Do Interbank Interest Rates Matter for Stock Prices at Nepal Stock Exchange?

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Abstract

This study examines an auto-regressive distributed lag (ADRL) modeling approach to develop the relationship between the stock price and interest rate in the context of Nepal, using the monthly data for the period from July 1996 to January 2019. NEPSE Index in Nepal Stock Exchange Limited is used for the stock prices and interbank interest rate released in Quarterly Economic Bulletin of Nepal Rastra Bank is used for the interest rate. The bound test for co-integration and estimated negative coefficient of long-run regression results justified by the Error Correction Mechanisms (ECM) establishes a valid negative long-run association between the INTEREST and PRICE. This suggests important considerations for policies towards an interest rate stabilization for the stock price stability and further development of the stock market in Nepal.

Keywords: Interest, Price, ADRL

Introduction

The finance-economic theory argues for the developed stock market in ensuring long-term capital to promote the real economic activity of a country. For instance; Morck, Shleifer, and Vishny (1990) claim that the debates over stock market efficiency would not be important if the stock market did not affect real economic activity then the market inefficiencies would merely redistribute wealth between smark investors and noise traders. However, the stock market if influences real economic activity, the investors' sentiment that affects stock prices could also indirectly affect the real activity. This entails measuring the stock market efficiency as imperative from the viewpoint of investors, policymakers, and other market participants. Moreover, a well-developed stock market is perceived as a yardstick of the economic health and prospect of a country.

Interest rate is an important macro-economic component and as a cost of credit to the borrowing firms, any change in the rate can cause the profit situation of the firms thereby fluctuating the prices of stocks of the companies. As the news regarding the change in interest rate is indicative of stock price variation; this is the reason how the policy consideration becomes an imperative issue in stabilizing the interest rate in the financial system. Considerable numbers of theoretical and empirical evidence have documented the relationship between interest rates and stock prices. Fama (1981), for example, argues that the expected inflation rate as a proxy of short-term interest rate is negatively correlated with the anticipated real activity which in turn is positively related to returns on the stock market. The studies (Zhou, 1996;Uddin& Alam, 2009; Ali, 2014; Amarasinghe, 2015 among others) have examined the relationship between the interest rate and stock prices and have concluded the negative relationship between them. However, the most recent study carried out by Eldomiaty et al. (2020), using quarterly data on non-financial firms listed in DJIA 30 and NASDAQ100 for the period 1999-2016, in a Johansen co-integration analysis have shown the stock prices are positively associated with the real interest rates, and negatively with that of the inflation rates.

This provides the evidence of research results varying from country to country as well as the nature of data used and other methodological considerations.

Methodology and Analysis

This study employs an auto-regressive distributed lag (ADRL) modeling approach to develop the relationship between the stock price and interest rate in the context of Nepal, using the 283 monthly observations from the period from July 1996 to January 2019. NEPSE Index in Nepal Stock Exchange Limited, after the transformation in natural logarithmic form, is used for the stock prices, 'PRICE' hereafter, and interbank interest rate released in Quarterly Economic Bulletin of Nepal Rastra Bank is used as a proxy for the interest rate, 'INTEREST' hereafter. The uni-variate properties of each of these time series have been observed by plotting trends and carrying out the stationary test. The bound test of co-integration has been applied to confirm the long-run association amongst time series. The equation then re-parameterized into short-run dynamics and error correction mechanisms to validate their long-run relationship. The model diagnostic and stability is performed with serial correlation LM test and CUSUM test, respectively. The mean values and their associated standard deviations in descriptive statistics confirm the INTEREST [i.e., 3.26 ±2,67%] is more fluctuating [Figure 1] as in comparison to the PRICE [i.e., 599.19 ±433.83 points].

Time Series Trend

Figure 1 presents the trend of the PRICE and INTEREST, and it can be noted that the time series trend tends to move in the opposite direction. For example, the interbank interest rates from April 1998 (4.7%) to March 1999 (0.73%) were trended towards downward whereas index values (price) were tended towards upward (158.73 versus 180.89). Similarly, for the twelve months from August to July 2011/12, NEPSE Index trending downward with the interbank interest rate aloft. This reverse relationship between the stock price and interest rate is further justified by their negative correlation coefficients (i.e., - 0.31).
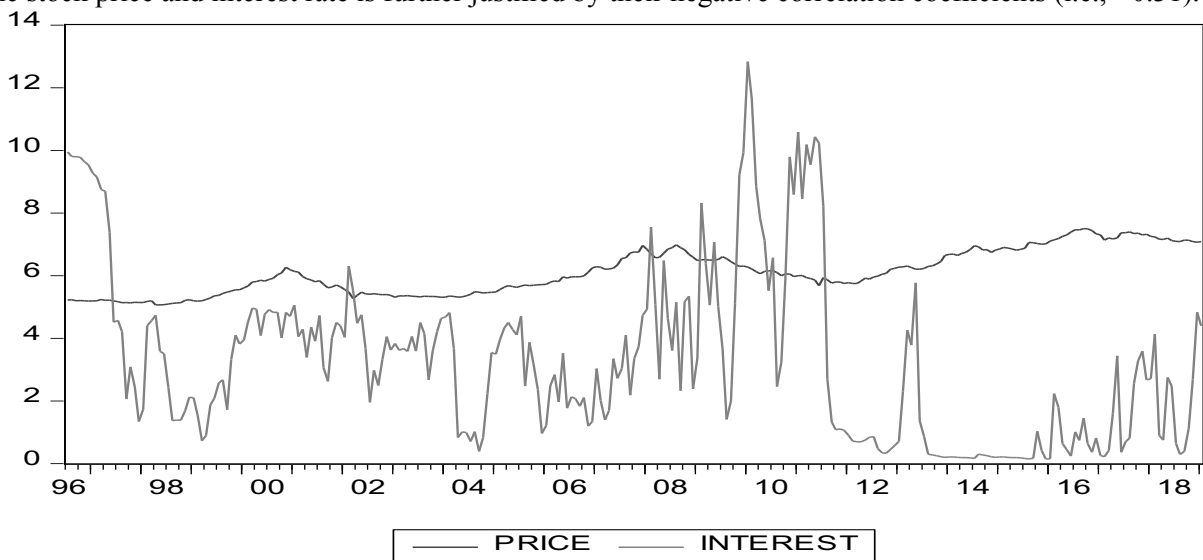

Figure 1: Time Series Trend

Testing for Unit Root

The short-run dynamics and long-run causality between these sets of variables with a different order of integration have been examined with the cointegration procedure and auto-regressive distributed lag model prescribed by Pesaran et al. (2001). After the observation of co-movements of times series over periods, a unit root test has been carried out in this section to examine the data stationary and to identify the order of integration, I(d). Equation [1a] and [1b] represents the Augmented Dickey-Fuller (ADF) tests

for the purpose. Concerning the PRICE, the null hypothesis in Equation [1a] states that the PRICE has got unit root [i.e., H_0: β_2 = 0], and regarding INTEREST, the null hypothesis in Equation [1b]] represents the INTEREST has got unit root [i.e., H_0: θ_2 = 0]. The null hypothesis of the time series that has got unit root would be rejected in the favor of alternative hypotheses when their respective coefficients become significantly negative [i.e., $\beta_2 < 0$ and $\theta_2 < 0$].

$$\Delta PRICE_t = \beta_1 + \beta2 PRICE_{t-1} + i=1m\ \beta i \Delta PRICEt\text{-}i + e_t \qquad [1a]$$
$$\Delta INTEREST = \theta_1 + \theta_2 INTEREST_{t-1} + i=1n\ \theta i \Delta INTERESTt\text{-}i + e_t \qquad [1b]$$

Whereas Δ is the difference operator; β, and θ represent the parameters of stock price and interest rate, respectively. The e_t and e_t are white noise error terms, and m and n are the maximum lengths of the series of respective time series. To avoid the specification error, the maximum number of lags has been taken 12 for each of the time series as suggested by Gujarati (2015) and Wooldridge (2009) for monthly data sets. The results of unit root tests and their respective order to integration have been reported in Table 1.

Table 1

Results for Unit Root Test

Null Hypothesis: Time series has got unit root								
	Level				First Difference			Order of Integration
Variable	Intercept		Intercept & Trend		Intercept		Intercept & Trend	
	t-stat	p-val	t-stat	p-val	t-stat	p-val	t-stat	p-val	I(d)
PRICE	-0.851	0.802	-1.972	0.613	-13.391*	0.000	-13.367*	0.000	I(1)
INTEREST	-4.454*	0.000	-4.534*	0.002	-17.354*	0.000	-17.348*	0.000	I(0)

The unit root results reported in Table 1 indicated that the null hypothesis of the PRICE has got unit root cannot be rejected, both the cases with intercept and intercept & trend, at level data; however the null hypothesis has been rejected at the first difference while running the equation with intercept and then intercept & trend. This shows the data series of stock price exhibits the integrated of order 1, I(1). For the interest rate, the null hypothesis of the INTEREST has got unit root has been rejected at level, which evidenced the INTEREST bears an integrated of order 0, I(0).

Testing for Co-Integration

The econometric theory argues that the two or more non-stationary (unit root) time series when integrated are unable to deviate from stable equilibrium in the long-run, and they are said to be co-integrated. This suggests the test of co-integration is an important step to establish whether the model empirically exhibits a valid long-run relationship and can be re-parameterized into an error correction mechanism. The results of the unit root tests have provided the time series with integrated of order 1 and 0; the Auto-Regressive Distributed Lag (ARDL) bound test technique, suggested by Pesaran & Shin (1999) and Pesaran et al. (2001), can be employed to examine the co-integration between the PRICE and INTEREST [Equation 2].

$$\Delta PRICE_t = \alpha_0 + i=1P\ \alpha 1i \Delta PRICEt\text{-}i\ \alpha 1iy/Nt\text{-}i + i=0\ q\ \alpha 2i\Delta\ INTERESTt\text{-}i + \delta_1 PRICE_{t-1} + \delta_2 INTERESTt_{-1} + e_t \cdots \qquad ....[2]$$

Whereas δ_1 and δ_2 correspond to the coefficients of long-run relationships. The null hypothesis of no existence of long-run relationship (i.e., H_0: $\delta_1 = \delta_2 = 0$) between the PRICE and INTEREST is tested against the alternative hypothesis (i.e., there is a long-run relationship between PRICE and INTEREST, H_1: $\delta_1 \neq 0$; $\delta_2 = 0$). The α_{1i} and α_{2i} in the given equation are the corresponding coefficients of short-run dynamics for the PRICE and INTEREST. The F-statistic values after running the Equation [2] provides the decision regarding the long-run association between these two-time series. This F-statistic value for the long-run relationship is reported in

Table 2.

Table 2

Bound Test for Co-Integration

		Critical Value					
		1 percent		5 percent		10 percent	
D. Variable	F-Statistics	Lower Bound I(0)	Upper Bound I(1)	Lower Bound I(0)	Upper Bound I(1)	Lower Bound I(0)	Upper Bound I(1)
PRICE	5.802** (k=1)	4.068	5.250	3.62	4.16	2.496	3.346

The automatic lag selection criteria of ARDL techniques suggest an optimal number of lags of 11 for PRICE and 1 for INTEREST. Thus, the F-statistic of 5.802 for the ARDL (11,1) model reported in Table 2 is higher than the upper bound I(1) critical value of 4.16 for a 5 percent level of significance and rejects the null hypothesis in the favor of the alternative hypothesis. This implies that, for a 5 percent level of significance, there exists a long-run relationship between the PRICE and INTEREST. The estimated long-run coefficients for ARDL (11,1) with the PRICE as a dependent and INTEREST as an independent variable is reported as:

$$PRICE \quad = \quad 7.757 \quad - \quad 0.424^{***}INTEREST$$
$$(0.000) \quad\quad (0.062)$$

While the figures in the parentheses include the probability values, the coefficient of interest rate is negative 0.424 and it is significant at the 6.2 percent level. This suggests the interest rate has contributed negatively to the stock prices of the country in the long-run. In fact, for a 1 percentage point increase in the INTEREST causes to decline in PRICE almost by 42 percentage points, and vice-versa.

Short-Run Dynamics and Error Correction Mechanism (ECM)

Pesaran et al. (2001) argue that the long-run relationship justified by the ARDL bound test in Equation [2] requires re-parameterization into short-run dynamics and error correction mechanisms (ECM) to validate long-run associations among variables. More specifically, the lag long-term variables in the form of unrestricted ECM of Equation [2]are replaced by lag error correction term, (ECT_{t-1}) allowing to estimate restricted vector auto-regressive models. Hence, it allows Equation [2] to re-specify into Equation [3]as follows.[1]

$\Delta PRICE_t = \beta_0 + i=1P \beta 1i\Delta PRICEt-i \alpha 1iy/Nt-i + i=0 q \beta 2i\Delta INTERESTt-i + \lambda ECT_{t-1} + e_t$ …… ….[3]

Whereas λ in Equation [3] is a parameter that stands for speed for an adjustment, particularly it measures the extent to which any disequilibrium in the PRICE-INTEREST relationship in the previous period is being adjusted in the current period towards equilibrium. Theoretically, the coefficient of error correction term (λ) is expected to lie between -1 and 0 that is, $-1 < \lambda < 0$) so that it allows the deviation converge towards equilibrium, whereas a positive coefficient adds towards a divergence between a set of time series.

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1   ECT = LN_INDEX – (-0.423) + 7.757

Table 3

ARDL Error Correction Regression, ARDL (11,1)

Dependent Variable: D(PRICE)

Variable	Coefficient	Standard Error	t-Statistics	p-values
D(PRICE(-1))	0.150	0.062	2.415	0.017
D(PRICE(-2))	0.087	0.062	1.389	0.166
D(PRICE(-3))	-0.028	0.063	-0.448	0.655
D(PRICE(-4))	-0.167	0.062	-2.677	0.008
D(PRICE(-5))	0.025	0.062	0.394	0.694
D(PRICE(-6))	0.176	0.062	2.825	0.005
D(PRICE(-7))	-0.070	0.062	-1.120	0.264
D(PRICE(-8))	-0.014	0.063	-0.221	0.825
D(PRICE(-9))	0.131	0.063	2.087	0.038
D(PRICE(-10))	0.106	0.062	1.714	0.088
D(INTEREST)	0.001	0.003	0.447	0.655
ECT(-1)*	-0.013	0.004	-3.473	0.001

Table 3 reports the selected ARDL Error Correction Regression (ARDL (11,1)) and the coefficient of error correction term is negative 0.013 and highly significant at 1 percent level. This implies that a deviation from the long-run equilibrium following a short-run shock is corrected by about 1.3 percent after each period and confirms the existence of a stable long-run relationship between the PRICE and the INTEREST. This suggests that there exists a long-run relationship between the interest rate and stock prices. This negative association between the interest rate and stock prices is similar to the findings of earlier studies in the context of Nepal (Shrestha & Subedi, 2014; Gaire, 2017 among others). However, only the 12 percentage points variation is the PRICE is explained by the variation in the INTEREST [adjusted R^2 = 0.12]. It further suggests that the interest rate is not only a factor that hurts the stock prices of Nepal. Moreover, theorists and researchers have a common understanding of the roles of quantitative and qualitative factors to influence the stock prices of a particular country, however, they have not yet agreed on specific factor/s. The earlier studies too, for instance; Dongol (2008), Joshi (2009), Pradha (2017), Bhattarai (2018), Khatri (2019), Shrestha & Pokharel (2019) among others have documented the impact of various factors such as political factors. policy issues, macro-economic forces, and company-specific fundamentals on the stock prices of Nepal.
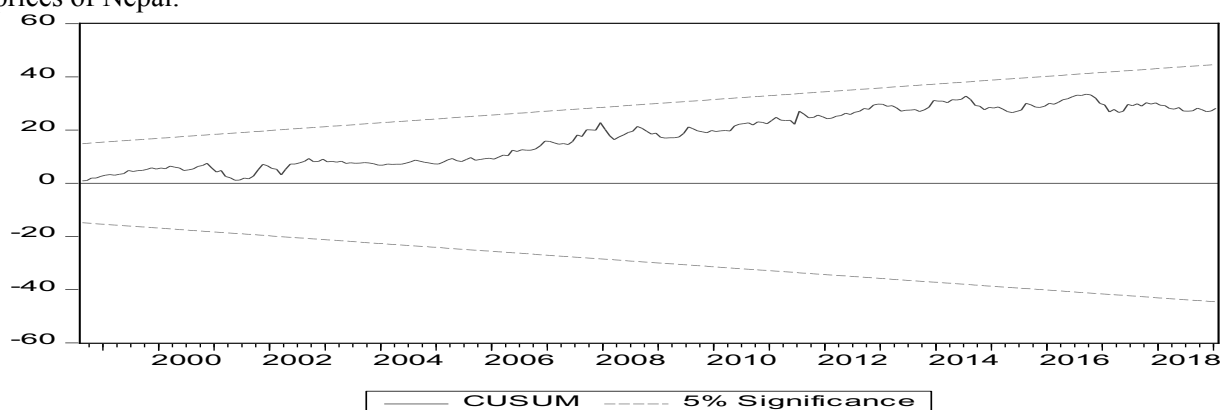

Figure 2: Plots of Cumulative Sum (CUSUM)

Since the Breusch-Godfrey Serial Correlation LM Test provides chi-square p-values [i.e., $\chi2$ (12) = 9.810 (0.633)] higher than 0.05, this indicates the model with no evidence of serial

correlation. The graphical presentation [Figure 2] presents the CUSUM Squares test for the stability of the long-run coefficients. The line that represents the values of CUSUM Squares which falls within the two critical bound (dotted lines) at the 5 percent significance level evidence the parameters in the model are stable over the period.

Conclusion

This study examined an autoregressive distributed lag (ARDL) modeling approach to develop the relationship between the INTEREST andPRICES, using the time series of 283 monthly observations from July 1996 to January 2019. The bound test of co-integration confirms the long-run association and it is further justified by the significant speed of adjustment in the short-run shock towards the long-run equilibrium. This concludes the interest rate has caused the stock prices in the long-run in Nepal. This finding provides important considerations for policies towards an interest rate stabilization for the stock price stability and further development of the stock market in Nepal. Furthermore, the interest rate is not only a factor that hurts the stock prices but there can be many other quantitative and qualitative factors that causing the stock prices to suffer. Therefore, similar research can be further carried out with more inclusive variables, time horizon, and methodology.

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