CHAPTER 5
FISCAL DEFICIT AND INTEREST RATE IN INDIA

This Chapter investigates the relationship between fiscal deficit and interest rate in India. This chapter is divided into eight sections followed by introduction. Section 2 encapsulates the review of recent studies. Section 3 explains the theoretical framework of the study. Section 4 discusses trends in goods and money market in India. Section 5 explains the effectiveness of fiscal policy and Interest rate. Section 6 describes the model for the study. Results of the study are discussed in Section 7. Section 8 concludes the chapter.

5.1 INTRODUCTION

In the recent years many developed and developing countries have experienced high fiscal deficit and it is widely believed that fiscal deficit raises the real interest rate. According to IMF and World Bank directions, fiscal deficit above a certain ratio of GDP is not good for the health of the country because it raises interest rate, hence reduces the private investments in the country. Therefore, fiscal deficit has to be kept up to certain limit. But, the prevailing orthodox based of Keynesian theory that increases in government expenditure is the key instrument of expansionary policy. On the basis of this belief, if government expenditure crowds out private investment, then the whole idea of increasing government spending to increase demand to reduce unemployment and to increase national income is questionable. So there is a need to investigate the relationship between fiscal deficit and real interest rate. Theoretically fiscal deficit can influence interest in three ways. First, according to Keynesian IS-LM framework, IS curve shifts rightward as a result of increase in government expenditure. This leads to increase the interest rate. Moreover, it is important to note that persistent fiscal deficit as a result of tax cut or
increase in government expenditure leads to increase the aggregate demand. Although it improves private saving but the net effect is less than the tax cut and this reduces the desired national saving. As a result, real rate of interest will rise to restore equality between national saving and demand for investment. This will crowd out private investment. In addition, financing of fiscal deficit through market borrowing may raise interest rate which crowd out private investment. Second effect is within the parameter of loanable funds approach which advocates that increased government deficit increases the supply of government securities reducing their price, results in rise in interest rate (Burney and Yasmeen, 1986). Finally, Ricardian Equivalence theorem states that a budget deficit or public dissaving leads to increase the private saving and thereby offsets the effects deficits. This will neutralize the impact of government borrowing and interest rates (Barro, 1974).

5.2 REVIEW OF LITERATURE

Premchand (1984) emphasized that financing fiscal deficit by borrowing from public results a raise in the supply of public bonds. Government offers these bonds at lower price in order to improve the attractiveness which results in rise in interest rates. The boost in interest rates further crowds out private investment. This results in decrease in national output and also affects the overall development of the country.

Evans (1985) by using IS-LM model empirically tested the relationship among real rate of interest, public expenditure as proxy of fiscal deficit, money stock and expected inflation. He concluded that deficit does not have impact on rate of interest rate.

Hoelscher (1986) by using regression analysis found that deficit and interest rate connection is strong, vigorous and very significant for the post war period and crowding out effects of deficit spending are potentially serious. The key result of this study was that larger deficits increase the slope of yield curve and also supports all available evidence that there is no relation between short term rates and deficits, while higher deficits increase the long run interest rates.

Spector and Norman (1988) critically analyzed the statement that government deficits do have a positive and significant impact on short term interest
rate. They utilized the IS-LM framework and demonstrated that the amount of crowding out depends on interest rate sensitivity. Further, they pointed out that the relationship between deficit, interest rate and crowding out cannot be determined only with the coefficient in the equation, but it does depend on the slopes of IS-LM curve.

Gupta (1989) examined the effect of budget deficit on interest rate in United States. He concluded that there is no support for the proposal that budget deficit persuade interest rate and thus denied the recent finding by Cebula (1987) and Kulluri and Giannaros (1987). Further, there is significant support for the ‘Inverted’ Fisher Hypothesis for the U.S.

Cebula (1991) examined the relationship between real interest rate and budget deficit in case of United States over the period of 1974 to 1985. The study used IS-LM model and found that budget deficit and real interest rate are considerably and positively related to each other. Further, Cebula (1997) found the same relationship in long run in the case of France’s economy.

Giavazzi and Pagano (1990) argue that the effects on interest rates are also important for contractionary fiscal policy. A permanent reduction in public spending is the reason for decreasing interest rates that will lead to an increase in employment and gross domestic product in the short run as well as in the long run.

Fisher and Easterty (1990) examined the financing of fiscal deficit and brought to light the different kinds of macroeconomic imbalance the deficit can cause. They found that printing money excessively shows up as inflation, excessive use of foreign reserves leads to crises in the balance of payments, high foreign borrowing leads to a debt crisis, and too much domestic borrowing leads to high real interest rates and crowding out of private investment.

According to Humpage (1992) there was no evidence of a long term relationship between fiscal policy, long term interest rates, the real dollar exchange rates and real net exports in his study conducted by applying cointegration tests.
Edward (1992) analyzed the impact of government budget deficit on interest rate. Regression results showed that both structural and cyclical deficit are significant and positively related to the level of corporate bond rate, whereas government fiscal and monetary policy are not significantly related to nominal rate of interest. Other finding of the study is that expected inflation rate and the real short term rate of interest are significant and positively related to the long term bond rate.

Feldstein (1992) argued that the trade deficit was a product of the spendthrift tendencies of American consumers and not a result of the budget deficit. The study argued that Americans were spending more than they produced. To do this, they were forced to borrow from foreigners at very high levels of interest rates.

Anusic (1993) investigated that budget deficit is destructive in nature for the proper functioning of the economic system of a developing country. Further, the study advocated the Keynesian view that increase in budget deficit will leads to increase in real interest rate, resulting in decline in real investment.

Bahmani (1993) examined the statistical relationship between the twin deficits over the period 1970-1990 and found that the two variables were cointegrated. No conclusive evidence of a relationship between large budget deficits and high interest rates was found.

Ahmed (1994) used IS-LM model to investigate the relationship between real interest rate, government expenditure, government deficit, change in money stock and expected inflation. He found that monetary and fiscal policy variables do not have any impact on interest rate rather inflation has significant impact on real interest rate.

Correia and Stemitsiotis (1995) by using loanable fund model found that deficit affects long run interest rate. He took the data over the period of 1970-93 in ten (10) OECD countries.

Hakkio (1996) examined the eighteen OECD economies and found that budget deficit and real interest rate are positively and significantly related to each other.
Kulkarni and Erick (1996) investigated the relationship among short run interest rate, inflation, exchange rate and budget deficit in India over the period of 1960-88. They concluded that deficit does not affect rate of interest.

Murthy and Phillips (1996) found a long run relationship between budget deficit and capital inflow with the use of new maximum likelihood procedure developed by Johansen (1988) and Johansen and Juselius (1990) to do cointegration tests. They also used Error-Correlation modeling and revealed that short run disequilibria in financial markets are corrected very rapidly.

Serven (1996) empirically tested the crowd-in and crowd-out effect in India for the time period of 1960-1995. The time series data was analyzed using cointegration, VAR model and Error Correction Model. The empirical findings indicate that public infrastructure projects crowd-in private sector investment in long run but there is negative relationship between these two in short run.

Cheng (1998) investigated causality between budget deficit and interest rate in Japan. By applying cointegration and Hsiao’s version of Granger Causality, the study found that there is no evidence of linkage between budget deficit and long run interest rate in Japan rather causality runs from budget deficit to short run interest rate. This causality confirms Keynesian Liquidity Preference and crowding out effect theory i.e. larger deficit causes high short term interest rate.

Vamvoukas (2000) investigated the linkage between budget deficits and interest rates in Greece over the time periods 1949- 1994, 1953-1994 and 1957-1994. He used Cointegration, ECM strategy, and several diagnostic and specification test. The results showed significant and positive relationship between budget deficits and interest rates that support the Keynesian model.

Chakraborty (2002) found that in the deregulated financial regime fiscal deficit does not put upward pressure on the interest rate rather the causality run from real rate of interest to fiscal deficit where high interest rate leads to increase the interest rate which results in high fiscal deficit. Asymmetric Vector Autoregressive model was used for the analysis.

Saleh (2003) analyzed the literature of Budget Deficit and Macroeconomic Variables such as growth, interest rates, trade deficit, exchange rate and among other
variables. He found that majority of these studies regress macroeconomic variables on the deficit variable. The key outcomes from the studies indicated that both the method of financing and the component of government expenditure could have different effects. Even though, the bulk of the empirical studies find a significantly negative effect of public consumption expenditure on growth, while the effect of public investment expenditure have positive effect. Many studies are supporting Keynesian proposition which suggest that increase in budget deficit would induce domestic absorption that lead to import expansion, causing a current account deficit.

Das (2004) investigated the relationship between fiscal deficit and interest rate in India and for a number of countries in the world. Regression results showed that in case of India, interest rate does not necessarily depend on fiscal deficit and that policy based on this proposition is erroneous.

Goyal (2004) re-examined the relationship between fiscal deficit and interest rate that was previously investigated by Chakkarborty (2002). VAR model was used to find out the relationship and the results showed the two way causality between fiscal deficit and the real interest rate. The results also indicate that there is no relationship between reserve money and the fiscal deficit and direction of causality is unidirectional between interest rate and reserve money.

Rakshit (2005) points out that fiscal deficit affect macro stabilization and growth. He points out that high fiscal deficit implies faster accumulation of public debt, larger interest payments and higher revenue deficit or government dissaving.

Chakarborty (2007) found out that there is no real crowding out between public and private investment, rather opposite relationship is observed between the two. Private investment is interest rate sensitive.

Aisen and Hauner (2008) examined the relationship between budget deficit and interest rate in 60 emerging economies over the period of 1970-2006. The study found that budget deficit has both positive and negative effects on interest rate.

Mukhtar and Zakaria (2008) examined the long run relationship between nominal interest rates and budget deficits for Pakistan using quarterly time-series data for the period 1960 to 2005. Regression results show that budget deficits do not
have significant effect on nominal interest rates. These results revealed the existence of the Ricardian deficit neutrality in Pakistan.

Bhattacharya (2009) argued that larger borrowings by the government need not raise the short term nominal interest rate. He also argued that investment expenditure is not affected by short term interest rate but the long term real interest rate.

Glannaros and Kolluri (2010) examined the relationship between budget deficit, inflation, and interest rate by using IS-LM model. The study found that there is a negative association between inflation and interest rate. Further, the study found indirect significant association between interest rate and budget deficit.

Bayat et al. (2012) analyzed causality between budget deficits and its ratio to gross domestic product and interest rate in the Turkish economy during years between 2006 and 2011. It was found that there is no causal relation between budget deficits, budget deficit ratio to gross domestic product and nominal interest rate. Results reveal the existence of Ricardian Equivalence hypothesis.

5.3 THEORETICAL FRAMEWORK

The theoretical framework, which is commonly used to describe the potential effects of fiscal deficit on interest rates have several important implications for empirical analysis of those effects. The change in the interest rate is affected by fiscal deficit. Keynesian theory with IS-LM framework suggests that deficit affects the level of the interest rate. Deficit not only stimulates aggregate demand and raises output but also crowds out private investment. However, an impact of increased interest rates in the short run is quite different from long-run effect i.e. crowding out private capital (Engen and Hubbard, 2005).

Secondly, factors other than fiscal can influence the determination of interest rates in credit markets. Generally in developing economy, government intervenes in the market to stabilize interest rate by purchase and sale of government securities. Purchase of government securities from the market increases the money supply and sale of government security reduces the money supply in the economy. Apart from this, the other factor that affects the interest rate is price level of the country. When inflation is high in the economy, people have to spend more out of their disposable
income and gets reduced national saving. To control inflation government reduce money supply through increase in interest rate. But in developing countries like India, situation is quite different. Inflation in a developing economy is mainly caused by supply shocks. In such a situation, in order to improve supply of goods, government reduces interest rate to induce private players to make investment. As interest rates are lowered, more people are able to borrow more money. The result is that consumers have more money to spend, causing the economy to grow and inflation to increase.

Barro and Sala-i-Martin (1990) and Barro (1992) investigated the effects of fiscal and monetary policy variables on expected real world interest rates across ten major developed economies. By using structural approach, they found that world interest rate is determined by investment demand and desired saving. They also concluded that current fiscal deficit does not play a significant role in the determination of real expected interest rates in these countries. Elmendorf and Mankiw (1999) stated that their findings supported the Ricardian view that budget deficits have no effect on interest rates. The REH (Ricardian Equivalence Hypothesis) considers that all government spending must be financed by taxation either now or by putting taxes on future generation. Chakraborty (2002) investigated the empirical link and concluded that deficit does not induce rise in rate of interest in India. Chakraborty (2007) found that the rate of interest is a significant determinant of private corporate investment. If increase in fiscal deficit increases the rate of interest, it would imply financial crowding out. Evans (1985), Tanzi (1985), Dalamagas (1987), Ahamad (1994), Kulkarni and Lee (1996) found no positive link between rate of interest and deficit. While Cebula (1990), Correia and Stemitsiotis (1995), Ostrosky (1979) did find evidence for the link between fiscal deficit and rate of interest. Cebula (1997) examined the direction of causality between long term interest rates and structural budget deficits in the US for a period between 1973 and 1991 and found that there is bi-directional causality between rate of interest and the deficit. Das (2010) found that there is enough potential within the banking system to control rise in interest rate by accommodating extra liquidity demand of commercial banks.
5.3.1 Loanable Funds Approach

It is widely believed that there is always a trade-off between deficits financed public expenditure and private investments because there is limited pool of resources available in the economy. As a result of expansionary fiscal policy, government takes away the larger proportion from this pool and smaller portion will be left for private sectors borrowings (Das, 2010). Loanable fund model helps in determining interest rate by examining the relationship between high fiscal deficit (leading to increased borrowings) and interest rate in the economy. It is well known that the loanable-funds approach and IS-LM model are formally equivalent and contain identical information about the macro economy.

**Figure 5.1**

*Interest Rate Determination in Loanable Funds Approach*

Figure 5.1 describes a comparative-statics equilibrium model that employs a supply and demand curve to locate a market-clearing equilibrium price. The price in this model is the cost of credit known as interest rate. Further, demand curve shows the demand for credit by borrowers and the supply curve represents the supply of credit by lenders. Borrowers include consumers, business and government. On the other hand, lenders or suppliers of credit include banks, mortgage companies, credit
card companies and the purchasers of the interest-bearing financial assets such as bonds, treasury bills, securities and stocks etc. When the government runs a budget deficit, the difference can be financed through sale of bonds and treasury bills in the market results, this increases the demand for credit, thereby shift the initial demand curve $D_1$ to $D_2$. This could mean disequilibrium in the money market, subsequently causing interest rate to rise. In order to restore the economy, central bank has the ability to increase the amount of credit available to the economy through a expansionary monetary policy called as open market operations. This is reflected in figure 1 that expansionary monetary policy shifts the supply curve from $S_1$ to $S_2$ and also reduces the rate of interest. It will also increase the volume of total credit in the economy. Thus, in order to stimulate the economy, government needs a combination of fiscal and monetary policy.

5.4 TRENDS IN GOODS AND MONEY MARKET IN INDIA

Figure 5.2 reveals that out of total liabilities; government dependence on market borrowing in India was 26.02 percent in 1980-81 which came down to 16.99 percent in 1992-93. It showed an increasing trend thereafter and reached at 33.17 percent in 2000-01 and 58.73 percent in 2013-14.

Figure 5.2
Trends in Money Market in India

Source: Handbook of statistics of Indian Economy, Reserve Bank of India, 2015
However, heavy dependence on market borrowings in the domestic credit market takes away larger proportion from the limiting pool and smaller proportion is available for private players could be reason for crowding out of private investment in India.

**Figure 5.3**  
**Trend and Pattern of Treasury Bills (91 days and 182/364 days) as the percentage of Total Government Liabilities**

![Graph showing trend of treasury bills](image)

Source: Handbook of statistics of Indian Economy, Reserve Bank of India, 2015

**Figure 5.3** reveals the declining trend of financing fiscal deficit through 91-day treasury bills in India since 1980. The share of 91-day treasury bills in total government liabilities was 21.50 in 1980-81. It sharply came down to 3.66 percent in 1987-88. It increased to 8.23 in 1989-90 but subsequently came down to 1.99 percent in 1990-91. Dependence on treasury bills was less than one percent between 1997-98 and 2005-06. However, it increased thereafter and reached at 2.14 in 2013-14. On the other hand, government started using 182/364-days treasury bills from 1988-89. The share of 182/364-days treasury bills was only 0.21 percent in 1988-89. It reached at 1.83 in 1992-93 but came down to 0.26 percent in 1995-96. It was less than 2 percent till 2010-11 but increased to 3.72 percent in 2012-13.
It is reflected in Figure 5.4 that prime lending interest rate in India has been very high in comparison to other largest economies of the world and is a big obstacle for manufacturing sector. The recent data of world fact book shows that prime lending interest rates in United States were 3.25 percent in 2014 and 3.3 percent in 2015. China, Japan, Germany, United Kingdom, France and Italy also have lower rate of interest. The above figure shows that prime lending interest rate in India was 10.25 in 2014 that decreased to 9.9 percent in 2015. High interest rates in India make fiscal and monetary policy ineffective and crowd out private investment. Although India is one of the fastest growing economies in the world in terms of nominal GDP and holds seventh position in the world but still depend on agriculture (16%), in comparison to western countries. However, the services sector has picked up in recent years and now accounts for 54.4 percent of the GDP, while industry contributes only 29.5 percent. Chinese economy is gaining strength with a high contribution from manufacturing and services about 45% each and 10 percent contribution from agriculture (according to World Fact Book). However, the huge difference between these economies is due to slow growth of manufacturing sector in India. Further, it can also be stated that high interest rate is the reason for sluggish growth of private investment in India.
Figure 5.5
Decade Wise analysis of Government Liabilities

Source: Handbook of statistics of Indian Economy, Reserve Bank of India, 2015

Figure 5.5 shows that high government expenditure over its revenue in India is mainly financed through market borrowing, which results in contracting funds for private players. It is reflected in the above figure that in 1980s (average), out of total liabilities of central government, 24.48 percent was financed through market loans, 13.8 percent from 91 days treasury bills and 0.04 percent through 182/364 days treasury bills. Dependence on market loans showed upward trend since 1980-81. The average share of market loan and 91 days treasury bills decreased to 22.68 and 3.33 respectively in nineties, but the share of 182/364 days treasury bills increased to 1.12 during this period. In next decade, the average share of market loans increased to 39.51 percent, but the share of 91 days treasury bills decreased to 0.89 percent. However, the dependence on 182/364 days treasury bills increased to 1.49 percent during this decade. Furthermore, the average dependence of market loans, 91 days treasury bills and 182/364 days treasury bills between 2010-11 and 2014-15 increased to 56.16 %, 2.21% 3.09% respectively. Heavy dependence on market borrowings is the reason for crowding out of private investment in India.
Figure 5.6 demonstrates the real interest rates and inflation (deflator) in India since 1980. Real interest rate is the inflation adjusted interest rate. Both the variables do not show any specific trend. It is depicted in the above figure that when inflation is high, interest rate is low and vice versa. It also shows that inflation reduces the real interest rate in the economy. In 1980-81, inflation was about 10.8 and real interest rate was 5.1. In order to control high inflation, government increased the interest rates to 7.8 percent in 1981-82, further increased to 9.1 in 1985-86. Thus as a result of tight monetary policy, government is able to control high inflation and it reached at 6.8 percent in 1985-86. In next year, government adopted expansionary monetary policy and reduced the interest rate to 6.6 percent and further reduced to 3 percent in 1990-91. But this led to take inflation at a peak level (13.8%) in 1990-91. To control high rate of inflation, RBI increased the interest rate to 9.1 percent and was able to bring it down to 9 percent in 1991-92. As a result of tight monetary policy, government was able to control high rate of inflation and it came down to 3 percent approximately in the end to nineties. But after economic crisis of 2007, in order to increase the sluggish demand, RBI adopted expansionary monetary policy and reduced the interest rate to 2.8 percent in 2011-12. Simultaneously, it led to increase the inflation and again it reached at 9 percent in 2009-10 and 7.6 percent in 2011-12. Thus the above facts explain that when
inflation is high, government adopts tight monetary policy and is able to control over inflation.

Average Prime lending rates were 16.2% in 1980-81 and further reached at 19 percent in 1992-93. The reasons for the high prime lending interest rates were high CRR (15%) and high SLR (38.5%) in 1981 and remained high till 1997. RBI reduced CRR to 9.50% and SLR to 25% in 1998. Then government was able bring down prime lending interest rate to 11 percent in 2004-05. During this period CRR was reduced to 4.5% (2003). However, average prime lending interest rates increased in 2005-06 and reached at 12.75 percent as RBI increased CRR to 9 percent in 2008. Further PLR rose to 16.75 percent in 2008-09. As a result of reducing CRR to 5% in 2009 and 4% in 2013, RBI has been able to reduce the prime lending rate to 9.5 percent in 2010-11 and 10.25 in 2012-13 (Handbook of Statistics of Indian Economy, 2015).

5.5 INTEREST RATE AND EFFECTIVENESS OF FISCAL POLICY

In order to get the result of increase in government expenditure, differentiate both the equations IS as well as LM (assuming supply of money to be constant or no change in LM curve).

\[
\text{IS: } \delta Y = \delta G + c(1-t)\delta Y + I_r\delta r \\
\text{LM: } 0 = h\delta Y + l_r\delta r
\]

---

Eq. 1

Eq. 2

IS represents investment saving equation and LM represents demand for money. \( I_r \) represents investment demand for money as a function of interest rate and \( Y \) is the national income. \( h \) represents the income responsiveness of the demand for money, that is the function of \( Y \) and \( l_r \) is the speculative demand for money is a function of rate of interest.

\[
\delta r = \frac{-h\delta Y}{l_r}
\]

By substituting the value of \( \Delta r \) we will get the equation 3
\[ \delta Y = \delta G + c(1-t)\delta Y + I_r \left( \frac{-h\delta Y}{l_r} \right) \]

\[ \frac{\delta Y}{\delta G} = \frac{1}{(1-c(1-t)+I_r h/l_r)} \]  \hspace{1cm} \text{Eq. 3} \]

It is clearly shown in equation 3 that value of government expenditure will be weaker due to increased interest rate and crowding out of private investments. The value of government expenditure multiplier will be greater if the whole bunch \( I_r h/l_r = 0 \). Further, it is possible only in two cases:

1) When \( I_r \rightarrow 0 \) means private investment does not respond to change in interest rate. So the value of multiplier will be as below

\[ \frac{\delta Y}{\delta G} = \frac{1}{[1-c(1-t)]} \]

2) If interest rate doesn’t change or \( \delta r = 0 \)

\[ \frac{\delta Y}{\delta G} = \frac{1}{1-c(1-t)} \]  \hspace{1cm} \text{Eq. 4} \]

Because \( \delta r = \frac{-h\delta Y}{l_r} = 0 \)

The above situation is possible when monetary authority control over the rate of interest rate by increasing money supply in the economy. Therefore, effectiveness of fiscal policy depends upon proper monetary policy otherwise as per IS-LM model; interest rate will increase as a result of increase in government spending.

**5.6 THE MODEL**

Although the focus of the present study is to analyze the relationship between fiscal deficit and interest rate, an appropriate model specification is extremely important as some other macroeconomic variables may also affect the
movement of rate of interest. So, multivariate framework is designed to test the relationship real interest rate, fiscal deficit, money supply and inflation. The rate of interest is mainly affected by fiscal deficit, money supply and inflation. Further, interest rate is adjusted to remove the effects of inflation to reflect the real cost of funds to the borrower. So the difference between nominal rate of interest and inflation is taken as real interest rate.

The relation between real and nominal interest rates and the expected inflation rate is given by the Fisher equation

\[ 1+n = (1+r) (1+i) \]

where \( n \) = nominal interest rate, \( r \) = real interest rate, \( i \) = inflation

Further model specification for real rate of interest rate is explained in equation 5

\[ \text{RINT} = f (\text{FD, MS, INFD}) \]

In model, RINT is real interest rate, FD is fiscal deficit as percentage of GDP, MS (broad money) is the money supply as the percentage of GDP and INFD is the inflation (deflator). Data has been collected from RBI and World Bank and cover the period between 1980-81 and 2013-14. Inflation (deflator) is the most accurate indicator to measure the inflation as it covers the entire range of goods and services produced in the economy while the other two indices (WPI and CPI) are derived from price quotations for select commodity baskets. These variables have been taken under consideration because as per IS-LM model, interest rate is decided through equilibrium in goods (fiscal policy) and money market (monetary policy). In addition, inflation plays a key role as it affects the rate of interest. In addition, the autoregressive distributed lag (ARDL) model has been used to find out short run and long run coefficients. To investigate the presence of long-run relationships among the RINT, FD, MS, INFD bound testing under Pesaran, et al. (2001) procedure has been used. The bound testing procedure is based on the F-test. The F-test is actually a test based on the hypothesis of no cointegration among the variables against the existence of cointegration among them. If the computed F-statistic is greater than the
upper bound critical value (bound test), then the null hypothesis of no cointegration is rejected (meaning that variables are cointegrated).

\[
\Delta RINT_t = \beta_0 + \sum_{i=1}^{k} \beta_i \Delta RINT_{t-i} + \sum_{i=0}^{k} \beta_i \Delta FD_{t-i} + \sum_{i=0}^{k} \beta_i \Delta MS_{t-i} + \sum_{i=0}^{k} \beta_i \Delta INF D_{t-i} + \alpha_i RINT_{t-1} + \alpha_2 FD_{t-1} + \alpha_3 MS_{t-1} + \alpha_4 INF D_{t-1} + \varepsilon_t
\]

The left-hand side in the model is the real interest rate. On the right-hand side \(\alpha_1, \alpha_2, \alpha_3, \alpha_4\) represent the coefficient of long-run relationship. The remaining expressions with the summation sign (\(\beta_1 \sim \beta_4\)) represent the short-run dynamics of the model.

\[
\begin{align*}
H_0 & \rightarrow \alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = 0 \quad \text{(No cointegration)} \\
H_1 & \rightarrow \alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4 \neq 0 \quad \text{(Cointegration exists)}
\end{align*}
\]

In addition, the error correction version of ARDL model pertaining to the variables in equation (2) is as follows:

\[
\Delta RINT_t = \beta_0 + \sum_{i=1}^{k} \beta_i \Delta RINT_{t-i} + \sum_{i=0}^{k} \beta_i \Delta FD_{t-i} + \sum_{i=0}^{k} \beta_i \Delta MS_{t-i} + \sum_{i=0}^{k} \beta_i \Delta INF D_{t-i} + \lambda \text{ECM}_{t-1} + \mu_t
\]

Where

\(ECM_{t-1}\) = error correction term

\(\mu_t\) = error term

\(\lambda\) = coefficient of the error correction term which shows the speed of adjustment of the variables towards equilibrium in long run
5.7 RESULTS AND DISCUSSIONS

5.7.1 Unit Root Test

The first practice in applying any cointegration technique is to determine the degree of integration of each variable. The results of Augmented Dickey fuller test are presented in Table 5.1 which shows that fiscal deficit, money supply and inflation are stationary at first difference (the null hypothesis of the presence of unit root is rejected once the series are in the first difference). On the other hand, Real interest rate is stationary at level.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Level</th>
<th>At first difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>RINT</td>
<td>0.0007*</td>
<td>0.0000*</td>
</tr>
<tr>
<td>FD</td>
<td>0.1286</td>
<td>0.0000*</td>
</tr>
<tr>
<td>MS</td>
<td>0.9800</td>
<td>0.0017*</td>
</tr>
<tr>
<td>INFD</td>
<td>0.1267</td>
<td>0.0000*</td>
</tr>
</tbody>
</table>

Note: * denotes the rejection of null hypothesis of the presence of a unit-root at 1% level of significance.
Source: Authors’ computation with Eviews 9.0.

5.7.2 Long-run and Short-run Elasticities Estimates

The long run elasticities of real interest rate with respect to fiscal deficit, money supply and inflation have been estimated using the underlying ARDL model is shown in Table 5.2. According to Table 5.2, fiscal deficit elasticity is 0.33 percent at lag 2. It indicates that 1 percent increase in fiscal deficit would increase the real interest rate by 0.33 percent (supported by IS-LM model). Further, Money supply elasticity is -0.18 at lag 2 shows that when government increases money supply by 1 percent (adopts expansionary monetary policy), this would decrease the interest rate by 0.18 percent.
### Table 5.2
Long-run Elasticities Estimates

**Selected Model: ARDL (2, 2, 2, 2) for Long run Relationship among Variables**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>RINT(-2)</td>
<td>-0.52571</td>
<td>0.14044</td>
<td>-3.74342</td>
<td>0.0014*</td>
</tr>
<tr>
<td>FD(-2)</td>
<td>0.33905</td>
<td>0.15854</td>
<td>2.13857</td>
<td>0.0457*</td>
</tr>
<tr>
<td>MS(-2)</td>
<td>-0.18188</td>
<td>0.08577</td>
<td>-2.12047</td>
<td>0.0474*</td>
</tr>
<tr>
<td>INF D</td>
<td>-0.73302</td>
<td>0.07391</td>
<td>-9.91819</td>
<td>0.0000*</td>
</tr>
<tr>
<td>INF D(-1)</td>
<td>0.70406</td>
<td>0.16451</td>
<td>4.27984</td>
<td>0.0004*</td>
</tr>
<tr>
<td>INF D(-2)</td>
<td>-0.52639</td>
<td>0.15634</td>
<td>-3.36704</td>
<td>0.0032*</td>
</tr>
<tr>
<td>C</td>
<td>17.87821</td>
<td>3.19256</td>
<td>5.59996</td>
<td>0.0000*</td>
</tr>
</tbody>
</table>

Note: * denote significance at 5% level, Prob. = Probability, Author’s computation with Eviews 9.0. R-squared=0.95198, Adjusted R-squared=0.92417, S.E. of regression= 0.61446, Sum squared resid=7.17363, F-statistic=34.23935, Prob(F-statistic)= 0.00000, Mean dependent var=6.187097, Akaike info criterion=2.148495, Durbin-Watson stat=2.038645, Breusch-Godfrey Serial Correlation LM Test=0.9496, Heteroskedasticity Test (Prob. Chi-Square value of Breusch-Pagan-Godfrey) =0.9580

An interesting part of long run analysis is that inflation elasticity is -0.73 percent in current year indicates that that 1% increase in inflation would decrease the real rate of interest (i.e. nominal interest-inflation) by 0.73 percent or inflation is the reason for decline in the real return on deposits with banks. Further, it is also observed that supply shocks are the main cause of inflation in India. Hence, in order to control inflation; government reduces interest rate to induce private players for making investments. But inflation found positive sign at lag one meaning that any increase in inflation from the previous period positively affects rate of interest. Indeed, as a result of inflation, government would keep control on rate of interest by increasing it in next year for the benefit of investors or to extract excess purchasing power from the market. All the variables are found statistically significant at 5 percent level. In addition, the value of R square is very high (95%) that is good for the model. Moreover, the estimated ARDL model passed the usual diagnostic tests. Breusch-Godfrey Serial Correlation LM Test shows that there is no serial correlation. Further, chi square value of heteroskedasticity Test is also significant at five percent level of significant.
The long-run model of the corresponding ARDL (2, 2, 2, 2) for the interest rate (RINT) can be written as follows:

\[ \text{RINT}_t = 17.87821 + 0.33905 \text{FD}_t - 0.18188 \text{MS}_t - 0.73302 \text{INFD}_t \]

The above long run relationship between rate of interest, fiscal deficit and money supply supports the working of IS-LM model in India. Basically, IS-LM model is used to explain fluctuation in output and interest rate and to examine the effectiveness of fiscal and monetary policy for economic stabilisation. According to IS-LM model, increase in fiscal deficit as a result of increased government spending leads to increase the interest rate, hence crowd out private investments. Further, increase in money supply shifts the LM curve to right leads to decrease the interest rate. Thus positive relationship between fiscal deficit and rate of interest confirms that financing of government expenditure (as a result of expansionary fiscal policy) mainly through market borrowings compete creates extra pressure in money market. This results in increase in interest rate. On the other hand, negative relationship between money supply and interest rate indicates that increase in money supply inject extra cash in banks thus lowering the rate of interest.

<table>
<thead>
<tr>
<th>Test Statistic</th>
<th>Value</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-statistic</td>
<td>7.231248</td>
<td>3</td>
</tr>
</tbody>
</table>

Critical Value Bounds

<table>
<thead>
<tr>
<th>Significance</th>
<th>I0 Bound</th>
<th>I1 Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>2.37</td>
<td>3.2</td>
</tr>
<tr>
<td>5%</td>
<td>2.79</td>
<td>3.67</td>
</tr>
<tr>
<td>2.50%</td>
<td>3.15</td>
<td>4.08</td>
</tr>
<tr>
<td>1%</td>
<td>3.65</td>
<td>4.66</td>
</tr>
</tbody>
</table>

Source: Author’s computation with Eviews 9.0.

In Table 5.3, ARDL bound test confirms the long run relationship among real interest rate, fiscal deficit, money supply and inflation as computed F statistic (7.23) is greater than upper bound (3.67) at 5 percent level of significance. In addition CUSUM and CUSUMSQ tests results are presented in Figure 7 and 8.
respectively. CUSUM and CUSUM square confirm the stability of model in long run.

Figure 5.7: CUSUM

Figure 5.8: CUSUMSQ
Table 5.4
Error Correction Model for the Selected ARDL (2, 2, 2, 2)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.09442</td>
<td>0.17700</td>
<td>0.53341</td>
<td>0.59890</td>
</tr>
<tr>
<td>D(RINT(-2))</td>
<td>-0.35736</td>
<td>0.13270</td>
<td>-2.69302</td>
<td>0.01300</td>
</tr>
<tr>
<td>D(FD(-2))</td>
<td>0.41340</td>
<td>0.14380</td>
<td>2.87491</td>
<td>0.00860</td>
</tr>
<tr>
<td>D(MS(-2))</td>
<td>-0.19613</td>
<td>0.07380</td>
<td>-2.65751</td>
<td>0.01410</td>
</tr>
<tr>
<td>D(INFD)</td>
<td>-0.78347</td>
<td>0.08107</td>
<td>-9.66425</td>
<td>0.00000</td>
</tr>
<tr>
<td>D(INFD(-1))</td>
<td>0.38834</td>
<td>0.08629</td>
<td>4.50016</td>
<td>0.00020</td>
</tr>
<tr>
<td>ECT(-1)</td>
<td>-0.57704</td>
<td>0.29559</td>
<td>-1.95219</td>
<td>0.00620</td>
</tr>
</tbody>
</table>

R-squared=0.931063, Adjusted R-squared=0.910082, S.E. of regression=0.739649, F-statistic=44.37691, Prob(F-statistic)=0.0000, Mean dependent var=-0.009677, Akaike info criterion=2.452354, Durbin-Watson stat=1.731599

Source: Author’s computation with Eviews 9.0.

Table 5.4 shows the summary of the short run analysis, fiscal deficit is found positively related with real interest rate and 1 percent increase in fiscal deficit will increase real rate of interest by 0.43 percent. This depicts that high fiscal deficit is a reason for high interest rate in India. Therefore, Government should control on its expenditure. An interesting part of short run result is that 1 percent increase in money supply will decrease the real rate of interest by 0.19 percent. Besides, inflation is found positively related with real interest rate at lag 1. In addition, the value of ECT is negative and significant at 5 percent indicates that the speed of adjustment is -0.57704. This negative coefficient of error correction term indicates that 57 percent disequilibrium in rate of interest will be offset each year by short run adjustment of explanatory variables (fiscal deficit, money supply and inflation). Thus, it is important to reduce the disequilibrium in rate of interest over time by implementing adequate fiscal and monetary policy in order to maintain long-run equilibrium.
5.7.3 Granger Causality Analysis

Once cointegration is found among variables, there must be uni or bidirectional causality between the series (Ohlan, 2015). Such knowledge is worthwhile for formulating appropriate fiscal and monetary policy for economic growth. In the presence of cointegration among the series, the VECM can be presented as given below.

\[
(1 - L) \begin{bmatrix}
RINT_t \\
FD_t \\
MS_t \\
INF_D_t
\end{bmatrix} = \begin{bmatrix}
\lambda_1 \\
\lambda_2 \\
\lambda_3 \\
\lambda_4
\end{bmatrix} + \sum_{i=1}^{n} (1 - L) \begin{bmatrix}
\delta_{11,i} \\
\delta_{12,i} \\
\delta_{13,i} \\
\delta_{14,i}
\end{bmatrix} \begin{bmatrix}
RINT_{t-1} \\
FD_{t-1} \\
MS_{t-1} \\
INF_D_{t-1}
\end{bmatrix} + \begin{bmatrix}
\eta_t \\
\eta_2 \\
\eta_3 \\
\eta_4
\end{bmatrix} (ECT_{t-1}) + \begin{bmatrix}
\mu_1 \\
\mu_2 \\
\mu_3 \\
\mu_4
\end{bmatrix}
\]

Where \((1 - L)\) is showing the difference operator, \(ECT_{t-1}\) is the one period lagged error correction term. The statistical significance of \(ECT_{t-1}\) is checked by applying t-test statistic, confirms the existence of long-run Granger-causality while that of Wald's test chi square statistic for the combined significance of lagged values of variable exhibits short-run dynamics.

The results of the test on causality are presented in Table 5.5. The results show that there is no short run causality between fiscal deficit, money supply and real interest rate. However, there is unidirectional causality running from inflation to real interest rate in short run and the results are significant at 5 percent level of significance. However, real interest rate granger cause fiscal deficit at 10 percent level of significance in short run.
### Table 5.5
Results of Causality based on Error Correction Model

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Source of causation (Independent variables)</th>
<th>Long-run Causality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Short run causality</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F values (Wald Test)</td>
<td>t-values</td>
</tr>
<tr>
<td>Dependent Variables</td>
<td>ΔRINT</td>
<td>ΔFD</td>
</tr>
<tr>
<td>Fiscal Deficit and/or Money Supply and/or Inflation do not granger cause Real Interest rate</td>
<td>-----</td>
<td>1.847(0.1823)</td>
</tr>
<tr>
<td>Real interest rate and/or Money Supply and/or Inflation do not granger cause Fiscal deficit</td>
<td>3.319(0.0652)**</td>
<td>-----</td>
</tr>
<tr>
<td>Real interest rate and/or fiscal deficit and/or Inflation do not granger cause Money supply</td>
<td>1.612(0.222)</td>
<td>1.590(0.2286)</td>
</tr>
<tr>
<td>Real interest rate and/or Fiscal deficit and/or Money Supply and/or do not granger cause Inflation</td>
<td>2.045(0.1546)</td>
<td>0.5738(0.5719)</td>
</tr>
</tbody>
</table>

Note: RINT, FD, MS and INFD indicate real interest rate, fiscal deficit, money supply and inflation. The optimal lag lengths were selected by using AIC criterion mentioned in Pantula et.al (1994). The numbers under parenthesis are P values. * indicate rejection of null hypothesis at 5 percent, ** indicate rejection of null hypothesis at 10 percent.

Source: Author’s computation with Eviews 9.0.

The results of long run causality showed that the p value of $\eta_1$ in VECM equation is found to be significant at 5 percent level of significance, implying that granger causality run from fiscal deficit, money supply and inflation to real interest rate in long run. Moreover, value of $\eta_2$ in VECM equation is also significant at 5 percent level of significance meaning that long run causality running from real interest rate, money supply and inflation to fiscal deficit. In addition, the value of $\eta_3$ and $\eta_4$ in the VECM equation are also significant at five percent level of significance implying that causality running from real interest rate, fiscal deficit and inflation to money supply and also from real interest rate, fiscal deficit and money supply to inflation respectively. Thus, there is long run causality running among competing variables.

#### 5.8. CONCLUSIONS

The interesting results of ARDL model are that the rate of interest and fiscal deficit are positively related with each other in long run and fiscal deficit elasticity is
0.33 percent at lag 2. Money supply (lag 2) and inflation (at level) have negative relationship with rate of interest in long run. Money supply elasticity is -0.18 at lag 2. This means that 1 percent increase in money supply leads to decrease the real interest rate by -0.18 percent. Inflation elasticity is -0.73 percent in current year indicates that that 1 % increase in inflation would decrease the real rate of interest (i.e. nominal interest- inflation) by 0.73 percent. Further, the error correction term indicates that 57 percent disequilibrium in rate of interest will be offset each year by short run adjustment of explanatory variables. In addition, results of vector error correction model showed that there is unidirectional causality running from inflation to real interest rate in short run. As far as long run causality is concerned, causality is running from real interest rate, fiscal deficit and inflation to money supply and also from real interest rate, fiscal deficit and money supply to inflation. In other words, high interest rate, fiscal deficit and money supply are the reason for high inflation in India. Furthermore, there is bidirectional causality among variables in long run.