**NRB Working Paper No. 49**

March 2020

# Assessing the Effectiveness of Operating Target of Monetary Policy in Nepal

Nanda Kumar Dhakal[1]
Mitra Prasad Timsina[2]

**ABSTRACT**

*This paper assesses the relative effectiveness of excess reserve versus interest rate as operating target of monetary policy of Nepal using hybrid method of quantitative and inferential research design. To analyze the relationship of operating targets (short term interest rate and excess reserve) with monetary policy instruments (CRR, Bank Rate, FX intervention) and intermediate target (M2), the monthly data series have been used for the period of mid-July 2012 to mid-October 2019. To assess the effectiveness of operating targets, the response of instruments to operating target and the operating targets (interbank rate and excess reserve) to intermediate targets is examined separately. The econometric methods like ADF test, ARDL Model, Bound Test, Error Correction Model, Residual Test and Stability test have been used in the study. The empirical results show that both the excess reserve and interbank rate are influenced by the non–policy variables than policy variables. Bank rate, foreign exchange intervention and interbank transaction have significant impact on excess reserve. Likewise, the effectiveness of OMO should be strengthen to explain interbank rate. Moreover, the M2 is influenced by its past behaviour rather than excess reserve. This implies that the existing provision of dual operating target is suitable given the monetary policy environment of Nepal.*

**JEL Classification:** E4, E52, C32

**Key Words:** Monetary Policy, Monetary Policy Framework, Operating Target, ARDL Model.

[1] Deputy Director, Nepal Rastra Bank. E-mail: dhakalnk@nrb.org.np

[2] Assistant Director, Nepal Rastra Bank. E-mail: mitratimsina@nrb.org.np

# I. INTRODUCTION

Monetary policy implementation follows operating procedures involving variety of rules, traditions and practices (Walsh, 2010). Operating procedures generally include the choice of instruments, the operating target, the conditions under which the instruments and operating targets are automatically adjusted, and the way of signaling policy intentions. A carefully designed, transparent and efficient operational framework not only helps a central bank to achieve monetary policy objectives, but also strengthen the efficiency and stability of the financial system. Therefore, identifying best operational framework always became a crucial issue for central bank and will remain further (Bindseil, 2016).

As a significant part of operational framework in actual monetary policy implementation, the assessment of the effectiveness of operating target is always in the heart of discussion. However, there has long been debate among central bankers and economist about whether a central bank should utilize bank reserves or short-term rate of interest as the operational target of monetary policy (Goodfriend, 2002). The Federal Reserve has shifted from using targets for monetary aggregates, to targets for the federal funds rate, to targets for inflation during the last few decades (Reis, 2013). The United States has started to target federal funds rate, the short term interest, in the 1990s. During the period 1920 to the late 1980s, operating procedure of the Federal Reserve Monetary Policy was conceptually based on steering of reserves to impact on monetary aggregates and ultimate goals via the money multiplier (Bindseil, 2004). The Bank of Japan shifted the operating target from interest rates to the monetary base with the introduction of quantitative and qualitative monetary easing in 2013 (Nakaso, 2017). Likewise, Bank of England uses bank rate as conventional operating targets and the monetary base as qualitative easing of unconventional monetary policy.

State Bank of Pakistan modernize monetary policy framework in 2009 by introducing interest rate corridor framework. It currently implements monetary policy using overnight repo rate as the operational target. In Bangladesh, the central bank currently uses the reserve money as an operational target and broad money as an intermediate target in its monetary policy. Similarly, in the monetary policy framework of Sri Lanka, reserve money is the operating target and broad money supply is the intermediate target. The major tools in steering reserve money target are the Open Market Operations (OMO), and the pair of official rates that forms the floor and the ceiling for eligible commercial bank bidding rates in the auction organized for their 'overnight repo' or 'reverse repo' with the Central Bank. Reserve bank of India uses the weighted average call rate as operating target.

Most central banks focus on a short term market interest rate as operating target, although it is often unclear which specific interest rate performs the role. Neither does there exist connection between the interest rate targeted and the maturity of open market operations carried out by the central banks (Swank and Velden, 1996). However, in recent years, central banks have further sharpened their focus on interest rates as operating target. Regarding the choice of operating target, Poole (1970) suggests that when money market volatility is higher than the volatility of goods market, the nominal interest rate will be the better operating target.

Many researchers have done several studies to find an optimal operating target of monetary policy in the context of different countries. Those studies estimated the suitable operating target based on a set of conditions including policy goals, instruments, intermediate target, and many others. Therefore, operating target variable is not a single and dominating factor to determine the effectiveness of monetary policy. On the other hand, the monetary policy framework should be changed according to development of financial market and the structure of the economy.

The monetary policy framework in India was changed from multiple indicators approach to inflation targeting after 2013. Bhattacharya (2006) explained that the India has a long evolutionary process of Monetary Policy Framework beginning with pre monitory targeting (1970-71 to 1984-85), monetary targeting (1985-86 to 1997-98), and multiple indicators approach (1998-99 to 2004/05). Flexible inflation targeting was formally adopted in India with the Monetary Policy Framework Agreement between Government and RBI in 2015. Moreover, as the monetary policy committee (MPC) was formed in 2016, the MPC has mandate to determine appropriate policy interest rate to achieve targeted inflation rate (Mohan and Ray, 2018).

There is no consensus among central bankers and economists regarding the superiority of the operating target. While Gordon (1979) finds that interest rates were the superior instrument for monetary policy, Sergeant and Wallace (1975) prefer reserve money as the instrument. Niemann et al (2010) concludes that the welfare maximizing choice of instruments depends on the economic environment under consideration. Poole (1970), Woglom (1979), Benavie and Froyen (1983), Butter (1983) and Phongthiengtham (undated) on the other hand argues that monetary authorities can even have an optimal combination instrument which lies between the interests rate and monetary instruments.

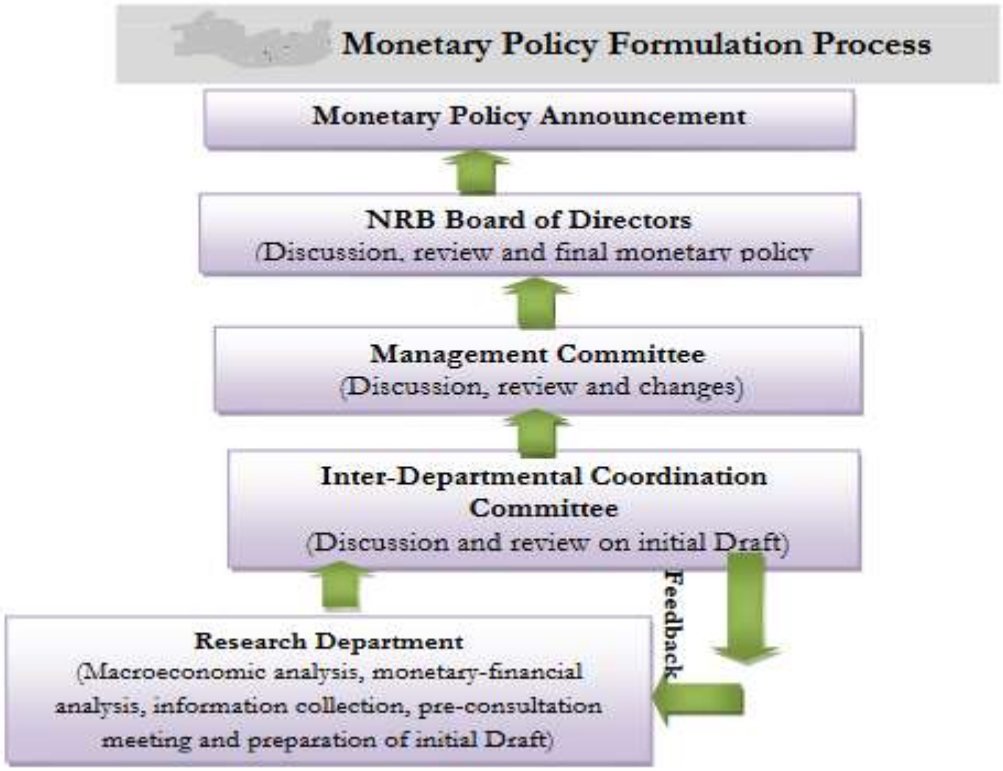
Financial inclusion and innovations in the Nepalese economy increased the importance of the interest rate channel. However, the effectiveness of interest rate channel of monetary policy transmission depends on different phases. It primarily depends on whether central bank policy rates affect the explicit or the implicit operating target, often the short term interest rate or not. In the next phase, it depends on the pass through effect of the short term rates to the long-term rates through the yield curve. Finally, the stability of the relationship between the intermediate and the final target is critical to the successful conduct of the operations. On the other hand, the stability and the predictability of the money multiplier is primary condition in monetary targeting.

Furthermore, there are several other practical issues including fixed exchange rate as a nominal anchor in influencing the effectiveness of monetary policy in Nepal. Since there is no clear consensus among economists and central bankers regarding choice of operating target variable for the country like Nepal, the issue should be concluded by the empirical results. This study assesses and compares the relative strength of interest rate and excess reserve as operating target of monetary policy in Nepal. Since, no study has been done in Nepal to determine the optimal instrument of monetary policy; this study will not only bridges the research gap but also explores the area of further research.

# II. EVOLUTION OF MONETARY POLICY FRAMEWORK IN NEPAL

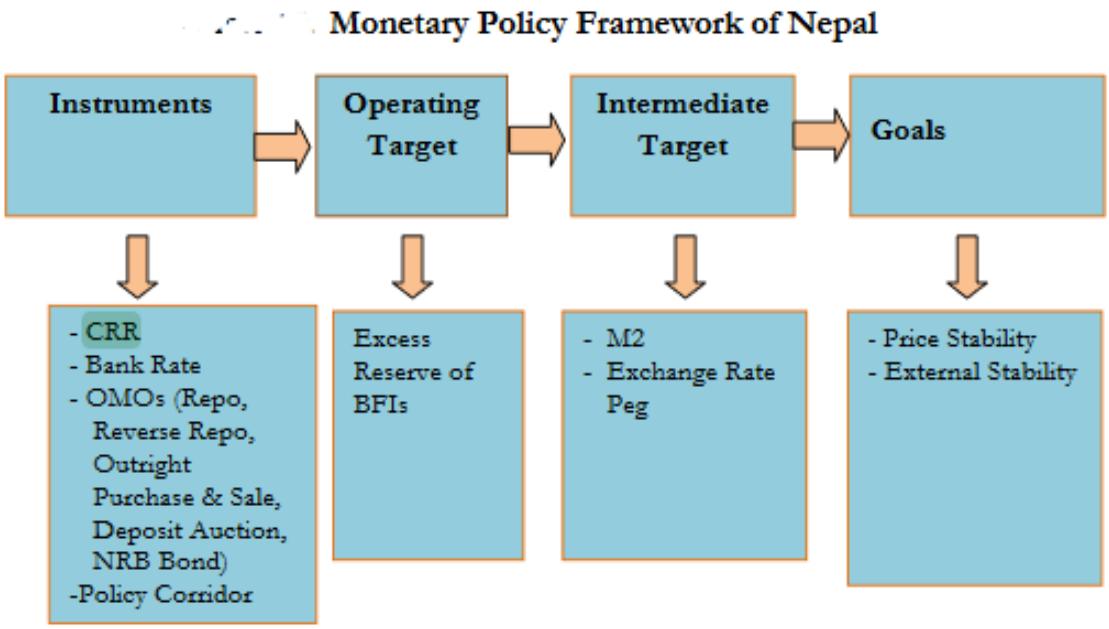
## 2.1 Present monetary policy framework: legal, institutional and operational

Nepal Rastra Bank Act 2002 and its two amendments have given the authority to NRB for monetary policy formulation. Monetary policy is formulated after completing several phases including collection of suggestions from stakeholders to final approval from NRB Board. Research Department of Nepal Rastra Bank works as a coordinating department to draft monetary policy. Research Department prepares draft report of monetary policy based on macroeconomic and financial situation and the domestic and international economic outlook. The policy goals and programs are designed taking into account the long term development goals along with policy and programs of government budget. The important suggestions collected from public and key stakeholders are incorporated in the policy document. The suggestions from different department more specifically regulation and supervision, payment system, foreign exchange management are rigorously discussed in inter departmental co-ordination committee, the 10 member committee chaired by Executive Director of Research Department. Appropriate issues from committee are incorporated in draft report. The draft is presented in management committee of the bank. The Research Department incorporates the feedback and suggestions of management committee in the report and presents in the NRB Board, chaired by the Governor. Finally, Governor releases the monetary policy after approval of Board of Directors.




*Source : Nepal Rastra Bank (2018)*

The NRB has legal mandates of attaining multiple goals such as price stability, external sector stability, and facilitating economic growth. In order to achieve these goals, NRB uses the instruments such as open market operations instruments sale/ purchase of government/NRB securities, repo and reverse repo auctions using the assets like Treasury bills, development bonds of the GON, NRB bonds in case they exist. NRB has introduced Interest Rate Corridor in 2016. However, it has still been in developing phase. Along with, deposit collection auction, NRB bonds are used to mop up excess liquidity of the market. The liquidity operation related function is guided by "Nepal Rastra Bank Khulla Bajar Biniyamali, 2071 and Interest Rate Corridor Related Procedure, 2076". NRB also uses its conventional instruments such as CRR, SLR, SLF and refinancing facilities. The interbank rate hase been taken as an operating target and previously it was excess reserve of counterparties ("Commercial Banks, "Development Banks" and "Finance Companies"). The broad money (M2) is considered as an Intermediate target, given fixed exchange rate with India as nominal anchor. The Building block form instrument to final goals of monetary policy is known as monetary policy framework. It is shown in figure below:




*Source : Nepal Rastra Bank (2018)*

## 2.2 Operational procedure

The formulation of monetary policy follows from Research Department to Board of Directors. The issue here comes how the monetary policy works. The answer is NRB observes the current state of economy. This includes the aggregate demand, supply, exchange rate, monetary condition, real marginal cost, neutral interest rate, covered interest parity, inflation expectation, etc. The analysis gives information to the central bank for further initiatives. The central bank cannot directly control monetary supply and interest rate to

guide the economy in the desired direction. It uses available instruments. The impact of instruments falls on the operating target, which again fall to intermediate target and this transmitted to the final goals. If the central bank is able to choose these variables from instruments to intermediate targets align with final goals, central bank is effective in achieving its goals. Otherwise, the effort of central bank goes in vain. The main objective of this study is to find the effectiveness of operating target of monetary policy in Nepal.

### 2.3 How it evolved over time?

After the establishment of Nepal Rastra Bank in 1956, the main role at that time was to increase the circulation of Nepalese currency over the country. In the 1966, Nepal Rastra Bank realized the role of monetary policy to influence the availability of money in order to guide the economy at determined director. So, the central bank of Nepal issued the Cash Reserve Ratio.

In 1989, the monetary policy implementation started to give emphasis on indirect instruments shifting from the direct instruments. The focus had been given to use of OMOs instruments in liquidity operation.

Realizing the need for clear communication of monetary policy to stakeholders, Nepal Rastra Bank started to publish its monetary policy in annual basis. Nepal Rastra Bank started mid-term review of annual monetary policy in 2004/05 realizing the periodic review is effective to have impact on specified goals. Considering this view as well as change may occur in short span of time, monetary policy was started in quarterly basis in 2016/17.

## III. RESEARCH METHODOLOGY

### 3.1 Data and Model Specification

This study is quantitative in nature and inferential research design has been used. To analyse the relationship between selected variables, the monthly secondary data series has been used from mid-July 2012 to mid-October 2019. The data are collected from Quarterly Economic Bulletin and Current Macroeconomic and Financial Situation published by the Nepal Rastra Bank.

The study uses interbank rate and transaction of commercial banks, excess reserve of commercial banks at NRB, weighted average deposit and lending rate of commercial banks, 91-days treasury bills rate, liquidity injection and absorption through OMO, cash reserve ratio for commercial bank (CRRa), bank rate, standing liquidity facility, foreign exchange intervention and broad money. Broad money is converted to flows taking difference with preceding month. CRRa, bank rate, Liquidity injection and absorption represent monetary policy instruments; interbank rate and excess reserve are operating targets; and broad money is intermediated target of monetary policy.

In order to assess the effectiveness of operating targets, the response of instruments to operating target is also examined. Likewise, the relationships of interbank rate and excess reserve have been observed with intermediate targets.

### 3.2 Relationship between variables

#### *(a) Monetary instruments to operating target*

The monetary framework suggests that the impact of monetary instruments fall on operating target. There exist two equations based on this argument.

$$I\_BANK = a1 + a2CRR + a3BR + a4\ LIQ\_INJ + a5\ LIQ\_ABSORP + a6\ Trans\_interbank + a7\ FOREX\_INT + e1 \quad \ldots\ldots\ldots (1)$$

$$EXCESS\_RES = b1 + b2CRR + b3BR + b4\ LIQ\_INJ + b5\ LIQ\_ABSORP + b6\ Trans\_interbank + b7\ FOREX\_INT + e2 \quad \ldots\ldots\ldots (2)$$

Where, EXCESS_RES= Excess reserve, I_BANK=Interbank rate CRR=Cash Reserve Ratio for commercial banks (CRR times total domestic deposit of same month), BR= Bank Rate, LIQ_ABSORP = Liquidity Absorption, LIQ_INJ =Liquidity Injection, TRANS_INTERBANK=Interbank transaction FOREX_INT=Foreign Exchange Intervention, SLF=Standing Liquidity Facility.

#### *(b) Operating target to intermediate target*

The following two equations represent the impact of operating target on intermediate target:

$$F\_M2 = c1 + c2interbank\ rate + e3 \quad \ldots\ldots\ldots (3)$$

$$F\_M2 = d1 + d2excess\ reserve + e4 \quad \ldots\ldots\ldots (4)$$

Where, F_M2= Monthly Flows of M2

Hence, there is scope of seven bivariate models in this analysis.

### 3.3 Methods of analysis

Time series econometrics has been used to estimate and analyse the coefficients. This work uses the methods of analysis as below.

#### *(a) Unit Root Test*

The theory behind ARMA estimation is based on stationary time series. A series is said to be (weakly or covariance) stationary if the mean and auto covariance of the series do not depend on time. Any series that is not stationary is said to be non-stationary. A common example of a non-stationary series is the random walk:

$$yt = yt\text{-}1 + e1$$

where, e is a stationary random disturbance term. The series y has a constant forecast value, conditional on t, and the variance is increasing over time. The random walk is a difference stationary series since the first difference of y is stationary:

$$yt-yt-1=(1-L)yt = e1$$

A difference stationary series is said to be integrated and is denoted as I(d) where d is the order of integration. The order of integration is the number of unit roots contained in the series, or the number of differencing operations it takes to make the series stationary. For the random walk above, there is one unit root, so it is an I(1) series. Similarly, a stationary series is I(0). Standard inference procedures do not apply to regressions which contain an integrated dependent variable or integrated regressors. Therefore, it is important to check whether a series is stationary or not before using it in a regression. The formal method to test the stationary of a series is the unit root test.

### *(b) Auto Regressive Distributed Lag (ARDL)*

The ARDL co-integration procedure, introduced by Pesaran and Shin (1999) and Pesaran, Shin, and Smith (1997, 2001), has been used to examine the long-run relationship between the dependent and independent variables. One of the important features of this test is that it is free from unit-root pre-testing and can be applied regardless of whether variables are I(0) or I(1). In addition, it does not matter whether the explanatory variables are exogenous (Pesaran and Shin, 1997). The short run and long run parameters with appropriate asymptotic inferences can be obtained by applying OLS to ARDL with an appropriate lag length.

### *(c) Bound Test*

This study applies Bound Test to examine the existence of the long run equilibrium relationship among variables because of the presence of stationary and non-stationary data. Bounds at 1 percent, 5 percent and 10 percent level of significance are compared with the value of F-Statistic.

### *(d) Error Correction Model*

This study examines the speed of adjustment of short term towards the long term equilibrium using error correction model. The error correction model based on the relationship between instruments to operating target and operating target to intermediate targets are tested in the study.

### *(e) Residual Test*

The residual tests have been applied to know the normality of distribution of residual, absence of serial correlation and constant variance. In the most of the cases, the serial correlation is tested by using Breusch-Godfrey Serial Correlation LM tests; heteroscedasticity is checked by using Breusch-Pagan Godfrey test; and normality using Jarque-Bera test. Similarly, Cumulative Sum test is used to test the stability of the models.

### *(f) Stability Test*

This study applies CUSUM test to examine the stability of the parameters in all equations.

## IV. EMPIRICAL ANALYSIS

### Results of Unit Root Test

As mentioned in the research methodology, stationarity of all series is checked using the Augmented Dickey-Fuller unit root tests. Since, they have been found stationary at first difference, they are integrated of the order one, i.e., I(1). The result of the Augmented Dickey-Fuller unit root tests are presented in Table 1.

**Table 1**
**Unit Root Test**

| Description | Level | | | 1st Difference | | |
|---|---|---|---|---|---|---|
| | Intercept | Trend & Intercept | None | Intercept | Trend & Intercept | None |
| Interbank rate | -2.85*** | -4.48* | 0.75 | -5.41* | -5.68* | -5.34* |
| Excess Reserve (EXCESS_RES) | -5.17* | -4.48* | -0.6900 | -6.17* | -6.17* | -6.22* |
| Weighted Average Deposit Rate | -0.4400 | -1.6600 | 0.4000 | -6.72* | -7.05* | -6.74* |
| Weighted Average Lending Rate | -1.7800 | -1.9300 | -0.4900 | -3.09** | -3.41*** | -3.1* |
| Tbills 91 Days | -2.88** | -3.58** | -1.84*** | -5.12* | -5.26* | -5.12* |
| Liquidity Injection | -2.3100 | -2.4600 | -1.68*** | -9.74* | -9.68* | -9.8* |
| Liquidity Absorption | -2.96** | -3.21*** | -2.46* | -8.65* | -8.62* | -8.7* |
| CRR | -1.2400 | -1.9500 | -0.5400 | -9.96* | -9.93* | -9.96* |
| Bank Rate | -0.2900 | -4.65* | -0.6500 | -12.1* | -12.15* | -11.9* |
| SLF | -8.39* | -8.78* | -7.84* | -7.1* | -7.12* | -7.09* |
| Foreign Intervention | -5.94* | -6.4* | 0.3600 | -3.9* | -5.31* | -3.93* |
| Interbank Transaction | -1.3200 | -2.5700 | 0.1600 | -10.63* | -10.58* | -10.58* |
| M2_Monthly_Flows | -1.0400 | -2.1200 | 1.0600 | -8* | -7.92* | -7.82* |

* Stationary at 1% level of significance, ** Stationary at 5% level of significance, *** Stationary at 10% level of significance

### ARDL

The results of ARDL Tests based on the relationships of instruments with operating targets and operating targets with intermediate targets are presented in Table 2.

**Table 2**
**ARDL Test**
**Dependent Variable: Excess Reserve**

| Variable | Coefficient | t-Statistic | Prob.* |
|---|---|---|---|
| EXCESS_RES(-1) | 0.43 | 3.65 | 0.00 |
| EXCESS_RES(-2) | -0.15 | -1.37 | 0.17 |
| EXCESS_RES(-3) | 0.29 | 2.78 | 0.01 |
| EXCESS_RES(-4) | -0.16 | -1.58 | 0.12 |
| LIQ_ABSORP | -0.03 | -0.13 | 0.90 |
| LIQ_INJ | 0.08 | 0.43 | 0.67 |
| LIQ_INJ(-1) | -0.10 | -0.59 | 0.56 |
| LIQ_INJ(-2) | 0.22 | 1.32 | 0.19 |
| LIQ_INJ(-3) | -0.39 | -2.55 | 0.01 |
| LIQ_INJ(-4) | 0.26 | 1.95 | 0.06 |
| CRR_A | -7843.63 | -0.83 | 0.41 |
| CRR_A(-1) | -31290.48 | -2.50 | 0.01 |
| CRR_A(-2) | 54051.01 | 4.31 | 0.00 |
| CRR_A(-3) | -26928.42 | -2.95 | 0.00 |
| BANK_RATE | 34729.01 | 1.84 | 0.07 |
| BANK_RATE(-1) | -40852.63 | -1.61 | 0.11 |
| BANK_RATE(-2) | 59939.03 | 2.44 | 0.02 |
| BANK_RATE(-3) | -44212.08 | -2.41 | 0.02 |
| FOREX_INT | 0.90 | 2.94 | 0.00 |
| TRANS_INTERBANK | -0.35 | -4.13 | 0.00 |
| TRANS_INTERBANK(-1) | 0.25 | 2.66 | 0.01 |
| C | -9825.77 | -0.22 | 0.83 |
| R-squared =0.67 | Adjusted R-Squared : 0.56 | | |

The ARDL Test shows that the excess reserve is influenced by the non–policy variables than policy variables. It is determined by its past behaviour. In the policy front, bank rate is significant to influence excess reserve of commercial banks maintained at NRB. A one percentage point change in bank rate makes change in excess reserves by Rs. 35 billion. In the non-policy front, foreign exchange intervention and interbank transaction have significant impact on excess reserve.

Likewise, the interbank bank rate is positively influenced by its past behaviour. It is mainly determined by non–policy variables. OMO seems insignificant to explain interbank rate. However, in the non-policy front, interbank transaction of Rs. 1 billion increases 0.02 percentage point in interbank rate. Such transaction of one month and two months ago decreases interbank rate by 0.01 percentage point (Table3).

**Table 3**
**ARDL Test**
**Dependent Variable: I_RATE**

| Variable | Coefficient | t-Statistic | Prob.* |
|---|---|---|---|
| I_RATE(-1) | 0.61 | 6.53 | 0.00 |
| LIQ_ABSORP/1000 | 0.00 | -0.48 | 0.63 |
| LIQ_INJ/1000 | 0.00 | 0.53 | 0.60 |
| TRANS_INTERBANK/1000 | 0.02 | 4.96 | 0.00 |
| TRANS_INTERBANK(-1)/1000 | -0.01 | -1.11 | 0.27 |
| TRANS_INTERBANK(-2)/1000 | -0.01 | -1.97 | 0.05 |
| FOREX_INT/1000 | 0.02 | 1.75 | 0.08 |
| FOREX_INT(-1)/1000 | 0.01 | 0.77 | 0.44 |
| FOREX_INT(-2)/1000 | 0.00 | -0.02 | 0.99 |
| FOREX_INT(-3)/1000 | -0.03 | -2.57 | 0.01 |
| BANK_RATE | -0.42 | -1.45 | 0.15 |
| CRR_A | 0.17 | 0.87 | 0.39 |
| C | 2.46 | 1.11 | 0.27 |
| R-squared | 0.77 | D-W | 2.00 |
| Adjusted R-squared | 0.73 | | |

Moreover, the M2 is influenced by its behaviour of three months lags. A one unit increase in M2 of three months lags increases M2 of current period by 0.53 units. However, it is observed that the excess reserve has insignificant impact on M2. Likewise, it is observed that the one month lag excess reserve has negative impact on M2 (Table 4).

**Table 4**
**ARDL Test**
**Dependent Variable: Broad Money (M2)**

| Variable | Coefficient | t-Statistic | Prob.* |
|---|---|---|---|
| F_M2(-1) | -0.11 | -1.49 | 0.14 |
| F_M2(-2) | -0.08 | -1.24 | 0.22 |
| F_M2(-3) | 0.53 | 7.65 | 0.00 |
| EXCESS_RES | 0.04 | 0.41 | 0.69 |
| EXCESS_RES(-1) | -0.16 | -1.82 | 0.07 |
| DUM1 (Cyclical factor for July) | 78238.67 | 9.91 | 0.00 |
| C | 17105.37 | 3.13 | 0.00 |
| R-squared: 0.72 | Adjusted R-squared: 0.69 | DW: 1.79 | |

M2 is influenced by its behaviour of three months lags. One unit increase in three months lags M2 increases current period M2 by 0.5 units. Similarly, one percentage point increase in one month lag interbank rate increases M2 by Rs. 5 billion. Contrary to this, one percentage point increase in two month lag interbank rate decreases M2 by Rs. 6 billion (Table 4).

**Bound Test**

**Table 5**
**Bound Test**

| Significance | Instruments | | | | M2 | | | |
|---|---|---|---|---|---|---|---|---|
| | Excess Reserve | | Interbank Rate | | Excess Reserve | | Interbank Rate | |
| | I(0) | I(1) | I(0) | I(1) | I(0) | I(1) | I(0) | I(1) |
| 10% | 2.09 | 3.10 | 2.24 | 3.38 | 4.14 | 4.90 | 4.14 | 4.90 |
| 5% | 2.43 | 3.52 | 2.63 | 3.86 | 5.06 | 5.93 | 5.06 | 5.93 |
| 1% | 3.17 | 4.49 | 3.46 | 4.94 | 7.10 | 8.26 | 7.10 | 8.26 |
| F-Statistics | 3.51 | | 3.15 | | 10.62 | | 11.89 | |
| Conclusion | Co-integration | | No Co-integration | | Co-integration | | Co-integration | |

**Error Correction Model**

Error correction shows the disequilibrium correction is fast and significant (Table 6, 7 and 8). The coefficient on the error correction term is expected in between -1 and 0. The negative sign shows the degree of correction.

**Table 6**
**Error Correction Model**

Instruments-Excess Reserve

ARDL Error Correction Regression

| Dependent Variable: D(EXCESS_RES) | | | |
|---|---|---|---|
| Selected Model: ARDL(4, 0, 4, 3, 3, 0, 1) | | | |
| ECM Regression | | | |
| Case 2: Restricted Constant and No Trend | | | |
| Variable | Coefficient | t-Statistic | Prob |
| D(EXCESS_RES(-1)) | 0.02 | 0.10 | 0.21 |
| D(EXCESS_RES(-2)) | -0.13 | 0.09 | -1.38 |
| D(EXCESS_RES(-3)) | 0.16 | 0.09 | 1.90 |
| D(LIQ_INJ) | 0.08 | 0.12 | 0.66 |
| D(LIQ_INJ(-1)) | -0.09 | 0.13 | -0.66 |
| D(LIQ_INJ(-2)) | 0.13 | 0.13 | 0.96 |
| D(LIQ_INJ(-3)) | -0.26 | 0.12 | -2.17 |
| D(CRR_A) | -7843.63 | 8194.78 | -0.96 |
| D(CRR_A(-1)) | -27122.59 | 8340.43 | -3.25 |
| D(CRR_A(-2)) | 26928.42 | 8252.63 | 3.26 |
| D(BANK_RATE) | 34729.01 | 16326.72 | 2.13 |
| D(BANK_RATE(-1)) | -15726.95 | 16246.55 | -0.97 |
| D(BANK_RATE(-2)) | 44212.08 | 15824.68 | 2.79 |
| D(TRANS_INTERBANK) | -0.35 | 0.07 | -4.89 |
| CointEq(-1)* | -0.59 | 0.11 | -5.59 |
| R-squared : 0.65 | | DW : 2.27 | |
| Adjusted R-squared : 0.58 | | | |

* P-value incompatible with t-Bounds distribution.

**Table 7**
**Error Correction Model**

Interbank-M2

| ARDL Error Correction Regression | | | |
|---|---|---|---|
| Dependent Variable: D(F_M2) | | | |
| Selected Model: ARDL(3, 3) | | | |
| ECM Regression | | | |
| Case 3: Unrestricted Constant and No Trend | | | |
| Variable | Coefficient | t-Statistic | Prob. |
| C | 8260.88 | 2.30 | 0.02 |
| D(F_M2(-1)) | -0.42 | -3.97 | 0.00 |
| D(F_M2(-2)) | -0.50 | -7.64 | 0.00 |
| D(I_RATE) | 1198.14 | 0.76 | 0.45 |
| D(I_RATE(-1)) | 2690.00 | 1.45 | 0.15 |
| D(I_RATE(-2)) | -3128.19 | -1.76 | 0.08 |
| DUM1 | 83489.07 | 11.04 | 0.00 |
| DUM | -6660.27 | -1.02 | 0.31 |
| CointEq(-1)* | -0.71 | -4.91 | 0.00 |
| R-squared : 0.89 | | DW : 1.61 | |
| Adjusted R-squared: 0.88 | | | |
| * p-value incompatible with t-Bounds distribution. | | | |

**Table 8**
**Error Correction Model**

Reserve-M2

| ARDL Error Correction Regression | | | |
|---|---|---|---|
| Dependent Variable: D(F_M2) | | | |
| Selected Model: ARDL(3, 1) | | | |
| Variable | Coefficient | t-Statistic | Prob. |
| C | 17105.37 | 3.24 | 0.00 |
| D(F_M2(-1)) | -0.44 | -4.21 | 0.00 |
| D(F_M2(-2)) | -0.53 | -7.74 | 0.00 |
| D(EXCESS_RES) | 0.04 | 0.46 | 0.65 |
| DUM1 | 78238.67 | 10.49 | 0.00 |
| CointEq(-1)* | -0.66 | -4.64 | 0.00 |
| R-squared : 0.88 | | DW : 1.79 | |
| * p-value incompatible with t-Bounds distribution. | | Adjusted R-squared : 0.87 | |

In all cases, the co-integrations are significant and the coefficient values that the correction is fast towards long-run equilibrium

## Residual Test

**Table 9**
**Residual Test**

| | Normality | | Autocorrelation | | Homoscedasticity | |
|---|---|---|---|---|---|---|
| | JB Test | Prob. | Obs*R-squared | Prob. Chi-Square | Obs*R-squared | Prob. Chi-Square |
| Instruments-Excess Reserve | 0.05 | 0.97 | 5.07 | 0.08 | 14.27 | 0.86 |
| Instruments-Interbank Rate | 5.38 | 0.07 | 0.03 | 0.99 | 23.7 | 0.02 |
| Excess Reserve-M2 | 0.37 | 0.83 | 5.17 | 0.08 | 15.95 | 0.01 |
| Interbank-M2 | 1.04 | 0.60 | 18.59 | 0.10 | 10.21 | 0.33 |

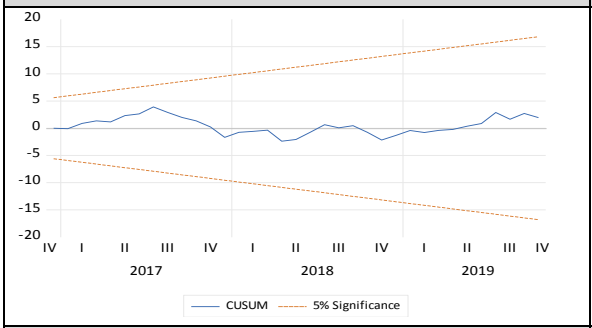
The normality test shows that the error terms in all relations are normally distributed at 5 percent level of significance as the probability value of JB tests are greater than 5 percent. Similarly, there is absence of serial autocorrelation at 5 percent level of significance in these relations as probability chi-square of Obs R-Square are greater than 5 percent. However, the variance of error terms is constant at 1 percent level of significance as the probability of the tests is greater than 1 percent.

## Stability Test

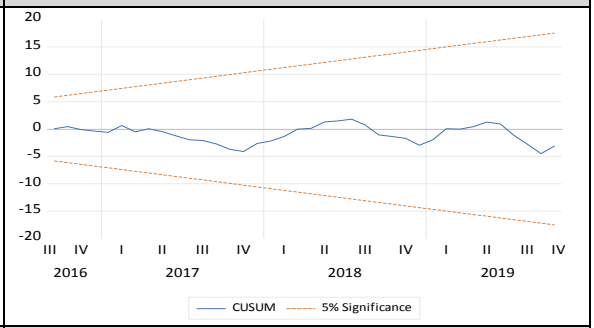
The results of CUSUM test shows that the parameters are stable in all equations at 5 percent level of significance (Table 10).

**Table 10**
**Stability Tests**

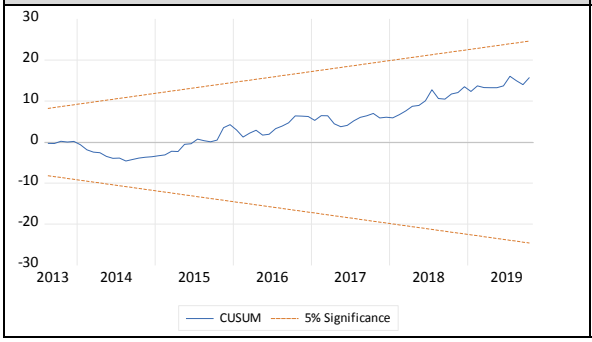
**Instruments-Excess Reserve**



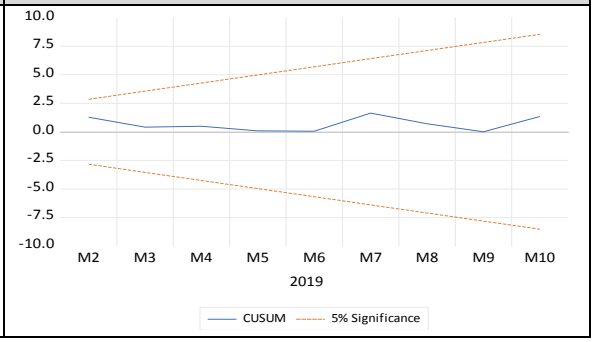

**Instruments-Interbank Rate**




**Reserve-M2**




**Interbank-M2**



The CUSUM tests show that the cumulative sums (CUSUMs) of the deviations of each sample value from the target value. All tests show that the CUSUMs are within the critical bounds of a 5% significance level.

## V. CONCLUSION

The paper makes the comparative analysis of the efficiency of excess reserve and interest rate as an operating target of monetary policy of Nepal. By using the monthly data series for the period of mid-July 2012 to mid-October 2019, the study assesses the effectiveness of operating targets; the response of instruments to operating target and the operating targets (interbank rate and excess reserve) to intermediate targets is examined separately. The study uses econometric methods like ADF test, ARDL Model, Bound Test, Error Correction Model, Residual Test and Stability test to estimate the results. The results obtained from quantitative method do not declare superiority of any one operating target for Nepal.

The empirical results show that both the excess reserve and interbank rate are influenced by the non–policy variables than policy variables. Bank rate, foreign exchange intervention and interbank transaction have significant impact on excess reserve. Likewise, the effectiveness of OMO should be strengthen to explain interbank rate. Moreover, the M2 is influenced by its past behavior rather than excess reserve. Overall, the empirical results supports the existing practice of implementing interest rate based monetary policy taking into consideration of excess reserve in BFIs.

## REFERENCES

Benavie, A and Froyen R. T . 1983. Combination Monetary Policies to Stabilize Price and Output under Rational Expectations. Journal of Money, Credit, and banking, 186-98.

Bhattacharya, K. 2006. Monetary policy approaches in India in BIS Papers 31. Monetary Policy in Asia: Approaches and Implementation.

Bindseil, U. 2004. The Operational Target of Monetary Policy and the Rise and Fall of Reserve Position Doctrine. ECB Working Paper No. 372.

Bindseil, U. 2016. Evaluating Monetary Policy Operational Frameworks. Economic Policy Symposium at Jackson Hole, Wyoming.

Butter, F.A.G. 1983. Choice of Monetary Policy Instruments in a Stochastic IS-LM Model: Some Empirical Remarks for the Netherlands. De Economist, NR 1.

Goodfriend, M. 2002. Interest on Reserves and Monetary Policy. Federal Reserve Bank of New York Economic Policy Review 8 (May): pp.77–84.

Gordon, R. S. 1979. The Choice of Monetary Policy Instruments in Canada. Canadian Journal of Economics. Canadian Economics Association. Vol. 12(4), PP. 615-624.

Mohan R. and Ray P. 2018. Indian monetary policy in the time of inflation targeting and demonetization. Asian Economic Policy Review, 14 (1).

Nakaso, H. 2017. Monetary Policy Divergence and Global Financial Stability: From the Perspective of Demand and Supply of Safe Assets. Speech at a Meeting Hosted by the International Bankers Association of Japan, Tokyo.

Nepal Rastra Bank. Interest Rate Corridor Related Procedure, 2076.

Nepal Rastra Bank. Nepal Rastra Bank (Second Amendment) Act, 2073 BS (2016).

Nepal Rastra Bank. Nepal Rastra Bank Khulla Bajar Biniyamali, 2071.

Nepal Rastra Bank. Sixty Years of Nepal Rastra Bank, 2018

Niemann, S., Pichler P. and Sorger G. 2010. Central Bank Independence and the Monetary Instrument Problem. University of Essex. Department of Economics.

Phongthiengtham P. (undated). A Combination of Monetary Base Targeting and Interest Rate Targeting: Case of Thailand. Chulalongkorn University.

Poole, W. 1970. Optimal Choice of monetary policy instruments in a simple stochastic macro model. Quarterly Journal of Economics, 84, PP. 197-216.

Reis, R. 2013. Central Bank Design. Journal of Economic Perspectives. Volume 27, Number 4. (Fall 2013). PP. 17–44

Sargent, T. J. and Wallace N. 1975. Rational Expectations, the Optimal Monetary Instrument and the Optimal Money Supply Rule. Journal of Political Economy, 83, PP 241-255.

Swank, J. and Velden, L. 1996. Instruments, procedures and strategies of monetary policy: an assessment of possible relationships for 21 OECD countries in Implementation and Tactics of Monetary Policy. BIS Conference Papers: Vol.3.

Walsh, C.E. 2010. Monetary Theory and Monetary Policy (Third Edition). MIT Press, Cambridge, Massachusetts.

Woglom, G. R. H. 1979. Rational Expectations and Monetary Policy in a Simple Macroeconomic Model. Quarterly Journal of Economics, 93 91-105.