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THE TRINITY OF INTEREST RATE, EXCHANGE RATE, AND INFLATION: THE CASE FOR INFLATION TARGETING IN INDIA

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ABSTRACT

The paper attempts to estimate the interest rate, exchange rate and inflation nexus in the wake of Inflation Targeting (IT) in India. IT is a flexible monetary framework used to tame inflation and maintain price stability. Initially adopted by industrial countries, IT delivered robust results not only it helped in maintaining price stability but also anchored people's future inflation expectations and hence reduced inflation persistence. Motivated by the performance of IT regime in developed countries, developing nations became enthusiastic about it and followed suit. The economists all around share the common view that developing nations before implementing IT as a monetary arrangement should initiate economic and financial reforms to meet certain fundamental conditions imperative for IT's success. The existing empirical literature provides adequate evidence on the fulfillment of pre-condition of fiscal discipline in economies implementing IT, high external debt leads to currency depreciation when interest rates are increased to curtail rising inflation, this further leads to increase in inflation, contradicting the purpose of IT. The data of Three month Treasury bill rate as the rate of interest, real exchange rate and Consumer Price Index (CPI) inflation for twenty years (1995-2015) is considered. The study employs Autoregressive Distributed Lag (ARDL) model to evaluate the short run and long run relationship between the variables. The results show the existence of significant and positive short run relationship between real interest rate (RIR) and real exchange rate (RER). The short run relationship between real interest rate, real exchange rate, and CPI inflation is inverse and significant; the most interesting revelation is that when exchange rate depreciates inflation reduces. In both the cases, the long run relationship between the variables is inconclusive and ambiguous.

Keywords: Autoregressive Distributed Lag Model, Inflation Targeting

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1. INTRODUCTION

High and volatile inflation in both developed and developing countries around the world led to one of the most important monetary regime; Inflation Targeting or Inflation-Forecast Targeting (IT). Inflation Targeting is known to lower the uncertainties related to inflation and removes the instability which it instills in the economy by improving the design and performance of the monetary policy. New Zealand became the first country to adopt this framework and after witnessing significant success in terms of macroeconomic outcomes of developed countries, many developing economies became enthusiastic about this arrangement, since then increasing number of developing economies have been adopting this framework. Svensson (2002) emphasizes that IT includes a numerical target which can be a point target or a range. Secondly, high degree of accountability and transparency is requited for IT to be successful. It is implicit that for successful execution of IT regime and for it to deliver desirable outcomes such as stable and low inflation, it is imperative to satisfy certain pre-conditions. One such essential pre-condition is *central bank independence*, whatever the policy framework, instrument independence is mandatory. *Sound fiscal policy* passes as an important pre-condition as good government finances are desirable and erratic government spending gives way to significant changes in inflation (Mishkin and Schimdt-Hebbel, 2000). Large government debts are also problematic, high dollar denominated debts and a high degree of risk aversion of foreign investors are contrary to the purpose of IT. Another important pre-condition is *immunity from fluctuations in interest rates and exchange rates* (Mishkin, 2000). Under IT, central bank intervenes in case of excessive exchange rate depreciation and increases the short term interest rate to achieve the inflation objective which eventually impacts the economy.

India recently acquired the status of an inflation targeting economy by fixing the target at 4 per cent with a range of 2 per cent on either side, for a period of five years, until March 2021. Thus, it is of crucial importance to observe whether the pre-conditions are met for the successful implementation of IT. This paper tries to understand the interest rate, exchange rate and inflation nexus in India by witnessing the changes in real exchange rates due to changes in real interest rate, and, it also empirically reveals the impact of changes in real exchange rate and the real interest rate on inflation. The following section formalizes the interaction between interest rate, exchange rate, and inflation. The third section reviews the relevant literature; data and methodology are discussed in the fourth section. Econometric analysis and conclusion are presented in the final section.

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2. THE INTERACTION BETWEEN INTEREST RATE, EXCHANGE RATE, AND INFLATION

Inflation is the most important indicator of the macroeconomic performance of any economy and maintaining a stable and low level of inflation is the top agenda of any central bank. Inflation targeting is one such framework which motivates the entire economy to achieve the set target rate of inflation. In order to reap benefits from implementation of IT, it is necessary to ensure the proper fiscal health of the country especially emerging market economies (EME's) and to have proper insight into the causal relationships between interest rate, exchange rate, and inflation. The central bank employs interest rate as its tool to anchor inflation in the economy thus, it is imperative to understand the effect of the change in interest rate on other important economic variables such as the exchange rate. In a high debt economy, with high external debt and high-risk aversion of foreign investors, an increase in real interest rate in response to high inflation increases the probability of default on the debt making government debt less attractive which results in exchange rate depreciation leading to further increase in inflation.

India is a middle-income country with large, open and fast growing economy. Like any other developing economy, India's external debt to gross domestic product (GDP) ratio is quite high, standing at 20.2 per cent as at end-March, 2017. US dollar denominated debt constitutes the largest component of its external debt with a share of 52.1 per cent as at end-March, 2017 (Reserve Bank of India). The approach towards exchange rate regime took a remarkable turn during 1990's. Earlier, India followed the fixed exchange rate system set by the Reserve Bank of India (RBI) and currently the flexible exchange rate system is being followed where the RBI intervenes when the conditions in foreign exchange market are unstable. To contain the excessive volatility in foreign exchange market often, the policy of high-interest rate is adopted which brings the exchange rate stability. There is no thumb rule to the relationship between interest rate and exchange rate, which makes it intriguing. According to the Mundell-Flemming model, high-interest rate attract foreign investors thus increasing capital inflows and result in exchange rate appreciation. On the other hand, Furman et al. (1998) argue that high-interest rate policy of the central bank is not the best policy at the time of the crisis and it in fact increases the risk premium on domestic assets; causing exchange rate depreciation. Abundant evidence is available in the literature where countries exhibit both direct and indirect relationship between the two depending upon factors such as fiscal discipline, political stability, sound banking system etc. The direction in which interest rate influences exchange rate and exchange rate influences inflation is of crucial under IT.

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3. REVIEW OF LITERATURE

A lot of literature is available on various aspects of inflation targeting, but here in the paper, we focus on the part relevant to the objectives. Batini and Laxton (2006) conclude that meeting the set of pre-conditions for the adoption of IT is not of much importance and that they could be met while executing the strategy, the study also reveals that IT is successful in emerging economies and performs better than any other macroeconomic regime. Blanchard (2004) taking the cue from experiences of Brazil, insists on meeting the precondition of good fiscal discipline. It is argued that when fiscal conditions are wrong like a high proportion of dollar denominated debt and high-risk aversion of foreign investors, an increase in the interest rate leads to depreciation than to an appreciation further leading to rise in inflation thus, contradicting the purpose of IT. Leiderman et al. (2006) examines various aspects of monetary transmission and policy formulation in and compares Peru and Bolivia with Chile and Colombia which have a low level of dollarization. It is found that though a high level of dollarization imposes difficulties in the transmission mechanism of IT and its impact on the real and financial sector; it does not prevent the use of IT as a policy regime. As mentioned above the literature is flooded with studies examining the nature and direction of the relationship between interest rate and the exchange rate for both developed and developing economies. Goldfajn and Baig (1998) used the daily data of real interest rate and real exchange rate from July 1997 to July 1998 and found out no strong relationship existing between the two. There is a dearth of research on the linkage between interest rate and exchange rate in India. One empirical study by Pattanaik and Mitra (2001) found out initial appreciation in the exchange rate due to increase in the call money rate but eventually it depreciated.

4. DATA SOURCE AND METHODOLOGY

The paper tries to examine the nexus between real interest rate, real exchange rate and inflation measured by consumer price index (CPI). The three month Treasury bill rate is taken as a proxy for the interest rate. The variables under study are the monthly observations starting from January 1995 to December 2015. The monthly data for all the variables have been taken from Handbook of Statistics on Indian Economy, Reserve Bank of India (RBI). The study uses real interest rate and real exchange rate, for which nominal values have been divided by year-on-year monthly CPI.

The methodology involves checking for stationarity of all the variables. According to Wooldridge (2012), the notion of stationary process is an important one when we consider the econometric analysis of time series data; a stationary process is one which is stable over time that is its mean and variance will be the same. To check for the existence of unit root, Augmented

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Dickey-Fuller (ADF) test is used which controls for the possible autocorrelation in the error terms. The general ADF model is stated as follows:

$$\Delta Y_t = \alpha_0 + p_1 Y_{t-1} + \sum_{i=1}^{k} \Delta Y_{t-1} + U_t$$

Autoregressive distributed lag (ARDL) Model is used in two stages, first to find short run and long run relationship between real exchange rate and real interest rate and secondly, to estimate the short run and long run dynamics among CPI inflation, real exchange rate, and real interest rate. Till a long time, it was believed that long run relationship between variables exists under certain considerations. It was assumed that the underlying time series were stationary. Recent developments in econometrics show that time series is not often stationary as was conventionally thought. To relax the assumption of stationarity in the econometric analysis of the time series data, the cointegration technique is used (Nkoro and Uko, 2016). Autoregressive Distributed Lag (ARDL) model or bounds test of cointegration (Pesaran and Shin, 1999 and Pesaran et al. 2001) does not require testing for unit roots, unlike other techniques, hence this technique is preferable when dealing with variables that are integrated of different order, I(0), I(1) or combination of both. The ARDL approach fails in the presence of variables that are integrated of order two that is I (2). ARDL model helps in determining the long run and short run relationship among the variables that are non-stationary. After estimating the ARDL model, Diagnostic tests are carried out to check its robustness.

5. DISCUSSION OF RESULTS & CONCLUSION

This section deliberates on the results obtained after the application of various econometric tools and models. The ADF test, using the Schwarz Information Criterion (SIC) concludes that real interest rate (RIR) is stationary at level with intercept only i.e. RIR is I(0) whereas, both real exchange rate (RER) and CPI inflation (CPI) are I(1) with a trend and intercept. Since the variables in the study are integrated of the different order and no variable is I (2), it becomes imperative to use ARDL approach which reckons the short run and long run association between variables adequately. The basic form of ARDL equation is given as:

$$y_t = \beta_0 + \beta_1 y_{t-1} + \ldots\ldots + \beta_k y_{t-p} + \alpha_0 x_t + \alpha_1 x_{t-1} + \alpha_2 x_{t-2} + \ldots\ldots\ldots + \alpha_q x_{t-q} + \varepsilon_t$$

ARDL technique is used in two stages, in the first, ARDL model is estimated to find the relationship (short run and long run) between RER and RIR. The automatically selected ARDL (1, 1) model is robust with no serial correlation among the errors and no heteroskedasticity, the probability (p) value for Breusch-Godfrey Serial correlation LM test comes out to be 0.3904 and the p value for Breusch-Pagan-Godfrey test for heteroskedasticity is 0.2634. The stability of the

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model is checked through cumulative sum (CUSUM) test (results not reported here). The unrestricted error correction model (ECM) is:

Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(RIR)	0.290508	0.050097	5.798893	0.0000
D(@TREND())	-0.004059	0.001941	-2.091614	0.0375
CointEq(-1)	-0.037755	0.014789	-2.552869	0.0113

R-squared	0.984027
Adjusted R-squared	0.983767
Durbin-Watson	1.83

Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
RIR	1.679782	0.749501	2.241199	0.0259
C	82.105599	4.483393	18.313274	0.0000
@TREND	-0.107507	0.030668	-3.505493	0.0005

The bounds test is conducted on the long run coefficients in the unrestricted ECM to test the existence of the relationship between RER, RIR and CPI inflation. The F-statistic value (5.17) obtained lies between the lower bound and upper bound value at 10% and we cannot reject the null hypothesis of no long run relationship. The error correction term is negative (-0.03) and very significant, which implies the presence of long run relationship among the variables, given the F-statistic value, the long run relationship among the variables remain ambiguous. The existence of a positive short run relationship between RER and RIR is very significant, a percentage point increase in real interest rate in short run leads to depreciation of exchange rate by 0.29%.

The second ARDL estimation gives the combined effect of changes in RIR and RER on CPI inflation in the short run and long run. ARDL (8, 1, 1) is selected automatically by Akaike

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Information Criterion (AIC). The model is adequate with no serial correlation and p value 0.7730 (Breusch-Godfrey serial Correlation Test), the presence of heteroskedasticity is tested using Harvey Heteroskedasticity test, the p value 0.0959 implies no problem of heteroskedasticity. The CUSUM test presents strong evidence in support of the stability of the model. The bounds test gives the F-statistic value of 16.74 which is significantly above the upper bound value at 1% level. The high F-statistic value shows that there is a long run relationship between the variables. The long run and cointegrating form are presented as follows:

Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CPI(-1))	-0.223647	0.05389	-4.150108	0
D(CPI(-2))	-0.163159	0.053571	-3.045654	0.0026
D(CPI(-3))	-0.135766	0.053554	-2.535101	0.0119
D(CPI(-4))	-0.106973	0.053397	-2.003344	0.0463
D(CPI(-5))	-0.125579	0.053489	-2.34774	0.0197
D(CPI(-6))	-0.171996	0.053314	-3.226065	0.0014
D(CPI(-7))	-0.175312	0.050897	-3.444447	0.0007
D(RER)	-0.277458	0.075532	-3.673377	0.0003
D(RIR)	-0.665273	0.063162	-10.532856	0
CointEq(-1)	0.006647	0.003419	1.944206	0.0531

R-squared	0.999381
Adjusted R-squared	0.999349
Durbin-Watson	1.95

Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
RER	7.216691	6.339413	1.138385	0.2561
RIR	15.397033	7.562548	2.035958	0.0429
C	-628.085606	571.827824	-1.098382	0.2732

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The above unrestricted ECM shows significant short run relationships (Wald test results not reported); both RER and RIR have a negative relationship with CPI inflation in the short run. A point per cent increase in the real interest rate reduces inflation by 0.66% in the short run, similarly when RER depreciates by 1%; inflation goes down by 0.27%. The presence of a long run relationship between the variables is however uncertain, the bounds test results indicate the presence of long run association but the coefficient of error correction term is not negative and is significant at 10% level. The speed adjustment term with incorrect sign makes the existence of any long run relationship dubious.

The study focuses on highlighting the dynamics between the real interest rate, real exchange rate, and CPI inflation. The econometric analysis done above presents the fact that the short run relationship between the concerned variables is more prominent than the long run relationship. As hypothesized, due to the presence of high external debt, increase in the interest rate leads to depreciation of the exchange rate in the Indian economy. The ARDL estimation of the three variables together exhibits an interesting result, which is depreciation of the Indian rupee or increase in the real exchange rate leads to a reduction in the inflation rate. The revelations made in the study are all in the favor of India adopting IT as a monetary framework, as inflation is responsive to changes in the interest rate in the short run. Also, the depreciation of the real exchange rate due to increase in the real interest rate does not lead to increase in inflation, on the contrary, the analysis unveils that it causes inflation level to fall. The inverse relationship between real exchange rate and inflation makes Inflation Targeting an appropriate policy to stabilize inflation in the Indian economy.

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