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An Econometric Analysis on Interest Rate Reforms and Financial Deepening

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Abstract:

Purpose: *This paper intends to analyze the impact of interest rate reforms on financial deepening in Nepal during 1989 Q1 to 2021 Q2.*
Design/Methodology/Approach: *This paper uses seven different measures of financial deepening and applied vector error correction model. An empirical result strongly supports the hypothesis that interest rate reforms lead to financial deepening and did not supported by two variables export and change of deposit. Similarly, Granger causality test show the unidirectional causal relationship among most of the variables.*
Findings: *The findings suggest that financial reforms need to accelerate the financial reforms that was lunched since 1989 and to improve the efficiency of the financial system, stimulate the saving /investment and economic growth.*

Keywords: *Liberalization, deepening, reforms, interest rate, saving investment.*

JEL codes: *G11, G12.*

Paper type: *Research article.*

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1. Introduction

Financial deepening of country highly influenced by the interest rate. Financial deepeningis the assets which mainly covers the amount of time and saving deposit in the banking and financial system (Kiyotaki and Moore, 2005; Rousseaul and Wachtel, 2011; Sahay *et al.*, 2015). Similarly, interest rate is the cost of fund offered and charged by banks and financial institutions to savers and users (Bakang, 2015).

From the inception of money market development in 1970s, the concept of financial liberalization was hypothesized by Mckinnon (1973) and Shaw (1973) arguing that reforms or changes in financial sectors or financial liberalization promote economic growth by encouraging saving and investment. So, many developing nations have enacted far reaching financial reforms since the doctrine of financial liberalization gained popular support (Madsen *et al.*, 2018).

Specifically, most of the nations had made attempts financial reforms by deregulating interest rate, reducing credit, allowing free entry into the banking industry, imparting autonomy tobank and financial institutions, allowing privatization in banking industry and liberalization of the foreign capital or investment inflows (Ang and McKibbin, 2007).

However, interest rate liberalization has received most attention among the six elements of financial liberalization, because it has the impact on deposit, credit creation through banking system and economic growth by saving investment relationship (Temitope and Olayemi, 2018). As emerged byinterest rate liberalization theory, positive change increase in the real interest offered by banking and financial institutions induce savers to save in the banks and financial institutions, which generates more savings in the banking system and higher saving leads to increase in the investment (Hachicha, 2005).

Therefore, the reforms in interest rate is to stimulates the domestic saving and make credit fund available in the banking and financial institutions and have impact on the economy. Roux (2015) viewed financial deepening as the financial system which is highly free from financial repressions and restrictions and market determines the interest rate and stated that financial depth as the increase in the relative size of banks deposit and credit in the financial system of economy.

The global financial crisis of 2008/09 reignited the discussion over financial reforms, with contrasting viewpoints over the effect of financial deregulation in achieving economic development, particularly in the effect of interest rate reforms or adjustment on banks deposit and advancing made by the banks on financial deepening. Interest rate liberalization has three effects on the economy, the first is the effect of interest rate on banks saving, the second is the impact of saving and investment, and the third is impact of investment on economic growth (Moyo and Roux, 2018).

Interest rates have been slashed over the world in attempting to increase aggregate demand and economic development. Low rate of interest rate is also seen engine to increase investment by charging lower interest. Despite decreasing interest rates, the recovery forms the global financial crises has been gradual, since investment and economic growth rates in most regions of world remain low (Ahmed, 2013).

The purpose of interest rate reform is to improve financial sector efficiency while also encouraging financial deepening (Ang and McKibbin, 2007). Therefore, the interest rate deregulation lowers the financial inter-mediation cost. However, many nations that have tried interest-rate deregulation, but result have had a mixed outcome and nations have seen large rises in nominal interest rate, increasing inflation, unstable exchange rate and decreased saving and investment rates as a result of interest rate liberalization (Cooney, 2007).

Developing nations are often also characterized by credit limit (constraints) and market imperfections like asymmetric information, moral hazard issue and interest rate is a tool of increasing the deposit and removing the credit constraints (Rachmawati *et al.*, 2021). Nepal, being a developing country, has had repeated saving and liquidity problems (Khanal, 2016) and government as well as central bank areapplying different fiscal policies; tax rate, government expenditure, public debt, and monetary strategies; reserve requirement, discount rate, open market operation, still problem is arising frequently in recent years in Nepal banking industry.

In 1989, Nepal abolished its interest rate control regime and BFIs were assigned full autonomy to determine their interest rate on deposit and landing. This was during the time of financial and economic liberalization, when the number of BFIs expanded tremendously from 7 banks to around250 in 2010 A.D. including microfinance, an increase by over 33 times (Maskay and Pandit, 2010) and currently it has decreased to 127 after enacting the merger and acquisition law in 2016, but branches are high about 11398 (NRB, 2021).

Based on the theoretical approach, after increasing the number of financial institutions, the size of bank deposit is higher because financial institutions are able to collect the scattered money in the market. However, there is the high fluctuation in the bank deposit instead of increasing the size of bank deposit (NRB, 2021).

Therefore, the concern remains whether the interest rate reforms impact on the financial deepening in Nepal. As a result of a widening spread rates, despite NRB's delegating interest rate determination authority to the bank, the institution has been forced to issue directives on an as-needed basis to address anomalies. Therefore, the aim of interest rate deregulation or reforms to lower the financial intermediary cost was not succeeded.

Increased fund mobilization and utilization, an efficient financial sector, and more productive financial industry organizations are all made possible by interest rate

deregulation (Mohan *et al.,* 2005). The promulgation of NRB act 2002 tried to address growth and development of financial market.

The fact that the interest rate spread has remained so wide suggests that the increased development of the financial sector has failed to bring efficiency to the financial system (Guo and Liang, 2016). To address this issue in the financial system NRB attempted to maintain the interest rate spread of BFIs at a desire level through using moral suasion instead other more effective controlling tools.

In the Nepalese scenario, interest rate reforms are classified into four phases; pre-interest rateprior 1955 where private people, merchants, and landlords dominated Nepal's financial system (Pant, 1964), controlled period 1956 to 1983, there was financial repression and establishment of banks (formal financial system) and NRB implemented a regulated interest rate determination regime in the same year, fixing commercial banks' deposit, borrowing, and credit rates.

In the early1980s, Nepal had balance of payment problems, or high imports and low exports. Nepal implemented an IMF-supported economic stabilization program in 1985 and later joined the SAF.,transition period 1984 to 1989 and liberalized period 1990 onwards and number of BFIs were increased significantly in Nepal after 1989s, (Maskay and Pandit, 2010) and prior to liberalization period, interest rates were repressed.

Financial repression, as stated by Shaw, (1973), where government regulations and other non-market constraints prohibit an economy's financial intermediaries from operating at maximum potential or efficiently. Saving mobilization and challenging of mobilized funds through the financial sector are discouraged by the cause of the interest rate spreads. Under the liberalized system, the market determines the behavior of lenders and borrowers. Interest rate plays significant role in financial management decision of the bankingand financial institutions (Rizvi *et al.,* 2018).

Therefore, this study has analyzed the effect of interest rate reforms on financial deepening in Nepal after imposing the financial liberalization in 1989.In addition, the study also investigated whether there exist long run association between interest rate reforms and financial deepening or not in Nepal.

The rest of the paper is arranged as follows: Segment two touches the literature review on interest rate reforms and the trends of financial deepening in the different context. Segment three drafts the methodological aspect, how the study has been carried out. Estimation process and empirical results are discussed in segment four, and the concluding remarks of the study have presented in the final segment.

2. Literature Review

The impact of interest rate reforms has been the subject of considerable empirical

study in the area of financial economics. Globalized economic world and international banking, interest rate is a tool of financial deepening. McKinnon (1973) and Shaw (1973) established the theoretical association between the interest rate liberalization and financial deepening. Financial liberalization, according to these assumptions, allows savers to shift part of their saving from non-productive assets to financial assets, hence increasing the availability of credit to the economy.

Financial liberalization thus plays an important role on financial deepening. Odhhiambo (2008), found significant positive effect of interest rate reforms on Tanzanian based on financial deepening model and saving model, empirical findings, which were obtained using the co-integration and error correction technique. Following Nazmi (2005), analyzed the effect of financial development on capital accumulation and credit and the model suggested that firm increased their production's capital intensity because of deregulation and a more developed banking sector.

Hachicha (2005), empirically analyzed key empirical output implied that financial constraints caused negative consequences on financial growth in the long and short term, regardless of its clear influence by the level of interest rate. With the view of international financial integration, Levine (2001) concluded that enabling larger foreign BFIs participation tends to improve the local banking system's efficiency.

Saqib (2016), examined in emerging nations, development of the banking industry and nation’s financial and economic growth have a considerable favorable long-term linkage is the key result. A study in South Asian Developing Countries by Roux (2015), Moyo and Roux, (2018), found financial freedom has effect on the achievement of financial and economic growth but the amplitude of the elasticity parameters varies.

Research conducted in Sub-Saharan African nations by Ahmed (2013) on impact of financial flexibility in encouraging financial depth and economic growth based on GMM estimator in dynamic panel data covering the data spans from 1981 to 2009 and including 21 nations. The result on financial liberalization appeared to be inversely related with positive change in SSA areas.

However, after controlling for important macro-economic characteristics like institutional quality, fiscal imbalances and inflation, the research demonstrated that financial liberalization hasbeneficial influence on financial deepening and resource mobilization in SSA area. Ang and McKibbin (2007), analyzed the interest rate liberalization on time and saving deposit and credit insmall open economy of Malasiya and found a positive influence on financial sector development.

As highlighted by Christopoulos and Tsionas (2004), based on co-intregation and error-correction models, found substantial support for the positive effect of interest rate liberalization on financial deepening, but the strength and clarity of its efficiency is sensitive to the level of the dependence ratio.

Research in financial liberalization by Lee and Shin (2008) in crisis experienced country found financial reforms have a net positive influence based on integrating panel and Probit model,concluded that the crisis-affected nations are largely emerging countries, which typically have faster growth rates than industrialized countries due to the catching-up phenomena. Hassan *et al.* (2011) presented a linkage; most regions have a bidirectional causality between the financial reforms and depth.

Akinboade and Kinfack (2013), concluded that financial repression aids the growth of money supply. A cross country assessment of financial liberalization in eight different emerging nations by Bandiera *et al.* (2000) showed that financial liberalization is theoretically ambiguous, outcome did not support the idea that financial deregulation raise savings. Ang and McKibbin (2007), examined and found the dynamic impact of interest rate reforms on financial deepening.

The combined effect of real interest rate and exchange rate on financial depth in the four Asian countries was studied empirically by Agrawal (2001) and discovered that generallyincreased with higher real interest rate and real currency depreciation. Jankee (2006), found no clear evidence that financial repression aided financial depth and growth.

Khan *et al.* (2005) used Auto-regressive distributed lag (ARDL) model and investigated the actual connectionbetween interest rate and deposit in Pakistan, reformed interest rate has a favorable impact on the financial depth and leads to encourage economic growth in long run. Azeakpono and Ayodeji (2022), investigated the effect of interest rate reforms in developing countries and found it has the positive impact on financial deepening.

3. Research Methodology

This study is carried out based on causal comparative research design to ascertain the sensitivity and forms of observed relationship among the variable used in the study such as banks deposit size, banks interest rate, exchange rate in US$, remittance, change in GDP, inflation rate, liquidity reserve ratio and financial shift or policy change.

To measure the strengths and robustness of the regression analysis, this study has included the variables related with the financial development drawing from the earlier work by Ene *et al.* (2015), Azeakpono and Ayodeji (2022), Odhiambo (2011), researcher conceptualized a modified model for measuring the financial deepening by the interest rate reforms.

The applied in this study covers the quarterly time series data of 1989/90 - 2020/21 A.D. because Nepal Rastra Bank has followed the financial liberalization policy in 1989 in full phase. Data have sourced from the Ministry of Finance Economic survey and published data by NRB. All the annual data have classified into quarterly data

based on Chow-Lin method suggested by Adhikari and Nepal (2019). After converting the annual data into quarterly data of 32 years' data, number of observation period is increased to 128 periods and these data have used for analyzingand to generalize the result based on empirical evidence. Since reviewed literature for this study and the based on conceptual framework applied in earlier, the following hypotheses have been approached to address the research issue and question.

H1: There is significance impact of interest rate on financial deepening in Nepal.

Financial Depth = β0 + β1 Interest rate + β2 Liquidity reserve ration + β3 Inflation + β4 change in GDP + β5 Exchange rate + β6 Remittance + β7 Financial Shift + Ɛ

4. Empirical Analysis

Unit Root result: Prior to any analysis of a time series of data, it is critical that researchers check to see whether the variables being used are stationary or not. The Augmented Dickey Fuller test for assessing the variability or stationery of the variable was misguided and have resulted in spurious (wrong) regression because of the huge fluctuations in the economy indicators during the study period.

To rule out errors in homoscedastic distributions, use ADF; for heteroscedastic distributions, use PP; when the mean of stationary variable changes structurally, use of Augmented Dickey Fuller test to find out the assumptions of unit root test (Phillips and Perron 1988). Hence for researchers to assess the stationary of the data set used in the study, Phillips Perron (PP) unit root test has also been performed.

H0: There are no stationary variables.
H1: There are stationary variables.

Table 1(a). *Unit Root Test Result by ADF procedure.*

Variables	At level		At first diff.		Order
	Intercept	Trend &intercept	Intercept	Trend &intercept	
LM2	-0.0678 (0.9496)	-2.0298 (0.5793)	-4.1001*** (0.0014)	-4.0845*** (0.0085)	I(1)
IR	-3.5192 (0.0566)	-3.4917 (0.0545)	-3.8401*** (0.0034)	-3.8620*** (0.0167)	I(1)
LRMT	-1.1496 (0.6945)	-1.4942 (0.8267)	-5.3602*** (0.0000)	-5.4332*** (0.0001)	I(1)
IN	-2.2060 (0.2053)	-2.5997 (0.2813)	-5.0061*** (0.0000)	-4.9951*** (0.0004)	I(1)
CGDP	-2.1798 (0.8654)	-1.8266 (0.6834)	-5.9653 (0.0000)***	-5.9778 (0.000)***	I(1)
PS	-1.1588 (0.6908)	-1.8148 (0.6921)	-11.4017*** (0.0000)	11.3640*** (0.0000)	I(1)
LRR	-1.4960	-3.2539	-4.5220***	-4.4928***	I(1)

	(0.5324)	(0.0790)	(0.0003)	(0.0023)	

Source: *Author calculation. Numbers in parenthesis are probability values, and superscript ***indicates that the alternative hypothesis is accepted at a 1% level of significance.*

Table 1(b). *Unit Root Test Result by PP procedure.*

Vari	At level		At first diff.		Order
	Intercept	Trend &intercept	Intercept	Trend &intercept	
LM2	-0.0771 (0.9628)	-1.5646 (0.8015)	-3.6574*** (0.0059)	-3.6518*** (0.0294)	I(1)
IR	-2.3298 (0.1643)	-2.4204 (0.3673)	-4.5998*** (0.0002)	-4.5722*** (0.0017)	I(1)
Ex	-0.6835 (0.8461)	-1.6404 (0.7714)	-4.2946*** (0.0007)	-4.2900*** (0.0045)	I(1)
LRMT	-1.1441 (0.6968)	-0.8126 (0.9611)	-4.9986*** (0.0000)	-4.9481*** (0.0005)	I(1)
IN	-2.4460 (0.1314)	-2.6880 (0.2434)	-4.9250*** (0.0001)	-4.8837*** (0.0006)	I(1)
CGDP	-2.6319 (0.0892)	-2.7277 (0.2274)	-6.5527*** (0.0000)	-6.5197*** (0.0000)	I(1)
LRR	-1.2517 (0.6504)	-2.6558 (0.2569)	-5.7252*** (0.0000)	-5.7853*** (0.0000)	I(1)
PS	-1.1351 (0.7005)	-1.8812 (0.6585)	-11.2694*** (0.0000)	-11.2296*** (0.0000)	I(1)

Source: *Author calculation. Numbers in parenthesis are probability values, and superscript ***indicates that the alternative hypothesis is accepted at a 1% level of significance.*

The result of unit root test (ADF and PP) of money supply (deposit), interest rate, exchange rate, liquidity reserve ratio, inflation rate, remittance, policy change and change in GDP, all these variables are not stationary at level. It suggests checking the stationary at the first difference and tested by Augmented Dickey Fullerand Phillips Perron (PP) test and all variables are found stationary at first difference where p value is less than 0.05 or 5%. If the variables are significant at first difference, then Johansen co-integration tested to show the association among the variables (Atkins, 1989).

4.1 Lag Length Selection

In time series data analysis, one of the most important considerations is lag length selection. According to Johansen, (1992), the length of the lag should be adjusted to account for possible biases. All such researchers also mentioned that serial correlation (Auto-correlation) and heteroscedasticity should not be present in the data.

There are many different approaches to determining the optimal lag time for each individual variable. Nevertheless, the SIC criteria produce slightly better estimates than the AIC criteria when applied to samples of limited size (Johansen, 1992). In addition, AIC criteria tend to overestimate the number of lags that should be included, which is undesirable in small samples because the number of observations tends to

decrease as the lag period increases. In order to establish a model that is consistent across all scenarios, the AIC criterion is applied to the process of determining optimal size of lag period each model.

4.1.1 VAR Lag Order Selection Criteria

Endogenous variables: LM2 IR IN EX LRMT CGDP PS LRR
Exogenous variables: C
Sample: 1989Q1-2021Q1
Included observations: 121

Table 2. *Results of Lag Length Selection*

Lag	LogL	LR	FPE	AIC	SIC	HQ
0	-1701.755	NA	259.1495	28.26042	28.44526	28.33549
1	-81.33778	2999.781	1.75e-09	2.534509	4.198120	3.210165
2	208.0547	497.4681	4.26e-11	-1.899888*	1.951389*	0.085251*
3	242.5166	54.68334	7.18e-11	-0.702754	3.918387	1.174067
4	283.7835	60.02453	1.12e-10	-0.327000	5.772907	2.150405
5	394.8604	146.8786	5.72e-11	-1.105131	6.473541	1.972856
6	501.2706	126.6368*	3.36e-11*	-1.806125	7.251312	1.872446
7	549.7273	51.26000	5.60e-11	-1.549211	8.986991	2.729942
8	634.9433	78.87759	5.66e-11	-1.190987	10.11508	2.979848

Note: **Indicates lag order selected by the criterion.*
Source: *Appendix 1.*

From the above results the optimal lag length is two and two lag has been used in this study. As per Akaike information criterion (AIC), Schwarz information criterion (SC) and Hannan-Quinn information criterion (HQ) suggests that optimal lag is two. However, as per Final prediction error (FRE), Sequential modified LR test statistic, the optimal lag length is six. Most of the tests (FPE, AIC, SR, HQ) have suggested at lag two, so this study have followed two lags (Thiede *et al.*, 2005).

4.1.2 Johansen Co-integration Test

Following to Engle and Granger, 1987, If all the applied variables are stationary at first order or difference I(0), As the suggested by methodology, So a researcher here test of co-integrating relationship using the method established by Johansen, (1992) for detecting the long term relationship. As suggested by the optimal lag length selection result, AIC, SIC, and HQ are used to determine the optimal level VAR lag length of 2 lag (Appendix-1).

Null hypothesis (H0): There is no co-integration.
Alternative hypothesis (H1): There is at least one co-integration.
Based on the above hypothesis, Johansen co integration test output as follows.
Sample (adjusted): 1989Q1-2021Q1
Included observations: 126 after adjustment.
Trend assumption: Linear deterministic trend.

Series: LM2 IR IN EX LRMT CGDP PS LRR
Lags interval (in first differences): 1 to 2

Table 3(a). *Unrestricted Co-Integration Rank test (Trace)*

Hypothesized No. of CEs	Eigen value	Trace Statistic	0.05 Critical Value	Prob. **
None*	0.433589	244.3405	159.5297	0.0000
At most 1*	0.327920	172.7176	125.6154	0.0000
At most 2*	0.311266	122.6480	95.75366	0.0002
At most 3*	0.209751	75.66253	69.81889	0.0158
At most 4	0.167564	46.00119	47.85613	0.0739
At most 5	0.140413	22.89289	29.79707	0.2514
At most 6	0.028487	3,828683	15.49471	0.9169
At most 7	0.001485	0.187250	3.841465	0.6652

Note: *Trace test indicates 3 co-integrating eqn(s) at the 0.05 level.*
**Denotes rejection of hypothesis at 0.05 level.*
***MacKinnon-Haug Michelis (1999) p-values. Table 3(b)*
Source: *Own study.*

Table 3(b). *Unrestricted Co-Integration Rank Test (Maximum Eigenvalue)*

Hypothesized No. of CEs	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob. **
None*	0.433589	71.62294	52.36261	0.0002
At most 1*	0.327920	50.06956	46.23142	0.0186
At most 2*	0.311266	46.98547	40.07757	0.0072
At most 3	0.209751	29.66135	33.87687	0.1468
At most 4	0.167564	23.10830	27.58434	0.1689
At most 5	0.140413	19.06420	21.13162	0.0950
At most 6	0.0.028487	3.641433	14.26460	0.8951
At most 7	0.001485	0.187250	3.841465	0.6652

Note: *Trace test indicates 1 cointegrating eqn(s) at the 0.05 level.*
**Denotes rejection of hypothesis at 0.05 level.*
***MacKinnon-Haug_Michelis (1999) p-values.*
Source: *Own study.*

Table no. 3a and 3b have shown the results of Johansen Co-integration test. Results of both Trace and Maximum Eigenvalue tests reject the null hypothesis or there is co-integration among the variables. The probability value is less than five percent (0.05) level of significant and says that the existence of at least 4 (trace stat) and 3 (max eigne test) co-integrating relationship among the variables in the series at 5% level of significance. The result states that the series under consideration are driven by at least 1 common trend.

Hence, the long run equilibrium relationshipbetween financial deepening, interest rate, inflation, exchange rate, inflation, remittance, change in GDP, policy shift and liquidity reserve ratio, meaning that move together in such a way that their linear

combination results in a stationary time series and share an underlying common stochastic trend.

Table 4. *Normalized co-integrating coefficients (Standard error in Parentheses).*

LM2	IR	IN	EX	LRMT	CGDP	PS	LRR
1.00000	-0.341822	0.482127	0.009174	-1.057746	-0.073567	-3.492132	-0.389000
	(0.07457)	(0.06647)	(1.02346)	(0.23424)	(0.05593)	(0.79403)	(0.04736)

Source: *Own study.*

From the above co-integrating equation, coefficient signs are reversed in the normalized co- integrating equation of the Johansen model (Hunter and Ali, 2014) and which is representing the long run. LM2 is the target variable, in the co-integrating equation interest rate (IR), log of remittance (LRMT), change in GDP (CGDP), policy shift (PS) has the negative sign, so it has the positive impact to financial deepening in the long run. Similarly, inflation rate (IN) and exchange rate (EX) have the positive signs, so it has the negative impact to financial deepening inthe long run, which also supported the financial liberalization. Now co-integration follows the VECM model.

4.2 Vector Error Correction Model

Since the results of the co-integration confirmed that there existed long run association between variables, VECM model is used for additional analysis as suggested by Engle, and Granger, (1987). As pointed out by Gries and Redlin, 2020 in analysis of financial components, the last-period deviation (the error) from a long-run equilibrium influences the short-run dynamics ofthat long-run equilibrium.

According to Lütkepohl and Reimers, (1992), the VECM model is used in this study to confirm the co-integrating associations among the variables in order to predictthe long run cause and effect among the financial depth, interest rate, exchange rate US$, liquidity rate ratio, annual inflation rate, remittance, financial policy change and change in annual GDP. Following to Banumathy *et al.* (2018), now researchers checked long run relationship in the samecontext by VECM approach.

Dependent variable: D (LM2)
Method: Least Squares (Gauss-Newton / Marquardt Steps)
Sample (Adjusted): 1989Q4-2021Q1
Included observations: 129 after adjustments.
D(LM2) = C(1)*(LM2(-1) - 0.341821897719*IR(-1) + 0.482126558323*IN(-1)+ 0.00917413668109*EX(-1) - 1.05774603467*LRMT(-1)- 0.0735673389283*CGDP (-1) -3.49213203027*PS(-1) - 0.388999866629*LRR(-1) + 5.06027621076) + C(2)*D(LM2(-1)) + C(3)*D(LM2(-2)) + C(4)*D(IR(-1)) + C(5)*D(IR(-2)) + C(6)*D(IN(-1)) + C(7)*D(IN(-2)) +C(8)*D(EX(-1)) + C(9)*D(EX(-2)) + C(10)*D(LRMT(-1)) + C(11)*D(LRMT(-2)) + C(12)*D(CGDP (-1)) + C(13)*D(CGDP(-2)) + C(14)*D(PS(-1)) + C(15)*D(PS(-2)) + C(16)*D(LRR(-1)) + C(17)*D(LRR(-2)) + C(18)

Table 5. *Vector Error Correction Model*

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.002654	0.000819	-3.239616	0.0065 ***
C(2)	0.794789	0.100554	7.904078	0.0000***
C(3)	0.907720	0.102349	8.868863	0.0000***
C(4)	0.004442	0.002190	2.028068	0.0396***
C(5)	-0.067078	0.022592	-2.969138	0.0071***
C(6)	-2.32E-05	0.000967	-0.023989	0.9809
C(7)	0.010197	0.000916	11.36710	0.0000***
C(8)	0.000311	0.000914	0.340140	0.7344
C(9)	-7.00E-05	0.000882	-0.079372	0.9369
C(10)	-0.025181	0.016176	-1.556663	0.0765*
C(11)	-0.124465	0.015848	-7.853738	0.0000***
C(12)	-0.000565	0.000720	-0.785442	0.4337
C(13)	0.000495	0.000734	0.674167	0.5016
C(14)	0.067927	0.008156	8.328292	0.0000***
C(15)	-0.029365	0.008449	-3.475660	0.0088***
C(16)	4.92E-05	0.000578	0.085098	0.9323
C(17)	0.002958	0.000717	4.125372	0.0007***
C(18)	0.008693	0.002833	3.068711	0.0027***
R-square		0.671562		
Adjusted R-square		0.619864		
F-stat		12.98998		
Prob(F-statistic)		0.000000***		
DW test		2.055531		

Source: *Appendix 4.*

Note: *Numbers in parenthesis are probability values, and superscript *** indicates that the alternative hypothesis is accepted at a 1% level of significance.*

From the result of VECM, Table 5, C (1) is error correction term or speed of adjustment within which the model restores its equilibrium following any disturbances. The coefficient C (1) is negative and significant, this states that there is long run causality running from interest rate (IR), exchange rate (EX), log of remittance (LRMT), change in GDP, inflation (IN), liquidity reserve ratio (LRR) and policy shift (PS).

In above result only three C (1), C (2), C (3), C (4), C (5), C (7), C (9), C (11), C (14), C (15) and C (17) are significant at 1% and C (6), C (9), C (12), C (13), C (16) are insignificant. Here C (18) is the intercept term.

All variables supported the hypothesis except change in GDP and export did not contribute to achieving financial deepening. Prob. of F-stat i.e., 0.0000 is also less than 5% which indicate that these all variables jointly influence to financial deepening. 67.15% variation in financial deepening is explained by these independent variables.

4.3 Granger Causality Test

The Granger Causality Test states that if two variables, one independent and the other dependent, are found to be co-integrated, then one of the following three relationships could be present: independent variable affects dependent variable, dependent variable affects independent variable and independent and dependent affect each other, if the variables are not co-integrated, then they are independent of one another because they do not affect one another (Gujarati and Porter, 1995).

The Granger causality test is used to determine if two variables in a time series are causally linked. There is a probabilistic view of causality in this method, which uses empirical data to look for patterns of association. Granger and Weiss, (1983) developed a causality test method, and the same procedure has been followed in this study. This was done so that the pattern of sucha relationship could be determined.

Researchers have investigated, with the help of the Granger causality test, the potential directions of causality that exist between financial deepening and (deposit) interest rate, exchange rate, liquidity reserve ratio, inflation rate, remittance, policy change, and changes in GDP. The following table only displays the values that have a significant impact.

Table 6. *Granger Causality Result*

Null Hypothesis	F-stat	Prob.	Relation
IN does not Granger cause LM2 LM2 does not Granger cause IN	1.08631 9.00410	0.3407 0.0002***	Unidirectional
EX does not Granger cause LM2 LM2 does not Granger cause EX	1.70713 4.19783	0.1857 0.0173***	Unidirectional
LRR does not Granger cause LM2 LM2 does not Granger cause LRR	0.15514 9,64866	0.8565 0.0001***	Unidirectional
IN does not Granger cause IR IR does not Granger cause IN	1.42872 6.82582	0.2436 0.0015***	Unidirectional
EX does not Granger cause IN IN does not Granger cause EX	4.98393 0.64635	0.0083*** 0.5257	Unidirectional
LRMT does not Granger cause IN IN does not Granger cause LRMT	3.21040 0.39015	0.0438*** 0.6778	Unidirectional
LRR does not Granger cause EX EX does not Granger cause LRR	0.05125 6.77837	0.9501 0.0016***	Unidirectional
LRR does not Granger cause LMT LMT does not Granger cause LRR	5.15744 12.2185	0.0071*** 0.0000***	Bidirectional
LRR does not Granger cause PS PS does not Granger cause LRR	4.66480 8.21082	0.0112*** 0.0005***	Bidirectional

Source: *Appendix. Numbers in the parenthesis are probability values & superscripts ***represents the acceptance of alternative hypothesis 1% significance level.*

From the above Granger Causality table, financial deepening cause inflation, financial deepening cause exchange rate, financial deepening cause liquidity reserve ratio,

interest rate cause inflation,exchange rate cause inflation, remittance cause inflation, exchange rate cause liquidity reserve ratio, since p-value is less than 0.05, so there is unidirectional relationship. Liquidity reserve ratiocause remittance and remittance cause liquidity reserve ratio since p-value is less than 0.05 so thereis bidirectional relationship.

Liquidity reserve ratio cause policy shift and policy shift because liquidity reserve ratio since p-value is less than 0.05 so there is bidirectional relationship. Rest all variables did not have causality among them in long run.

4.4 Residual Diagnosis Test

Following Chen *et al.,* (2018), Gries and Redlin (2020), to make the estimated model robust and unbiased, researcher determined the fitness of the model through checking goodness of fit statisticsand conducting diagnostics tests. Residuals diagnostic tools (serial LM test, Heteroscedasticity testand normal distribution test, Multicollinearity) applied to make estimation free of spurious.

If the P-value of respective testis greater than 5% then hypothesis is accepted and model is assumed to free from the wrong regression and data are fitted for the test (Kim *et al.,* 2000). Similarly, VIF is less than 5, suggested that there is no multicollinearity between the variables (Akinwande, et al., 2015).

Table 7. *Result of Residuals.*

Particulars	Obs-R^2	P-value
Heteroscedasticity BPG test	11.30877	0.9866
BG serial correlation LM test	4.399245	0.1108
Normality JB test	JB-2.593730	0.2733

Source: *Own study.*

In Table 3, B-G serial LM test depicts that the residuals are free from serial correlations as p- value of observed R-square is 0.1108 which is more than 5% level of significance. Similarly, BPG test shows that the residuals are homoscedastic where p-value of observed R square i.e., 0.9866 is greater than 5% level of significance.

Finally, JB test also shows the residuals are normally distributed where p-value i.e. 0.2733 is also than 5% level of significance. Similarly, VIF factor ofall coefficient C (1) to C (17) (Appendix-6) are less than 5, so there is no strong correlation amongthe explanatory variables.

5. Discussion, Conclusions, and Implications

In this study, researchers examined interest rate reforms in Nepal to gain some insights about influence into the financial deepening. As the main result of this paper confirmed that there is longterm association of interest rate reforms and financial deepening

during the sample period 1989 to 2021. The result of this study is consistent with earlier study conducted by Obamuyi and Demehin (2012), argued that their interest rate reforms have the positive and significant impact onthe financial deepening in Nigeria. Odhiambo (2008), also spotted that there is the significant and positive relation between interest rate reforms and financial deepening during 1995 to 2006 in Tanzania.

In Latin America, deregulation has impact on saving, investment, and financial development (Nazmi, 2005). In Tunisia, effects of various forms of banking sector restrictions onfinancial deepening and key empirical output implied that financial repression caused negative consequences on financial growth in the long and short term, regardless of its well-known influence via the level of the real interest rate (Hachicha, 2005).

In emerging countries, sound andefficient financial institutions are especially vital for maintaining growth. The development of the banking sector and the country's economic growth have a considerable favorable long-term linkageis the key result (Saqib, 2016). In the context of South Asian Developing Countries by Le Roux (2015), found economic freedom has impact on financial and economic growth. The amplitude of the elasticity parameters varies, but all components are extremely important and positively associated to deepening.

In Southern nations Moyo and Roux (2018), found in the majority of nations for controlling the important macroeconomic characteristics such as institutional quality, fiscal imbalances, and inflation, the research demonstrated that financial liberalization has a beneficial influence on financial deepening and resource mobilization in the SSA area. Banks haveestablished their subsidiary company and they are operating in the city area and rural areas and banks are offering the different accounts.

NRB has clear guideline for minimum credit sectors foradvancing loan. So, banks have also segmented their target depositors from the different sectors, so banks itself and its subsidiaries should be increased in the level of banks deposits. Similarly, BFIs are developing the new financial product and offering to its customers at different interest rate. There is the interest rate spread in between the lending and deposit rate, so there may not bethe significant increase in the value of banks deposit.

The main outcome as equation of this paper confirmed that there is long run association of interest rate reforms and financial deepening. To test the impact of interest rate reforms on financialdeepening in Nepal, seven proxies of financial development have been used and supported financial theory of liberalization, where only change in GDP and exchange rate found insignificant.

As Nepal is an import-based economy, constant depreciation of domestic currency against the USdollar, also make imports costlier and impacts on cash outflow, not on deposit, when thedependency ratio is high, a larger portion of income will be diverted

toward consumption rather than financial savings thereby making financial depth less responsive to exchange rate.

Similarly, based on monetarism the average change in economic growth rate is less than the average rate of inflation over the long time and most of the developing country have the mixed economy therebymaking financial depth less responsive to change in GDP. As discussed in the introduction, this implies that higher real interest rates are likely to increase these economies' investment ratios.

These findings support the policy of interest rate liberalization (to market clearing levels) advocated by McKinnon (1973) and Shaw (1973). The challenge is to gradually raise interest rateswhile avoiding the excessive accumulation of non-performing loans and resulting financial crashesthat have all too often accompanied such efforts.

As the implication of this study, it gives BFIs specific information about how interest rate reformsaffect bank deposits and helps develop new approaches to overcoming the difficulties posed by interest rates in the banking industry while gaining a competitive edge. The research's conclusionsare useful for regulatory authorities regarding the formulation of policies and their effects on the country's monetary and fiscal authorities, the Nepal Rastra Bank and the Ministry of Finance, in order to maintain a stable and sound banking system as well as sustainable economic growth.

For further research, researchers can find a wealth of literature from this study in the same field, as well as information on why some variables used in this study, such as the two variables exchangerate and change in GDP, were found to be insignificant. According to the researcher's knowledge, this is the first study conducted in the Nepalese context. Therefore, other researchers can carry outresearch in the same area using various techniques, variables, and dimensions, etc. The outcome may help foreign investors and MNCs make investment decisions and/or model plans, policies, and strategies in various sectors.

As a key contribution of this study, the result has reflected the scenario of developing country’s context regarding interest rate reform. Further study can be carried out to examine the effect of interest rate reform before and after global financial crisis 2008/09 as well as developingand developed countries context.

References

Adhikari, N., Nepal, T. 2019. Estimating Quarterly GDP for Nepal: An Application of Chow-Lin Procedure. Economic Journal of Nepal, 42(3-4), 41-53.

Abiad, A., Mody, A. 2005. Financial reform: What shakes it? What shapes it? American Economic Review, 95(1), 66-88.

Afanasyeva, O., Korovin, D. 2020. The impact of reserve requirements of central banks on macroeconomic indicators. Entrepreneurship and sustainability issues, 8(1), 413.

Ahmed, A.D. 2013. Effects of financial liberalization on financial market development

and economic performance of the SSA region: An empirical assessment. Economic Modelling, 30, 261-273.

Akinboade, O.A., Kinfack, E.C. 2013. Interest rate reforms, financial deepening, and economic growth in Cameroon: an empirical investigation. Applied Economics, 45(25), 3574-3586.

Adu, G., Marbuah, G., Mensah, J.T. 2013. Financial development and economic growth in Ghana: does the measure of financial development matter? Review of Development Finance, 3(4), 192-203.

Akinwande, M.O., Dikko, H.G., Samson, A. 2015. Variance inflation factor: as a condition for the inclusion of suppressor variable (s) in regression analysis. Open Journal ofStatistics, 5(07), 754.

Almalki, A.M., Batayneh, K.I. 2015. The relationship between inflation and financial development in Saudi Arabia. The Journal of Developing Areas, 49(6), 321-332.

Ang, J.B., McKibbin, W.J. 2007. Financial liberalization, financial sector development and growth: Evidence from Malaysia. Journal of development economics, 84(1), 215-233.

Atkins, F.J. 1989. Co-integration, error correction and the Fisher effect. Applied Economics, 21(12), 1611-1620.

Azeakpono, E.F., Ayodeji, I.N. 2022. Interest Rate Reforms, Financial Deepening, and Economic Development in Nigeria.

Bandiera, O., Caprio, G., Honohan, P., Schiantarelli, F. 2000. Does financial reform raise or reduce saving? Review of Economics and statistics, 82(2), 239-263.

Banerjee, A., Dolado, J.J., Galbraith, J.W., Hendry, D. 1993. Co-integration, error correction, and the econometric analysis of non-stationary data. Oxford university press.

Bakang, M.L.N. 2015. Effects of financial deepening on economic growth in Kenya. International journal of business and commerce, 4(7), 1-50.

Banumathy, Karunanithy, Ramachandran Azhagaiah. 2015. Long-run and short-run causality between stock price and gold price: evidence of VECM analysis from India. Management Studies and Economic Systems, 1(4), 247-256.

Bhattarai, Y.R. 2016. Effect of credit risk on the performance of Nepalese commercial banks. NRB Economic Review, 28(1), 41-64.

Bhetuwal, K.R. (2007). Financial liberalization and financial development in Nepal. Economic Review, 19(2), 23-41.

Budha, B.B. 2013. The bank lending channel of monetary policy in Nepal: evidence from bank level data. NRB Economic Review, 25(2), 43-65.

Christopoulos, D.K., Tsionas, E.G. 2004. Financial development and economic growth: evidence from panel unit root and cointegration tests. Journal of development Economics, 73(1), 55-74.

Cogley, T., Nason, J.M. 1995. Effects of the Hodrick-Prescott filter on trend and difference stationary time series Implications for business cycle research. Journal of Economic Dynamics and control, 19(1-2), 253-278.

Cooney, P. 2007. Argentina's quarter century experiment with neoliberalism: from dictatorshipto depression. Revista de economia contemporanea, 11, 7-37.

Dickey, D.A., Fuller, W.A. 1981. Likelihood ratio statistics for autoregressive time series with a unit root. Econometrica: journal of the Econometric Society, 1057-1072.

Eichengreen, B., Leblang, D. 2003. Capital account liberalization and growth: was Mr. Mahathir right? International Journal of Finance & Economics, 8(3), 205-224.

Ene, E.E., Agoke, S.A., Ene, C.J. 2015. Effect of interest rates deregulation on the performance of deposit money banks in Nigeria. International Journal of

Managerial Studies and Research, 3(9), 164-176.

Engle, R.F., Granger, C.W. 1987. Co-integration and error correction: representation, estimation, and testing. Econometrica: journal of the Econometric Society, 251-276.

Gibson, H.D., Tsakalotos, E. 1994. The scope and limits of financial liberalization in developing countries: A critical survey. The Journal of Development Studies, 30(3), 578- 628.

Granger, C.W., Weiss, A.A. 1983. Time series analysis of error-correction models. In Studies in econometrics, time series, and multivariate statistics, 255-278. Academic Press.

Gries, T., Redlin, M. 2020. Trade and economic development: global causality and development-and openness-related heterogeneity. International Economics and Economic Policy, 17(4), 923-944.

Gujarati, D.N., Porter, D.C. 1995. Basic Econometrics. McGraw-Hill Inc., New York.

Guo, Y., Liang, C. 2016. Blockchain application and outlook in the banking industry. Financial innovation, 2(1), 1-12.

Hachicha, N. 2005. Banking sector controls and financial deepening: A structural error correctionmodel for Tunisia. The Developing Economies, 43(2), 265-284.

Hansen, P.R., Lunde, A., Nason, J.M. 2011. The model confidence set. Econometrica, 79(2), 453-497.

Hassan, M.K., Sanchez, B., Yu, J.S. 2011. Financial development and economic growth: New evidence from panel data. The Quarterly Review of economics and finance, 51(1), 88-104.

Ho, C.Y., Huang, S., Shi, H., Wu, J. 2018. Financial deepening and innovation: The role of political institutions. World Development, 109, 1-13.

Hunter, J., Ali, F.M. 2014. Money demand instability and real exchange rate persistence in the monetary model of USD–JPY exchange rate. Economic Modelling, 40, 42-51.

Jankee, K. 2006. Banking controls, Financial deepening and economic growth in Mauritius. African Review of Money Finance and Banking, 75-96.

Jappelli, T., Pagano, M. 1994. Saving, growth, and liquidity constraints. The Quarterly Journal of Economics, 109(1), 83-109.

Johansen, S. 1988. Statistical analysis of cointegration vectors. Journal of economic dynamics and control, 12(2-3), 231-254.

Johansen, S. 1992. Co-integration in partial systems and the efficiency of single-equation analysis. Journal of econometrics, 52(3), 389-402.

Karki, C.B. 2020. Impact of Interest Rate Spread on Profitability in Nepalese Commercial Banks. Dristikon: A Multidisciplinary Journal, 10(1), 73-81.

Khan, M.A., Qayyum, A., Sheikh, S.A., Siddique, O. 2005. Financial development and economic growth: The case of Pakistan with Comments. The Pakistan development review, 819-837.

Khanal, M. 2016. Easing the Nepali liquidity crisis.

Kiyotaki, N., Moore, J. 2005. Financial deepening. Journal of the European Economic Association, 3(2-3), 701-713.

Lai, D. 2005. Monitoring the SARS epidemic in China: a time series analysis. J. Data Sci, 3(3), 279-93.

Le Roux, P. 2015. The impact of economic freedom on economic growth in the SADC: an individual component analysis. Studies in Economics and Econometrics, 39(2), 41-61.

Lee, I., Shin, J.H. 2008. Financial Liberalization, Crises, and Economic Growth. Asian Economic Papers, 7(1), 106-115.

Levine, R. 2001. International financial liberalization and economic growth. Review of international Economics, 9(4), 688-702.

Lütkepohl, H., Reimers, H.E. 1992. Impulse response analysis of cointegrated systems. Journal of economic dynamics and control, 16(1), 53-78.

Madsen, J., Md Rabiul Islam, B., Doucouliagos, C. 2018. Inequality, financial development and economic growth in the OECD, 1870–2011. European Economic Review, 101, 605-624.

Maskay, N.M., Pandit, R. 2010. Interest rate pass-through in Nepal. NRB Economic Review, 22, 1-18.

McKinnon, R. 1973. Money and capital in economic development, the Brookings institute. Washington, D.C.

Mohan, R., Khan, M.S., Janjua, M.A. 2005. Reforms, Productivity, and Efficiency in Banking: The Indian Experience. The Pakistan Development Review, 505-538.

Moyo, C., Le Roux, P. 2018. Interest rate reforms and economic growth: the savings and investment channel.

Muktadir-Al-Mukit, D., Islam, N. 2016. Relationship between Remittance and Credit Disbursement of the Banking Sector: A Study from Bangladesh. Journal of Business and Management Research, 1(1), 39-52.

Nasir, M.A., Ahmad, M., Ahmad, F., Wu, J. 2015. Financial and economic stability as 'two sides of a coin': Non-crisis regime evidence from the UK based on VECM. Journal of Financial Economic Policy.

Nazmi, N. 2005. Deregulation, financial deepening, and economic growth: The case of Latin America. The Quarterly Review of Economics and Finance, 45(2-3), 447-459.

Nyawata, O., Bird, G. 2004. Financial liberalization in southern Africa: an assessment. Development Policy Review, 22(3), 287-307.

Obamuyi, T.M. 2009. An investigation of the relationship between interest rates and economic growth in Nigeria, 1970-2006. Journal of economics and International Finance, 1(4), 093-098.

Obamuyi, T.M., Demehin, J.A. 2012. Interest rate reforms and financial deepening in Nigeria. The International Journal of Business and Finance Research, 6(2), 81-90.

Odhiambo, N.M. 2008. Interest rate reforms, financial depth and savings in Tanzania: A dynamic linkage. Savings and development, 141-158.

Olawumi, S.O., Lateef, L.A., Oladeji, E.O. 2017. Financial deepening and bank performance: A case study of selected commercial banks in Nigeria. Journal of Mathematical Finance, 7(3), 519-535.

Panta, B. 2018. Non-performing loans and bank profitability: Study of joint venture banks in Nepal. International Journal of Sciences: Basic and Applied Research (IJSBAR), 42, 151-16.

Phillips, P.C., Perron, P. 1988. Testing for a unit root in time series regression. Biometrika, 75(2), 335-346.

Rachmawati, A.M., Wulandari, D., Narmaditya, B.S. 2021. Financial deepening and income in equality in Indonesia. Global Business Review, 22(1), 57-68.

Rizvi, N.U., Kashiramka, S., Singh, S. 2018. Basel I to Basel III: Impact of credit risk and interest rate risk of banks in India. Journal of Emerging Market Finance, 17(1_suppl), S83-S111.

Rousseau, P.L., Wachtel, P. 2011. What is happening to the impact of financial deepening

oneconomic growth? Economic inquiry, 49(1), 276-288.

Sahay, R., Čihák, M., N'Diaye, P., Barajas, A. 2015. Rethinking financial deepening: Stabilityand growth in emerging markets. Revista de Economía Institucional, 17(33), 73-107.

Saqib, N. 2016. Banking sector liberalization and economic growth: case study of Pakistan. Journal of Business Economics and Management, 17(1), 125-139.

Shaw, E.S. 1973. Financial deepening in economic development.

Shrestha, M.B., Guna R.B. 2018. Selecting appropriate methodological frame work for time series data analysis. The Journal of Finance and Data Science 4.2, 71-89.

Shrestha, R. 2010. Effects of Interest Rate on Financial Performance of Commercial Banks in Nepal. Doctoral dissertation, Faculty of Management.

Temitope, D.J., Olayemi, A.E. 2018. Financial Deregulation and Economic Growth in Nigeria: Evidence from Error Correction Model. Journal of Academic Research in Economics, 10(3).

Timsina, N. 2017. Determinants of bank lending in Nepal. NRB Economic Review, 20(1), 22-42.

Upadhya, B.R. 2021. Deposit Mobilization of Commercial Banks in Nepal. Doctoral dissertation, Faculty of Management.