Channels of Monetary Policy Transmission in India: A Post-Reforms Macro-econometric Analysis

Ramandeep Kaur

This paper examines the effectiveness and relative strength of various channels of monetary policy transmission in India during the post reform period using the monthly data spanning over 1991:M4 to 2017:M12. The analysis has been via regular and seasonal unit root methods and graphical method has been applied for identification of structural breaks. Alternative methods namely, HEGY, Augmented Dickey Fuller (ADF), Phillips-Perron (PP), KPSS and DF-GLS have been applied for testing the presence of seasonal and regular unit roots. The long-run and short-run behaviors of different channels have been analyzed through Structural Vector Error Correction Model (VECM). In India, first and second important channels of monetary policy transmission mechanism are Credit and Interest rate.

Ramandeep Kaur is Research Scholar, Department of Economics, Panjab University, Chandigarh 160014
Email: raman190589@ gmail.com.

Introduction

The channels of monetary transmission are often referred to as a black box implying that we know that monetary policy does influence output and inflation but we do not know for certain how precisely it does so. This is because not only different channels of monetary transmission tend to operate at the same time but they change over time also. According to the observations of Bernanke and Gertler (1995), to a large extent, empirical analysis of monetary policy has treated monetary transmission mechanism as a "black box." As a result, questions remain: does monetary policy affect the real economy? If so, what is the transmission mechanism by which these effects take place? Therefore, the transmission channels through which monetary policy is conducted are often subtle and complex. While the aim has always been to target a real variable such as aggregate output or employment, the selection of the correct channel of monetary transmission in order to execute the desired plan is often impeded by the structural issues of a given economy's internal context. The story of the channels of monetary transmission, although without doubt built upon certain fundamental theoretical blocs, is an empirical issue.

Several factors influence the path through which monetary policy impulses get transmitted to the different sectors of the economy.

The working of each monetary transmission channel (and there are several of them) depends on a plethora of factors, ranging from the overall stage of macroeconomic development to the nuances of micro-structures of domestic financial markets. Those factors differ tremendously in different regions and regimes of the world, thus, necessitating differentiated and/or regional approaches to the study of monetary transmission channels. So, several factors influence the path through which monetary policy impulses get transmitted to the different sectors of the economy. These are: i) Structure of the economy; ii) Position of financial markets; iii) Degree of financial market integration; iv) Availability of several monetary policy tools; v) Fiscal stance and the pattern of financing fiscal deficit; vi) Central bank's autonomy in conducting monetary policy; vii) Determination of interest rates, exchange rate and various other prices in the economy; and viii) Degree of openness in the economy.

Thus, the rapidly changing structure of the economy tends to influence the effects of given monetary policy measures which requires that it is essential for monetary authorities to continuously reinterpret monetary transmission channels according to the changing economic environment (Kaur R, 2019). The paper is an endeavor in the same direction and addresses the issue of identification of appropriate channels and instruments of monetary policy transmission mechanism.

Literature Review

Several Indian and international researchers have endeavored to examine the channels of monetary policy transmission mechanism e.g., Kulkarni and Huth (1988), Ray et al. (1998), Verma and Pal (2007), Kaushal and Pathak (2012), Mohanty (2012) and Khundrakpam and Jain (2012) are of the view that interest rate channel has emerged as the most important channel of monetary policy transmission mechanism in India especially during the post reform scenario. According to Padhan (2006), money supply and bank credit are equally important in the transmission mechanism of monetary policy during both the pre- and post-deregulation periods. As per the findings of the study, interest rate channel is more strong and important than quantum channel in transmission mechanism of monetary policy during deregulation period.

Interest rate channel is more strong and important than quantum channel in transmission mechanism of monetary policy during deregulation period.

Samantaraya (2003) suggested that in the long run, money neutrality proposition holds good for the Indian economy and in the short-run monetary policy positively impacts the real output, particularly in the post-reform period, mainly through the rate channels. Bhattacharyya and Sensarma (2005) pointed out that increasing reliance on indirect instruments, great market integration and technological innovations improved the channels of communication between RBI and the financial markets and facilitated the conduct of monetary policy.

Mengesha and Holmes (2013) have empirically examined the relevance of monetary policy transmission in case of Ereitrean economy. It has been concluded that the channels of official exchange rate and interest rate are not active, however, the credit channel and effective exchange rate channel are in action. Babatunde and Olatunji (2017) have conducted an empirical analysis with the application of structural modeling through VECM framework to understand the working of interest rate channel of monetary policy transmission mechanism. It has been found that the interest rate and exchange rate play very effective role in the success of monetary policy.

Data Sources & Construction of Variables

The empirical analysis is confined to the post-reform period using the monthly data spanning over the years 1991:M4 to 2017:M12. The Tornquist Index of Moneyness is used as an indicator of monetary policy stance while the wholesale price index (WPI) has been used as indicator of prices. The index of industrial production (IIP) has been taken as a proxy variable for real output because the monthly series of GDP for the period covered under the study is not available (Arora et al, 2018).

To define the interest rate channel of transmission mechanism, the 91-day treasury bills rate (TB) and Call Money Rates (CMR) have been used. However, to define asset price channel, the use of BSE Sensex (BSE) has been preferred. Moreover, to define the credit channel, Total Bank Credit (BC) and Total Deposits (TD) as credit and deposit variables, respectively are used. The expectation channel has been defined through a variable called expected Call Money Rate. The deseasonalized Call Money Rate (DCMR) has been used as a proxy variable for defining expectation channel. However, the exchange rate channel has been defined by using the variables, Exchange Rate in terms of Rupees per U.S. Dollar (ER) and Net Exports (NX).

Different instruments of monetary policy namely, Statutory Liquidity Ratio (SLR), Prime Lending Rates (PLR), Bank Rate (BR), Cash Reserve Ratio (CRR), Net Sale of Dated Securities (DSNS), Dated Securities Rates (DSR), Repo Rate (RR) and Reverse Repo Rate (RRR) have been utilized to test the effectiveness and importance of each instrument of monetary policy transmission in India during the study period. Further, different variables such as Currency with public (CWP), Demand Deposits (DD), Time Deposits (TD), Prime Lending Rates (PLR), Rate of interest on Demand Deposits (RDD) and average Rate of Interest on Time Deposits (RTD) are used for the construction of Tornquist Index of Moneyness.

Source of data for the variables namely, WPI, IIP, BSE, BC, ER, NX, SLR, BR, CRR, DSNS, DSR, RR, RRR, CWP, DD, TD and CMR is Handbook of Statistics on Indian Economy. The monthly data on PLR, Rate of interest on Demand Deposits (RDD) and Rate of Interest on Time Deposits (RTD) have been collected from the head office of SBI under the provisions of Right to Information Act-2005. The T-bills rates (TB) have been downloaded from Business Beacon database of Centre for Monitoring Indian Economy (CMIE).

Except the variables representing rates in percentage terms, the remaining variables are indexed with the base period 2011:08 and transformed into logarithms. However, following Besimi et al. (2006: 9), the variables representing rates in percentage terms (e.g., Interest Rate) are defined as $[(1+\text{interest rate}/100)*100]$. Hence, the coefficients of the logged value variables measure constant elasticities and the coefficients on the Interest Rates will show the percent changes of the dependent variable in response to a percentage change in Interest Rates.

In addition, Tornquist Index of Moneyness has been used instead of M_3 as the variable of monetary stance. A primary pitfall of simple sum is its lack of theoretical foundations. It is a naive index in the sense that it rules out the difference in liquidation and interest yielding properties of all monetary components i.e., it implicitly assumes perfect substitutability among monetary assets. Evaluating the economy by means of simple sum of monetary aggregates, having no theoretical foundations whatsoever can lead to erroneous judgments. Instead, economic decisions must be made based upon solid theoretical foundations, using micro economic theory and statistical index number theory.

Following Ramachandran et al. (2010), the growth rate of Divisia quantity Index or Tornquist Index of moneyness is defined as:

$$\log(Q)_t - \log(Q)_{t-1} = \sum_{i=1}^{n} S_{it}^{*}(\log x_{it} - \log x_{it-1})$$

Where is the average expenditure share of two adjacent periods, is the expenditure share of i^{th} asset. p_{it} is the user cost of i^{th} asset defined as $p_{it} = \frac{R_t - r_{it}}{1 + R_t}$ with r_{it} being the return on i^{th} asset and R_t being the return on the benchmark asset that does not provide monetary services. The Divisia index number is a statistical number which is a non-parametric function of current and past prices and quantities which accurately approximate the exact but unknown quantity aggregates function. In our methodology x_{it} is the quantity of i^{th} financial asset during period t and p_{it} is the price (user cost) of i^{th} financial asset during period t.

Empirical Results

To test the presence of seasonal unit roots, HEGY and Osborne test statistics have been used, whereas, alternative tests namely, ADF, PP, KPSS and ADF-GLS have been utilized to test the presence of regular unit-root. Although, the presence of regular unit-root can also be confirmed from the output of HEGY's procedure, alternative test statistics have been utilized to remove the computational biases (Kaur, 2018, & Kaur, 2019). Therefore, the decision about the existence of regular unit-root is based upon the common outcome of majority of aforementioned test statistics.

Table 1 concludes that regular unit root exists in all the variables under evaluation except CMR, DCMR, DSNS and NX. In HEGY test, $|t(\pi_1)|$ is less than tabulated value of *t* at 5 percent level of significance for all variables except the three above mentioned variables. In Table 2, Osborne test statistics shows that $|t|$ is statistically significant with significant p-values in case of CMR, TD, DCMR and DSNS. Consequently, we cannot reject the null of unit root in TB, TD, BC, ER, NX, BSE, BR, CRR, SLR, PLR, RR, RRR and DSR. Thus, it is required to test the accurate order of integration of these series. Moreover, HEGY and Osborne test statistics rejects the null of stochastic seasonality for all the variables given; i) p-values of t_2 statistics are less than 5% level of significance in case of Osborne test; and ii) F (π_1 to π_{12}) is statistically significant with their values higher than the tabulated values in HEGY test. However, application of HEGY test has showed the presence of deterministic seasonality among 12 variables namely TB, TD, BC, DSNS, NX, CMR, ER, RR, RRR, DCMR, PLR and SLR. So, the seasonal dummies will be included in the analysis of long-run relationship in order to remove the deterministic seasonal components in aforementioned variables.

After analyzing the results of HEGY and Osborne procedures, we have reached the conclusion that except four variables (i.e., *CMR, DCMR, DSNS* and *NX*), all other variables are non-stationary at levels i.e., they have unit root. Thus, in order to identify the order of integration of all the variables, the ADF, PP, KPSS and DF-GLS tests have been executed. However, in case of time series data, it is always necessary to look for the significant structural breaks in the series. The presence of structural break may lead to deceptive results while analyzing the long run relationship. After using Chow test, significant structural breaks have been observed in four variables namely, IIP, TB, ER and SLR variables. Fig.1 shows four panels related to four variables namely, IIP, CMR, SLR and ER, respectively. In each panel, structural break has been highlighted with a dotted line i.e., each of the four above mentioned variables has a significant break or pulse i.e. potential structural break in 1998:M1, 1997:M10 and 1993:M3 in Call money rate (CMR), Statutory Liquidity Ratio (SLR) and Exchange rate (ER), respectively. These pulses are statistically significant and explain sufficient variations in CMR, SLR and ER and therefore, must be introduced as exogenous shocks while analyzing long-run relationships.

Table 1 Testing Seasonality Using Hylleberg-Engle-Granger-Yoo (HEGY) Test

Variables	t (π_1)	t (π_2)	F(π_3& π_4)	F(π_5 & π_6)	F(π_7 & π_8)	F(π_9&π_{10})	F(π_{11} &π_{12})	F(π_1 To π_{12})	F(π_2 To π_{12})
TB	1.979	1.932	12.529**	24.704**	(16.176)**	31.075**	14.662**	20.446**	20.247**
	(3.35)	(3.35)	(6.35)	(6.48)	(6.30)	(6.40)	(3.10)	(1.89)	(2.07)
TD	2.483	2.489	8.839**	22.771**	14.182**	8.317**	9.161**	12.042**	11.891**
	(-3.35)	(-2.81)	(6.35)	(6.48)	(6.30)	(6.40)	(6.46)	(4.44)	(4.58)
BC	0.770	-1.779	14.021**	11.535**	6.297**	11.625**	7.058**	8.730**	8.999**
	(-3.37)	(-1.94)	(3.05)	(3.05)	(3.08)	(3.08)	(3.09)	(1.88)	(2.30)
ER	2.646	2.767	20.108**	18.953**	29.239**	19.256**	20.920**	26.730**	28.312**
	(-2.81)	(-2.81)	(6.35)	(6.48)	(6.33)	(6.41)	(6.47)	(4.44)	(4.37)
NX	2.842**	2.024	15.303**	20.567**	17.241**	25.148**	15.929**	20.079**	20.758**
	(-2.81)	(-2.81)	(6.35)	(6.48)	(6.33)	(6.41)	(6.47)	(4.44)	(4.37)
BSE	-0.122	-4.560**	26.656**	29.089**	19.211**	22.972**	21.289**	25.613**	26.420**
	(-3.37)	(-1.94)	(3.05)	(3.05)	(3.08)	(3.08)	(3.09)	(1.88)	(2.30)
DCMR	3.876**	2.812**	18.617**	14.380**	21.131**	14.649**	31.347**	22.462**	22.679**
	(3.35)	(2.81)	(6.35)	(6.48)	(6.30)	(6.40)	(3.10)	(1.89)	(2.07)
BR	3.024	-2.948**	19.225**	32.638**	9.261**	36.321**	9.231**	26.552**	28.413**
	(-2.82)	(-1.94)	(3.07)	(3.05)	(3.09)	(3.09)	(3.10)	(1.89)	(2.07)
CRR	0.976	-3.389**	1452**	19.598**	16.297**	18.396**	14.493**	17.556**	18.583**
	(-2.82)	(-1.94)	(3.07)	(3.05)	(3.09)	(3.09)	(3.10)	(1.89)	(2.07)
SLR	2.452	2.454	14.729**	17.081**	16.144**	19.868**	14.955**	17.456**	17.978**
	(-2.81)	(-2.81)	(6.35)	(6.48)	(6.33)	(6.41)	(6.47)	(4.44)	(4.37)
RR	2.292	2.273	13.855**	17.128**	15.554**	19.008**	14.207**	17.603**	17.529**
	(3.35)	(3.35)	(6.35)	(6.48)	(6.30)	(6.40)	(3.10)	(1.89)	(2.07)
RRR	2.531	2.521	15.046**	16.795**	15.686**	18.895**	15.132**	17.971**	17.492**
	(3.35)	(3.35)	(6.35)	(6.48)	(6.30)	(6.40)	(3.10)	(1.89)	(2.07)
PLR	2.922	2.618	18.163**	26.999**	15.833**	33.189**	17.037**	31.612**	31.061**
	(-2.81)	(-2.81)	(6.35)	(6.48)	(6.33)	(6.41)	(6.47)	(4.44)	(4.37)

CMR	5.543**	5.521**	0.948	34.525**	33.961**	41.828**	55.436**	30.336**	30.064**
	(3.35)	(2.81)	(6.35)	(6.48)	(6.30)	(6.40)	(6.46)	(4.44)	(4.58)
DSNS	2.805**	2.933**	6.477**	42.108**	12.935**	21.558**	28.957**	23.735**	25.110**
	(-2.81)	(-2.81)	(6.35)	(6.48)	(6.33)	(6.40)	(6.47)	(4.44)	(4.37)
DSR	2.042	2.025	15.303**	20.567**	17.241**	25.148**	15.929**	20.080**	20.758**
	(-2.81)	(-2.81)	(6.35)	(6.48)	(6.33)	(6.41)	(6.47)	(4.44)	(4.37)

Notes: i) The tabulated value for each statistics has been given in parenthesis of type ( ); ii) See Franses & Hobijn (1997) for details on HEGY test; and iii) ** the value is significant at 5 percent level.
Source: Author's Calculations.

Table 3 provides the summary of entire preliminary analysis. It has been observed that except four variables namely *CMR*, *DCMR*, *DSNS* and *NX*, all other variables are non-stationary at levels and are integrated of order one (i.e. I(1)). The results are therefore, supporting the unit root analysis of HEGY and Osborne procedures.

The results are therefore, supporting the unit root analysis of HEGY and Osborne procedures.

In a set of large number of variables there is the possibility of more than one co-integration vector and thus, restrictions will be required to transform the obtained co-integration vectors as per the desired economic theory. Moreover, in co-integration analysis we will have to test all the channels separately and analyze the transmission mechanism in the light of constant effect of other channels. However, under SEM we may use the interaction of all the channels and evaluate the direct and indirect effects of monetary policy shocks on inflation and output. In co-integration analysis, all the variables are assumed to be endogenous whereas using SEM we may use external variables to analyze the effect of instruments of monetary policy transmission mechanism on inflation and output given the different channels of monetary policy transmission mechanism. The instruments of monetary policy transmission mechanism, such as policy rates, are under the control of RBI and thus, assumed to be the exogenous in the model. To exercise monetary policy RBI generally use these rates to target the money supply. Consequently, given different transmission channels, the change in money supply is transmitted to changes in price level and aggregate output. The use of following SEM over the co-integration analysis has been preferred:

A) Interest Rate channel:

IIP = iip (TB, CMR, SDs, Break IIP, T)

WPI = wpi (TB, CMR, SDs, T)

Table 2 Osborne Test of Seasonal and Regular Unit-root

Variable	Unit-root Statistics (t_1)	Seasonality Test (t_2)
TB	-2.711**(0.007)	-14.993***(0.000)
TD	-1.768**(0.078)	-7.729***(0.000)
BC	-0.843(0.819)	-7.739***(0.000)
NFCBC	0.230(0.818)	-7.159***(0.000)
FCBC	-0.615(0.539)	-6.694***(0.000)
ER	0.227(0.820)	-15.244***(0.000)
NX	-11.311***(0.000)	-5.184***(0.000)
BSE	0.031(0.975)	-17.008***(0.000)
DCMR	18.671***(0.000)	5.356***(0.000)
BR	-0.208(0.835)	-13.049***(0.000)
CRR	2.239**(0.026)	-14.744(0.000)
SLR	-0.739(0.461)	-13.362***(0.000)
RR	-0.233(0.873)	-13.686***(0.000)
RRR	0.438(0.662)	-14.072***(0.000)
PLR	0.641(0.522)	-15.948***(0.000)
CMR	-4.826***(0.000)	1.685*(0.056)
DSNS	-6.610***(0.000)	-11.614***(0.000)
DSR	-0.285(0.776)	-15.407***(0.000)

Notes: i) The tabulated value for each statistics has been given in parenthesis of type ( ); ii) See Franses & Hobijn (1997) for details on HEGY test; and iii) ** the value is significant at 5 percent level, and ***signifies 1 percent level of significance.
Source: Author's Calculations.

TB = tb (Tornquist, SDs, T)

CMR= cmr (Tornquist, SDs, T)

Tornquist = tornquist (RR, RRR, CRR, SLR, PLR, DSNS, DSR)

B) Asset Price channel:

IIP = iip (WPI)

WPI = wpi (BSE)

BSE = bse (Tornquist)

Tornquist = tornquist (RR, RRR, CRR, SLR, PLR, DSNS, DSR)

C) Credit channel:

IIP = iip (BC, SDs, Break IIP, T)

WPI = wpi (BC, SDs, T)

BC= bc (TD, SDs, T)

TD= td (Tornquist, SDs, T)

Tornquist = tornquist (RR, RRR, CRR, SLR, PLR, DSNS, DSR, T)

D) Exchange Rate channel:

IIP = iip (NX, SDs, Break IIP, T)

WPI = wpi (NX, SDs, T)

NX = nx (ER, SDs, T)

ER = er (Tornquist, SDs, Break ER)

Tornquist = tornquist (RR, RRR, CRR, SLR, PLR, DSNS, DSR, T)

E) Expectation Channel:

IIP = iip (DCMR, SDs, Break IIP, T)

Table 3 Testing Regular & Seasonal Unit-roots along with Structural Breaks

Series	Presence of Seasonality	Order of Integration	Structural Break(s)
IIP	Yes	*I(1)*	Yes (1995:M3, 2011:M3)
WPI	No	*I(1)*	Not Significant
Tornquist Index	No	*I(1)*	Not Significant
TB	Yes	*I(1)*	Not Significant
CMR	Yes	*I(0)*	Yes(1998:M1)
TD	Yes	*I(1)*	Not Significant
BC	Yes	*I(1)*	Not Significant
BSE	No	*I(1)*	Not Significant
ER	Yes	*I(1)*	Yes (1993:M3)
NX	Yes	*I(0)*	Not Significant
DCMR	Yes	*I(0)*	Not Significant
RR	Yes	*I(1)*	Not Significant
RRR	Yes	*I(1)*	Not Significant
PLR	Yes	*I(1)*	Not Significant
SLR	Yes	*I(1)*	Yes (1997:M10)
BR	No	*I(1)*	Not Significant
CRR	No	*I(1)*	Not Significant
DSNS	Yes	*I(0)*	Not Significant
DSR	No	*I(1)*	Not Significant

Notes: i) Decision on the presence of seasonality is based upon HEGY test; ii) Decision on order of integration is based upon HEGY, ADF, PP, KPSS, DF-GLS test statistics; iii) Structural break has been tested by executing Chow test in JMulti; and iv) Interested readers may ask author for detailed tables on all the tests.
Source: Author's elaborations.

WPI = wpi (DCMR. SDs, T)

DCMR = dcmr (Tornquist, SDs, T)

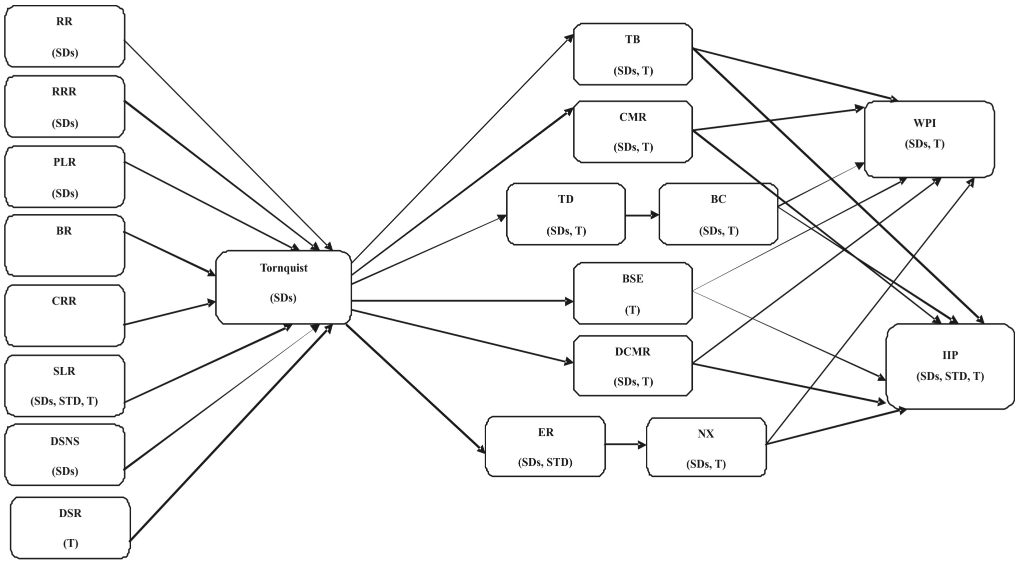
Tornquist = tornquist (RR, RRR, CRR, SLR, PLR, DSNS, DSR, T)

Fig.1 is the diagrammatic representation of aforementioned model. The model has been executed using the Full Information Maximum Likelihood (FIML) method. To remove the estimation biases, use of bootstrapped S.E and p-values have been preferred for testing the significance of estimated values of parameters.

The significance of each channel has been tested using the restricted (L_U) and unrestricted L_{UR} likelihood values obtained via executing restricted model without channel under evaluation and full unrestricted model with all the channels. The LR test statistics obtained using the formula $2(\text{Log } L_{UR} - \text{Log } L_R)$ may be then utilized to interpret the relative significance of channel under evaluation.

The LR-statistics follows χ^2 distribution with degree of freedom equals number of restrictions imposed. Higher value of test statistics implies greater difference between log likelihood values of restricted and unrestricted models. Thus, the magnitude of statistics in such case can be used to judge the relative

Fig.1 Structural Equation Model (SEM)



Source: Author's Elaborations
Note: SDs, STD and T represent Seasonal Dummies, Structural Dummy and Time Trend, respectively.

importance of the restricted channel under evaluation; higher, higher the deviation, more the importance of channel.

Table 4 provides the Wald test statistics obtained to test the relative significance of each channel of monetary policy transmission in India. The Wald test statistics of linear hypothesis approaches to the Chi-square variate with degree of freedom equals number of restrictions imposed. For example, four paths in Fig.1, joining Tornquist-TB-IIP (WPI), Tornquist-CMR-IIP (WPI), Tornquist-TB-WPI-IIP and Tornquist-CMR-WPI-IIP, represent Interest Rate channel of monetary policy transmission mechanism in India. If the restrictions of zero coefficients of TB (i.e., Treasury Bills Rate) and CMR (i.e., Call Money Rate) are imposed then these paths will become redundant and consequently Interest Rate channel will be declared ineffective. However, if anyone of these coefficients is significant i.e., non-zero then the Interest Rate channel will be considered effective in controlling inflation and output in the economy.

The Chi-square statistics obtained for each channel are significant at 1 percent level of significance. As discussed in above example, the Chi-square statistics for Interest Rate channel is 181.44 with a p-value of 0.000. Thus, the imposed restrictions are redundant and the Interest Rate channel plays important role in controlling prices and output in India. However, four alternative paths have been used to define Interest Rate channel; two with CMR rate and other two with TB rates. The chi-square test statistics reveal that TB rates are more important than CMR rates in targeting prices and output in India. The value of Chi-square obtained with zero restriction on TB rates is 116.91 in comparison to that obtained for CMR rate to the tune of 28.82. Thus, the TB rates are better conductors of monetary policy in comparison to Call Money rates. Moreover, in India Call Money market is not so developed as Treasury Bills market. The sale and purchase of T-bills by RBI on the behalf of government is major source of funds for state government finances. Further, the instrument helps Central Government to finance the budgetary deficit.

TB rates are more important than CMR rates in targeting prices and output in India.

Table 4 Wald Test Statistics Obtained to Test the Relative Significance of Each Channel of Monetary Policy Transmission In India

Channels	**Restrictions**	χ^2	**p-values**
Interest Rate Channel	[IIP]CMR=[WPI]CMR=[IIP]TB=[WPI]TB=0	181.44**	0.000
1a) Treasury Bill Rate	[IIP]TB=[WPI]TB=0	116.91**	0.000
1b) Call Money Rate	[IIP]CMR=[WPI]CMR=0	28.82**	0.001
Asset Price Channel	[IIP]BSE =[WPI]BSE = 0	152.58**	0.000
Credit Channel	[BC]TD=[IIP] BC =[WPI]BC= 0	2551.66**	0.000
Exchange Rate Channel	[IIP]ER =[NX]ER =[IIP]NX =[WPI]NX = 0	48.12**	0.000
Expectation Channel	[IIP]DCMR =[WPI]DCMR = 0	18.15**	0.000

Note: ** represents the significance at one percent.
Source: Author's Calculations.

Credit channel is the most effective channel in transmitting monetary policy in India.

Further, the comparative analysis of all five channels of monetary policy transmission represents that Credit channel is the most effective channel in transmitting monetary policy in India. The test of the zero restriction of the variables TD (i.e., total deposits) and BC (i.e., total bank credit), yields the highest χ^2 test statistics to the tune of 2551.66 with a p-value 0.000. Hence, the Credit channel has been identified to be the most significant and important channel of monetary policy transmission in India.

The second most important channel is Interest Rate channel with a significant Chi-square value 181.44. In the analysis, two alternative paths have been used to structure the Interest Rate channel; Call Money Rate (CMR) and Treasury Bill Rate (TB). The third most significant channel in monetary policy transmission is Asset price channel. The total effects of BSE Sensex on WPI and IIP are to the tune of (-) 0.068 and 0.083, respectively. Among these impact coefficients, the sign of the total impact of BSE Sensex on IIP is in accordance with the apriori information whereas the sign of WPI doesn't satisfy apriori expectations. A negative impact of BSE Sensex on WPI may be justified on the ground that high share prices distort the consumer preference towards speculation. The reallocation of consumption investment portfolio reduces demand for consumer goods and increases demand for investment goods. In India's WPI, consumer goods explain the majority of the weight and investment goods are the meager source of it. Moreover, the increase in BSE Sensex indicates higher investment and more output in the economy. Enhancing the supply through raising capital may be helpful in reducing the excess demand for commodities and thus, ease the inflationary pressure.

The analysis of another possible Exchange Rate channel holds fourth important place among the five channels of monetary policy transmission in India with a χ^2 value of 48.12 and a p-value less than the level of significance. The rationale behind the modest role being played by this particular channel could be that India has not achieved full capital account convertibility till date and the impact of exchange rate variations is less on domestic prices and output (see D'souza, 2008: 310 for theoretical expositions).

Moreover, the Expectation channel has been observed as the least significant channel in transmitting the monetary policy in India. Although the value to the tune of 18.15 is statistically significant,

Expectations play important role in controlling price level whereas, the output remains unaffected by expectations channel.

yet the observed statistics is lowest in comparison to that obtained for other channels. The results regarding this channel lead us to the conclusion that although expectations work in Indian economy, yet the expectation channel is feeble to target output and prices in India. In our analysis, the expected rate of interest negatively and significantly affects WPI. However, the same channel fails to control aggregate output in the economy. Thus, expectations play important role in controlling price level whereas, the output remains unaffected by expectations channel. It is worth mentioning here that Indians are risk-averse and their economic decisions are mainly guided by saving motives than investment motives i.e. speculative motive is not so important for Indian population. Given the insignificant involvement in speculation, the expectation channel is observed to be operating in a sluggish manner.

Concluding Remarks

An effort has been made to understand the working of channels of monetary policy transmission mechanism in India. The empirical analysis through SEM leads to following conclusions: i) Among the five channels of monetary policy transmission mechanism in India most important is the Credit channel in the post-reform period. Second important channel is Interest Rate channel and it works mainly through the sub-channel of Treasury Bill Rate; ii) Asset Price channel and Exchange Rate channel are third and fourth important ones, respectively, of monetary policy transmission mechanism in India in the post-reform era; and iii) Expectations channel is the least important in the monetary policy transmission mechanism in India in post-reform scenario.

References

Arora, N., Kaur, R. & Kaur, S. (2018), "To What Extent Indian Monetary Policy Is Independent From International Key Players", *Panjab University Research Journal of Arts (PURJA)*, XLV (2), Available at http://purja.puchd.ac.in/journals/volume-xlv-no-2-july-december-2018.pdf.

Arora, N. & Kaur, R., (2019), "Modeling International Trinity and Policy Choices for India", *The Indian Journal of Industrial Relations- A Review of Social and Economic Development*, 54 (4): 631-43.

Babatunde, A. & Olatunji, A.S., (2017), "Monetary Policy Transmission Mechanism and Macroeconomic Aggregates in Nigeria", *Caleb Journal of Social and Management Sciences*, 3 (2) :115 – 34

Bernanke, B. S. & Gertler, M. (1995), Inside the Black Box: the Credit Channel of Monetary Policy Transmission, NBER Working Paper No. 5146, National Bureau of Economic Research.

Besimi, F., Pugh, G. & Adnett, N. (2002), The Monetary Transmission Mechanism in Macedonia: Implications for Monetary Policy, CREE Working Paper 2 (Staffordshire: Centre for Research on Emerging Economies).

Bhatia, D. K. (1991), "Some Suggestions on Monetary Policy", Reserve Bank of India Bombay: Occasional papers, 12 (3) : 277-85.

Bhattacharya, B. B. (1987), "The Effectiveness of Monetary Policy in Controlling Inflation: The Indian Experience, 1951-1985", *Prajnan*, 16 (4) :419-30.

Bhattacharya, I. & Sensarma. R. (2005), "Signaling of Instruments of Monetary Policy: The Indian Experience", *Journal of Quantitative Economics,* 3(2): 180-96.

Boivin, J., Kiley, M. T. & Mishkin, F. S. (2010), How Has the Monetary Transmission Mechanism Evolved Over time? NBER Working Paper No.15879, National Bureau of Economic Research.

Charemza, W. W. & Deadman, D. F. (1997), New Directions in Econometric Practice: General to Specific Modelling, Cointegration and Vector Autoregresion, Edward Elgar, Cheltenham, UK

D'Souza, E. (2008), Macroeconomics. Dorling Kindersley (India) Private Limited., Licensees of Pearson Education in South Asia, *New Delhi.*

D'Souza, E. (2003), "What Is Monetary Policy Doing?" *Economic and Political Weekly*: 821-23.

Kaur, R. (2018), "Sensitivity of Output and Prices to Monetary Policy in India: A Post-Reforms Scenario", *Zenith International Journal of Multidisciplinary Research*, 8(5):13-24.

Kaur R, (2019), "The Effectiveness of Monetary Policy in India: Pre and Post Reforms Comparison", *International Journal of Social Science and Economic Research*, 4 (1): 617-31.

Kaushal, L. & Pathak, N. (2012), "Bank Credit and Aggregate Demand: Evidence on Monetary Policy Transmission", *International Journal of Business Ethics in Developing Economies*, 1 (2): 6-15.

Khundrakpam, J. K. & Jain, R. (2012), "Monetary Policy Transmission in India: A Peep Inside the Black Box" RBI Working Paper Series, No.7.

Kulkarni, G. K. & Huth, L. W. (1988), "Monetary Policy Transmission in India : A Var Analysis", *Prajnan*, 47 (3): 319-28.

Mengesha, L. G. & Holmes, M. J. (2013), "Monetary Policy and Its Transmission Mechanisms in Eritrea", *Journal of Policy Modeling*, 35(5): 766-80.

Mohanty, D. (2012), "Evidence on Interest Rate Channel of Monetary Policy Transmission in India", in *Second International Research Conference at the Reserve Bank of India, February*: 1-2.

Morris, S. C. & Sellon, H. G. (1995), "Bank Lending and Monetary Policy: Evidence on Credit Channel", *Federal Reserve Bank of Kansas City, Quarterly Review (1995):* 59-75.

Padhan, C. P. (2006), "The Relative Importance of Money Supply and Bank Credit in the Transmission Mechanism of Monetary Policy under Interest Rate Deregulation", *Indian Journal of Economics*, 86 (343): 513-20.

Ray, P., Joshi, H. & Saggar, M. (1998), "New Monetary Transmission Channels", *Economic and Political Weekly*, 33 (44): 2787-94.

Verma, S. & Pal S. (2007), "Transmission in Mechanism of Monetary Policy in Pre- and Post-Reforms Periods in India", *Prajnan*, 36 (4): 195-210.