in the inflation. As expected, it has noted the positive and a significant relationship between broad money supply (M2) and stock prices. The statistically significant positive relationship between stock prices and money supply is consistent with the findings of Adel (2004) but contradicts the findings of Flannery and Protopapadakis (2002), who found negative relation of money supply on stock prices.

Test for Long-Run Equilibrium

One of the major objectives of this study is to examine the long-run equilibrium between stock prices and macroeconomic variables. The empirical studies associated with macroeconomic influences on common stock prices have documented a causal relationship between stock prices and macroeconomic variables. For example, Ibrahim and Aziz (2003) examined the effect of macroeconomic variables and found that stock prices have positive long-run relationship with real GDP. Therefore, it is a matter of interest to explore whether macroeconomic variables such as real GDP, inflation, interest rate, and money supply could capture the variation in stock market prices. The methodology employed to test long-run equilibrium in this study is the cointegration test and the modeling strategy adopted is based on the widely used Engle-Granger methodology (Engle & Granger, 1987). The steps involved for cointegration test are described as follows:

Stationarity/Unit Root Test

First step is to determine whether the variables used are stationary or non-stationary. Many macroeconomic time series contain unit roots dominated by stochastic trends as developed by Nelson and Plosser (1982). Knowing that unit root tests are sensitive to the presence of deterministic regressors, tests for each variable then is performed on both levels and first differences. Table 5 reports the results of Augmented Dickey Fuller (ADF) test for the model without constant and no trend, and with constant and no trend.

According to Table 5, investigating the stationary of variables using ADF test shows that none of the variables were stationary at the level and become stationary after first order difference. Hence it is concluded that the variables are integrated of order one I(1). This result is consistent to the finding of Nelson and Plosser (1982) that most of macroeconomic variables are non-stationary at level, but they are stationary after first differencing.

Table 5 Augmented Dickey-Fuller Test for Unit Roots of the Variables

Variables	With Constant and no Trend		With Constant and Trend	
	Level	First	Level	First
	(τ)	Difference	(τ)	Difference
NI	0.699 (0.989)	-3.709*** (0.004)	-0.803 (0.950)	-3.735** (0.020)
L_RGDP	-0.834 (0.789)	-3.695*** (0.004)	-2.114 (0.510)	-3.549* (0.059)
INF	-2.656 (0.098)	-6.822*** (0.000)	-3.084 (0.134)	-6.690*** (0.000)
IR	-1.831 (0.356)	-4.199*** (0.004)	-2.539 (0.308)	-4.078** (0.021)
M2	-3.103 (0.041)	-5.302*** (0.000)	-3.193 (0.111)	-5.168*** (0.002)
Critical Values				
1%		-2.66		-3.75
5%		-1.95		-3.00
10%		-1.60		-2.62

Note: The Table 5 shows the unit root tests of the macroeconomic variables for the period of 1994 to 2016 using Augmented Dickey Fuller criteria. The variables are NEPSE Index (NI), real gross domestic product (RGDP), rate of inflation (INF), interest rate (IR) defined as the annualized weighted average of 91 days treasury bills rate and the growth rate of broad money supply (M2). As the plot of the data suggests, model without constant and no trend is avoided. Probabilities are in parentheses. ***, **, and * denote rejection of the unit root hypothesis at 1%, 5%, and 10% respectively. Tests for unit roots have been carried out on Gretl software.

Cointegration Test

Testing for Cointegration (long-run equilibrium) entails testing the order of integration of the error term in the relationship. For the purpose of this study therefore, testing for Cointegration implies testing for stationarity in the residuals of the regression equation. In order to estimate the long-run relationship between variables using the Engle-Granger integration technique, first, it is to find the optimal order of the VAR model using lag determining criteria.

Table 6 Number of Optimal Lag Using Schwarz-Bayesian Criteria

Number of Lags	Schwarz-Bayesian Criteria (BIC)
3	14.017
2	14.536
1	14.395*

* indicates amount of optimal lag

According to the above Table 6, it can be claimed that optimal lag of the VAR model regarding the Schwarz – Bayesian criteria is one.

The test for Cointegration has been conducted using the residuals based method of Engle and Granger (1987). According to them, if the residuals obtained from the above static regression are stationary, it implies that the variables are cointegrated. Hence, there is a tendency for the variables to move together in the long-run even though the variable may wander or drift individually apart. The results obtained using the Engle and Granger (1987) Cointegration test is presented in Table 7.

Table 7 Cointegrating Regression: OLS Estimates of the Long-run Model

Dependent variable	Independent variables	Coefficient	t-Statistics	Probability
NI	Const	72390.5	1.407	0.177
	L_GDP	-5771.45	-1.413	0.175
	INF	-20.93	-0.725	0.478
	IR	5.759	0.222	0.827
	M2	31.339	2.122	0.048**
	Time	256.597	1.660	0.115
	R ²	0.666		
	Adj. R ²	0.568		
	S.D. dep. var	382.71		
	Durbin-Watson	1.131		
	S.E. of Regression	251.546		

Stationarity Test of Residual

Test variable	Null Hypothesis	Test statistics (τ)	p-value	Null hypothesis	Result
\hat{u}	Residual is not stationary	-2.207	0.957	Could not be rejected	Residual is not stationary

The result in Table 7 indicates that unit root hypothesis of no stationarity (null hypothesis of no cointegration) could not be rejected for the residuals (\hat{u}) since p-value is 0.957. This shows that there is no evidence for the existence of cointegrating relationship among the variables used and therefore do not maintain long-run equilibrium. This concludes that there is no cointegration and long-run equilibrium between included macroeconomic variables and stock prices in the context of Nepal. This result contradicts the findings by Chen, Roll and Ross (1986), Ibrahim and Aziz (2003), Abu-Libdeh and Harasheh (2011), Osamyoni and Osagie (2012), among others. It also contradicts the findings by G.C., and Neupane (2006) and Bhattarai and Joshi (2009) in Nepalese context. However, this result is consistent with the findings by Pethe and Karnik (2000) and also supports the findings by Baskota (2007) in Nepalese context.

Error Correction Model (ECM)

The necessary and sufficient condition of cointegration is existence of ECM which indicates the speed of adjustment if the variables are cointegrated. When there is no cointegration, there does not exist ECM. We do not need to test for ECM further. If require otherwise to test for ECM, the residual from OLS regression shall be included in the ordinary least square regression of the variables whose first differences are considered. The lag value of order 1 is taken for the independent variables used to run the model. The ECM describes the short-run dynamics consistent with the long-run relationship. The estimated coefficient of error correction term measures the speed of adjustment to restore equilibrium in the dynamic model. The results though not significant, shows the expected negative sign for the residual (i.e Residual (\hat{u}_{t-1}) = -0.341) which is the necessary condition for error correction model.

Model Specification and Diagnostic Checking

To ensure the robustness of the estimation process, model specification and diagnostic checking was conducted.

Model Specification Test

This study is based on the model proposed by different prior studies conducted in developed economies. There may be chance of specification error in the model due to addition and

omission of some variables. Thus, a test is conducted to ensure the appropriate specification of the models. The given values of *F*-statistics ($F=11.94$ and $p\text{-value } 0.0001 < 1\%$) in full model V of table 4 confirmed that the overall specification of the model is significant. The RESET test further confirmed that the fitted model is valid and there is no specification biased.

Ramsey's regression specification error test (RESET) Test:

H0: Model is properly specified
 Test statistic: $F = 2.917$, with $p\text{-value} = P(F(2,16) > 2.917) = 0.083$
 Since, the *F* test is significant and *p*-value doesn't reject the null hypothesis at 5% level of significance, it could be claimed that model is not mis-specified.

Autocorrelation Test

Breusch-Godfrey (LM) test for autocorrelation

H0: There is no serial autocorrelation
 Test statistic: $LMF = 2.364553$, $p\text{-value} = P(F(2,16) > 2.36455) = 0.126$
 Since, *p* value of given statistics (0.126) is greater than 0.05, it couldn't reject the null hypothesis. Hence, the model is free from serial autocorrelation.

Multicollinearity Test

The diagnostic check has been conducted using variance inflationary factor (VIF) of explanatory variables to detect the multicollinearity problem, if any. The values of VIF associated with several specifications of the model are reported in Appendix E. The result shows that VIF of explanatory variables across all the models are significantly lower than 10. Therefore, there is no evidence of Multicollinearity.

Heterskedasticity Test

White's test for heteroskedasticity

H0: Heteroscedasticity not present
 Test statistic: $\chi^2 = 16.342$, $p\text{-value} = P(\chi^2(14) > 16.341885) = 0.292945$
 Since *p*-value > 0.05 , it could not reject the null hypothesis. That means there is no heteroscedasticity.

The summary of the results has been illustrated as below:

Table 8 Summary of Results

Hypothesis	Independent variable	Dependent variable	Hypothesized relationship	Finding
H ₁	Real GDP	Market index	Positive	Supported
H ₂	Inflation	Market index	Positive	Supported
H ₃	Interest rate	Market index	Negative	Supported
H ₄	Broad money supply	Market index	Positive	Supported
H ₅	Macroeconomic variables	Market index	Long-run Eq ^m	Contradicted

CONCLUSIONS

The results documented in this study find the priori expected sign of relationship between stock prices and macroeconomic variables including real GDP, inflation, interest rate, and broad money supply. Their correlation coefficients as well as estimated regression coefficients are found statistically significant to predict stock prices. However, the study doesn't find long run- equilibrium relationship between macro-economy and stock prices and conclude that the macroeconomic variables could not explain the variation in

stock prices in the long-run. This result contradicts the prior finding by Ibrahim and Aziz (2003), Bhattarai and Joshi (2009) and many others. However, this result is consistent with the findings by Pethe and Karnik (2000) and also supports the findings by Baskota (2007) in Nepalese context. Viewing from macroeconomic perspective, the results support the random walk hypothesis in Nepalese context.

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