International Journal of Foreign Trade and International Business

E-ISSN: 2663-3159
P-ISSN: 2663-3140
Impact Factor: RJIF 5.22
www.foreigntradejournal.com
IJFTIB 2022; 4(2): 45-51
Received: 23-05-2022
Accepted: 03-07-2022

Dr. Swami Prasad Saxena
Professor, Macroeconomics & Finance, Department of Applied Business Economics, Dayalbagh Educational Institute Deemed to be University, Dayalbagh, Agra, Uttar Pradesh, India

Dr. Swami Prasad Saxena
Assistant Professor, Faculty of Commerce, KRPG College, Mathura, Uttar Pradesh, India

Corresponding Author:
Dr. Swami Prasad Saxena
Professor, Macroeconomics & Finance, Department of Applied Business Economics, Dayalbagh Educational Institute Deemed to be University, Dayalbagh, Agra, Uttar Pradesh, India

Causal analysis of the relationship among inflation, interest rate and exchange rate: Evidence from India

Dr. Veerangna Singh and Dr. Swami Prasad Saxena

DOI: https://doi.org/10.33545/26633140.2022.v4.i2a.76

Abstract
Exchange rate, one of the crucial variables that determines country's competitiveness in the international market depends on several factors, hence is volatile and unpredictable. Besides exchange rate other macroeconomic variables, especially interest rate and inflation also have impact on international market. Present paper is an attempt to know the direction of causality among inflation, interest rate and exchange rate, and examine the impact of impulses or shocks on variations in selected variables considering monthly data for April 2001 to March 2018. VAR granger causality test, the study observes unidirectional causality running from interest rate to exchange rate, interest rate to inflation (CPI), and exchange rate to CPI. The results of SVAR indicate that exchange rate is majorly impacted by interest rate and less by CPI. The impact of exchange rate on CPI is almost negligible.

Keywords: Exchange rate, macroeconomic indicators, VAR granger causality, impulsive response function, SVAR model, variance decomposition

Introduction

Macroeconomic performance of a country is affected by several macroeconomic factors. Among these, exchange rate, one of the crucial variables that determines country's competitiveness in the international market depends on several factors, hence is volatile and unpredictable. Besides exchange rate, interest rate and inflation also have considerable impact on country's performance in domestic market as well as competitiveness in international market. Alike other macroeconomic factors, these variables also are not independent and constant. Fluctuations in these variables take place due to many endogenous and exogenous shocks.

The relationship between inflation and exchange rate is a complex one, which becomes more complicated when interest rate also fluctuates. Among theories and empirical studies explaining the relationship among exchange rate, interest rate and inflation, economists believe that a relatively high inflation in the domestic economy leads to a decrease in exports as export products become less attractive to foreigners as they are more expensive. This results into a decrease in demand for the domestic currency, thus puts downward pressure on the exchange rate. Similarly, high interest rates increase the value of a given country's currency. The higher interest rates that can be earned tend to attract foreign investment, increasing the demand for and value of the home country's currency. Conversely, lower interest rates tend to be unattractive for foreign investment and decrease the currency's relative value. Flexible price monetary model (Frenkel, 1976) states that the change in interest rate is reflection of expected inflation that causes fall in the demand of domestic currency comparative to foreign currency (Dua and Ranjan, 2012) [7].

International Fisher Effect (IFE) theory, an important postulate in macroeconomics links interest rates, inflation, and exchange rates similar to the Purchasing Power Parity (PPP) theory. IFE theory attributes changes in exchange rate to interest rate differentials, rather than inflation rate differentials among countries. The two theories are closely related because of high correlation between interest and inflation rates. The IFE theory suggests that currency of any country with a relatively higher interest rate will depreciate because high nominal interest rates reflect expected inflation. Assuming that the real rate of return is the same across countries, differences in interest rates between countries may be attributed to differences in expected inflation rates.

Literature review

Among researchers who studies relationship among inflation, interest rate and exchange rate, Fama (1975) [10], and Fama and Schwert (1977) [9] tested for Fisher effect in the US and found evidence in favor of approximately constant real interest rates, as implied by the Fisher hypothesis. In contrast, Summers (1983) [19] rejected the Fisher hypothesis for the period before 1990s. Wilcox (1983) [23], Berument and Jelassi (2002) [4], Benhabib, Schmitt-Grohe and Uribe (2002) [3], and Fahmy and Kandil (2002) [8] investigated the effect of inflation on interest rates, while Barshky and Delong (1991) [2] examined the influence of interest rates on inflation (Teker *et al*. 2012) [20].

Wijnbergen (1987) [22] while analyzing behaviour of inflation under fixed and floating exchange rate regimes observed that an underlying fall in government budget constraints facilitate the exchange rate crisis followed by inflation rate. Ghosh *et al*. (1996) [11] did analysis to identify influence of various exchange rate regimes on inflation and productivity growth in 145 IMF countries. They exclaimed that with low inflation rate it is easy to maintain exchange rate peg, but the causality also moves in different direction i.e., countries with fixed exchange rate faces lower inflation rate. Vinh and Fujita (2007) [21] analyzed the impact of real exchange rate on inflation and output in Vietnam. Their results exhibit that a real devaluation affects the inflation and output (IIP) through trade balance and money supply.

Brzezina (2001) [5] while describing the relationship between real interest rate and inflation with reference to monetary theory of price level stated that the quantity theory of money can be used under certain assumptions as a good description of the long-run relationship between money and prices. Villavicencio and Bara (2006) [16] explored short term and long-term determinants of real exchange rate in Mexico; they identified interest rate, foreign assets position, and productivity as an important driver of real exchange rate. Their findings indicate that interest rate and foreign assets position have a significant impact on the exchange rate in short run as well as in long run. Dash and Bhole (2007) [6] analysed the interest rate affect over the exchange rate in phased manner during a period from January 1991 to December 2005. They observed positive relationship between interest rate and foreign exchange rate during high interest rate period (January 1991 to March 1997) and not in other case, the low or soft interest rate period (April 1997 to December 2005).

Teker *et al*. (2012) [20] examined the relationship between consumer price index and deposit interest rates in Turkey through threshold vector error correction (T-VEC) analysis. According to the T-VEC equations; the inflation and the interest rate are positively affected by their past two and one periods respectively. Kayhan, Tayfur and Ahmet (2013) applied non-linear causality test and frequency domain causality test to analyse relationship between interest rates and exchange rates in BRIC-T Countries. They found that interest rate affects exchange rate only in China and that too in long run only. Mohanty and Bhanumurthy (2014) [18] studied the relationship between exchange rate regimes and inflation rate in India. They observed that low inflation rate is not caused by exchange rate regimes, but intervention of RBI causes it through money supply and policies to stabilize the exchange rate. Ikeda, Medvedev, and Rama (2015) [13] examined the impact of US tapering on rupee by considering selected macroeconomic variables. They observed that domestic macroeconomic variables have significant impact on exchange rate dynamics during the 2013 tapering period. US 10 years T-bond yield was found to be the most influencing determinant in that period. Recently, Khumalo *et al*. (2017) [15] while assessing the relationship between inflation and interest rate to form monetary and fiscal policies in Swaziland observed positive relation between these variables.

Objectives

Although, theories and empirical literature discussed above throw light on the relationship of inflation, interest rate, and exchange rate; but their results are inconclusive. Further, these studies do not consider the effects of contemporaneous shocks. Present paper is an attempt to know the direction of causality among inflation, interest rate and exchange rate, and examine the impact of impulses or shocks on variations in selected variables considering monthly data for a period from April 2001 to March 2018.

Material and methods

The data: Data include Rupee-Dollar exchange rate (taken as percentage change), 91 Day Treasury bills return in India, 3-Month Treasury bills return in US, and Consumer price index (CPI) in India and US. Data period is April 2001 to March 2018.

Analytical tools: The collected information is analyzed by using various econometrics techniques, such as vector autoregressive (VAR) Granger causality, structural VAR (SVAR), variance decomposition and impulsive response function. SVAR model is an improvement over VAR model with regard to problem identification; it puts restrictions on the contemporaneous relation among the endogenous variables in the model, and thus identifies the exogenous shocks. Variance decomposition is used to know the explained variance in variables due to exogenous shocks. Impulsive Response Function is used to know the response of exchange rate, interest rate and inflation to the exogenous impulses. The stationarity of data is checked through Augmented Dickey Fuller (ADF) unit root test, Dickey Fuller-Generalized Least Square (DF-GLS), and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) test. VAR granger causality test is applied to check the direction of causality among the variables.

Results and Discussion

Lag order selection: Lag selection done by using Akaike Information Criterion (AIC), indicates lag 4 appropriate for further analysis (table 1).

Stationarity test: To test stationarity of data ADF, DF-GLS and KPSS are used (table 2). The results indicate that exchange rate is stationary at level (I(0)), while interest rate and inflation (CPI) are stationary at first difference (I(1)).

VAR Granger causality: The results of VAR granger causality test (table 3) indicate that CPI and exchange rate do not granger cause interest rate at any level of significance (1 percent, 5 percent, 10 percent, or 20 percent). Exchange rate granger cause CPI at 20 percent and interest rate granger cause CPI at 15 percent level of significance. Similarly, interest rate granger cause exchange rate at 15 percent, but CPI does not granger cause exchange rate at any level of significance. Thus, a unidirectional causality is observed among these three variables that moves from interest rate to exchange rate, exchange rate to CPI, and interest rate to CPI.

SVAR modeling: Structural VAR (SVAR) improves the traditional way of problem identification that resides in VAR model. SVAR identifies exogenous shocks/ structural shocks through identified restrictions. Short run restrictions are placed on the matrices A and B.

Symbolically, *SVAR (1):* $AX_t = \beta_0 + \beta_1 X_{t-1} + \mu_t$.

Here, X has two variables *'r'* and *'y'*, thus $X_t = \begin{bmatrix} r_t \\ y_t \end{bmatrix}$. Thus, the system will be:
$r_t + a_{12}\, y_t = \beta_{10} + \beta_{11}\, r_{t-1} + \beta_{12}\, y_{t-1} + \mu_{rt}$
$a_{21}\, r_t + y_t = \beta_{20} + \beta 21\, r_{t-1} + \beta_{22}\, y_{t-1} + \mu_{yt}$

In matrices form, it can be written as:

$$\begin{bmatrix} 1 & a_{12} \\ a_{21} & 1 \end{bmatrix}\begin{bmatrix} r_t \\ y_t \end{bmatrix} = \begin{bmatrix} \beta_{10} \\ \beta_{20} \end{bmatrix} + \begin{bmatrix} \beta_{11} & \beta_{12} \\ \beta_{21} & \beta_{22} \end{bmatrix}\begin{bmatrix} r_{t-1} \\ y_{t-1} \end{bmatrix} + \begin{bmatrix} \mu_{rt} \\ \mu_{yt} \end{bmatrix}$$

In the above form a_{12} and a_{21} are system coefficients which represent a contemporaneous relation between endogenous variables *r* and *y* (the coefficients of matrix *A*). In SVAR model restrictions are imposed on the contemporaneous relation among the endogenous variables of the model, based on the economic concept and theories. SVAR model is developed by multiplying Matrix *A* with VAR estimation model. If we multiply SVAR model by inverse A, such as: $A^{-1} AX_t = A^{-1} \beta_0 + A^{-1} \beta_1 X_{t-1} + A^{-1} \mu_t$, it gives reduced form of VAR, i.e., $X_t = G_0 + G_1 X_{t-1} + e_t$
Matrix *A* relates the forecast errors of the reduced form VAR, e_t and structural shocks, μ_t, such as: $e_t = A^{-1} \mu_t$. SVAR isolates exogenous shocks and measures the impact of these shocks on the variables included in the model. Forecast errors are linear combinations of the structural shocks. These shocks can be identified directly from reduced form residual (e_t) with matrix *B*, $e_t = B\mu_t$. The more general way of relating errors and shocks in SVARs used by Bernanke and Mihov (1998), Blanchard and Perotti (2002) and others is by combining these two matrices, $e_t = A^{-1} B\mu_t$.

Restrictions imposed on matrix *A* such that

$$A = \begin{pmatrix} 1 & 0 & \cdots & 0 \\ a21 & 1 & \cdots & 0 \\ \cdots & . & . & \cdots \\ ak1 & ak2 & \cdots & 1 \end{pmatrix}$$

Restrictions in matrix '*A*' are imposed on the off-diagonal terms based on economic concepts. The diagonal terms indicate unit change in the variable on itself that should be one, while off diagonal terms indicate contemporaneous relation among the variables that are given restrictions according to economic theories. The matrix is always in a square form, thus for two variables model 2x2 matrix, for three model 3x3 matrix and so on. The number of restrictions is identified as $k(k-1)/2$, where *k* is the number of variables included in model. Here total variables are three, so, the number of restrictions is $3(3-1)/2 = 3$. As per the VAR granger causality results the recursive order of variables identified: 1) interest rate, 2) exchange rate, and 3) CPI. Having these three variables matrix *A* is written as:

$$A = \begin{pmatrix} 1 & 0 & 0 \\ a21 & 1 & 0 \\ a31 & a32 & 1 \end{pmatrix}$$

The diagonal terms are unitary that indicate causality relation of the variables i.e., interest rate, exchange rate and CPI, with themselves. Upper triangular matrix consists of zeroes indicating restrictions, and lower triangular matrix contains coefficients to be estimated. Second row and first column coefficient ($a21$) indicates interest rate impact on exchange rate, third row and first column coefficient ($a31$) indicates interest rate impact on CPI and third row and second column coefficient ($a32$) indicates impact of exchange rate on CPI. As per the assumption of SVAR model, structural shocks are orthogonal that means shocks (μrt, μyt) are uncorrelated. On this note, structural shocks are identified by Matrix *B*, which is a variance - covariance matrix with zero covariance restrictions. It can be written as:

$$B = \begin{pmatrix} a11 & 0 & 0 \\ 0 & a22 & 0 \\ 0 & 0 & a33 \end{pmatrix}$$

The SVAR model for Interest rate (i), exchange rate (r) and CPI (c) is as follows

$$\begin{bmatrix} 1 & 0 & 0 \\ a21 & 1 & 0 \\ a31 & a32 & 1 \end{bmatrix}\begin{bmatrix} i_t \\ r_t \\ c_t \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ a21 & 1 & 0 \\ a31 & a32 & 1 \end{bmatrix}\begin{bmatrix} G_{10} \\ G_{20} \\ G_{30} \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 \\ a21 & 1 & 0 \\ a31 & a32 & 1 \end{bmatrix}\begin{bmatrix} G_{11} & G_{12} & G_{13} \\ G_{21} & G_{22} & G_{23} \\ G_{31} & G_{32} & G_{33} \end{bmatrix}\begin{bmatrix} i_{t-1} \\ r_{t-1} \\ c_{t-1} \end{bmatrix} + \cdots$$

$$\begin{bmatrix} 1 & 0 & 0 \\ a21 & 1 & 0 \\ a31 & a32 & 1 \end{bmatrix}\begin{bmatrix} G_{11} & G_{12} & G_{13} \\ G_{21} & G_{22} & G_{23} \\ G_{31} & G_{32} & G_{33} \end{bmatrix}\begin{bmatrix} i_{t-4} \\ r_{t-4} \\ c_{t-4} \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 \\ a21 & 1 & 0 \\ a31 & a32 & 1 \end{bmatrix}\begin{bmatrix} e_{it} \\ e_{rt} \\ e_{ct} \end{bmatrix}\begin{bmatrix} -b_{11} & 0 & 0 \\ 0 & -b_{22} & 0 \\ 0 & 0 & -b_{33} \end{bmatrix}$$

The estimates of VAR model and SVAR matrices (table 4 and 5) are as follows.

$$\begin{bmatrix} 1 & 0 & 0 \\ 0.4062 & 1 & 0 \\ 0.0165 & 0.0057 & 1 \end{bmatrix}\begin{bmatrix} i_t \\ r_t \\ c_t \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0.4062 & 1 & 0 \\ 0.0165 & 0.0057 & 1 \end{bmatrix}\begin{bmatrix} -0.111 \\ 2.662 \\ 0.069 \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 \\ 0.4062 & 1 & 0 \\ 0.0165 & 0.0057 & 1 \end{bmatrix}$$

$$\begin{bmatrix} 0.226 & 0.034 & -0.217 \\ 0.311 & 0.048 & 0.481 \\ -0.046 & -0.023 & 0.621 \end{bmatrix} \begin{bmatrix} i_{t-1} \\ r_{t-1} \\ c_{t-1} \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 \\ 0.4062 & 1 & 0 \\ 0.0165 & 0.0057 & 1 \end{bmatrix} \begin{bmatrix} -0.185 & 0.016 & -0.285 \\ 0.087 & -0.185 & 0.036 \\ 0.011 & -0.002 & -0.128 \end{bmatrix}$$

$$\begin{bmatrix} i_{t-2} \\ r_{t-2} \\ c_{t-2} \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 \\ 0.4062 & 1 & 0 \\ 0.0165 & 0.0057 & 1 \end{bmatrix} \begin{bmatrix} -0.061 & -0.034 & 0.266 \\ 0.284 & 0.015 & 0.577 \\ -0.001 & -0.006 & -0.233 \end{bmatrix} \begin{bmatrix} i_{t-3} \\ r_{t-3} \\ c_{t-3} \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 \\ 0.4062 & 1 & 0 \\ 0.0165 & 0.0057 & 1 \end{bmatrix}$$

$$\begin{bmatrix} -0.035 & 0.045 & -0.108 \\ 0.004 & -0.206 & -0.010 \\ 0.026 & 0.002 & 0.320 \end{bmatrix} \begin{bmatrix} i_{t-4} \\ r_{t-4} \\ c_{t-4} \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 \\ 0.4062 & 1 & 0 \\ 0.0165 & 0.0057 & 1 \end{bmatrix} \begin{bmatrix} e_{it} \\ e_{rt} \\ e_{ct} \end{bmatrix} \begin{bmatrix} -0.1496 & 0 & 0 \\ 0 & -0.3189 & 0 \\ 0 & 0 & -0.0414 \end{bmatrix}$$

The results of SVAR indicate that the exogenous impact of interest rate on exchange rate is 40.62 percent, impact of interest rate on CPI it is 1.65 percent and the impact of exchange rate on CPI is 0.57 percent.

Variance decomposition

The results (table 6) indicate that interest rate explains 3.50 percent, 5.11 percent, and 5.87 percent variance in exchange rate due to shocks, in the first, second and third month respectively. In following seven months, the explained variance is 6.39 percent (recorded in the fifth month) to 6.93 percent (recorded in the tenth month). CPI does not explain variance in exchange rate in the first month, while, in following nine months it explains 0.37 percent (recorded in the second month) to 0.89 percent (recorded in the tenth month) variance. For ten months' period, interest rate explains 0.26 percent (recorded in the first month) to 3.44 percent variance in CPI (recorded in the tenth month) due to shocks. Similarly, exchange rate explains 0.19 percent (recorded in the first month) to 4.87 percent (recorded in the tenth month). For the same period, exchange rate and CPI both explain zero variance in interest rate in the first month, while in further nine months, exchange rate explains 0.53 percent (recorded in the second month) to 1.74 percent (recorded in the tenth month) variance; and CPI explains 0.34 percent (recorded in the second month) to 2.07 percent (recorded in the tenth month) variance in interest rate caused by shocks.

Impulse response function: The results of impulse response function presented in indicate that exchange rate and CPI respond to the shocks to interest rate for seven and eight months respectively, while CPI responds to the impulses (shocks) to exchange rate for nine months and dies out thereafter. In first four months the response of exchange rate to the shocks to interest rate is maximum. In the first month the response is negative that becomes positive from the second month and continues to the fourth month. Exchange rate responses negatively in the sixth and seventh month and dies out thereafter. In the first three months the response of CPI against the shocks to interest rate is negative and maximum. In the fourth month the response becomes positive that continues to the sixth month. In the seventh and eighth month, CPI response is very low and negative. The respond of CPI against the shocks to exchange rate is negative and maximum in the first four months. The response is positive, but very low in the fifth and sixth month. The response is almost unobservable in the seventh month. Further, in the eighth and ninth month the response is negative and mild.

Table 1: VAR lag order selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-514.6958	NA	0.040602	5.309700	5.360054	5.330088
1	347.9263	1689.855	6.40e-06	-3.445398	-3.243982	-3.363847
2	383.8722	69.31117	4.86e-06	-3.721767	-3.369290*	-3.579053*
3	392.6015	16.56325	4.87e-06	-3.718990	-3.215452	-3.515113
4	401.9999	17.54367*	4.85e-06*	-3.723076*	-3.068476	-3.458036
5	409.5867	13.92864	4.93e-06	-3.708582	-2.902921	-3.382379
6	414.2381	8.396322	5.15e-06	-3.663981	-2.707258	-3.276615
7	419.8844	10.01858	5.34e-06	-3.629584	-2.521799	-3.181055
8	422.9762	5.390784	5.68e-06	-3.568987	-2.310141	-3.059295

* Lag order selected by the criterion

Source: Own calculations

Table 2: Stationarity test

	ADF	DF-GLS	KPSS	Conclusion
CPI	1.608877	0.177079	0.682230	
EXRT	-6.893073	-6.719648	0.028783	
INTT.	-2.046189	-1.594763	0.215060	
Critical values				
1 Percent	-4.004836	-3.461200	0.216000	
5 Percent	-3.432566	-2.931000	0.146000	
10 Percent	-3.140059	-2.641000	0.119000	
Results summary				
CPI	I(1)	I(1)	I(1)[a]	I(1)
EXRT	I(0)	I(0)	I(0)	I(0)

INTT.	I(1)	I(1)	I(0)[b]	I(1)

a) Stationary after first differencing only at 1% level of significance and after second differencing at 1%, 5% and 10% levels of significance.
b) Stationary at level only at 1% level of significance and after first differencing at 1%, 5% and 10% levels of significance
Source: Own calculations

Table 3: VAR Granger causality/Block exogeneity Wald test

	Chi-Sq.	DF	Prob.
Dependent variable: EXRT			
CPI	1.851690	2	0.7630
INTT	7.391779	2	0.1166
Dependent variable: CPI			
EXRT	6.519214	2	0.1636
INTT	7.066096	2	0.1324
Dependent variable: INTT			
EXRT	4.039162	2	0.4007
CPI	3.289874	2	0.5105

Source: Own calculations

Table 4: Vector auto regression estimates

VAR estimates							
	INT	EXRT	CPI		INT	EXRT	CPI
INT(-1)	0.226364	0.311336	-0.046065	INT(-3)	-0.060801	0.284410	-0.001010
	(0.07470)	(0.16210)	(0.02075)		(0.07755)	(0.16827)	(0.02154)
	[3.03012]	[1.92061]	[-2.21992]		[-0.78405]	[1.69018]	[-0.04689]
INT(-2)	-0.185327	0.087380	0.011284	INT(-4)	-0.035041	0.004439	0.025987
	(0.07793)	(0.16911)	(0.02165)		(0.07628)	(0.16553)	(0.02119)
	[-2.37808]	[0.51672]	[0.52127]		[-0.45934]	[0.02682]	[1.22642]
EXRT(-1)	0.033855	0.048227	-0.023489	EXRT(-3)	-0.034547	0.014661	-0.005958
	(0.03381)	(0.07336)	(0.00939)		(0.03419)	(0.07420)	(0.00950)
	[1.00142]	[0.65742]	[-2.50136]		[-1.01031]	[0.19759]	[-0.62727]
EXRT(-2)	0.016054	-0.185172	-0.001706	EXRT(-4)	0.044959	-0.205531	0.002090
	(0.03402)	(0.07382)	(0.00945)		(0.03377)	(0.07328)	(0.00938)
	[0.47193]	[-2.50856]	[-0.18057]		[1.33126]	[-2.80464]	[0.22278]
CPI(-1)	-0.217088	0.480854	0.621329	CPI(-3)	0.266096	0.576602	-0.232930
	(0.25658)	(0.55676)	(0.07127)		(0.33623)	(0.72960)	(0.09340)
	[-0.84608]	[0.86367]	[8.71786]		[0.79140]	[0.79030]	[-2.49399]
CPI(-2)	-0.284642	0.036190	-0.128097	CPI(-4)	-0.108264	-0.010513	0.320383
	(0.30590)	(0.66378)	(0.08497)		(0.31152)	(0.67598)	(0.08653)
	[-0.93051]	[0.05452]	[-1.50755]		[-0.34753]	[-0.01555]	[3.70249]
C	-0.111087	2.662539	0.069040				
	(0.14185)	(0.30780)	(0.03940)				
	[-0.78315]	[8.65036]	[1.75225]				
Results summary							
	INT	EXRT	CPI		INT	EXRT	CPI
R^2	0.102204	0.110878	0.389917	Log like.	102.4244	-51.73906	357.3342
Adj. R^2	0.044282	0.053515	0.350556	Akaike C	-0.898737	0.650644	-3.460645
S.S. Res.	4.162173	19.59782	0.321142	Schwarz C	-0.683597	0.865784	-3.245505
S.E. Eq.	0.149590	0.324599	0.041552	Mean Dep.	0.003015	2.023970	0.023015
F-Stat.	1.764508	1.932926	9.906360	S.D. Dep.	0.153017	0.333650	0.051561

Note: Standard errors in ( ) & t-statistics in [ ]
Source: Own calculations

Table 5: Structural VAR (SVAR) estimates

A =	**1**	**0**	**0**	
	C(1)	1	0	
	C(2)	C(3)	1	
B =	C(4)	0	0	
	0	C(5)	0	
	0	0	C(6)	
	Coefficient	Std. Error	Z-Statistic	Prob.
C (1)	0.406186	0.151103	2.688148	0.0072
C (2)	0.016530	0.020000	0.826531	0.4085
C (3)	0.005660	0.009217	0.614106	0.5391
C (4)	0.149590	0.007498	19.94994	0.0000
C (5)	0.318862	0.015983	19.94994	0.0000
C (6)	0.041458	0.002078	19.94994	0.0000
Log likelihood	391.8523			
Estimate A matrix	1.000000	0.000000	0.000000	

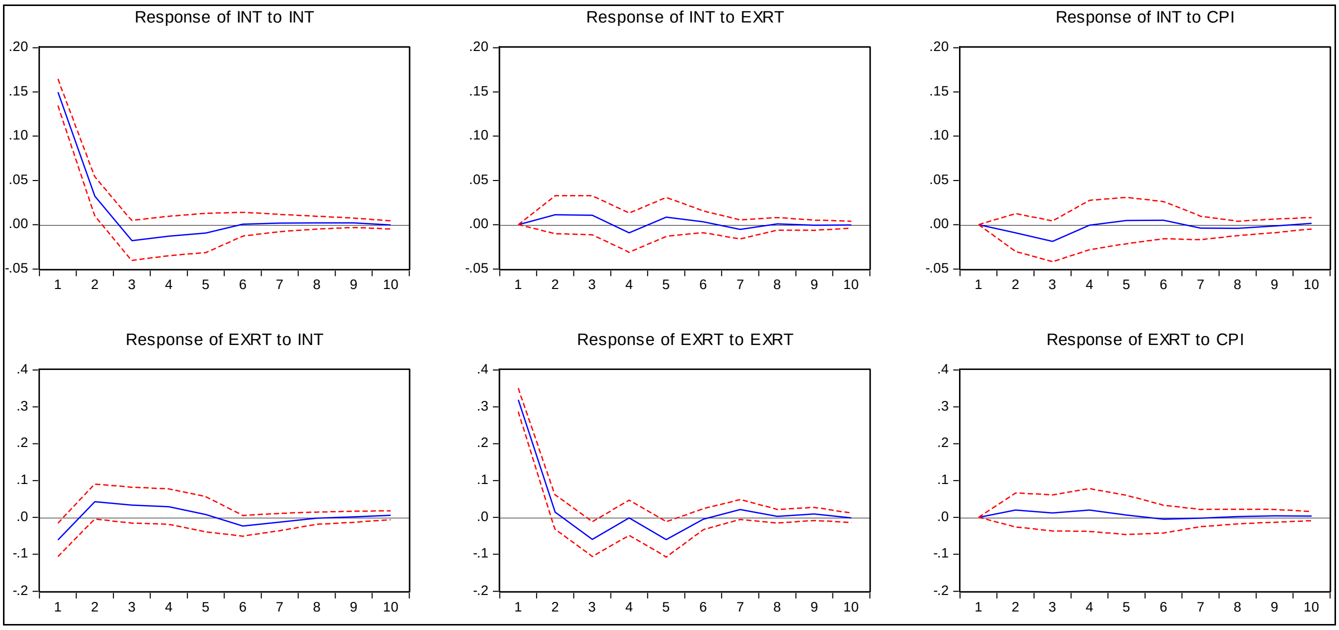
	0.406186	1.000000	0.000000	
	0.016530	0.005660	1.000000	
Estimate B matrix	0.149590	0.000000	0.000000	
	0.000000	0.318862	0.000000	
	0.000000	0.000000	0.041458	

Source: Own calculations

Table 6: Variance Decomposition

Variance Decomposition of EXRT				
Period	S.E.	INT	EXRT	CPI
1	0.324599	3.503988	96.49601	0.000000
2	0.328312	5.110294	94.52101	0.368700
3	0.335436	5.868287	93.64954	0.482171
4	0.337288	6.538644	92.62517	0.836189
5	0.342743	6.388513	92.76395	0.847541
6	0.343580	6.804501	92.33146	0.864039
7	0.344467	6.903666	92.23308	0.863255
8	0.344496	6.906492	92.22555	0.867962
9	0.344649	6.902331	92.21613	0.881541
10	0.344715	6.927461	92.18197	0.890570
Variance Decomposition of INT				
Period	S.E.	INT	EXRT	CPI
1	0.149590	100.0000	0.000000	0.000000
2	0.153703	99.12741	0.529722	0.342869
3	0.156226	97.26020	0.966685	1.773118
4	0.157017	96.95195	1.291889	1.756156
5	0.157616	96.58298	1.584269	1.832750
6	0.157729	96.44608	1.621440	1.932485
7	0.157878	96.27561	1.735368	1.989022
8	0.157952	96.20389	1.737377	2.058732
9	0.157973	96.19580	1.738658	2.065546
10	0.157981	96.18743	1.738574	2.073996
Variance Decomposition of CPI				
Period	S.E.	INT	EXRT	CPI
1	0.041552	0.262493	0.188656	99.54885
2	0.050103	2.015193	3.083650	94.90116
3	0.051842	2.683266	4.461711	92.85502
4	0.052298	2.671037	4.812666	92.51630
5	0.052490	3.237875	4.845423	91.91670
6	0.053002	3.368987	4.845742	91.78527
7	0.053627	3.299262	4.733937	91.96680
8	0.053738	3.410835	4.826144	91.76302
9	0.053754	3.416577	4.867169	91.71625
10	0.053760	3.435070	4.866873	91.69806

Source: Own calculations



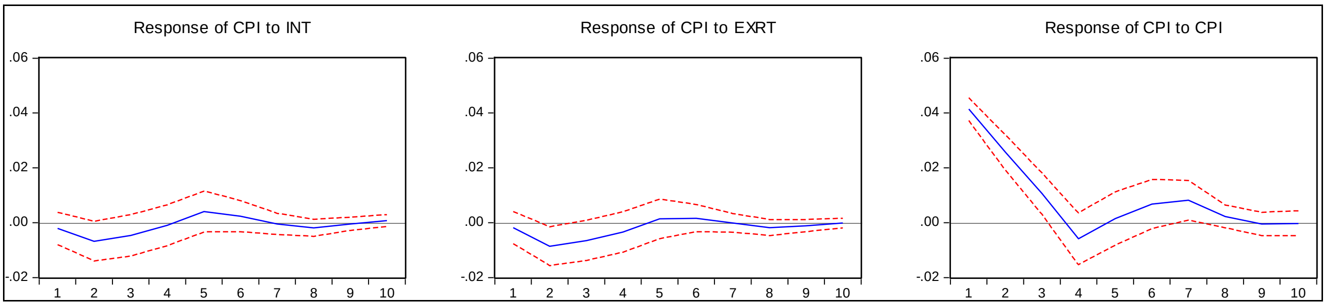


Fig 1: Response to Cholesky one S.D Innovation+ 2 S.E

Conclusion

To sum up, the results of VAR granger causality indicate a unidirectional causality that moves from interest rate to exchange rate, exchange rate to CPI, and interest rate to CPI. The results of variance decomposition show that a shock to interest rate is liable for variance in exchange rate of 3.50 percent to 6.93 percent. The variance in CPI due to shock to exchange rate is about 0.19 percent to 4.87 percent. While a shock to interest rate explains variance in CPI 0.26 percent to 3.44 percent. The impulse response function exhibits that none of the variables has a significant long-term impact on another variable. Rather, after 4 or 4.5 months the response of the variables to the impulses becomes low and insignificant. Results show a major impact of interest rate on exchange rate and less impact on CPI. The impact of exchange rate on CPI is almost negligible.

References

1. Asteriou Dimitorios. Applied econometrics: A modern approach using e-views and microfit. Palgrave Macmillan Limited, Hampshire; c2006.
2. Barshky R, Delong J. Forecasting Pre - World War - I inflation: The Fisher effect and the gold standard. Quarterly Journal of Economics. 1991;106(3).
3. Benhabib J, Schmitt-Grohé S, Uribe M. Chaotic interest-rate rules. The American Economic Review, 2002, 92(2).
4. Berument H, Jelassi M. The Fisher hypothesis: a multi-country analysis. Applied Economics. 2002;34(13).
5. Brzezina M. The relationship between real interest rates and inflation. Narodowy Bank Polski, Economic Research Department. Working Papers; c2002, 23.
6. Dash P, Bhole LM. The role of interest rate in exchange rate management in India; c2007. www.hss.iitb.ac.in/ties07/paper/ts4/psA/2.doc
7. Dua P, Ranjan R. Exchange rate policy and modelling in India. Department of Economic Analysis and Policy, Reserve Bank of India. Study No, 2012, 33.
8. Fahmy Y, Kandil M. The fisher effect: new evidence and implications. International Review of Economics & Finance; 2002;12(4).
9. Fama E, Schwert G. Asset returns and inflation. Journal of Financial Economics; 1977;5(2).
10. Fama E. Short-term interest rates as predictors of inflation. The American Economic Review; 1975;65(3).
11. Ghosh AR, Ostry JD, Gulde AM, Wolf HC. Does the Exchange Rate Regime Matter for Inflation and Growth? International Monetary Fund. Economic Issue; 1996, 2.
12. Gujarathi Damodar N. Econometrics by example. Palgrave Macmillan Limited, Hampshire; c2011.
13. Ikeda Y, Medvedev D, Rama M. Advanced country policies and emerging-market currencies the impact of U.S. tapering on India's Rupee. World Bank Group. Policy Research Paper No. 2015, 7219.
14. Kayhan S, Bayat T, Ugur A. Interest rate and exchange rate relationship in BRIC-T countries. Ege Academic; 2013;13(2).
15. Khumalo L, Mutambara E, Assensoh-Kodua A. Relationship between inflation and interest rates in Swaziland revisited. Banks and Bank Systems; 2017;12(4).
16. Lopez Villavicencio A, Lluís Raymond Bara J. The short and long-run determinants of the real exchange rate in Mexico; c2006. https://onlinelibrary.wiley.com/doi/full/10.1111/j.1746-1049.2007. 00055.x.
17. Maddala GS. Introduction to econometrics. John Wiley and Sons, Singapore; c2001.
18. Mohanty B, Bhanumurthy NR. Exchange rate regimes and inflation: Evidence from India. National Institute of Public Finance and Policy, New Delhi. Working Paper; c2014. p. 130.
19. Summers L. The non-adjustment of nominal interest rates: A study of the Fisher effect in J. Tobin (Ed.). Symposium in memory of Arthur Okun. Washington DC: Brooking Institution; c1983.
20. Teker D, Aykaç Alp E, Kent O. Long-run relation between interest rates and inflation: Evidence from Turkey. Journal of Applied Finance & Banking; 2012;2(6).
21. Vinh N, Fujita S. The impact of real exchange rate on output and inflation in Vietnam: A VAR approach; c2007. http://www.lib.kobe-u.ac.jp/repository/80200043.pdf.
22. Wijnbergen S. Fiscal deficits, exchange rate crises and inflation. National Bureau of Economic Research, Cambridge, MA, Working; c1987 p. 2130.
23. Wilcox J. Why real interest rates were so low in the 1970s? The American Economic Review; 1983;73(1).