

# Stock Index, Interest Rate and Gold Price of Nepal: Cointegration and Causality Analysis

Hom Nath Gaire<sup>\*</sup>

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## Abstract

*This study examines cointegration and causality between the NEPSE index vis-à-vis short term interest rates and gold prices in Nepal. Main objective of this study is to identify the long run equilibrium relationship as well as cause and effect relationship between the variables under consideration. Monthly time series data cover the period starting from January 2006 to December 2016, which were sourced from Nepal Stock Exchange (NEPSE), Nepal Rastra Bank (NRB) and Nepal Gold and Silver Dealers Association (NEGOSIDA). The results of the unit root (ADF) tests and Cointegration (Johansen) tests confirm that there is long-run equilibrium relationship between the NEPSE index, short term interest rates and gold prices in Nepal. In the meantime, Granger Causality test reveals that there is no causality between the gold price and NEPSE index. However, it is confirmed that there is unilateral causal relationship between the NEPSE index and short term interest rate which moves from interest rate to NEPSE index. From the test results it can be concluded that the short-term interest rates are the better predictor for NEPSE index and bullion (commodity) market is yet to be developed as substitute of the Stock Market.*

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**Keywords:** Granger Causality, Cointegration, Stock Index and Interest Rate

**JEL Classification:** C32, E47, G17

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<sup>\*</sup> Director (Research), Confederation of Nepalese Industries (CNI), Kathmandu

## I. INTRODUCTION

The primary role of capital market is to allocate the economy's capital stock among various productive sectors in the means of varieties of instruments named financial securities (Fisher and Ronald, 2000). The secondary role of the capital market is to provide trading mechanism for such securities so as to ensure transfer of ownership and exit route for the investors. Similarly, as the marketability and fungibility are the common characteristics of any securities it is essential to provide them a competitive price discovery mechanism and liquidity. No modern capital market of any size can function effectively without such facilities at the lowest possible cost. This is done by a well-organized secondary market also called the stock exchange. Stock exchange is an entity that provides a mechanism for stockholders, investors and traders to trade stocks, bonds, and other financial securities.

Although the history of capital market in Nepal can be traced back to the period of Rana regime, Nepali capital market is very small as compared to its neighbour countries. The organized secondary market in the country was started in 1976 when the government established Securities Exchange Centre (SEC) to provide trading platform for financial securities. Before its conversion into Nepal Stock Exchange (NEPSE) in 1993, SEC was only the capital market institution undertaking the job of brokering, underwriting, managing public issues, market making for government bonds and other financial services.

The basic objective of NEPSE was to impart free marketability and liquidity to the government and corporate securities by facilitating transactions in its trading floor through member brokers and markets intermediaries. Since 1994 Nepal Stock Exchange is regularly publishing the stock market index named 'NEPSE' on daily basis along with other vital capital market indicators. The stock exchange has a central location at least for record keeping; but trading is increasingly less linked to such a physical place, as modern markets are electronic networks, which gives the advantages of increased speed and reduced cost of transactions.

Capital market in general and the secondary market in particular are highly volatile in nature, which has been equally applicable for Nepali markets as well. As a result, the stock market of Nepal measured and indicated by NEPSE index has experienced many ups and downs during its journey of two decades. There are many factors which affect the stock prices and in turn the overall index. Of the many factors affecting stock market, costs of investible fund and prices of substitute investment vehicles have been considered to be more powerful. In this study, interbank lending rate is taken as the cost of investible fund and gold price is taken as the prices of substitute investible vehicle.

The main objective of this study is to identify the long run cointegrating (equilibrium) relationships between NEPSE index vis-à-vis short-term interest rate and gold price. In the meantime, the study aims to gauge the cause and effect relations (causality) between gold price and interest vis-à-vis NEPSE index. Since no such studies are done so far in Nepali context, this paper will signify the need of tested predictive model for Nepali stock

market and the stakeholders. Similarly, the findings of the study will serve as the guidelines while making investment and trading strategies in the Nepali stock markets.

The remaining portion of this paper is organized as follows. The second section reviews the literature while section three describes data sources and methodology used for the study. Section four consists of the empirical analysis and findings of the study. The final section presents summary and conclusions.

## **II. LITERATURE REVIEW**

Various authors have studied different aspects of the stock market with the help of different financial and statistical methods to analyze the performance of stock market behavior. Most of the researchers have focused on the importance of econometric models for forecasting as well as identification of cointegration and casual relationship between the stock market and economic indicators.

Tian and Ma (2010) employed the ARDL method of cointegration and found that prior to financial liberalization of 2005 there was no cointegration between the interest rates and the Shanghai stock price index in China. After liberalization, cointegration found and money supply along with interest rates had affected stock prices with positive correlation. They also found the previous month CPI Granger causes stock indices. Making a departure from previous studies in Sri-Lanka, Wickremasinghe (2011) established both short and long-run causal relationships between stock indices and macroeconomic variables. Bi-directional causal relationships were found from the stock index (ASPI) to the consumer price index, the ASPI to the narrow money supply (M1) and the ASPI to short-term interest rate.

Tantatape and Komain (2007), used unit root, cointegration and Granger causality tests in Thailand and found that the stock index, industrial production index, money supply, interest rate and gold prices were having cointegrating relations. Using monthly data from 2004 to 2010 Parsva and Lean (2011) modelled the stock index with interest rates, inflation rates and oil prices in Egypt, Iran, Jordan, Kuwait, Oman and Saudi Arabia. Results show both in short run and long run there is bi-directional causality between stock prices and interest rates for Egypt, Iran and Oman before the crisis. However, in Kuwait causality runs from interest rates and oil prices to stock prices. Sharma, Mahendra and Mandeep (2010) evaluated the long-term relationship between BSE and Macro-economic variables like exchange rates, interest rate, foreign exchange reserve, inflation rate and gold price. The study proved that domestic and international gold prices were cointegrated with the Indian stock indices.

Yahyazadehfar and Babaie (2012) revealed that there was a negative association between gold price and stock prices in Iran. They also examined the impact of interest rate and house prices on stock price on monthly data from March 2001 to April 2011 using VAR and Johansen cointegration model and found that most of the fluctuation in stock prices were explained by the selected variables, however, the house price had main role on stock price fluctuation. Smith (2001) examined the short-term and long-term relationships between four different macroeconomic variables and gold price vis-à-vis six different US stock indices over the period of 1991- 2001. He reported no bilateral long-term

relationship, or co-integration, between a gold price and stock index. There were, however, some evidences of short-term Granger causality running from interest rates to US stock indices, but not the reverse.

By using monthly data from 1986 to 2011 in Japan, Le and Chang (2011) found long run relationship as well as bilateral causality between interest rate and stock index in Japan. Shahzadi and Chohan (2012) evaluated the impact of gold prices on Karachi Stock Exchange by using monthly time series data from 2006 to 2010 and revealed that there is a perfectly negative relationship between monthly average gold prices and Karachi Stock Exchange 100 index. In contrast, monthly time series data of Mumbai gold prices and three stock market indices, viz; Sensex, BSE 100 and S&P CNX Nifty were cointegrated confirming a long-run equilibrium relationship among the variables (Patel, 2013). Tiwari and Gupta (2015), tested the causality between gold prices vis-a-vis BSE Sensex and found the stock markets were sensitive to both domestic and external factors, and one such factors was the gold price.

In Nepali context, Regmi (2012) examined causal relationship between stock index (NEPSE) and economic growth in Nepal for the period 1994-2011. Using unit root, co-integration, and vector error correction models for NEPSE composite index the finding suggests that there was bilateral causality between NEPSE index and economic growth for the review period.

Shrestha and Subedi (2014) examined the determinants of stock market performance in Nepal using monthly data of NEPSE index, inflation, money supply growth and interest rates. They have found the Nepali stock market has been behaving in line of the theoretical believes. Tests results have confirmed the strong positive relationship of NEPSE index with inflation and growth of money supply, and negative response to interest rate. From the study, the NEPSE index had been found to be influenced by political and NRB's policy. The positive outlook for political stability has positive impact on stock index. Similarly change in NRB's policy on lending against collateral of share has significant impact on the movement of stock index.

### III. DATA AND METHODOLOGY

In this study an experimental research design has been used so as to make the collection, analysis and interpretation of secondary data easier and reliable while drawing conclusions. Since the study is concentrated on the secondary market of Nepal and has made an attempt to model the NEPSE index with respect to short-term interest rate and gold price for the period January 2006 to December 2016 using monthly data.

#### NEPSE Index

The NEPSE is a value weighted index of all shares listed at the Nepal Stock Exchange and calculated once a day at the closing price. The basic equation of NEPSE index is defined as:

$$NEPSE_t = \frac{M.C_t}{M.C_b} \times IB \quad \dots\dots\dots (1)$$

Where,

$NEPSE_t$  = NEPSE Index at current time (t)

$M.C_t$  = Market Capitalization (market value) of all listed stocks at current time (t) period

$M.C_b$  = Market Capitalization (market value) of all listed stocks at base time (0) period

B = NEPSE Index at base period (100)

The standard NEPSE index is designed based on Weighted Market Capitalization (WMC) method, where stocks with the largest MC carries the greatest weight in the index, which is making the value of the index very vulnerable to the price movement of such dominant companies.

### Interbank Rate

Interbank rate is one which is charged by one bank to another in the interbank market to manage day-to-day liquidity and meet the regulatory requirements. The monthly average data of interbank rate is taken from quarterly economic bulletin of Nepal Rastra Bank (NRB).

### Gold Price

Gold is considered as one of the safe investment vehicles (safe haven) and used for hedging against the price risk across the world. Investors thus, buy gold as a way of diversifying risk, especially in forms of futures contracts and derivatives. In order to access the relationship between gold (commodity) market and capital market in Nepal, end of month's gold prices (per 10 gram) have been used. The source of gold prices for this study is Nepal Gold and Silver Dealers Association (NEGOSIDA).

### Econometric Models

An econometric model is said to be complete if it contains just enough equations to predict values for all of the variables in the model. In order to gauge the impact of interest rate and gold price on NEPSE index, the following models have been developed.

$$Y = \alpha_1 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon_t \quad \dots\dots\dots (2)$$

$$H_0: \beta_1 = \beta_2 = 0; \quad H_1: \beta_1 \neq \beta_2 \neq 0$$

Where,

Y = Monthly (End of Month) closing NEPSE Index

$X_1$  = Monthly (weighted average) interbank rate of the banking system

$X_2$  = Monthly (End of Month) closing price of gold per 10 gram (NPR)

$\varepsilon_t$  = Stochastic error term

$\alpha$ , and  $\beta_i$  parameters to be estimated

**Unit Root Test**

Many economic and financial time series exhibit trending behavior or non-stationary in the mean. Leading examples are stock prices, gold prices, exchange rates and the levels of macroeconomic aggregates like real GDP. An important econometric task is determining the stationary feature in the data series. The formal method to test the stationary of a series is the unit root test. Dickey and Fuller (1979) have explained the following form of basic unit root tests.

Consider a simple autoregressive (AR) 1 process:

$$Y_t = \rho Y_{t-1} + X_t' \delta + \epsilon_t \quad \dots\dots\dots (1)$$

Where,  $x_t$  are optional exogenous regressor, which may consist of constant, or a constant and trend,  $\rho$  and  $\delta$  are parameters to be estimated, and  $\epsilon_t$  is assumed to be white noise.

Series Y is a non-stationary series if  $|\rho| \geq 1$ , and the variance of Y increases with time and approaches infinity. Series Y has a (trend-) stationary process if  $|\rho| < 1$ . Thus, the hypothesis of (trend-) stationary can be evaluated by testing whether the absolute value of  $\rho$  is strictly less than one or not.

The standard Dickey and Fuller (DF) test is carried out by subtracting  $Y_{t-1}$  in both side of the equation 3.

$$\Delta Y_t = \alpha Y_{t-1} + X_t' \delta + \epsilon_t \quad \dots\dots\dots (3.1)$$

Where,  $\alpha = \rho - 1$ .

The null and alternative hypotheses are respectively:

$$H_0: \alpha = 0 \text{ and } H_1: \alpha < 0$$

The hypothesis can be evaluated using the conventional t-ratio for  $\alpha$ .

$$t_\alpha = \frac{\hat{\alpha}}{(S.E(\hat{\alpha}))} \quad \dots\dots\dots (3.2)$$

Where,  $\hat{\alpha}$  = Is the estimated  $\alpha$ , and S. E ( $\hat{\alpha}$ ) is the coefficient standard error of  $\hat{\alpha}$ .

The simple Dickey-Fuller unit root test described above is valid only if the series is an AR (1) process. If the series is correlated at higher order lags, the assumption of white noise disturbances  $\epsilon_t$  is violated. In order to cope with the Augmented Dickey-Fuller (ADF) test has been constructed with a parametric correction for higher-order autocorrelation by assuming that the series Y follows an AR (p) process. Adding p lagged difference terms of the dependent variable Y the ADF test follows the following process.

$$\Delta Y_t = \alpha Y_{t-1} + X_t' \delta + \beta_1 \Delta Y_{t-1} + \beta_2 \Delta Y_{t-2} + \dots + \beta_p \Delta Y_{t-p} + \vartheta_t \quad \dots\dots\dots (3.3)$$

This augmented specification is then used to test the above mentioned hypothesis using the t-ratio of (3.2).

**Co-integration Test**

The purpose of the co-integration test is to determine whether the groups of non-stationary series are co-integrated. There are number of methods for testing the co-integration. As explained below, the presence of a co-integrating relation forms the basis of the Vector Error Correction Model (VECM) specification. Here, VAR based co-integration tests are performed using the methodology developed by Johansen.

Consider a VAR of order (p):

$$Y_t = A_1 Y_{t-1} + \dots + A_p Y_{t-p} + BX_t + \epsilon_t \dots\dots\dots (4)$$

Where,  $Y_t$  is a k-vector of non-stationary I (1) variables,  $X_t$  is a d-vector of deterministic variables, and  $\epsilon_t$  is a vector of innovations. We may rewrite this VAR as:

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + BX_t + \epsilon_t \dots\dots\dots (4.1)$$

Where:

$$\Pi = \sum_{i=1}^p A_i - I$$

$$\Gamma_i = - \sum_{j=i+1}^p A_j$$

Granger's representation theorem asserts that if the coefficient matrix  $\Pi$  has reduced rank  $r < k$ , then there exist  $k \times r$  matrices  $\alpha$  and  $\beta$  each with rank  $r$  such that  $\Pi = \alpha\beta'$  and  $\beta'Y_t$  is I (0). Here,  $r$  represents the number of co-integrating relations (the co-integrating rank),  $k$  is the number of exogenous variable, and each column of  $\beta$  is the co-integrating vector. The elements of  $\alpha$  are known as the adjustment parameters in the VAR model.

Johansen proposes two different likelihood ratio tests of the significance of these canonical correlations and thereby the reduced rank of the  $\Pi$  matrix: the trace test and maximum Eigen value test, shown in the equations below respectively.

$$j_{\text{trace}} = -T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_i) \dots\dots\dots (4.2)$$

$$j_{\text{max}} = -T \ln(1 - \hat{\lambda}_r) \dots\dots\dots (4.3)$$

Here,  $T$  is the sample size and  $\lambda_i$  is the  $i^{\text{th}}$  largest correlation. The trace test tests the null hypothesis of  $r$  co-integrating vectors against the alternative hypothesis of  $n$  co-integrating vectors. The maximum Eigen value test the null hypothesis of  $r$  co-integrating vectors against the alternative hypothesis of  $r + 1$  co-integrating vectors.

**Granger Causality Test**

Correlation does not necessarily imply causation in any meaningful sense. The econometric graveyard is full of magnificent correlations, which are simply spurious or

meaningless. The common practice in testing the direction of causation between two variables is the Granger Causality test. The series Y is said to be Granger-caused by series X if X helps in predicting Y, or equivalently if the coefficients on the lagged X are statistically significant. Similarly, two-way causation is the situation when X Granger causes Y and Y Granger causes X. However, it is important to note that the statement "X Granger causes Y" does not imply that Y is the effect or the result of X.

Granger causality test measures precedence and information content but does not by itself indicate causality in the more common use of the term. The mathematical formulation of Granger Causality test is based on linear regression modeling of stochastic processes (Granger 1969). For illustration, consider a bivariate linear autoregressive model of two variables  $X_t$  and  $Y_t$  although more complex extensions to nonlinear cases exist.

$$\Delta X_t = \alpha + \sum_{i=1}^m \beta_i \Delta X_{t-i} + \sum_{j=1}^n \gamma_j \Delta Y_{t-j} + u_t \quad \dots\dots\dots (5)$$

$$\Delta Y_t = a + \sum_{i=1}^q b_i \Delta Y_{t-i} + \sum_{j=1}^r c_j \Delta X_{t-j} + v_t \quad \dots\dots\dots (6)$$

Where, m and n are the maximum number of lagged observations of respective series included in the model (the model order). The matrices  $\beta$ ,  $\gamma$ ,  $b$  and  $c$  contain the coefficients of the model (i.e. the contributions of each lagged observation to the predicted values of X (t) and Y (t). Finally,  $u(t)$  and  $v(t)$  are residuals (prediction errors) for each time series. In this model, Y (t) Granger causes X (t) if the coefficients in  $\gamma_j$  are jointly significantly different from zero. Similarly, X (t) Granger causes Y (t) if the coefficients in  $c_j$  are jointly significantly different from zero. This can be tested by performing an F-test of the null hypothesis that  $\gamma_j = c_j = 0$ , given assumptions of covariance Stationarity on X (t) and Y (t).

The magnitude of a Granger causality interaction can be estimated by the logarithm of the corresponding F-statistic (Geweke 1982). In order to determine the appropriate order (p) in the model, selection criteria such as the Bayesian Information Criterion (BIC, (Schwartz 1978)) or the Akaike Information Criterion (AIC, (Akaike 1974)), can be used.

#### **IV. RESULTS AND ANALYSIS**

##### **Unit Root Test**

ADF test is common in identifying stationarity feature of time series. In this study, this test has been performed to examine the unit root (stationary) feature of three time series comprising the NEPSE index, gold price and interest rate. The tests result confirms all the three series of data are non-stationary at level. However, they have become stationary at first difference. This has been proved as the null hypotheses that there is unit root in the data series rejected at 5 % level of significance. The results of the ADF tests have been presented in the following table 1.



**Table 1: Augmented Dickey-Fuller (ADF) tests: Nepse, Interest rate and Gold price**

Variables	At Level		At First Difference	
	t-statistics	p-value*	t-statistics	p-value*
Gold Price	-1.6006	0.1119	-13.4749	0.0000
Interest Rate	-3.5264	0.0634	-12.5102	0.0000
Nepse Index	-1.3144	0.1911	-8.1238	0.0000

\* Mackinnon (1996) one sided p-values.

As all the data series have become stationary at first difference further analysis of these data series is permitted.

### Cointegration Tests

Engle and Granger (1987) pointed out that a linear combination of two or more non-stationary series may be stationary. In such a case, the non-stationary time series are said to be co-integrated, which is interpreted as a long-run equilibrium relationship among the variables. The commonly used cointegration tests as suggested by Johansen are Unrestricted Cointegration Rank (Trace) Test and Unrestricted Cointegration Rank (Maximum Eigenvalue) Test.

In this study, the critical values of both Trace and Maximum Eigen Value tests reject the null hypotheses of no cointegrating relation at 5 % level of significance. MacKinnon P-values of both the tests have confirmed at least one cointegrating equation in model. Hence, the long run equilibrium relationship between NEPSE index vis-à-vis short term interest rate and gold price is confirmed. The following table summaries the results of Johansen co-integration tests.

**Table 2: Results of Johansen co-integration tests (Nepse, Interest Rate and Gold Price)**

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value	Prob.**
None *	0.176625	36.35245	29.79707	0.0076
At most 1	0.073880	11.67089	15.49471	0.1734
At most 2	0.015032	1.923513	3.841466	0.1655
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	Critical Value	Prob.**
None *	0.176625	24.68156	21.13162	0.0151
At most 1	0.073880	9.747379	14.26460	0.2290
At most 2	0.015032	1.923513	3.841466	0.1655
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

### Vector Error Correction Model (VECM)

The VECM model is one of the most successful, flexible, and easy to use models in analysing a multivariate time series. The term error-correction relates to the fact that last-periods deviation from a long-run equilibrium, the error, influences its short-run dynamics. Imposing known unit roots and known cointegration restrictions VECM may improve the power of statistical tests such as Granger causality tests (Lutkepohl and Reimers-1992b).

In this study, VEC model is estimated to reconfirm the cointegrating relationships among the variables under consideration and to gauge the long run causality between NEPSE index vis-à-vis interest rate and gold price. In order to estimate the VECM, one period lag difference is selected as indicated by AIC and BIC Lag Order Selection Criteria. The results are given in table-3 below

**Table 3: Results of VECM Estimates (Nepse, Interest Rate and Gold Price)**

<b>Error Correction:</b>	<b>D(NEPSE)</b>	<b>D(INT_RATE)</b>	<b>D(G_PRICE)</b>
<b>Cointegrating Eqation-1</b>	<b>0.00028</b>	<b>0.00002</b>	<b>-0.01191</b>
Standard Error	(0.00021)	(0.00005)	(0.00059)
T-Statistics	[1.3468]*	[3.4909]*	[-2.0105]*
<b>D(NEPSE)</b>	<b>0.2469</b>	<b>-0.0047</b>	<b>5.2048</b>
Standard Error	(0.09224)	(0.00228)	(2.6306)
T-Statistics	[ 2.6768]*	[-2.0824]*	[ 1.9788]
<b>D(INT_RATE)</b>	<b>-2.7084</b>	<b>0.0346</b>	<b>-73.4052</b>
Standard Error	(3.36297)	(0.08796)	(101.615)
T-Statistics	[-0.76015]	[ 0.3937]*	[-0.7224]
<b>D(G_PRICE)</b>	<b>-0.00057</b>	<b>-0.00001</b>	<b>-0.2249</b>
Standard Error	(0.00311)	(0.00008)	(0.08875)
T-Statistics	[-0.1844]*	[-1.1387]*	[-2.5344]*

\* Indicates  $H_0$  is rejected at 5% level of significance

The results of VECM show there is cointegrating relationships among the variables under consideration. This is confirmed when the values of t-statistics have been significant and indicated by the standard errors the coefficients of Cointegrating Equation-1. The results also indicate that there causality between NEPSE index and interest rate as well as gold price and interest rate. It is observed that interest causes to change both NEPSE index and gold price whereas NEPSE causes only gold price. But gold price does not cause to change NEPSE and interest rate. Although the results are statistically significant (as indicated by S.E. and T-statistic) the causal relationship between the variables and the direction of causal impacts is reconfirmed by the pairwise granger causality tests.

### Granger Causality Tests

According to Granger (1969), series X causes Y if the past values of X can more accurately predict Y than simply the past values of Y. In simple words, if past value X improves the prediction of Y with statistical significance, then we can conclude that X

Granger Causes Y. Here, Granger Causality test has been performed to check the direction of causality between NEPSE index and interest rate as well as NEPSE index and gold price.

The results of Pairwise Granger Causality tests have been summarized in Table 4 below. It is found that the causality moves from interest rate to NEPSE index as the p-value of corresponding F-statistic rejected the null hypothesis that interest rate does not Granger Cause NEPSE index at 5 % level of significance. This is obvious since the secondary market is basically guided by short term interest rate prevailing in the financial system.

However, no causality is found from NEPSE index to interest rate as the null hypothesis that NEPSE index does not Granger Cause interest rate has been accepted by the P-value of corresponding F-statistic. In the meantime, no causality is found between NEPSE and gold price as well as gold price and interest rate.

**Table 4: Pairwise Granger Causality Test (Nepse, interest rate and gold price)**

Null Hypothesis ( $H_0$ )	F-Statistic	P-value
Interest Rate does not granger cause NEPSE Index	7.4846	0.0071*
Gold Price does not granger cause NEPSE Index	0.13420	0.7147
NEPSE Index does not granger cause Interest Rate	0.00128	0.9716
NEPSE Index does not granger cause Gold Price	0.14793	0.7012
Gold Price does not granger cause Interest Rate	2.72382	0.1013
Interest Rate does not granger cause Gold Price	0.30777	0.5800

\* Null hypothesis rejected at the 0.05 level.

## V. CONCLUSIONS

This study examined cointegration and causality between the NEPSE index vis-à-vis short term interest rate and gold prices with an aim of identifying the long run equilibrium association (cointegration) as well as cause and effect relationship between the selected variables. For this, monthly time series data of all variables from 2006 January to 2016 December have been used. Based on the results of the unit root (ADF) tests and Cointegration (Johansen) tests, it is confirmed there is long-run equilibrium relationship between the NEPSE index, short term interest rate and gold prices in Nepal.

In the meantime, VECM estimate indicates that interest rates cause both the NEPSE index and gold price in the long run and NEPSE index cause the gold price. However, this is not confirmed by the Pairwise Granger Causality tests. From the Pairwise Granger Causality test it is confirmed that there is unilateral causality between the NEPSE index and short term interest rate which moves from interest rate to NEPSE index. It means the stock market of Nepal is sensitive to the country's financial system and short term interest rate has been one of the major determinants of the stock market represented by NEPSE Index. Thus, it is concluded that short term interest rate could be one of the predictors of the stock prices in the secondary market of Nepal.

Since the causality between gold price vis-à-vis NEPSE index and interest rate is not confirmed it is concluded from the findings of this study that the country's commodity (bullion) market is not developed well enough to provide alternative investment vehicles as the substitute of the secondary stock market.

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**Annex 1: Time Series Data Used in the Study**

Year	Month	NEPSE Index	INT Rate (%)	G. Price (Rs./10 gram)
2006	1	334.9	1.22	12911.2
	2	380.6	2.48	12691.8
	3	374.9	2.84	13343.7
	4	410.2	1.97	14881.2
	5	423.0	3.52	15554.4
	6	422.8	1.77	14531.5
	7	424.3	2.13	15150.7
	8	426.4	2.07	14927.1
	9	443.8	1.83	14158.5
	10	463.2	2.11	13986.8
	11	562.0	1.2	14882.7
	12	582.0	1.34	14390.9
2007	1	566.9	3.03	14779.4
	2	544.0	2.01	15129.2
	3	501.0	1.39	14797.7
	4	555.2	1.69	14346.3
	5	591.0	3.35	13768.6
	6	653.4	2.72	13630
	7	679.0	3.03	13826.1
	8	739.5	4.1	14131.4
	9	885.5	2.18	15231.7
	10	878.9	3.35	15972.2
	11	897.3	3.73	15972.3
	12	984.5	4.73	16906.6
2008	1	803.7	4.93	18702.5
	2	756.8	7.55	19999.8
	3	709.4	5.07	19267.9
	4	736.5	2.69	18154.9
	5	833.2	6.48	19346.4
	6	937.5	4.64	20591.1
	7	1034.0	3.61	20107.4
	8	1175.4	5.15	18827.5
	9	962.6	2.33	21371.3
	10	881.9	5.16	18590.7
	11	750.7	5.34	20987.4
	12	695.5	2.38	21800.2
2009	1	658.8	3.37	23122.9
	2	677.5	8.32	25047.1
	3	664.1	6.38	23922.1
	4	647.8	5.06	22736.2
	5	707.9	7.07	23645.4
	6	662.6	5.02	23031.4
	7	716.0	3.66	23164
	8	661.0	1.41	24001.2
	9	630.6	2	24643.4
	10	578.2	5.1	25128.2
	11	528.9	9.22	28136.3
	12	548.1	9.93	26035.7

Year	Month	NEPSE Index	INT Rate (%)	G. Price (Rs./10 gram)
2010	1	512.3	12.83	25617.7
	2	485.1	11.64	26287.3
	3	443.2	8.85	25764.8
	4	419.3	7.81	26912.7
	5	490.1	7.13	28802.9
	6	455.8	5.52	29724.8
	7	461.6	6.57	27908.7
	8	421.2	2.46	30154
	9	403.1	3.24	30214.8
	10	423.9	5.89	30780.5
	11	413.8	9.79	32659.5
	12	404.1	8.59	32332.7
2011	1	410.6	10.58	31342.8
	2	391.7	8.45	32858.6
	3	365.2	10.18	33014.6
	4	347.7	9.54	34928.4
	5	336.7	10.43	35607.3
	6	336.7	10.23	34623.6
	7	358.8	8.22	37023
	8	339.9	2.69	42964.2
	9	331.4	1.33	40817.7
	10	330.2	1.08	43139.7
	11	324.0	1.11	46893.8
	12	316.0	1.06	41828.3
2012	1	358.8	2.69	44363.8
	2	339.9	1.33	44629.0
	3	331.4	1.08	43573.5
	4	330.2	1.11	44769.6
	5	324.0	1.06	45012.7
	6	316.0	0.90	45917.5
	7	316.0	0.72	46409.2
	8	315.1	0.69	47175.7
	9	298.9	0.69	48193.0
	10	404.7	0.75	47574.8
	11	373.6	0.84	48301.4
	12	377.5	0.86	46721.2
2013	1	401.0	0.48	45555.3
	2	405.8	0.34	44461.7
	3	415.0	0.33	44689.3
	4	451.4	0.45	40716.3
	5	489.0	0.57	40523.9
	6	533.9	0.71	36442.2
	7	510.7	2.29	41120.6
	8	542.3	4.26	47408.9
	9	511.4	3.78	42724.4
	10	500.7	5.77	41860.5
	11	500.2	1.36	40282.9
	12	493.2	0.86	38330.2

Year	Month	NEPSE Index	INT Rate (%)	G. Price (Rs./10 gram)
2014	1	547.6	0.30	40324.8
	2	551.4	0.27	42297.9
	3	542.0	0.25	39689.5
	4	579.4	0.22	39982.4
	5	644.0	0.20	38015.2
	6	770.9	0.21	40689.7
	7	781.5	0.21	40018.8
	8	825.7	0.20	40138.5
	9	792.2	0.19	38652.6
	10	823.2	0.19	36776.8
	11	866.6	0.18	37759.8
	12	945.8	0.16	39164.4
2015	1	1066.1	0.15	40156.2
	2	952.6	0.17	38601.3
	3	938.0	1.03	38216.8
	4	930.2	0.42	38566.5
	5	856.9	0.15	39146.1
	6	902.3	0.15	38363.6
	7	986.7	2.23	36232.8
	8	945.7	1.80	38816.3
	9	945.1	0.64	37619.5
	10	871.9	0.44	38403.5
	11	949.1	0.24	36414.6
	12	1027.6	1.01	36077.5
2016	1	1220.7	0.21	38825.0
	2	1283.9	0.20	43466.8
	3	1355.5	0.89	42139.2
	4	1464.9	4.41	43867.5
	5	1532.12	0.45	41953.4
	6	1723.2	0.52	45856.7
	7	1862.8	0.49	46242.4
	8	1797.5	2.71	45103.8
	9	1753.4	2.99	45295.0
	10	1759.7	2.19	43700.5
	11	1608.3	2.48	41482.0
	12	1443.4	2.91	40006.9