Indian Twin Deficits : The Role of Inflation and Money Supply

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Abstract

The study explored the role of inflation and money supply in the twin deficits hypothesis using the IS-LM framework and posited that inflation could be the mediating variable which explains why a higher fiscal deficit may lead to worsening of the current account balance. This may hamper the effectiveness of the monetary policy and long run output growth. We tested the model empirically on Indian data using Johansen's cointegration test to find evidence that fiscal deficit, current account deficit, inflation, and money supply have a long-run relationship.

Keywords: **twin deficits hypothesis, Mundell - Fleming model, inflation, IS-LM model, Johansen cointegration, fiscal deficit, current account deficit**

JEL Classification: E6, H2, H5, H6

Paper Submission Date: August 5, 2015 ; Paper sent back for Revision : November 17, 2015 ; Paper Acceptance Date : January 4, 2016

The phenomenon of the twin-deficits hypothesis has intrigued economists and policy makers since the past few decades. It has been a key macroeconomic issue concerning the sustainability of continual budget and trade deficits as well as possible interrelationship between them. The term 'twin deficit' was initially coined to refer to the joint movement between the budget deficit and the current account deficit, which was observed in the United States of America during the early 1980s. The empirical testing of the twin deficits hypothesis gained prominence in the U.S. during the Reagan fiscal experiment in the 1980s. This marked a period of fiscal expansion with strong appreciation of the dollar and an unusual widening of the current account deficit.

In Europe (Germany and Sweden), a similar situation was witnessed in the early 1990s. Around 2006, decline in the U.S. current account and fiscal balances revoked interest in the twin deficit phenomenon and its implications for global economic stability, once again bringing it to the heart of economic policy debates. The widening of the current account deficit in a number of Southeast Asian (ASEAN) countries (Indonesia, Malaysia, the Philippines, and Thailand) over the past decades has also generated policy concerns.

India is currently experiencing a high fiscal deficit and worsening of the current account balance. Though the interest rates in India have been higher than the developed world economies and have been rising, exchange rate has been falling continuously over the last couple of years. The Mundell Fleming model, which relates the two deficits through their interaction with higher interest rates, and currency appreciation does not seem to adequately

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explain the current situation in the Indian economy. With the rupee reaching its lifetime low, stagnating growth, burgeoning current account deficit dominated by oil and gold imports, there has been a renewed interest in the twin deficits hypothesis and its role in overall macroeconomic stability. In this paper, we take a fresh look at the relationship between fiscal deficit and current account balance by exploring the role of inflation and money supply in explaining the causality between these key macroeconomic variables.

Basic Analytical Framework

The twin deficits hypothesis can be expressed with the help of the national income *(Y)* identity as follows:

$$Y = C + I + G + (X\text{-}M) \quad (1)$$

where,
C is private consumption expenditure, *I* is private investment, *G* is government expenditure, *X* is exports of goods and services, and *M* is imports of goods and services. Thus, *X-M* is net earnings from foreign trade.

We derive another term relating to national income identity, known as private saving *S*, which is given as income net of consumption and taxes as :

$$S = Y - C - T \quad (2)$$

where, *T* is tax revenue.
From equations (1) and (2), we can estimate the current account balance, and the gap between national investment and national savings (a sum of private and public saving). Therefore, the current account balance *(CA)* is presented as:

$$(X\text{-}M) = (S\text{-}I) + (T\text{-}G) \quad (3)$$
$$CA = (S\text{-}I) + BUD \quad (4)$$

Equation (4) indicates that the current account balance is related to the budget balance ($BUD = T\text{-}G$) through the gap between private savings and private investment. The saving investment gap remaining constant, fiscal deficit and current account deficit (labeled as the 'twin deficits') should move together in the same direction and by the same amount.

There are four competing views that explain the association between budget deficit and current account deficit.

(1) Keynesian Explanation : According to the conventional or Keynesian proposition, an increase in budget deficit enhances domestic absorption. Budget deficit occurs due to greater spending on domestic as well as foreign goods. Increased domestic spending pull exports down, especially in an economy characterized by supply bottlenecks. While increased spending on foreign goods push imports upward, which, consequently, deteriorates the trade deficit.

(2) The Mundell - Fleming Model : The Mundell - Fleming model modified the conventional model of the twin deficits hypothesis by incorporating the same in the IS-LM framework (explained in detail in the Theoretical Model section of this paper). Under this framework, a high fiscal deficit leads to higher interest rates. However, these increased interest rates attract capital inflows and thereby, cause an appreciation in the exchange rate (Cebula, 1988 ; Feldstein, 1986; Rosensweig & Tallman, 1993). Such a change in the value of currency makes exports dearer and imports cheaper, thereby worsening the trade deficit under flexible exchange rate. The model assumes prices to remain constant.

(3) Ricardian Equivalence Hypothesis : The Ricardian equivalence hypothesis (Barro, 1989), also known as the Barro-Ricardo equivalence position, asserts that there is an absence of any causal relationship between the budget deficit and trade deficit. According to this proposition, people foresee higher tax liabilities in future as the budgetary deficit expands. Thus, they attempt to save more by spending less. Hence, a budget deficit does not result in a widened trade account deficit (Enders & Lee, 1990).

(4) Reverse Causality : This view involves unidirectional causality running from the current account deficit to the budget deficit. Here, a deteriorated current account reduces the pace of economic growth. Therefore, budgetary deficit increases due to a loss in tax revenues or increased government expenditure on sectors facing falling exports.

(5) Bi-directional Causality : The final version of causal relation between the two deficits relates to the hypothesis that these two deficits are mutually dependent, that is, there could be bi-directional causality between the two deficits.

Literature Review

(1) Evidence from the Rest of the World : If we scan through the existing literature on evidence of the twin deficits hypothesis for developing countries, we find that there is abundance of research done in this area, and the results are mixed.

The twin deficits hypothesis started to attract attention in the 1980s. Early studies, such as the ones conducted by Milne (1977) and Bernheim (1988) found positive and statistically significant relationship between the two deficits using the ordinary least squares (OLS) regressions to cross-country data. Abell (1991) suggested that the hypothesis holds and indicates that budget deficits impact current account deficits through movements in interest rates and exchange rates. He used a seven-variable VAR system with first-differenced data for the United States over the period from 1979 - 1985. This is in consonance with the Mundell - Fleming model. Bachman (1992) and Rosensweig and Tallman (1993) used unrestricted VAR in differences and found that government budget deficits have a sizable impact on trade deficits.

Enders and Lee (1990) estimated a six variable structural VAR with the differenced data for the U.S. between 1947 to 1985. Their study supported the Ricardian equivalence hypothesis as it found no evidence that budget deficits raise the trade deficit. Kim and Roubini (2008) suggested that the U.S. government budget deficits actually improved the U.S. current account balance, which is exactly the opposite of what the theoretical model predicts. They estimated a VAR in levels for the post-Bretton- Woods period.

Grier and Ye (2009) suggested that the problem with establishing a robust relationship between the variables is a possibility of structural breaks in the series. They found that both the series are break stationary with no common pattern in the long run, but a persistent positive relationship in the short run. Baharumshah, Ismail, and Lau (2009) found evidence for the hypothesis for Malaysia, Thailand, and Philippines and did not find evidence for Indonesia and Singapore. They also examined the role of capital flows and found that government expenditure crowded out private investment. Azgün (2012) found evidence for the twin deficits hypothesis in the context of the Turkish economy for 1980-2009 - post adoption of the economic reforms.

Efremidze and Tomohora (2011) studied the importance of the twin deficits in predicting sudden stops or crises. They found that the role of the twin deficits in predicting sudden stops declined over the years, however, they still remained an important factor for predicting sudden stops. Bose and Jha (2011) suggested that the available literature indicates that the inter-relationship between the twin deficits depended upon method, space, and time. It is complicated and ambiguous in nature. Thus, it leads to varying policy conclusions and thereby, policy dilemma.

(2) Evidence from the Indian Economy : Bose and Jha (2011) examined the causal linkages between the budget deficit and current account deficit for India. Their model utilized exchange rates and interest rates as the mediating (interlinking) variables. The results on the direction of causality amongst four variables, that is, interest rates, exchange rates, budget deficit, and current account deficit remained inconclusive. The conventional hypothesis of causation running from the fiscal deficit to increased interest rates to higher exchange rates, ultimately resulting into current account deficit is only partially supported by their results, while the evidence for reverse causation is very strong. By introducing oil prices as the mediating variable, they found that the direction of causality unambiguously runs from oil prices to the current account deficit to the fiscal deficit. Since oil subsidies affect the fiscal deficit, rising oil prices impact both current account and fiscal deficit.

Similarly, Anoruo and Ramchander (1998) found that trade deficit Granger caused the budget deficit in India. Their study used Granger's causality test based on a vector autoregressive model to test the twin deficits hypothesis across five developing South-East Asian countries, namely, India, Indonesia, Korea, Malaysia, and Philippines. The study analyzed the role of exchange rate, interest rate, and inflation as the mediating variables and found them to be statistically significant in the Indian context. The plausible explanation of the reverse causality was that the government may step up spending in order to recover from the low growth/unemployment and loss to domestic industries caused by increasing trade deficit.

Ghatak and Ghatak (1996) conducted multi-cointegration analysis on data for the years from 1950-1986 but did not find evidence in favour of the Ricardian equivalence hypothesis. The study suggested the possibility of the conventional hypothesis to hold in the Indian context. On the contrary, Koussi, Mougoué, and Kymn (2004) found no causal relationship in case of India between the two for data collected for years from 1975-97. The study suggested incorporating additional macro-variables in the model.

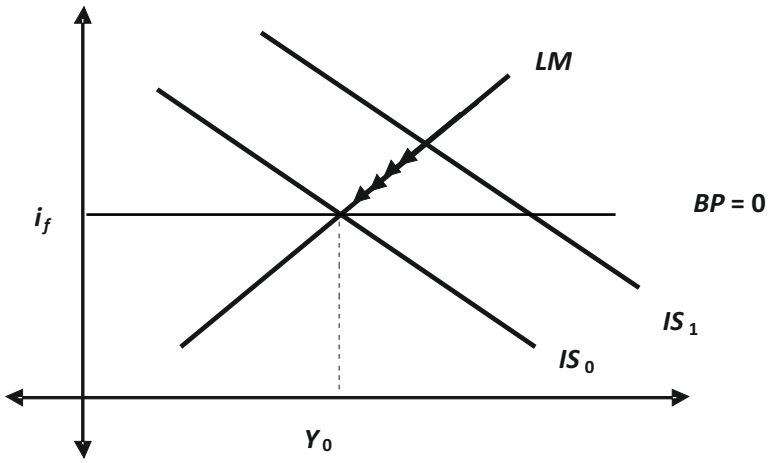
Ratha (2011) developed a model including macro-variables such as domestic and foreign incomes, real effective exchange rate, besides the two deficits. The model tried to improve over the earlier approaches by defining variables in non-negative, real, and unit free terms, employing the bound-testing approach, and using high-frequency data. The findings support Keynesian hypothesis for Indian data in the short-run, however, the study found that it does not hold during the long run. Kulkarni and Erickson (2011) found evidence for the twin deficits hypothesis for India using the regression analysis.

Similarly, our study also vindicates that fiscal and current account deficit are correlated, and inflation acts as the link between fiscal and current account deficit and hence, fiscal deficit, current account deficit, inflation, and money supply exhibit a long-run relation. Our model predicts that all these variables would persist and reinforce each other over a period of time if the fiscal deficit is not controlled and interest rates do not rise commensurate to inflation. The empirical evidence supports the view that all the four variables are cointegrated in the long run. Inflation, fiscal deficit, and current account deficit have persisted in India for quite some time and there is evidence to support the view that inflation could be the key mediating variable between the twin deficits.

Theoretical Model

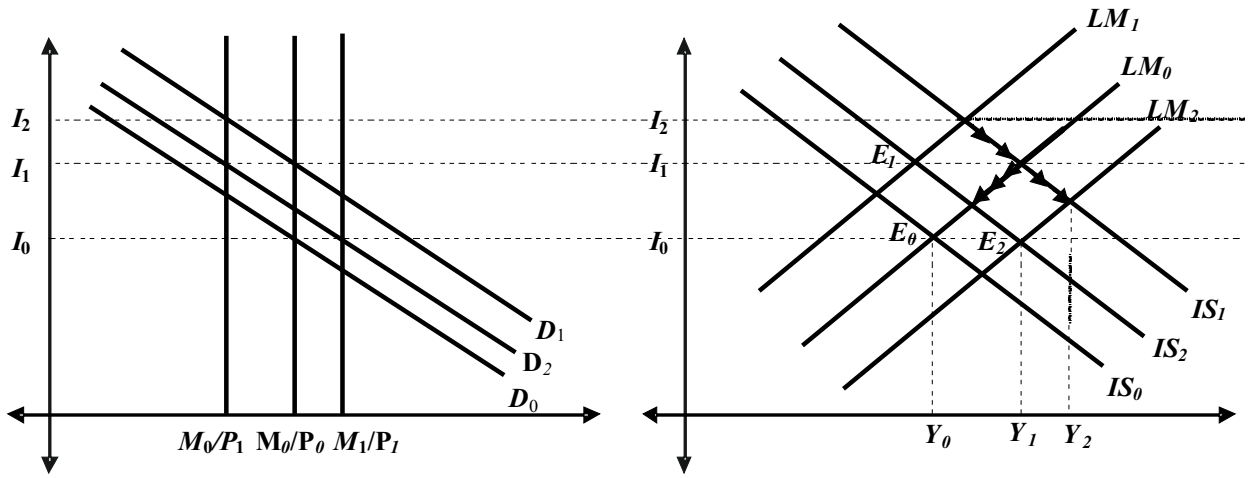
The Mundell Fleming model explains the interaction between fiscal deficit and current deficit, under both fixed and flexible exchange rate regimes, assuming the given level of prices. In this paper, we focus on the adjustment process under the flexible exchange rate regime. The Mundell Fleming model (as can be seen in Figure 1) posits that an expansion in fiscal deficit leads to an expansion in aggregate demand (upward shift in the IS curve) in the short run, leading to an increased demand for money and hence a higher interest rate, assuming money supply and price level (M/P) to remain constant. A higher interest rate (than the world interest rate levels) causes an immediate and massive inflow of capital (under the condition of perfect capital mobility) which leads to appreciation of the exchange rate. An appreciation of the currency further causes imports to become cheaper (hence more competitive) and exports to become expensive (and hence uncompetitive) in the international markets, leading to

Figure 1. Twin Deficits under the Mundell - Fleming Model



Source: Adapted from Dornbusch and Fischer (2011)

Figure 2. Twin Deficit, Inflation, and Money Supply



Source: Adapted from Dornbusch and Fischer (2011)

deterioration of the current account balance. This is the link between fiscal deficit and current account deficit, where an increase in fiscal deficit causes an increase in the current account deficit (thus the name 'twin deficits') through the interaction between interest rate and exchange rate. Eventually, the current account deficit leads to a fall in aggregate demand, causing the IS curve to shift back to its original position (refer Figure 1). The output and interest rate (which is again equal to the global interest rate level) remain unchanged, despite the fiscal expansion because the entire expansionary effect of the fiscal expansion is crowded out by the current account deficit.

As mentioned earlier, the Mundell - Fleming model assumes prices to remain constant and capital to remain perfectly mobile so that interest rate in the economy is always equal to the world interest rates *(i_f)*. The model essentially deals with the changes in the IS curve, leaving the LM curve unchanged in the IS-LM framework. In the real world, most economies, developed or developing, experience inflation. Capital may not be perfectly mobile across different countries. Moreover, interest rates also vary across countries. Interest rate is not the sole factor for capital to move across countries. Country-specific risks may also influence capital flows. This may weaken the causal link between nominal interest rates and exchange rate.

To incorporate the role of inflation and money supply (LM curve along with the IS curve), we provide the following alternative explanation for the twin deficits hypothesis within the IS-LM framework.

In the following analysis, we assume flexible prices, flexible exchange rate, and flexible interest rate levels. Unlike the Mundell Fleming model, we assume an imperfect capital mobility, which implies that the interest rate level in an economy may be different from the world interest rate. However, we assume that the Central bank targets a particular level of interest rate for the economy (although this is only for expositional purposes) and that the economy is at or near the full-employment level.

As depicted in the Figure 2, we start our analysis from point E_0, which is the initial point of equilibrium in the IS LM framework, with interest rate equal to I_0. An expansion of fiscal deficit is depicted by an upward shift in the *IS* curve from IS_0 to IS_1 (Please see Figure 2). This leads to an increase in output in the short run, thereby increasing the demand for nominal money (as we are assuming flexible prices) from D_0 to D_1 and consequent pressure on interest rate to rise (I_0 to I_1). If the fiscal expansion turns out to be inflationary, the price level would begin to rise, leading to an increase in the nominal demand for money and fall in the real money supply (from M_0/P_0 to M_0/P_1). Fall in real money supply implies upward shift of the LM curve (from LM_0 to LM_1), further increasing the pressure on interest rate (from I_1 to I_2). Inflation affects the IS curve in a different manner. Increase in prices relative to the rest of the world would lead to exports becoming expensive and imports becoming more competitive, leading to an increase in the current account deficit and fall in the IS curve, reversing the increase in output and demand for money, thus easing the pressure on interest rate. As can be seen in the graph 2 of Figure 2, the IS curve shifts downwards towards its original position due to deterioration in the current account from IS_1 to IS_2. The money demand shifts downwards from D_1 to D_2 consequent with the fall in output and interest rate.

In other words, the current account deficit crowds out the expansionary impact of the fiscal deficit. In the Mundell Fleming model also, the current account deficit crowds out the expansionary impact of fiscal deficit. However, the current account deterioration is caused by exchange rate appreciation which, in turn, is caused by higher interest rate under the Mundell Fleming model. The difference under this approach is that the current account deficit is caused by inflation. Another point of difference is that we assume imperfect capital mobility, which does not necessitate interest rates to equalize all over the world. Thus, an increase in interest rate does not necessitate exchange rate appreciation.

On the contrary, as per (relative) purchasing power parity, inflation is associated with exchange rate depreciation. If inflation leads to proportionate exchange rate depreciation, loss of competitiveness in foreign trade (caused due to domestic inflation) would be reversed completely and there would be no crowding out or loss of output. In this extreme case, where the relative PPP holds true, the IS curve would not shift at all. However, the empirical evidence for PPP is mixed (Enders, 1995). Even though inflation may cause exchange rate depreciation, the amount of depreciation may not be equal to the magnitude of inflation, for example, in case of India, since 1992, the rupee has depreciated by more than 100% (from 29.42 to 61), whereas the increase in consumer price index since 1992 is around 344%.

This suggests that total crowding out (i.e. reversal of IS curve from IS_1 to IS_0) is not possible due to exchange rate depreciation. There would be partial crowding out, meaning that the IS curve shifts from IS_1 to IS_2 (between the IS_0 and IS_1). Moreover, the import and export basket may not be equally price elastic. For example, if oil products constitute a significant portion of the import basket, the exchange rate depreciation may not lead to reduction in the import bill, implying that the currency depreciation may not fully correct the current account deficit. Furthermore, there could be an inflation-depreciation cycle (Gandolfo, 2001), where depreciation further leads to inflation and vice versa, leading to persistence of current account deficit. This suggests that partial crowding out may be a better depiction of the real world and full crowding out.

With this, the new long run equilibrium would be E_1, where the demand for money is D_2, money supply is M_0/P_1, and interest rate is I_1. However, if the Central bank targets a particular interest level, I_0 in this case or interest rate level lower than I_0, the money supply has to be increased accordingly. This implies an expansion of money supply

from M_0/P_1 to M_1/P_1 with the consequent shift in the LM curve from LM_1 to LM_2, leading to the new equilibrium level E_2. Comparing this with the initial equilibrium level of E_0, we can see that the fiscal deficit, price level, current account deficit, and money supply have increased in the long run.

Depending of the extent of crowding out, there is some increase in the output (from Y_0 to Y_1). However, the increase in output is lower than what could have been possible, had there been no inflation. Y_1Y_2 depicts the loss of output caused by inflation.

The increase in money supply (from LM_1 to LM_2) may further fuel inflation and consequent current account deficit, crowding out, and lowering of output. This implies that fiscal deficit, current account deficit, inflation, and money supply growth would persist over a period of time if interest rates are not allowed to adjust to inflation level. During this period, if the fiscal deficit continues to expand, the cycle continues, leading to persistence of twin deficit, inflation, and money supply.

Thus, the equilibrium E_2 is dynamic and unstable if the Central bank targets a given or lower level of interest rate (I_0). To reach a stable equilibrium, two factors are necessary: (a) the interest rate endogenously determined by the model should prevail. In other words, interest rates should be high enough to reflect and control the inflation level, and (b) control over fiscal deficit.

To sum up, the aforesaid analysis suggests that higher fiscal deficit leads to a higher current account deficit by means of inflation. If the central bank maintains or lowers the level of interest in the process, money supply increases, which leads to further inflation and current account deficit. Thus, the twin deficits hypothesis holds (as in case of the Mundell - Fleming model). However, intermediating variables are inflation and money supply (instead of exchange rate and interest rate).

Empirical Methodology

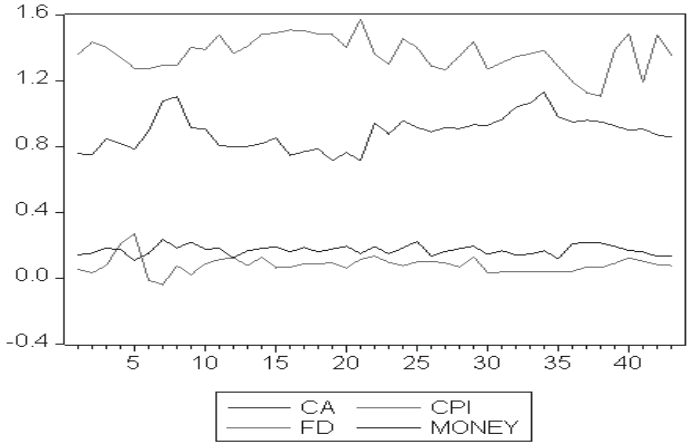
(1) Econometric Model : To test the model in the Indian context, we should test whether the four key variables in the model, that is, fiscal deficit, current account balance, inflation, and money supply should be cointegrated in the long run. We use the Johansen cointegration tests (trace test and maximum Eigenvalue test) to test for long run relationship between the variables. The test for cointegration required that all the series are non-stationary and integrated to the order (1). To test for stationarity, we use the augmented Dickey-Fuller unit root tests. If the variables are found to be cointegrated, we run the vector error correction model under the vector autoregression framework to understand the long run and short run causality between the variables. We also analyze the impulse response functions and variance decomposition under the unrestricted VAR framework.

(2) Data : This paper uses yearly data from 1970-71 to 2012-13. Current account (CA) is defined as the ratio of current receipts/current payments (CA above 1 implies current account surplus and CA less than 1 implies current account deficit). Fiscal deficit (FD) is defined as Central Government receipts/Central Government payments (FD above 1 implies fiscal deficit and CA less than 1 implies fiscal surplus). Year on year inflation (CPI) is calculated based on the consumer price index for industrial workers. Money supply growth (Money) is the year on year growth in broad money supply (M3). All the data has been sourced from the website of Reserve Bank of India, the central monetary authority (see Figure 3).

Analysis and Results

(1) Unit Root Tests : Based on the augmented Dickey Fuller (ADF) test with 2 lags (based on Akaike information criteria), we find that the current account series is non-stationary (refer Table 1) even at the 10% significance level, that is, current account is a unit root process. We also find that it is integrated of order *I* (1), that is, the series is first difference stationary. Based on the augmented Dickey Fuller (ADF) test with 2 lags (based on Akaike information

Figure 3. Current Account, Fiscal Deficit, Inflation, and Money Supply Growth



Source: Database on Indian Economy by Reserve Bank of India

Table 1. ADF Unit Root Test Results

		Level of Significance			
Series	**Test Statistic**	**1%**	**5%**	**10%**	**Lags**
Current Account	-0.156050	-2.624*	-1.949*	-1.612*	2
Fiscal Deficit	-0.259268	-2.624*	-1.949*	-1.612*	2
Inflation	-1.868098	-2.624*	-1.949*	-1.612	1
Money Supply	-0.532124	-2.624*	-1.949*	-1.612*	1

Notes: Lag length is determined by the Akaike Information Criterion (AIC). *indicates non rejection of H0

criteria), we find that the fiscal deficit is non-stationary (refer Table 1) even at the 10% significance level, that is, the fiscal deficit is also a unit root process. We also find that it is integrated of order *I*(1), that is, the series is first difference stationary.

Based on the augmented Dickey Fuller (ADF) test with 1 lag (based on Akaike information criteria), we find that inflation based on CPI is non-stationary (refer Table 1) at the 5% significance level, that is, inflation is also a unit root process. We also find that it is integrated of order *I*(1), that is, the series is first difference stationary. The ADF unit root test for growth in money supply with 1 lag (based on Akaike information criteria) suggests that the series is non-stationary (refer to Table 1) even at the 10% level of significance. We also find that it is integrated of order *I*(1), that is, the series is first difference stationary. As all the series (current account, fiscal deficit, inflation, and money) are found to be non-stationary based on the ADF test, we can proceed to test whether there is any cointegration between these variables.

(2) Test for Cointegration : Optimum lag size for Johansen's cointegration test and vector error correction model is one (1) based on the likelihood ratio, final prediction error, and HannQuinn information criteria. We run the Johansen cointegration rank (trace) test and the Johansen cointegration rank (maximum Eigenvalue) test. Cheung and Lai (1993) suggested that the likelihood ratio test for Johansen is derived for asymptotic results, and statistical inference for finite sample may not be appropriate. They suggested that the null hypothesis of no cointegration is often rejected due to what is known as "size distortion". To deal with the finite sample issue, we use the Reinsel-Ahn scaling factor *(T/(T-nk))* and multiply it with the Johansen test statistic, where T = Sample size, n = number of variables, and k = number of lag values.

Table 2. Johansen Trace Test for Current Account, Fiscal Deficit, Inflation, and Money Supply Growth

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.581062	79.10013	54.07904	0.0001
At most 1 *	0.456560	43.42876	35.19275	0.0052
At most 2	0.280615	18.42551	20.26184	0.0877
At most 3	0.113119	4.921830	9.164546	0.2921

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level.
* denotes rejection of the hypothesis at the 0.05 level.
**MacKinnon-Haug-Michelis (1999) *p*-values.

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.581062	35.67137	28.58808	0.0052
At most 1 *	0.456560	25.00325	22.29962	0.0204
At most 2	0.280615	13.50368	15.89210	0.1145
At most 3	0.113119	4.921830	9.164546	0.2921

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level.
* denotes rejection of the hypothesis at the 0.05 level.
**MacKinnon-Haug-Michelis (1999) *p*-values.

Table 3. Normalized Coefficient Matrix

Normalized cointegrating coefficients (standard error in parentheses)				
CA	**FD**	**CPI**	**MONEY**	**C**
1.000000	0.730529	2.395619	1.673502	-2.374829
	(0.14041)	(0.32410)	(0.65462)	(0.24040)
	[5.20289]	[7.39149]	[2.55655]	[-9.87902]

Values in ( ) denote standard deviation
Values in [ ] denote t-statistic

As depicted in the Table 2, both the Johansen cointegration tests (trace and maximum Eigenvalue) including an intercept term (but no deterministic trend) provide evidence of two cointegrating vectors for current account, fiscal deficit, inflation, and money supply growth. We are able to reject the null of no cointegration even at the 1% level of significance for both the trace and maximum Eigenvalue tests.

Even after applying the Reinsel-Ahn scaling factor to the Johansen test statistic, we find evidence for two cointegrating vectors for the trace test as before. However, for the Johansen maximum Eigenvalue test, we find evidence for only one cointegrating vector. Cheung and Lai (1993) suggested that the Johansen trace test is more robust to skewness and excess kurtosis in the residuals than the maximum Eigenvalue test. Johansen (1995) suggested that it is also more robust to departures from heteroskedasticity. However, the maximum Eigenvalue test has a sharper alternative hypothesis than the trace test and should be preferred in deciding the number of cointegrating vectors (Enders, 1995). Accordingly, the number of cointegrating vectors for current account, fiscal deficit, inflation, and money supply growth is one (1).

This implies that there is a long run relationship between current account, fiscal deficit, inflation, and money supply growth. The normalized coefficient matrix (see Table 3) for current account, fiscal deficit, inflation, and money supply growth is 1, 0.73, 2.39, 1.673.

The signs of the normalized cointegrating coefficients suggest that there is a negative relation between current account surplus and fiscal deficit, inflation, and money supply growth, that is, there is a positive relationship between current account deficit and fiscal deficit, inflation, and money supply growth. In other words, current account deficit tends to increase along with an increase in fiscal deficit, inflation, and money supply growth in the long run.

All the coefficients of speed of adjustment factors have the expected negative sign and are less than unity. The coefficients of speed of adjustment denote the error correction, that is, the rate at which variables respond to deviations from the long-run equilibrium. The coefficient of the speed of adjustment for inflation implies that 0.31 or 31% of the disturbance in the short run will be corrected each year. So also, for money supply growth, 14.50% of the disturbance will be corrected every year. This means that in case of deviation from long run equilibrium, inflation and money supply respond in order to restore the equilibrium. The coefficients for both inflation and money supply are found to be significant at the 5% level of significance.

In case of fiscal deficit, although the coefficient has the expected sign and magnitude, however, the value is not statistically significant, that is, different from 0 at 5% level of significance. Same is the case with the coefficient for current account (although the coefficient for fiscal deficit is significant at the 10% level of significance). This implies that in case of deviation from the long run equilibrium, current account and fiscal deficit may not respond to restore the equilibrium. Hence, both current account and fiscal deficit may be considered as weakly exogenous.

There are strong reasons why fiscal deficit and current account deficit can be considered weakly exogenous. Fiscal deficit is based on the fiscal policy of the government and may be influenced by factors other than those considered in the model, for example, growth, socioeconomic objectives, elections, and so forth. Current account balance, on the other hand, is influenced by oil prices as oil imports are the single largest constituent in India's import basket.

Tests for serial correlation, heteroskedasticity, and normality for the residuals for the vector error correction:

We conduct the LM test for serial correlation and find that the null hypothesis of no serial correlation is not rejected. We also conduct White's test for testing heteroskedasticity and find that the null hypothesis of no heteroskedasticity is not rejected. So, we also run the JarqueBera test for testing normality of residuals and find that the null hypothesis of multivariate normality is not rejected. Thus, we find that the vector error correction model does not suffer from serial correlation or heteroskedasticity. Furthermore, the residuals are distributed normally.

(3) Vector Error Correction Model : The detailed vector error correction model under vector autoregressive framework is given in the Table 5. The cointegration coefficients (speed of adjustment factors) or vector error correction term explains the long-run relationship between variables ; whereas, the other coefficients depict the short run relationship between variables. As can be seen from the Table 4, the error correction term is significant at the 5% level of significance for inflation and money supply growth, and the error correction term for fiscal deficit is significant at the 10% level of significance.

With regard to the short-run causality, the third equation (refer to Table 5) where the inflation is the dependent variable suggests that there is short run causality running from fiscal deficit and money supply to inflation, that is,

Table 4. Speed of Adjustment

Error Correction:	CA	FD	CPI	MONEY
Speed of adjustment (α)	-0.209107	-0.329331	-0.307840	-0.145010
	(0.12966)	(0.19517)	(0.09754)	(0.05655)
	[-1.61276]	[-1.68741]	[-3.15603]	[-2.56433]

increase in fiscal deficit and money supply causes inflation in the short run. However, we do not find any other short run coefficients significant in any of remaining three equations. On the whole, the vector error correction model under the vector autoregression framework suggests that there is a long run relationship between current account balance, fiscal deficit, inflation, and money supply growth. However, in the short run, there is a positive relationship between fiscal deficit and inflation as well as money supply growth and inflation.

(4) Impulse Response Function Based on Unrestricted VAR : The impulse response function based on unrestricted VAR is depicted in the Figure 4. As expected, the response of one standard deviation shock to current account leads to a fall in fiscal deficit (implying a positive relationship between fiscal deficit and current account deficit). Similarly, a one standard deviation shock to fiscal deficit leads to a fall in the current account. This suggests that increase in fiscal deficit worsens the current account balance. This is in line with the long run relationship suggested by the Johansen cointegration test.

Column 1 (row 2) of the Figure 4 depicts the response of inflation to current account balance. As expected, the inflation responds negatively to a shock in the current account balance, implying that worsening of the current account balance leads to higher inflation. Column 3 (row 1) of the figure depicts the response of current account balance to inflation. Current account balance remains unchanged in the first year, but falls in the second year. This implies that inflation worsens current account balance. Column 4 (row 1) of the figure depicts the response of current account balance to increase in the money supply. A one standard deviation shock to the money supply worsens the current account balance in the second year. All the aforesaid relationships are in consonance with the long-run relationship depicted by the Johansen cointegration test, which suggests that current account balance worsens with an increase in fiscal deficit, inflation, and money supply.

Column 4 (row 2) depicts the response of inflation to money supply. A one standard deviation shock to the money supply leads to an increase in the inflation in the second year. This is in line with the monetarists' view that increase

Table 5. Vector Error Correction Model

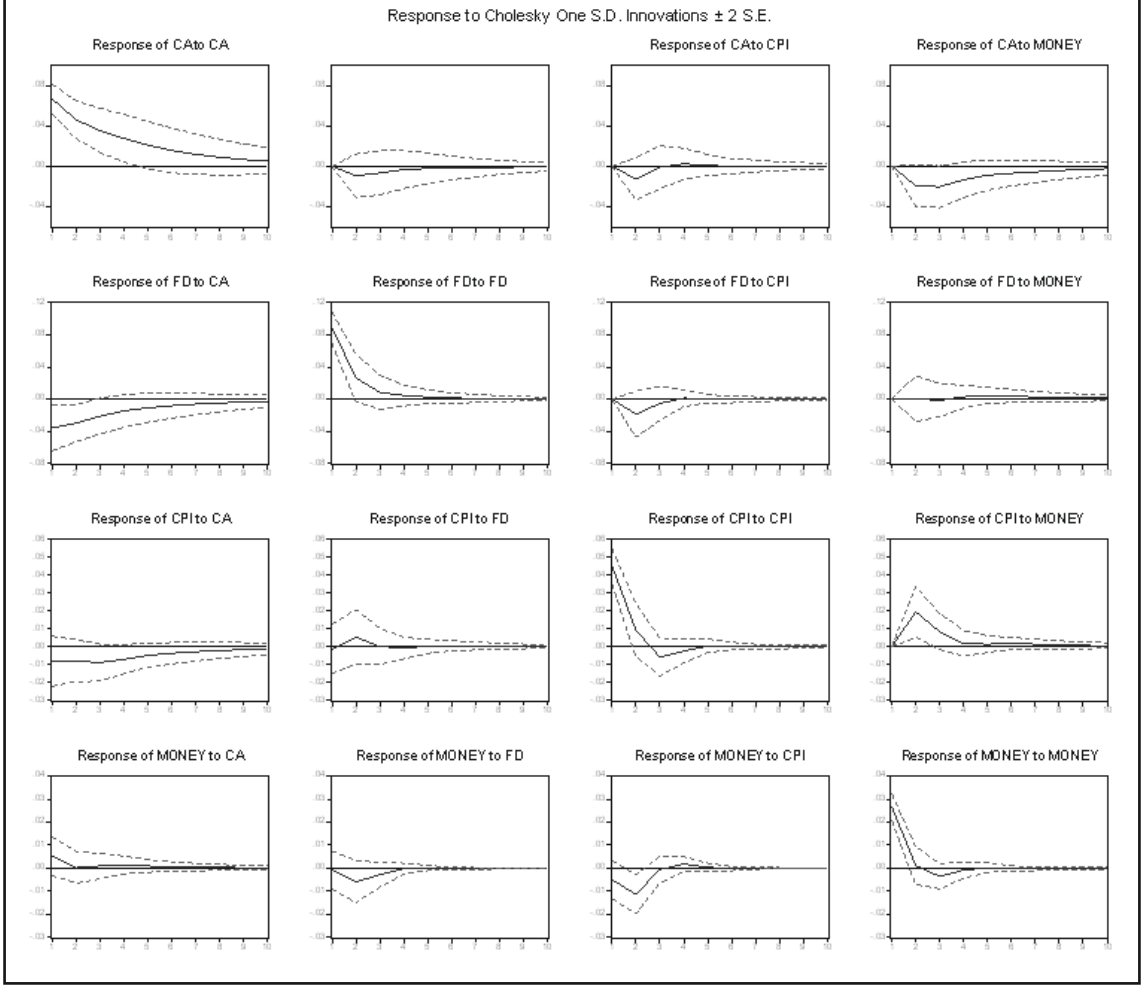
Error Correction:	D(CA)	D(FD)	D(CPI)	D(MONEY)
CointEq1	-0.209107	-0.329331**	-0.307840*	-0.145010*
	(0.12966)	(0.19517)	(0.09754)	(0.05655)
	[-1.61276]	[-1.68741]	[-3.15603]	[-2.56433]
D(CA(-1))	-0.034633	0.218872	0.061928	0.051277
	(0.17064)	(0.25686)	(0.12837)	(0.07442)
	[-0.20296]	[0.85211]	[0.48241]	[0.68900]
D(FD(-1))	0.156812	-0.252664	0.146564**	0.050896
	(0.10542)	(0.15869)	(0.07931)	(0.04598)
	[1.48748]	[-1.59222]	[1.84806]	[1.10696]
D(CPI(-1))	-0.164779	0.104070	0.414524*	-0.063453
	(0.26799)	(0.40339)	(0.20160)	(0.11688)
	[-0.61487]	[0.25799]	[2.05613]	[-0.54289]
D(MONEY(-1))	-0.117858	-0.302475	0.715344*	-0.501683*
	(0.31907)	(0.48028)	(0.24003)	(0.13916)
	[-0.36939]	[-0.62979]	[2.98023]	[-3.60516]

* Denotes significance at 5% level

** Denotes significance at 10% level

Standard errors in ( ) and *t*-statistics in [ ]

Figure 4. Impulse Response Function for Unrestricted VAR



in money supply causes inflation. The VECM (refer Table 5) also suggests short run causality running from money supply to inflation. Column 2 (row 2) depicts the response of inflation to fiscal deficit. A one standard deviation shock to the deficit leads to an increase in the inflation in the second year. The VECM (refer Table 5) also suggests short run causality running from fiscal deficit to inflation. Column 3 (row 4) depicts the response of money supply to inflation. A one standard deviation shock to inflation leads to a fall in the money supply. With this, we proceed to test the variance decomposition of the unrestricted VAR model as can be seen in the Table 6.

The variance decomposition analysis of current account balance suggests that, over a period of 10 years, 13% of the variation in current account balance is explained by money supply growth, inflation, and fiscal deficit. It is important to note that out of this, around 11.50% variation is explained by money supply growth and inflation. In case of fiscal deficit, 25% of the variation is explained by current account balance over a period of 10 years ; whereas, inflation and money supply explain only 3.6% of the variation. This suggests that a high current account deficit may lead to a higher fiscal deficit in the long run.

The variance decomposition of inflation suggests that around 16% of the variation in inflation is explained by money supply growth over a period of 3 years and remains the same over a period of 10 years, which is in line with the monetarist view that money supply causes inflation. More importantly, around 10% of the variation is explained by variation in the current account balance over a period of 10 years. This suggests that persistent current account deficit would lead to inflation in the long run.

Table 6. Variance Decomposition

Variance Decomposition of Current Account balance					
Period	**S.E.**	**CA**	**FD**	**CPI**	**MONEY**
1	0.067018	100.0000	0.000000	0.000000	0.000000
2	0.085060	91.51448	1.166922	2.171003	5.147596
3	0.094660	88.06544	1.435638	1.763801	8.735119
4	0.099625	87.27920	1.401060	1.656296	9.663447
5	0.102233	87.10896	1.373324	1.582947	9.934768
6	0.103689	86.99343	1.365335	1.538929	10.10231
7	0.104523	86.90919	1.362512	1.514600	10.21370
8	0.105000	86.86219	1.360375	1.501267	10.27617
9	0.105272	86.83754	1.358944	1.493789	10.30973
10	0.105426	86.82374	1.358149	1.489513	10.32859
Variance Decomposition of FD:					
Period	**S.E.**	**CA**	**FD**	**CPI**	**MONEY**
1	0.095636	14.02881	85.97119	0.000000	0.000000
2	0.105277	19.58138	77.22953	3.186162	0.002936
3	0.107846	22.49717	74.20251	3.281571	0.018756
4	0.108968	23.82346	72.86176	3.225420	0.089360
5	0.109630	24.49939	72.04686	3.188855	0.264895
6	0.110013	24.88895	71.56309	3.167904	0.380056
7	0.110227	25.11407	71.29110	3.156448	0.438380
8	0.110348	25.24106	71.13770	3.149628	0.471615
9	0.110417	25.31273	71.04975	3.145687	0.491835
10	0.110457	25.35364	70.99921	3.143435	0.503707
Variance Decomposition of CPI:					
Period	**S.E.**	**CA**	**FD**	**CPI**	**MONEY**
1	0.045662	3.115516	0.072304	96.81218	0.000000
2	0.051421	4.778123	1.200639	79.62077	14.40047
3	0.053174	7.268653	1.123401	75.62119	15.98675
4	0.053722	8.819464	1.120185	74.28869	15.77166
5	0.053967	9.562713	1.111816	73.62219	15.70328
6	0.054122	9.953825	1.115053	73.20593	15.72520
7	0.054214	10.18483	1.115757	72.95789	15.74152
8	0.054266	10.32046	1.115353	72.82032	15.74387
9	0.054295	10.39763	1.115180	72.74309	15.74410
10	0.054311	10.44137	1.115172	72.69880	15.74466
Variance Decomposition of MONEY:					
Period	**S.E.**	**CA**	**FD**	**CPI**	**MONEY**
1	0.027549	3.622664	0.106168	3.274666	92.99650
2	0.030374	2.987066	3.834001	16.53787	76.64107
3	0.030730	3.013733	4.591220	16.20081	76.19424

4	0.030825	3.183840	4.572137	16.45116	75.79286
5	0.030844	3.275563	4.567144	16.45079	75.70650
6	0.030850	3.312137	4.566256	16.44782	75.67379
7	0.030855	3.331736	4.566293	16.44374	75.65823
8	0.030858	3.344090	4.565833	16.44102	75.64906
9	0.030859	3.351405	4.565491	16.43957	75.64353
10	0.030860	3.355510	4.565309	16.43874	75.64044

Cholesky Ordering: CA, FD, CPI, MONEY

The variance decomposition of money supply growth suggests that around 16% of the variation in money supply is explained by inflation over a period of 10 years as compared to only 3% over a period of 1 year. This implies that there could be a bi-directional relationship between money supply and inflation. In the short run, money supply causes inflation (as discussed earlier). However, over the long run, high inflation may restrict money supply growth. Thus, money supply growth, which is a monetary policy variable, may be endogenous to other macro-economic variables. As a result, the Cholesky ordering flows from current account to fiscal deficit to inflation to money supply growth.

Discussion

Broadly, the theoretical framework is relevant to the Indian context as the economy has experienced persistent fiscal deficit, worsening of the current account balance, and inflation in the past as well as in the present. Although the RBI does not target any particular level of interest rate, the interest rates have been on a decreasing trend since their deregulation in 1993 (although RBI has resorted to increasing the interest rates in the short run to control inflation).

The results from the Johansen cointegration test suggest that there is a long run relationship between the aforesaid variables. The test also suggests that worsening of the current account is associated with an increase in fiscal deficit, inflation, and money supply. Both these findings are in line with the model. The vector error correction model suggests that in case of a deviation from the long run equilibrium, inflation and money supply respond to restore the relationship. However, fiscal deficit and current account are found to be weakly exogenous. Even in the aforesaid model, the fiscal deficit is considered exogenous as it determined by the fiscal policy of the government. Current account may be weakly exogenous due to the role of oil imports and oil prices, which are exogenous to the model. The VAR model, including the VECM, also suggests that fiscal deficit and money supply positively impact inflation in the short run. Besides this, we do not find any other significant short run relationships.

The VECM provides evidence for current account deficit impacting inflation in the long run, but doesn't provide evidence for inflation impacting current account in the long run or short run. We also performed impulse response function and variance decomposition analysis under unrestricted VAR framework. The results from IRF suggest a bi-directional relationship between fiscal deficit and current account balance. So also, the IRF predicts that a positive shock in inflation leads to a worsening of the current account balance and vice verca. In India, inflation affects current account deficit through another interesting channel, that is, investment in gold and rising gold prices. Investment in gold is considered to be an effective hedge against inflation on account of rising gold prices. Persistent inflation leads people to invest more in gold, all of which has to be imported. Besides, India has traditionally been the largest consumer of gold in the world. Higher inflation boosts the import demand for gold and worsens the current account deficit. On the other hand, the current account deficit could impact inflation on account of currency depreciation and inelasticity of imports such as oil.

Bi-directional relationship may exist due to increasing oil prices, which worsens the current account balance and consequently increases oil subsidies, which worsen the fiscal deficit (Bose & Jha, 2011). Positive shocks in fiscal deficit and money supply also lead to higher inflation as predicted by the model. Interestingly, a positive shock in inflation leads to a fall in the money supply, which suggests the use of monetary policy to control inflation. The results from IRF are in line with the model, except for the finding that there could be a bi-directional relationship between fiscal deficit and current account deficit and between inflation and current account deficit. The variance decomposition analysis confirms the aforesaid relationships and suggests that the ordering of variables is as follows: current account, fiscal deficit, inflation, and money supply.Bi-directional relationship may exist due to increasing oil prices, which worsens the current account balance and consequently increases oil subsidies, which worsen the fiscal deficit (Bose & Jha, 2011). Positive shocks in fiscal deficit and money supply also lead to higher inflation as predicted by the model. Interestingly, a positive shock in inflation leads to a fall in the money supply, which suggests the use of monetary policy to control inflation. The results from IRF are in line with the model, except for the finding that there could be a bi-directional relationship between fiscal deficit and current account deficit and between inflation and current account deficit. The variance decomposition analysis confirms the aforesaid relationships and suggests that the ordering of variables is as follows: current account, fiscal deficit, inflation, and money supply.

Interestingly, in all of the above analysis, we find that money is an endogenous variable in the system. This implies that monetary policy may lose some of its independence and effectiveness in the presence of persistent twin deficits and inflation. Especially so in a declining interest scenario.

Policy Implications

The policy recommendations based on the aforesaid analysis would be :

(1) Control over fiscal deficit.

(2) Inflation targeting to control inflation.

(3) Ensuring that real interest rates are positive.

(4) Deregulation of statutory liquidity ratio. This would lead to a better price discovery for government securities yield and in turn check overspending by the government.

(5) Supply side/structural reforms for higher output and export growth and removal of supply chain bottlenecks to control inflation.

(6) Regulation on import of gold.

Conclusion

The Mundell - Fleming model explains the twin deficits hypothesis within the IS-LM framework, mainly focusing on the movements in the IS curve (fiscal deficit), exchange rate, and interest rate assuming constant price level, money supply, and perfect capital mobility. In this paper, we have attempted to analyze the twin deficits hypothesis under the IS-LM framework, focusing on movements in both IS and LM curve (that is, money supply) under flexible prices. The model posits that the inflation could be the link between fiscal and current account deficit and hence, fiscal deficit, current account deficit, inflation, and money supply are related to each other in the long run. The model predicts that all these variables would persist and reinforce each other over a period of time if fiscal deficit is not controlled and interest rates do not rise commensurate to inflation. The empirical evidence supports the view that all the four variables are cointegrated in the long run. Inflation, fiscal deficit, and current account deficit have persisted in India for quite some time and there is evidence to support the view that inflation could be the key mediating variable between the twin deficits.

Limitations of the Study and Scope for Further Research

The study tests the TDH for Indian data. It could be extended to cover other similar economies. A few sophisticated statistical techniques could also be used to test the hypothesis. In future, our study could be extended to explore the causality between fiscal and current account deficit for other developing economies with high inflation.

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