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Indian Economy: Selected Methodological Advances

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Abstract

This paper develops tools to examine selected major issues in the Indian economy. The study computes the potential growth rate of the economy and the agricultural sector, extends the analysis of the fiscal stimulus and its effects, and estimates the short and long run elasticities of India's trade. This brings out the need for structural reforms in raising the potential growth rate of economy and that of agriculture to achieve a non-inflationary, high growth trajectory for the country. The fiscal stimulus effects indicate the importance of fiscal consolidation efforts to sustain high growth. The trade elasticities buttress the case for maintaining an appropriate real effective exchange rate.

***JEL Classification**: E 30, E 62, F 32.*
***Keywords**: Potential growth rate, Fiscal stimulus, Balance of payments, Exchange rate, Trade elasticities.*

Indian Economy: Selected Methodological Advances

Mathew Joseph, Karan Singh, Ranjan Kumar Dash, Jyotirmoy Bhattacharya and Ritika Tewari[1]

1. Introduction

The Indian economy after a two-year slowdown in the wake of global crisis, recorded a robust growth of nearly 9 per cent in the first half of 2010-11. This is equal to the average growth rate during the pre-crisis period, 2003-08. The critical question at this juncture is whether the Indian economy is getting back to the pre-crisis high growth trajectory. To examine this question we need analytical tools. The attempt here is to develop some analytical tools to understand the future prospects of the Indian economy.

The rest of the paper is organised as follows. In section 2, we address the issue of the Indian economy's potential growth rate and estimate India's potential growth rate. Inflation is the most important challenge confronting the economy at present and in that context section 3 examines the trends in potential growth rate in Indian agriculture and the demand-supply gap in agriculture. Section 4 examines the role of fiscal policy in tackling the impact of the global crisis and assisting the recovery. Section 5 estimates India's export and import elasticities to understand India's trade balance trends. Section 6 outlines policy conclusions.

2. Potential Growth Rate of the Indian Economy

The potential rate of growth of an economy is the maximum sustainable rate at which an economy can grow without causing a rise in the rate of inflation. The potential growth rate is determined by the growth in the economy's productive capacity which, in turn, depends on the growth in inputs (labour, capital, land, etc.) and technology. An economy can grow above the potential rate for some time but that will trigger rising inflationary pressures. Growing below the potential rate will imply a rise in the rate of unemployment.

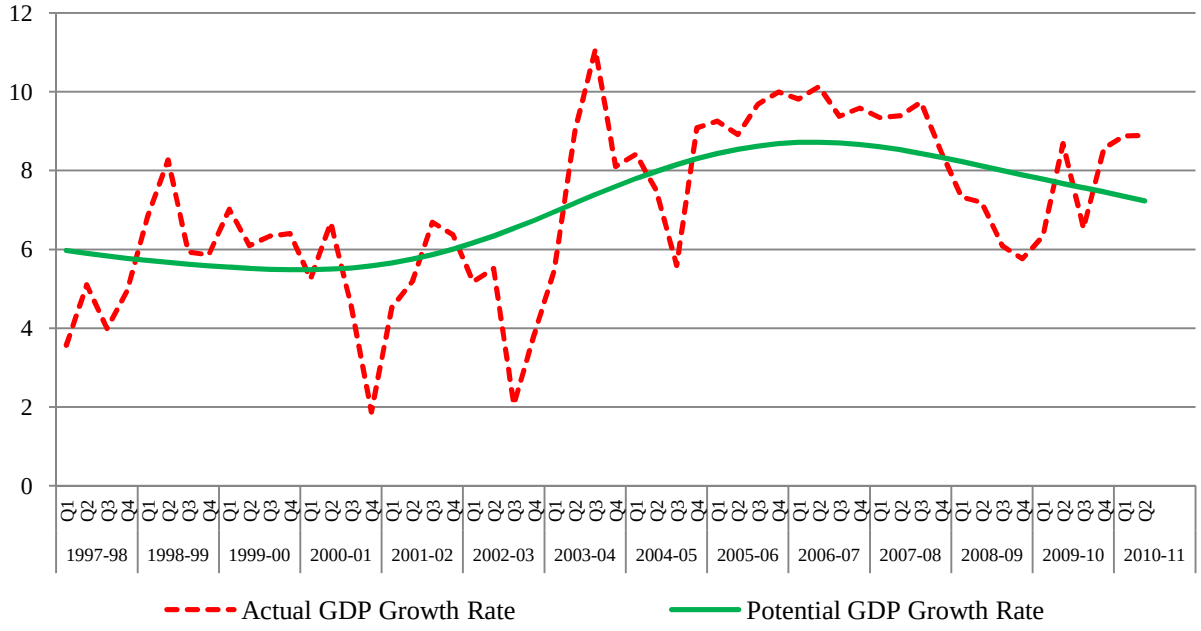
The Indian economy, which had grown at an average annual rate of close to 9 per cent during 2003-08, slowed down to 6.8 per cent in 2008-09 in the wake of the global crisis. The growth rate picked up to 8.0 per cent in 2009-10 and a robust 8.9 per cent in the first half of 2010-11. Does the robust recovery indicate that the economy is returning to the pre-crisis trajectory of

[1] We are grateful to Professor K. L. Krishna and Dr. Parthasarathi Shome for helpful comments. We are also thankful for the valuable comments from Professor A. Hoda and other participants in the peer review seminar at ICRIER. Any comments on the paper may please be sent to: mjoseph@icrier.res.in and karan@icrier.res.in.

9 per cent growth rate? This depends upon what the present potential growth rate of the Indian economy is.

The HP filter technique[2], as proposed by Hodrick and Prescott (1980), is the most commonly used method to estimate the potential growth rate of an economy. Using quarterly data from Q1 1996-97 to Q2 2010-11, the potential growth rates are computed for the Indian economy and are shown against actual growth rates in Figure 1. It shows that the potential growth rate for India had gone up from about 5.5 per cent in the late 1990s to slightly above 8.5 per cent in the mid-2000s. Thereafter, the potential rate of growth declined and, in the wake of the global crisis, it has come down to 7.5 per cent and below.

Figure 1: Growth Rate of Indian Economy: Actual Vs Potential
Q1 1997-98 to Q2 2010-11



Source: Constructed based on data from CSO.

The savings and investment rates in the economy dipped sharply following the crisis: the savings rate declined from about 37 per cent of GDP in 2007-08 to an average of 33 per cent in 2008-09 and 2009-10 and the investment rate declined from about 38 per cent of GDP to 35.5 per cent during the same period. The fall in savings and investment rates in a way reflects the fall in the potential growth rate in the Indian economy.

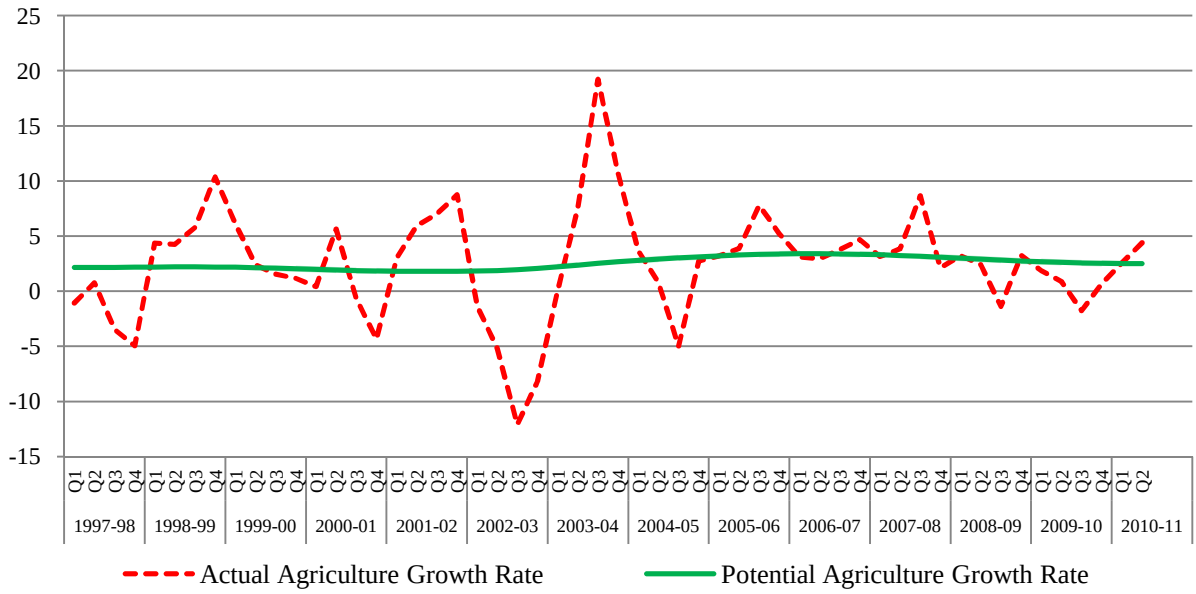
[2] The Hodrick-Prescott Filter is a smoothing method that is widely used among macroeconomists to obtain an estimate of the long-term trend component of a series. The method was first applied to analyse post-war U.S. business cycles in a working paper (Hodrick and Prescott, 1980). This was later published in 1997 (Hodrick and Prescott, 1997).

The economy grew by 8.9 per cent in the first half of the current financial year and this growth is way above the potential rate. This is also borne out by the persistence of inflationary pressures in the Indian economy.

3. Potential Growth Rate in Agriculture

While the current inflationary 'flare up' could have been caused by the monsoon failure of 2009, inflationary pressures had been building up for some time right from early 2006-07. A major reason for this is the fall in the potential growth rate of Indian agriculture (see Figure 2). The potential growth rate of agriculture in India had gradually increased to reach nearly 3.5 per cent in 2006-07, after which it moved down steadily to reach 2.5 per cent by late 2009-10. Actual growth rates have been quite unsteady and, for the period 2008-09 and 2009-10, actual growth rates had been even lower than the low potential growth rate. The roots of food inflation, which hit India in 2008-09 and continued into 2009-10 and 2010-11, can be seen not just in the recent, sudden collapse in agricultural production but more fundamentally in the gradual lowering of potential agricultural growth rate since 2006-07.

Figure 2: Potential and Actual Growth Rates in Agriculture

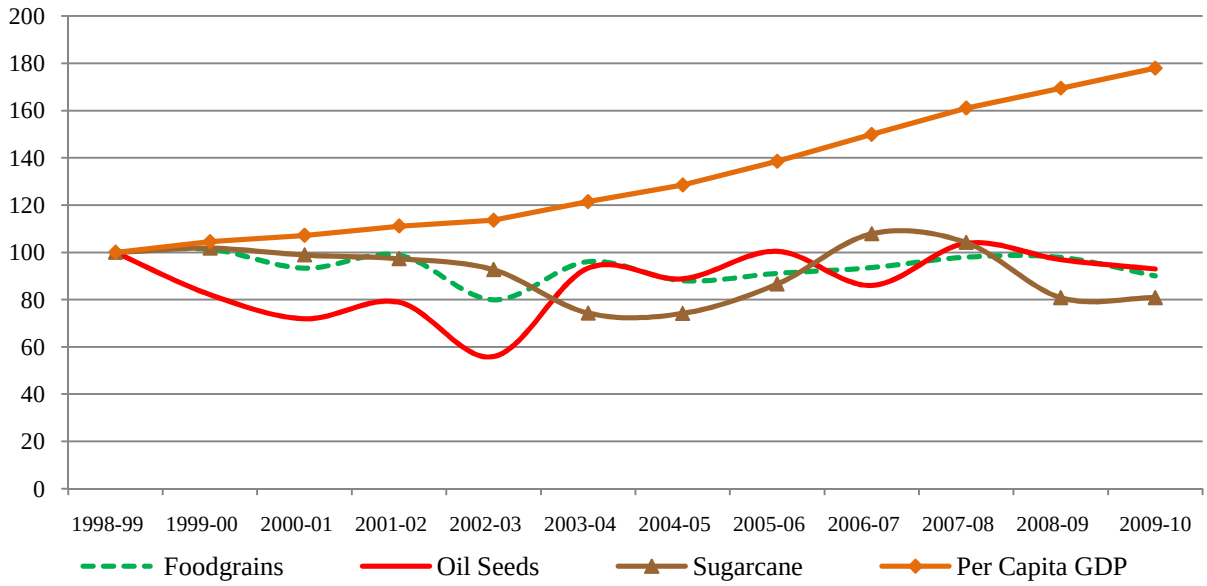


Source: Constructed based on data from CSO

There is a structural, rising demand-supply gap in Indian agriculture (see Kumar, et al., 2010). This is depicted in Figure 3. It shows that from 1998-99, when per capita real GDP rose on an average by about 5.5 per cent per annum, per capita availability of agriculture-based food products such as foodgrains, oilseeds, and sugarcane either stagnated or fell.

Therefore, unless there is a breakthrough in food production in the country, we may revert to the pre-2000 phase of high inflation.[3]

Figure 3: Index of Per Capita Availability of Major Agricultural Food Products



Note: Availability is calculated from domestic production by adding imports and deducting exports
Source: Computed based on data from Department of Agriculture and Co-operation; CSO

One part of the national strategy to raise agricultural output is raising agricultural investment. Indian agriculture suffered from huge underinvestment in the 1980s and the first half of 2000s (see Table 1). Encouragingly, in the second half of 2000s, investment in agriculture resumed in line with overall investment in the economy.

Table 1: Investment in Agriculture

(Average Annual Growth in Per cent)

	Total	Agriculture
1961-70	6.1	7.6
1970-80	5.0	7.3
1980-90	5.4	-2.6
1990-00	7.9	9.3
2000-05	9.0	3.2
2005-10	11.6	12.5

Source: CSO

[3] The impact of international food prices on Indian inflation is limited (see S. Mittal, 2007). During 2008, international food prices rose by 25 per cent whereas Indian food prices rose by 11 per cent; in 2009, world food prices declined by 13 per cent while Indian food prices rose by 10 per cent; and in 2010 (up to November), world food prices rose by 10 per cent while Indian food prices rose by 19 per cent.

The share of public investment in total investment in agriculture has come down over the years from two-fifths in the 1960s to hardly a fifth in the 2000s. The government, besides raising public investment in agriculture in the form of irrigation and rural roads, has to create more incentives to promote private investment in agriculture. The current "subsidy-control regime" has failed in helping either the farmer or the consumer and has to be replaced by an "investment-*cum*-market-based liberalised system". This suggestion is similar to what was done in the industrial sector in the 1990s. The dismantling of the license and control system in industry led to an upsurge in industrial growth.

4. Effectiveness of Fiscal Stimulus

India, like many other countries, took recourse to large fiscal stimuli to counter the contractionary effects of the global crisis. Fortunately, India had gained some fiscal space on the eve of the crisis from the process of fiscal consolidation it had undergone over the previous five years. Besides, India had a large stock of foreign exchange reserves that it accumulated, despite having current account deficits through plentiful capital inflows in the past. Reserves provided the buffer against a "sudden stop" and reversal of foreign capital inflows following the global crisis and enhanced the effectiveness of fiscal policy. Furthermore, monetary policy had turned deeply accommodative soon after the onset of the global crisis, thus supporting fiscal policy. How effective have India's fiscal stimulus measures in protecting growth been?

Empirical work has shown that the effectiveness of fiscal policy depends on the monetary policy, the exchange rate system, availability of spare capacity, the level of public debt, etc. (Spilimbergo et al., 2008 and Freedman et al., 2009). Studies, which have taken these factors into account, have shown that, in emerging economies, fiscal expansion has been generally ineffective in stimulating growth (see for example, Ilzetzki and Vegh, 2008 and Kandil and Morsy, 2010).

To study the effectiveness of fiscal stimulus in India, we have used the methodology developed by Kandil and Morsy (2010). These authors estimated a panel vector error correction model for a group of 34 emerging economies including India. Here we attempt to study the effectiveness of fiscal stimulus in India separately by applying a vector error

correction (VEC) model for the period 1975-2009. The model specification and estimates are detailed in Appendix 1.

For the study, the fiscal impulse is defined as the difference between the cyclically-adjusted fiscal balance in period *t*, and the actual fiscal balance in period *t*-1. The cyclically-adjusted fiscal deficit is computed on the assumption of no change in economic environment, i.e., economic growth remains at the previous year's level. Thus, the fiscal impulse captures the change in fiscal balance arising solely from changes in discretionary policy or what is called the "structural deficit". Accordingly, a decrease in fiscal impulse (a lower surplus or larger deficit) implies discretionary fiscal expansion and an increase in fiscal impulse (a higher surplus or lower deficit) implies discretionary fiscal contraction. Conditioning variables included in the model are the real effective exchange rate (REER) and money supply (M3). Additional conditioning variables are introduced in the form of interactive dummies. These are public debt, foreign exchange reserves, inflation, trade openness and the exchange rate regime.

The results of the estimation of the vector error correction model are given below in Table 2. They compute the variation in GDP growth from the fiscal impulse, money supply growth and real exchange rate changes in the long and short run.

Table 2: Effectiveness of Fiscal Policy: Vector Error Correction Estimates

(Dependent Variable: GDP Growth)

Variables	**Without Dummy**	**With Reserve Dummy**	**With Debt Dummy**	**With Inflation Dummy**	**With Openness Dummy**	**With Exchange Regime Dummy**
Long-run Coefficients						
Fiscal Impulse(-1)	-0.92 (-0.99)	-0.33 (-0.99)	0.09 (0.19)	-0.15 (-0.50)	0.42 (0.77)	0.12 (0.53)
Δlog (REER(-1))	113.98** (2.46)	30.82 (1.13)	81.74** (2.83)	39.33** (18.43)	-46.86 (-1.29)	21.88 (1.43)
Δlog (M3(-1))	-206.56** (-2.29)	-81.47** (- 2.12)	-204.71 *** (-4.21)	-52.93** (-2.23)	-172.7*** (-3.44)	-43.76** (-1.99)
Dum (-1) × Fiscal Impulse (-1)		0.05 (0.21)	-2.28* (-2.23)	-0.34 (-0.93)	-0.59 (-0.28)	-0.40 (-0.90)
Constant	-9.98	-6.89	-9.71	-6.60	-8.13	-5.88
Adjustment Coefficient	-0.23** (-2.56)	-0.65*** (-4.05)	-0.38** (-2.68)	-1.23*** (-2.26)	-0.87*** (-3.08)	-1.08*** (-3.45)

Variables	Without Dummy	With Reserve Dummy	With Debt Dummy	With Inflation Dummy	With Openness Dummy	With Exchange Regime Dummy
Short-run Coefficients						
Δ(Fiscal Impulse (-1))	-0.58** (-1.97)	0.24 (0.80)	-0.07 (-0.17)	0.15 (0.29)	0.14 (0.45)	0.36 (0.86)
Δ(Fiscal Impulse (-2))	-0.29 (-0.88)	-0.15 (-0.77)	0.32 (0.81)	-0.07 (-0.23)	0.25 (0.86)	0.26 (0.91)
Δ(Dum(-1)× Fiscal Impulse(-1))		-0.89** (-2.49)	1.63** (2.55)	0.05 (0.10)	1.12 (1.23)	-0.06 (-0.11)
Δ(Dum(-2) ×Fiscal Impulse(-2))		-0.26 (-0.86)	0.70 (1.41)	-0.19 (-0.39)	0.78 (0.91)	-0.09 (-0.23)
Adjusted R^2	0.53	0.74	0.52	0.54	0.35	0.60
F-statistic	4.47	8.54	3.92	4.14	3.47	4.89

Notes:

1. *Figures in the brackets are t-ratios.*
2. *Dum indicates "dummy".*
3. **** Significant at 1% level and ** significant at 5% level.*
4. *Lag length of the VECM is selected on the basis of Akaike Information Criteria (AIC).*
5. *Debt dummy equals one if public debt to GDP ratio is equal to or greater than 60 per cent and zero otherwise.*
6. *Reserve dummy equals one if exchange reserves in months of imports is four or more and zero otherwise.*
7. *Inflation dummy equals one if inflation rate is equal or more than 10 per cent and zero otherwise.*
8. *Openness dummy equals one if the trade ratio is 40 per cent or more and zero otherwise.*
9. *Exchange rate regime dummy equals zero for fixed and one for managed floating.*

First, in the long run, fiscal expansion has a neutral effect on output growth. The results indicate that an increase in the fiscal impulse (that is, a decrease in fiscal deficit) raises output growth in the long run but the relationship is not significant. Exchange rate appreciation depresses output growth significantly in the long run. Money supply growth increases output growth significantly in the long run. The neutrality of fiscal policy in the long run is not affected by the introduction of alternative dummy variables for reserve availability, inflation, trade openness and exchange rate regime. However, the debt dummy coefficient is positive and significant in the long run, implying that a reduction in fiscal impulse (that is, an expansionary fiscal policy) has a negative, significant effect on output growth in the long run in the presence of high level of public debt. Furthermore, exchange rate effects on output growth become insignificant with the introduction of reserves, trade openness or exchange rate regime dummies.

Second, in the short run, fiscal expansion stimulates GDP growth. A fall in the fiscal impulse (an increase in fiscal deficit) raises output growth significantly with a lag of one year. Besides, the interactive reserve dummy on the one-year lag of the fiscal impulse is negative and significant in the short run, indicating that with adequate reserves, fiscal stimulus becomes effective in stimulating output growth in the short run. The debt dummy coefficient is positive and significant in the short run, implying that a fall in the fiscal impulse (i.e., an expansionary fiscal policy) reduces output growth in the short run with high debt levels.

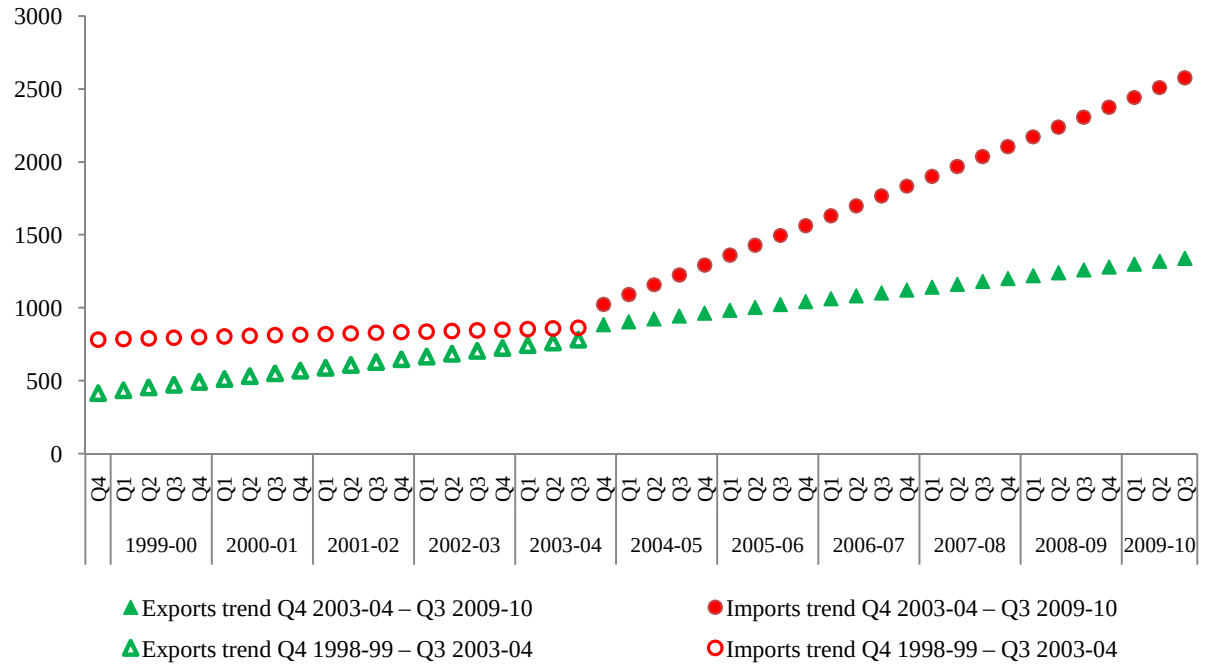
The above results give clues on how the Indian economy recovered from the global crisis after the introduction of fiscal stimulus measures. The fiscal stimulus introduced by the government expanded fiscal deficit substantially in 2008-09 to 8.5 per cent of GDP (10.2 per cent of GDP if off-budget bonds are added) from 4.1 per cent of GDP (4.7 per cent of GDP) in 2007-08. This huge fiscal expansion helped the economy to recover from a GDP growth of 6.8 per cent (4.9 per cent in terms of GDP at market prices) in 2008-09 to 8.0 per cent (9.1 per cent) in 2009-10. These results also provide the rationale for the government's fiscal consolidation efforts, which began this year. Expansionary fiscal policy cannot raise output growth in the long run; on the contrary, it could reduce output growth as public debt rises.

5. Balance of Payments

India's merchandise trade balance deteriorated in the recent period. The trade deficit rose from 2.3 per cent of GDP in 2003-04 to 9 per cent of GDP in 2009-10. Trade elasticities can explain a country's trade balance trends. Therefore, we undertake here the estimation of India's trade elasticities.

The worsening trade balance in the second half of the 2000s is best captured by fitting a time trend for the quarterly quantum indices of India's exports and imports for this period, split between the two sub-periods of Q4 1998-99 to Q3 2003-04 and Q4 2003-04 to Q3 2009-10 as shown in Figure 4. The time trend for seasonally adjusted quarterly indices clearly indicate a structural break from Q4 2003-04 for India's imports whereas there is no such break for exports.

Figure 4: The Trend in the Quantum Indices of Merchandise Exports and Imports, Q4 1998-99 to Q3 2009-10 (Base: 1978-79=100)



Source: DGCI & S, India

Existing studies on India's trade performance provide price and income elasticity coefficients for different time periods. Table 3 summarises those estimates.

Table 3: Income and Price Elasticities for India's Trade

		Exports elasticity coefficients	
Study	*Reference periods*	*Price*	*Income*
Houthakker and Magee (1969)	1951–1966	-0.23	0.54
Dipendra Sinha (2001)	1960–1996	-0.55	0.45
Mathew Joseph (1992)[a]	1969–1986	-1.34	0.52
T. N. Srinivasan (1998)	1963–1994	-0.53	0.75
UNTACD (2009)	1970–2008	-0.54	1.88
RBI (2010)	1993–2008		3.7
		Imports elasticity coefficients	
Houthakker and Magee (1969)	1951–1966		1.43
Dipendra Sinha (2001)	1950–1996	0.51	- 0.11

[a] *Price and income elasticities for manufacturing product exports.*

These estimates fail to explain the recent structural shifts in India's trade. Using deseasonalised quarterly data (using X-12-ARIMA method, Findley et al. (1998)) for the relevant period, i.e., Q4 1998-99 to Q3 2009-10, we undertook the estimation of trade elasticites for India. Making use of the latest developments in advanced time-series econometrics, the estimation is done in the framework of unrestricted error correction (UEC) with an autoregressive distributed lag (ARDL) structure. The methodology is explained in Appendix 2. Our estimates of India's long run and short run trade elasticities are presented in Tables 4 and 5.

Table 4: Estimated Long-run and Short-run Elasticities of Quantity Exports

Dependent variable Δ(X)		
	Long run	*Short run*
Real effective exchange rate	-2.06	-0.11
World income	3.11	7.62
Exchange risk	0.30	-0.13

Table 5: Estimated Long-run and Short-run Elasticities of Quantity Imports

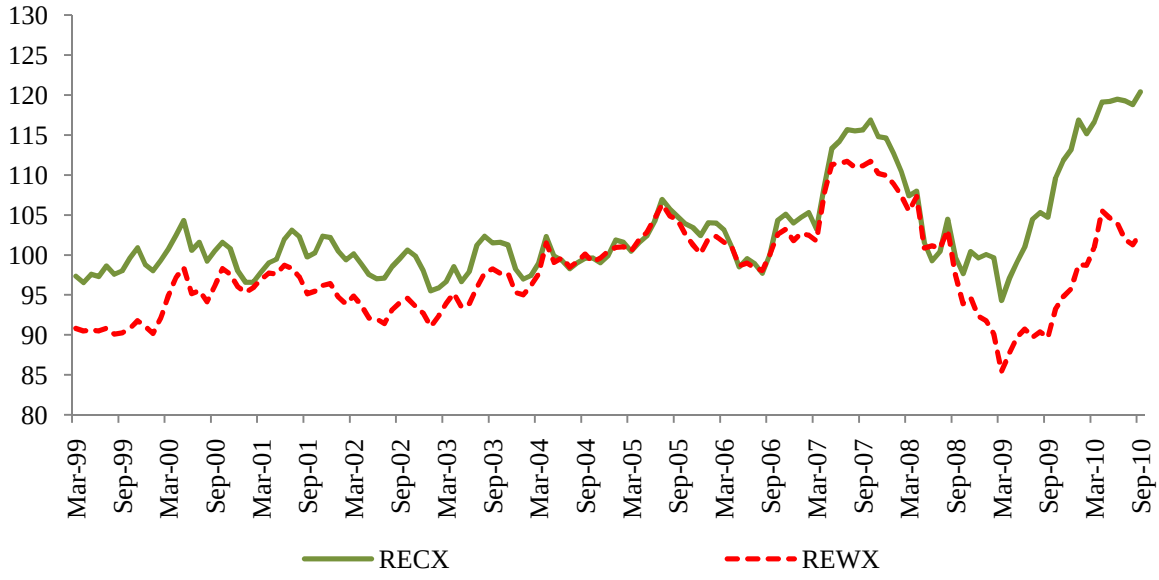
Dependent variable Δ(M)		
	Long run	*Short run*
Domestic income	1.52	-1.07

The results indicate that the real effective exchange rate (REER), computed using consumer price index,[4] is a crucial variable in determining export growth; a one per cent real appreciation/depreciation reduces/increases export growth by two percentage points in the long run. World income also has a very significant impact on India's exports; a one per cent growth in global GDP raises India's exports by about 3 percentage points in the long run. The short-run income elasticity is even larger at 7.6. However, imports are inelastic to prices confirming the results from other studies. This is natural as India's imports consist of essential capital goods, vital raw materials including oil and necessary food items. Domestic income is the major determinant of imports; the income elasticity of India's imports is 1.52 in the long run.

[4] Real effective exchange rate (REER) using wholesale price index (WPI) gives weaker results. We hold that the official REER constructed by the Reserve Bank of India using WPI is not correct, as WPI does not capture the true inflation in the country. The consumer price index (CPI) is used by a significantly large majority of countries now to track inflation.

The values of trade elasticity coefficients throw light on India's deteriorating trade balance and points to its trends in the future. A 4 per cent growth in the global economy, an 8 per cent growth in the Indian economy and just a 2 per cent appreciation of the rupee's REER would imply a real export growth of 8 per cent and a higher real import growth of 12 per cent. This and the higher base of imports compared to exports would result in progressively deteriorating trade deficits in real terms for India in the long run. The REER, based on CPI (RECX), has been appreciating sharply in the recent period and that is not shown to the same extent when REER based on WPI (REWX) is considered (see Figure 5).

Figure 5: Index of Real Effective Exchange Rate (REER) for the Rupee (36-Currency Export Weighted, Base: 2004-05=100)



Source: Constructed based on data from IFS, IMF, Labour Bureau (Ministry of Labour and Employment), and Office of the Economic Adviser (Ministry of Commerce and Industry)

6. Conclusions

The estimates of India's economy-wide potential growth rate and that for India's agriculture explain the present growth-inflation situation and points to the need for structural reforms in raising the potential growth of the economy and that of agriculture to achieve a non-inflationary, high growth scenario for the country. The analysis of fiscal stimulus and its effects brings out the need for fiscal consolidation to sustain high growth. Our estimation of short and long run elasticities of India's exports and imports has important implications for policy to maintain the viability of the country's balance of payments.

Appendix 1

Model Specification and Estimation for Study on Effectiveness of Fiscal Policy

The study adopts the Johansen (1995) cointegration approach to model the effectiveness of fiscal policy in India. The general framework is based on a vector autoregressive representation (VAR):

$$Y_t = \sum_{i=1}^{n} \Pi Y_{t-i} + \varepsilon_t$$

where Y is an n×1 vector of variables, $\prod$ is an n×n coefficient matrix and ε is an n×1 vector of disturbances with normal properties. According to Granger representation theorem (Engle and Granger, 1987), if there exists a cointegrating relationship among the variables, the above equation may be reparameterised into a vector error correction model (VECM) of the form:

$$\Delta Y_t = \sum_{i=1}^{n} C_i \Delta Y_{t-i} + \Pi Y_{t-1} + \varepsilon_t$$

where Y is a vector of variables first-differenced for stationarity. Y consists of a list of variables in the vector autoregression that vary with the shocks in the system. The variables include the 'fiscal impulse' and other dependent variables that are likely to be affected by the fiscal impulse. C is an n×n coefficient matrix that provides short-run response of Y to its n-period lags. $\prod Y_{t-1}$ is the error correction term (EC). The lagged value of the error correction term is the residual from each cointegrating vector and captures the speed of adjustment to a disturbance in the long-run equilibrium in the respective vectors. Hence, the VECM model gives estimates of both the long-run and short-run coefficients and tells us about the speed of adjustment to long run equilibrium.

The fiscal impulse is defined as the difference between the cyclically-adjusted fiscal balance in period *t* and the actual fiscal balance in period *t*-1. The cyclically-adjusted fiscal deficit is computed on the assumption of no change in the economic environment, i.e., economic growth remains at the previous year's level. Thus, the fiscal impulse captures the change in fiscal balance arising solely from changes in discretionary policy or what is called the "structural deficit". Accordingly, a decrease in fiscal impulse (a lower surplus or larger deficit) implies discretionary fiscal expansion and an increase in fiscal impulse (a higher surplus or lower deficit) implies discretionary fiscal contraction. Conditioning variables included in the model are the real effective exchange rate (REER) and money supply (M3).

First, we checked for stationarity of the main variables (real GDP, REER, M3 and the fiscal impulse) and found that, except for the fiscal impulse, all other variables are integrated of the order of one i.e., I(1). Then, we tested for cointegration between real GDP, REER, M3 and fiscal impulse at their levels. The results suggested the existence of a long-run relationship between real GDP and other variables.

Additional conditioning variables are introduced in the form of interactive dummies. These are public debt, foreign exchange reserves, inflation, trade openness and exchange rate regime.

The results of the estimation of the vector error correction model are given in table A1. They give the variation in GDP growth from the fiscal impulse, money supply growth and real exchange rate changes in the long and short run.

Table A1: Effectiveness of Fiscal Policy: Vector Error Correction Estimates
(Dependent Variable: GDP Growth)

Variables	**Without Dummy**	**With Reserve Dummy**	**With Debt Dummy**	**With Inflation Dummy**	**With Openness Dummy**	**With Exchange Regime Dummy**
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Dum(-1) × Fiscal Impulse(-1)		0.05 (0.21)	-2.28* (-2.23)	-0.34 (-0.93)	-0.59 (-0.28)	-0.40 (-0.90)
Constant	-9.98	-6.89	-9.71	-6.60	-8.13	-5.88
Adjustment Coefficient	-0.23** (-2.56)	-0.65*** (-4.05)	-0.38** (-2.68)	-1.23*** (-2.26)	-0.87*** (-3.08)	-1.08*** (-3.45)
Short-run Coefficients						
Δ(Fiscal Impulse (-1))	-0.58** (-1.97)	0.24 (0.80)	-0.07 (-0.17)	0.15 (0.29)	0.14 (0.45)	0.36 (0.86)
Δ(Fiscal Impulse (-2))	-0.29 (-0.88)	-0.15 (-0.77)	0.32 (0.81)	-0.07 (-0.23)	0.25 (0.86)	0.26 (0.91)
Δ (Dum(-1)× Fiscal Impulse(-1))		-0.89** (-2.49)	1.63** (2.55)	0.05 (0.10)	1.12 (1.23)	-0.06 (-0.11)
Δ (Dum(-2) ×Fiscal Impulse(-2))		-0.26 (-0.86)	0.70 (1.41)	-0.19 (-0.39)	0.78 (0.91)	-0.09 (-0.23)
Adjusted R^2 F-statistic	0.53 4.47	0.74 8.54	0.52 3.92	0.54 4.14	0.35 3.47	0.60 4.89

Notes:

10. *Figures in the brackets are t-ratios.*
11. *Dum indicates "dummy".*
12. **** Significant at 1% level and ** significant at 5% level.*
13. *Lag length of the VECM is selected on the basis of Akaike Information Criteria (AIC).*
14. *Debt dummy equals one if public debt to GDP ratio is equal to or greater than 60 per cent and zero otherwise.*
15. *Reserve dummy equals one if exchange reserves in months of imports is four or more and zero otherwise.*
16. *Inflation dummy equals one if inflation rate is equal or more than 10 per cent and zero otherwise.*
17. *Openness dummy equals one if the trade ratio is 40 per cent or more and zero otherwise.*
18. *Exchange rate regime dummy equals zero for fixed and one for managed floating.*

Appendix 2

Methodology for Estimation of Trade Elasticities

The method used in the paper is based on the "ARDL bounds cointegration approach" proposed by Pesaran et al. (2001). In the literature, a number of studies (e.g., Oskooee and Kara 2005; Hoque and Yusop, 2010) apply the ARDL approach in estimating trade elasticities. To derive the short-run and long- \run coefficients involves three steps: first, checking the variables for the order of integration; second, constructing and testing all the possible systems of equations using ARDL bounds approach and the last, deriving the long-run and short-run coefficients from the system of equations, which has shown the presence of cointegration.

Step 1

Applying the Augmented Dickey Fuller (ADF) unit root tests, we find that all variables except Y (India's real GDP) are integrated at the level of I(0) or I(1) at 1 per cent level of significance and Y is integrated at I(1) at 5 per cent level of significance.

Step 2

The results on bounds test for cointegration relations show that, in equations 1 and 2, the calculated F-statistic is above the upper bound critical values at the 1 per cent significance level. This has proven the existence of long-run conintegration for equations 1 and 2. Theoretical specification of equations 1 and 2 is described below.

We first derive the export equation (equation 1), basically modelled on Joseph (1992), but recast as an unrestricted error correction model (UECM), using the autoregressive distributed lag (ARDL) as proposed by Pesaran et al. (2001).

$$\Delta X_t = \sum_{i=1}^{n} \beta_{1i} \Delta X_{t-i} \sum_{i=1}^{n} \beta_{2i} \Delta RECX_{t-i} + \sum_{i=1}^{n} \beta_{3i} \Delta WY_{t-i} + \sum_{i=1}^{n} \beta_{4i} \Delta RICX_{t-i} + \beta_5 RECX_{t-1} + \beta_6 WY_{t-1} + \beta_7 RICX_{t-1} + \beta_8 X_{t-1} \quad \text{_____(1)}$$

where
X = quantum index of India's exports
WY = index of world real GDP
RECX = real effective exchange rate based on consumer price index (CPI) for India
RICX = exchange risk defined as deviation from the trend of RECX, where the trend is computed based on autoregressive (AR) model and the lags are determined based on the Akaike information criteria (AIC).

Import model (equation 2) is based on Kenen and Rodrik (1986) but rewritten in the form of UECM and using ARDL structure:

$$\Delta M_t = \alpha_0 + \sum_{i=1}^{n} \gamma_{1i} \Delta M_{t-i} + \sum_{i=1}^{n} \lambda_{2i} \Delta Y_{t-i} + \gamma_3 Y_{t-1} + \gamma_4 M_{t-1} + \gamma_5 SY_{t-1} \quad \text{(2)}$$

M = quantum index of India's imports
Y = index of India's real GDP
SY = Y for the time period between Q4 2003-04–Q3 2009-10, otherwise zero. This is a slope dummy introduced to capture the change in import intensity during the period.

All other variables other than the exchange risk have been seasonally adjusted using the X12 method. Risk variables have been calculated from seasonally-adjusted REER.

Step 3

The study uses quarterly data for the relevant period, i.e., Q4 1998-99 to Q3 2009-10. The equations (1) and (2) are estimated using ordinary least square (OLS) regression. Based on the estimated OLS regression coefficients, we derive the long run and short run elasticities. To derive the short run and long run elasticities, we follow Bardsen (1989) and Choong, et al. (2005), whose methods are described by Hoque and Yusop (2010). The long run and short run elasticities are presented in tables A2 and A3.

Table A2: Estimated Long-run and Short-run Elasticities of Quantity Exports-Equation (1)

Dependent Variable Δ(X)		
	Long run	*Short run*
$RECX_{t-1}$	-2.06***	-0.11
WY_{t-1}	3.11***	7.62***
$RICX_{t-1}$	0.30	-0.13

Table A3: Estimated Long-run and Short-run Elasticities of Quantity Imports–Equation (2)

Dependent Variable Δ(M)		
	Long run	*Short run*
Y_{t-1}	1.49***	-1.41
SY_{t-1}	0.03**	

**** Significant at 1 per cent level*
*** Significant at 5 per cent level*
** Significant at 10 per cent level.*

References

Bardsen, G. (1989), "Estimation of long-run coefficients in error correction models," *Oxford Bulletin of Economics and Statistics*, Vol. 51 (3), pp. 599-623

Choong, C. K., Law, S.H., Yusop, Z. B. and Choo, S. S. (2005), "Export-led Growth Hypothesis in Malaysia: A Revisit," *The IUP Journal of Monetary Economics*, Vol. 3(4), pp. 26-42

Dipendra, S. (2001), "A Note on Trade Elasticities in Asian Countries," *The International Trade Journal*, Vol. 15 (2), pp. 221-237

Engle, R.F. and C.W.J. Granger (1987), "Cointegration and Error-Correction: Representation, Estimation, and Testing", *Econometrica 55(2)*, pp. 251-276

Findley, D., Monsell, B., Bell, W., Otto, M. and Chen, B. C. (1998), "New capabilities and methods of the X-12-ARIMA seasonal adjustment program", *Journal of Business and Economic Statistics*, Vol 16(2), pp. 127-52

Freedman, C., Michael, K., Douglas, L. and Jaewoo, L. (2009), "The Case for Global Fiscal Stimulus," Staff Position Note 09/03, *International Monetary Fund*, Washington, D.C.

Hodrick, R.J. and Prescott, E.C, (1980) "Postwar U.S. Business Cycles: An Empirical Investigation," DP No. 451. *Carnegie Mellon University*, Pittsburgh, PA

Hodrick, R.J. and Prescott, E.C, (1997) "Postwar U.S. Business Cycles: An Empirical Investigation," *Journal of Money, Credit & Banking*, Vol. 29 (1), pp. 1-16

Hoque, M. M. and Yusop, Z. (2010), "Impacts of trade liberalisation on aggregate import in Bangladesh: An ARDL Bounds test approach," *Journal of Asian Economics*, Vol. 21(1), pp. 37-52

Houthakker, H. S. and Magee, S. P. (1969), "Income and Price Elasticities in World Trade," *Review of Economics and Statistics*, Vol. 51(2), pp. 1111-1125

Ilztetzki, E. and Vegh, C. A. (2008), "Procyclical Fiscal Policy in Developing Countries: Truth or Fiction?", WP No. W14191, *National Bureau of Economic Research*, Cambridge

Johansen, S. (1995), *Likelihood-Based Inference in Cointegrated Vector Autoregressive Models*. Oxford University Press, New York

Joseph, M. (1992), Exchange Rate Policy: Impact on Exports and Balance of Payments, Deep & Deep Publications, New Delhi, India

Kandil, M. and Morsy, H. (2010), "Fiscal Stimulus and Credibility in Emerging Countries," WP No. WP/10/123, *International Monetary Fund*, Washington, D.C.

Kenen, P. and Rodrik, D. (1986), "Measuring and Analyzing the Effects of Short-term Volatility in Real Exchange Rates," *The Review of Economics and Statistics*, Vol. 68(2), pp. 311-315

Kumar, R., Vashisht, P. and Kalita, G. (2010), "Food Inflation: Contingent and Structural Factors," *Economic & Political Weekly*, Vol. 45(10), pp. 16-19

Mittal, S. (2007). "OECD Agricultural Trade Reforms Impact on India's Prices and Producers Welfare", WP No. 195, Indian Council for Research on International Economic Relations, New Delhi, India

Oskooee, M. B. and Kara, O. (2005), Income and Price Elasticities of Trade: Some New Estimates. *The International Trade Journal*, Vol. 19 (2), pp. 165-178

Pesaran, M. H., Shin, Y., and Smith, R. J. (2001), "Bounds Testing Approaches to the Analysis of Level Relationships," *Journal of Applied Econometrics*, Vol. 16(3), pp. 289-326

Spilimbergo, A., Steve, S., Olivier, B. and Carlo C. (2008), "Fiscal Policy for the Crisis," Staff Position Note 08/01, *International Monetary Fund*, Washington D. C.

Srinivasan, T. N. (1998), "India's export performance: A comparative analysis," Ahluwalia, I. J. & Little, I.M.D. (Eds.), India's Economic Reforms and Development: Essays for Manmohan Singh, Delhi: Oxford University Press

RBI (2010), "Global Financial Crisis and Indian Economy," *Report on Currency and Finance 2008–09, The Reserve Bank of India*

UNTACD (2009), "Impact of Global Slowdown on India's Exports and Employment", New Delhi, India.

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