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Government Expenditure in India: Composition and Multipliers

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Abstract

We estimate fiscal multipliers for total, capital (capex), and revenue (revex) Indian government expenditure using a two variable Structural Vector Auto-Regression (SVAR). Our quarterly data allows us to estimate both short- and long-run multipliers. We then extend and re-estimate the model including supply shocks and the monetary policy response sequentially and together and re-estimate the multipliers. The long-run capex multiplier remains much larger than the corresponding revex multiplier in all the estimations. The short run impact multiplier is the highest for revex, but does not rise after the first quarter. The capex peak multiplier in the 2nd quarter is 1.6-1.9 times larger. The cumulative multiplier is also the highest for capex, 2.4-6.5 times the size of the revex multiplier. Capex also reduces inflation more over the long-term. Despite this, capex shows greater volatility since it is more vulnerable to discretionary cuts. Monetary accommodation of capex and revex is allowed to differ. It varies in the absence/presence of supply shocks. The combination of a direct cut in capex and monetary tightening in response to a supply shock reduces the capex multiplier. The results are consistent with an elastic long-run aggregate supply. Disaggregated evaluation of spending policy, therefore, gives useful insights.

Keywords: Fiscal multiplier; SVAR; Revenue expenditure; Capital expenditure; Fiscal – Monetary coordination; Supply shocks

JEL classification code: C32, E31, E62, E63, H50

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1. Introduction

In Emerging Market Economies (EMEs) that face limits on borrowing, there is a tendency for a pro-cyclical increase in government expenditure in a business cycle upswing and a reversal in a slump. This can be due to political pressures as well as to fund constraints. India adopted a Fiscal Responsibility and Budget Management (FRBM) Act in 2003, but there was steady reduction in capital expenditure (capex) in response to the pressure to reduce total expenditure while revenue expenditure (revex) grew. The composition of fiscal policy matters, as well as its relative impact on output in the long compared to the short run. Supply shocks and the monetary policy response can also affect the fiscal impact.

The fiscal multiplier, which gives the effect of expenditure on output, is a key statistic to estimate fiscal impact. But its correct estimation has to be independent of the business cycle since if government expenditure rises when output is down, the estimated multiplier would be reduced. Identification strategies are required to estimate the impact of fiscal policies orthogonal to current cyclical conditions. Structural Vector Auto-Regression (SVAR) is the strategy we use, since lags in fiscal response and other contextual features can be used for identification. Incorporating aspects of Indian structure such as an elastic supply curve subject to frequent supply shocks and a differential monetary policy response to capex and revex give additional insights and serve as robustness checks on the multiplier estimates. Internationally, there has been a revival of interest in estimating the fiscal multiplier under very accommodating monetary policy in conditions of near zero interest rates. For an EME, where interest rates remain high, the impact of differential monetary accommodation on the relative size of capex and revex multipliers is the relevant question. This differential policy reaction function can be used for identification.

We extend the estimation of fiscal multipliers for India in the following ways. First, we use a higher frequency of data (quarterly) for government expenditure variables to calculate fiscal multipliers. This allows us to analyze the size of the fiscal multiplier within a quarter as well as over 10 quarters (or close to 2 years), which we interpret as the long-run multiplier[1]. Impulse Response Functions and Forecast Error Variance Decomposition are used to analyze response to shocks. We estimate separate multipliers for capital as well as revenue

[1] In an EME there is no well-defined business cycle, let alone several cycles, over which to measure the multiplier, but we find impulse responses for India stabilize in 2 years. The period of 15 years for which quarterly data is available is also short, although estimation is feasible.

expenditure. We also analyze how these multipliers change after allowing for frequent supply shocks as well as their interactions with monetary policy. Differential monetary accommodation of capex and revex that varies with supply shocks is imposed.

We find capex shows much more volatility compared to revex. Although capex has a large impact on output, compared to revex, and reduces inflation more over the long term while revex raise it, capex is the one which is slashed. The short run impact multiplier is the highest for revex, but does not rise after the first quarter. The capex peak multiplier in the 2nd quarter is 1.6-1.9 times larger. The cumulative multiplier is also the highest for capex, 2.4-6.5 times the size of the revex multiplier. The capex multiplier rises when the monetary policy response and supply shocks are respectively introduced. The combination of a direct cut in capex and monetary tightening in response to a supply shock, however, reduces the capex multiplier. The difference between the two multipliers falls with a supply shock and a monetary policy response together if the latter does not actively accommodate capex. The total expenditure multiplier is similar to the revex, which is the largest component. The estimated values are consistent with many studies (see section 2) that find while spending multipliers are unity or less, they can rise in special circumstances, with cumulative investment multipliers reaching 4.

The impulse response and variance decomposition also show large variation in capex to own and supply shocks, while revex is more committed and stable. The results throughout are consistent with an elastic long-run aggregate supply, since supply shocks affect inflation predominantly and demand and fiscal shocks have a larger impact on Gross Domestic Product (GDP) growth than on inflation, as expected with an elastic aggregate supply.

The remainder of the paper is structured as follows. After a brief literature survey in Section 2, Section 3 discusses methodology and data; Section 4 derives spending multipliers using short-run restrictions; Section 5 extends these to include supply shocks while Section 6 brings in monetary policy shocks. Now long-run restrictions are also required for identification. Section 7 has both supply and interest rate shocks. Section 8 gives some policy suggestions while concluding the paper. Appendices report some tests, estimations and robustness analysis.

2. Literature Survey

The global financial crisis (GFC) has revived interest in the fiscal multiplier, which measures the impact of a fiscal stimulus (Spilimbergo et. al, 2009). Estimation of fiscal multipliers has used a number of techniques including the Dynamic Stochastic General Equilibrium Model, the NiGEM model, time series techniques such as VAR or SVAR, the narrative approaches and more recently, the bucket approach (Batini et. al, 2014) where the authors assign scores and cumulate them on the basis of the structural characteristics of the country and other adjustments based on the economy's position on the business cycle. Christiano et. al (2011) also show that the size of the government spending multiplier rises when zero lower bounds (ZLBs) on nominal interest rate bind, so the nominal interest rate does not respond to the rise in government spending. The impact multiplier in the ZLB scenario is roughly around 1.6 with the peak multiplier of 2.3 after five periods. The interesting conclusion for EMEs, which on an average have higher nominal interest rates, is the size of the fiscal multiplier depends on monetary policy.

A number of studies find fiscal multipliers are not constant across countries and time, and are much larger during slowdowns. For example, Riera-Crichton, Vegh and Vuletin (2015) find the long-run multiplier for bad times and rising government spending to be 2.3 compared to 1.3 in expansion. In extreme recessions, the long-run multiplier reaches 3.1. Qazizada and Stockhammer (2015) in a panel of 21 advanced economies (AEs) over the period of 1979–2011 find a spending multiplier of close to 1 during expansion and values of up to 3 during contractions. Karras (2014) finds the fiscal multiplier to be twice as large, exceeding one, in a panel data set of 61 countries, when output is below its long-term trend. Differences between expansion and downturn multipliers are greater in low-income countries. Studies also find compositional effects.

Gechert (2015), in a meta-regression analysis on 104 studies on multiplier effects find public investment multipliers to be larger than those of spending in general by approximately 0.5 units. Perotti (2005 and 2006) found average government spending multiplier to be about unity for 5 AEs. The three-year cumulative government investment multiplier reached as high as 3.8 for Germany but was low for other countries. Marattin and Salotti (2014) find the qualitative and quantitative dimensions of fiscal multipliers on private consumption change across different public spending categories.

Blanchard and Perotti (2002) used SVAR to identify taxation and spending shocks and assess their impact on GDP. They introduced dummies for large spending and taxation changes. Ilzetzki et al. (2011) use panel SVAR to determine factors affecting multiplier size across 44 countries. They find multipliers vary significantly across groups of countries classified according to their incomes, exchange rate regimes, level of monetary accommodation, openness to trade, and level of sovereign debt. Jain and Kumar (2013) estimated capital as well as revenue expenditure multipliers for India using SVAR over 1980-81 to 2011-12. They found a significant positive long run impact of capital outlay on GDP.

It has been claimed that an SVAR shock may not be orthogonal for private forecasters, since they would internalize the projections as well as the announcements. Aueurbach and Gorodnichenko (2011, 2012) extend the SVAR analysis to account for the size of fiscal multipliers when the economy is in recession. Using regime switching models (STVAR), they estimated varying effects of fiscal policies over business cycles to account for the difference in size of spending multipliers in recession and expansions (found to be larger during the former). They include the forecast errors of government purchases along with the actual GDP and government purchase data to compute multipliers for unanticipated government purchase. These forecast errors, computed from professional forecasts of the variables, provide a more precise measure of unanticipated shocks. With a well-developed system of forecasts, innovations to the fiscal variables may not be unanticipated shocks but follow changes in other variables. Such an analysis is not possible for India however, since high frequency professional forecasters' surveys were started, for some fiscal variables, only after 2006.

As Hemming et al. (2002) point out, while demand side effects of fiscal policy as a stabilization tool are important, the supply side effects can be more important over the longer term since they address capacity constraints. However, there are two sides to this issue. The supply side effects of fiscal policy may have short term demand side consequences because of expectations that longer term growth will be higher. A fiscal expansion that is good for the supply side will tend to increase the fiscal multiplier. These models pay attention to the way government spending on public goods affects the productivity of labour and capital.

Identification of supply shocks requires estimation of the short and long-run supply curve. Blanchard and Quah (1989) use a bivariate SVAR on output and unemployment with a long run identification restriction to decompose output into its temporary and permanent components and to identify unobservable structural shocks as demand and supply shocks. Cover et al. (2004) modify these restrictions to allow for correlation between shocks with causality from demand to supply shocks since simultaneous shifts in aggregate demand (AD) and aggregate supply (AS) curves are highly probable. Under this modified framework, demand shocks can have long run effects on output. This analysis can be extended to examine the impact of fiscal shocks, usually perceived to be temporary and not having a long term impact on output, on long run GDP levels and growth.

Goyal and Pujari (2005) estimate a long run supply curve for India testing the assumptions of both a horizontal (elastic) and a vertical (inelastic) AS curve. The evidence supports an elastic long run supply curve since supply shocks contribute largely to inflation and demand shocks largely to output growth, even in the unconstrained short-run. If a vertical supply curve is imposed, supply shocks account for the major part of inflation, which is inconsistent. Elastic AS is intuitive in an economy far from full employment. Using exogenous shocks in the post GFC period, Goyal (2012) establishes that short run supply is also not inelastic in India’s case. It is volatile, however, since it is subject to upward shifts from cost shocks.

Recent literature has also explored the relation of fiscal policy with supply shocks. Ahmad & Pentecost (2011) use a tri-variate SVAR with a long run identification scheme to identify supply and demand shocks in 22 African Economies between 1980 and 2005. They extend this analysis to find the correlation between fiscal policy measures, identify domestic supply and demand shocks, and government consumption to finally conclude fiscal policy undertaken was countercyclical and extra output produced due to positive supply shocks was largely absorbed by public sector consumption. Strawsinsky (2009) uses the Blanchard-Quah methodology to differentiate between permanent and temporary shocks for 22 OECD economies. Using panel regressions he finds while both deficits and expenditures react counter-cyclically to temporary shocks, there is no evidence of a pro-cyclical expenditure response to permanent shocks. Policies that cushion the impact of these shocks or moderate adverse demand and supply shocks are required.

The composition of fiscal policy also matters. Through bi-variate regressions, Baldacci et. al (2009) show that an increase in the share of public investment during a crisis significantly raises post-crisis GDP growth. The increase is more than from a higher share of public consumption, sine the latter results in crowding out. This relationship weakens, however, if initial economic conditions are poor.

As Batini, Eyraud, Forni, and Weber (2014) point out SVARs can be criticized because of omission of variables and specific conditions that impact fiscal variables implying shocks identified may not be fully exogenous. Moreover, since only average multipliers can be calculated from linear SVARs, especially in conditions of structural change, the actual impact of fiscal policy on output could differ. The impact is also state-contingent. Corsetti, Meier, and Müller (2012) follow a two stage procedure for multiplier estimates conditional on different events such as crisis conditions. Multipliers are typically higher in the latter.

Our contribution to the literature is to examine response to disaggregated Indian fiscal expenditure and calculate multipliers conditional on income growth, supply shocks and monetary policy. We also do robustness analysis by introducing dummies for the GFC, and using different price deflators (Appendix A.3). Our estimation period largely coincides with the imposition of the FRBM rule, so it is taken as part of the exogenous fiscal shock. Moreover, it imposes no restrictions on the composition of fiscal expenditure, which is our primary concern.

3. Methodology and Data

3.1 Identifying fiscal shocks with structural vector auto-regression

In contrast to monetary policy, decision and implementation lags in fiscal policy imply that at high enough frequency, for instance monthly or quarterly, there is little or no discretionary response of fiscal policy to unexpected movements in activity. Output stabilization is rarely a pre-dominant reason for the movement of budget variables. Using systematic information on spending systems, it is possible to construct estimates of automatic effects of unexpected movements in fiscal variables, which capture fiscal policy shocks, while controlling for the cycle in an SVAR (Blanchard and Perotti 2002). As a result, estimates of dynamic effects of fiscal policy shocks on output are obtained.

A reduced form VAR (Vector Auto-Regression) model with p lags is written as follows:

$$\boldsymbol{z_t = c + \phi_1 z_{t-1} + \phi_2 z_{t-2} +} \dots\dots\dots\dots\dots\dots \boldsymbol{+ \phi_p z_{t-p} + \epsilon_t}$$

Where,

$\boldsymbol{z_t}$ = (N × 1) vector of various stationary time series
$\boldsymbol{c} = (N \times 1)$ vector of constants and other exogenous variables
$\boldsymbol{\phi_j} = (N \times N)$ matrix of coefficients for j = 1,2, … , p, and
$\boldsymbol{\epsilon_t} = (N \times 1)$ vector of reduced form errors with expectation 0 and a symmetric covariance matrix Ω

The Structural VAR (or SVAR) model introduces restrictions on contemporaneous or long-run effects based on theory. It is written as:

$$B_0 Z_t = c^* + B_1 Z_{t-1} + B_2 Z_{t-2} + \dots \dots .. B_p Z_{t-p} + u_t$$

Where,
$B_0 = (N \times N)$ matrix of contemporaneous coefficients
$B_j = (N \times N)$ matrix of structural dynamic coefficients for j = 1,2, … , p, and
$u_t = (N \times 1)$ vector of structural errors such that, $E(u_t u_\tau') = \begin{cases} D \text{ for } t = \tau \\ 0 \text{ otherwise} \end{cases}$
Where D is a diagonal matrix
And, $c = B_0^{-1} c^*$
$\phi_s = B_0^{-1} B_s$
$\epsilon_t = B_0^{-1} u_t$

This implies that the reduced form innovations are a weighted sum of structural disturbances. In order to isolate the effects of shocks to a particular structural variable, that is, to assess the impact of $\boldsymbol{u_t}$ on other endogenous variables, we need to get an estimate of B_0 matrix. To do that, we need to use identifying restrictions on the structural model.

To get the number of restrictions that lead to exact identification of the model we make use of the variance-covariance matrix of the reduced form errors:
$\Omega = B_0^{-1} E(u_t u_t')(B_0^{-1})'$

Identification is also possible using long run restrictions where $\gamma(1) = \sum_{j=0}^{\infty} \phi_j$ is a long run matrix, linking the time series vector to the structural shocks.

Order condition for identification of the structural model: There should be as many free parameters in $\boldsymbol{B_0}$ and $\boldsymbol{D}$ put together, as there are in $\boldsymbol{\Omega}$ i.e. N(N+1)/2 since it is symmetric.

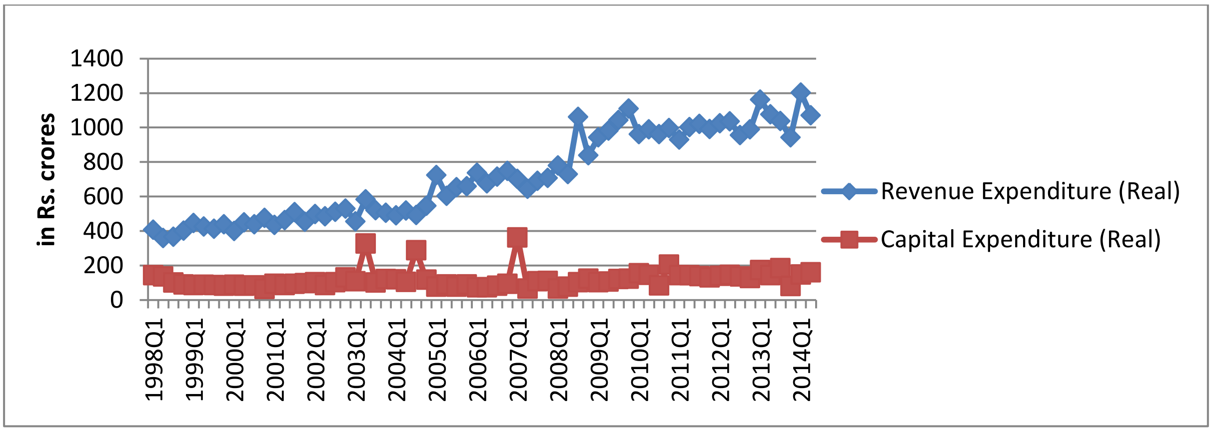
Since D has N elements, $\boldsymbol{B_0}$ should have N(N-1)/2 variables to have a just-identified structure.

We use short-run exclusion restrictions on the $\boldsymbol{B_0}$ matrix, as well as restrictions on the matrix of long-run responses of variables to shocks, based on theoretical properties, to identify the impact of fiscal shocks on output and distinguish between impacts of revenue and of capital expenditure.

3.2 Variable definitions and data

Revenue expenditure (revex) is defined as expenditure incurred on normal running of government departments and various services as well as subsidies, interest payments on debt etc. As per the Union Budget documents, "it is the expenditure which does not result in creation of assets for the Government of India". All grants given to State Governments/Union Territories and other parties are treated as a part of it. Even though they might be used for creation of assets, the ownership of these assets would not be with the Union Government.

Figure 1: Revenue and capital expenditure

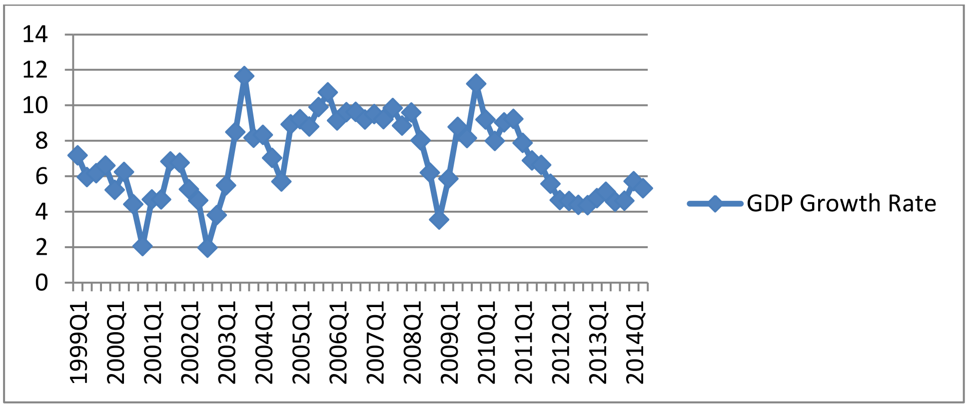


Capital expenditure (capex) includes expenditure on acquisition of assets like land, buildings, machinery, equipment, loans and advances granted by Central Government to State and Union Territory Governments, Government Companies etc. Any expenditure that increases the assets or reduces the liabilities of the Union Government would be included under this head. Both of these heads, when summed up over programs under the Five Year Plans (Plan Expenditure) or schemes outside the purview of the Planning Commission and the Five Year Plans (Non-Plan Expenditure), give us the total expenditure of the Central Government.

Figure 1 shows revex increased steadily compared to capex. Revex accounts for the major part of total Government expenditure (totex). Capex shows a flat trend, with significant increases being followed by decreases of equal or even greater magnitude, implying sharp fluctuations around the mean. These fluctuations result in a large variance of the series.

Despite a slight upward shift in the capex series since 2011, the gap between real revex and real capex has widened, especially since 2005 (Figure 1). Since the introduction of FRBM in 2003, fiscal authorities are under pressure to keep the fiscal balance in check. Central Government's total expenditure fell from 16% to 14% of GDP in the 2 years following implementation of FRBM. However, the brunt of this expenditure control was borne by capex which declined to 1.8% of the GDP in 2008-09 from 6.2% in the 1980s while revex continued to show a rising trend throughout[2]. Figure 2 shows accompanying fluctuations and stagnation in GDP growth rate.

Figure 2: GDP growth rate



We use quarterly data on real total, revenue and capital expenditure, retrieved from the monthly accounts available on the website of the Controller General of India (http://www.cga.nic.in/), deflated by the Wholesale Price Index[3]. In order to estimate the long run supply curve for India for the same period and frequency, we use the quarterly average of the monthly wholesale price index (WPI) (1993-94 base year) and the quarterly GDP at constant prices, for the period 1998-Q1 to 2014Q2. In order to control for monetary policy

[2] Following the Sixth Pay Commission, wages and salaries of government employees increased along with subsidies. Interest payments also rose on account of higher fiscal deficits.
[3] We also repeat the analysis using the GDP price deflator (Appendix A3) with no change in results, possibly because rates of growth are similar.

stance, quarterly averages of call money market rates[4] (CMMR) were used (Source: dbie.rbi.org.in).

The data on GDP and fiscal variables were deseasonalised[5] using the X-11 technique of the Census Bureau of USA and then converted into logarithms. All of these variables, converted into growth rates for estimation, were stationary at 5% level of significance using the Augmented Dickey Fuller (ADF) test. WPI inflation rate series were stationary, using ADF test, at both 5% and 1% levels of significance. CMMR was stationary at 10% level of significance. We used the ex-post real interest rate defined as the difference between the short term nominal CMMR and one period ahead expected inflation rate.

$$r_t = i_t - \pi_{t+1}^e$$

Where, $\pi_{t+1}^e = \pi_{t+1}$

4. Derivation of Spending Multipliers Using Short-Run Restrictions

In order to estimate government expenditure multipliers, we restrict the SVAR matrix of contemporaneous restrictions as follows:

$$\begin{matrix} e_t^{exp} \\ e_t^{gdp} \end{matrix} = \begin{bmatrix} B_{11} & 0 \\ B_{21} & B_{22} \end{bmatrix} \begin{matrix} u_t^{exp} \\ u_t^{gdp} \end{matrix}$$

This implies spending will impact output in the short run but not vice-versa. Fiscal decision and implementation lags justify this identification.

The ratio of impulse responses of output to fiscal variables and of fiscal to fiscal variables gives the elasticity, which when divided by a historical average ratio of real spending to GDP gives the multiplier. That is, the sample mean of output to spending ratio is multiplied by the ratio of impulse response of output growth to structural spending shock and impulse response of spending growth to structural spending shock.

[4] After the LAF was introduced in 2004, short term money market interest rates tend to move together. RBI (2014) argues CMMR is one of the best indicators of short term monetary policy since it reflects actions from liquidity constrained banks and it fluctuates only in the band specified by the LAF. The weighted average CMMR was recognized as an operating target for monetary policy.

[5] It is customary to deseasonalise government expenditure variables, given the much noted 'March Rush', or concentration of expenditure at the end of the fiscal year. Seasonal unit roots may have given spurious results from the SVAR, which requires all variables to be stationary.

$$\frac{dy}{dg} = \frac{\gamma_{yg}}{\gamma_{gg}} \cdot \frac{Y}{G}$$

Where,

y = Growth rate of output

g = Growth rate of spending variable

γ_{yg} = Impulse response of output growth to spending shock (absolute value)

γ_{gg} = Impulse response of spending growth to spending shock (absolute value)

The Impulse Response Functions (IRFs) to structural one standard deviation innovations and two standard deviation error bands (arrived at through Monte-Carlo integration) are given in Figure 3. Despite the small sample size the error bands are narrow. Greater variation in EMEs compared to AEs data may be improving precision in our EME estimation.

Figure 3(a): IRFs – Total Central Expenditure Growth and GDP Growth

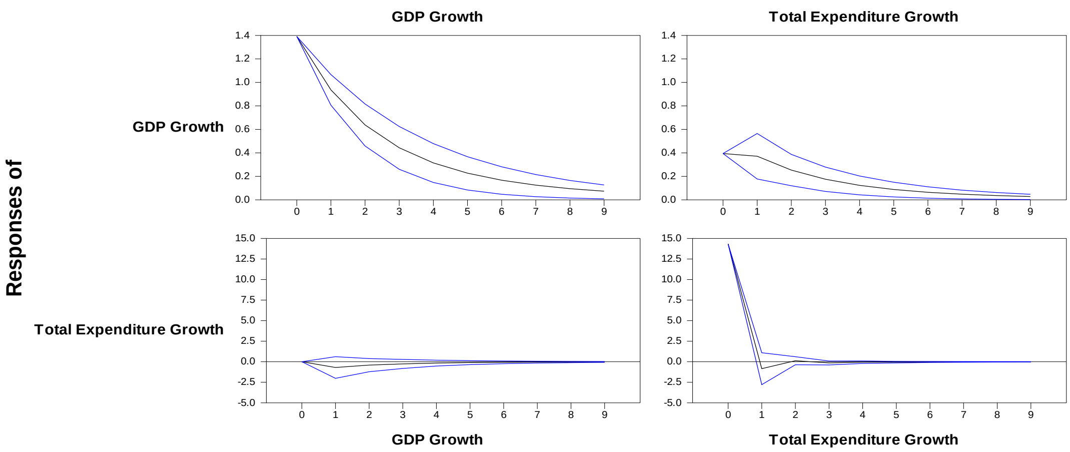


Figure 3(b): IRFs– Capex Growth and GDP Growth

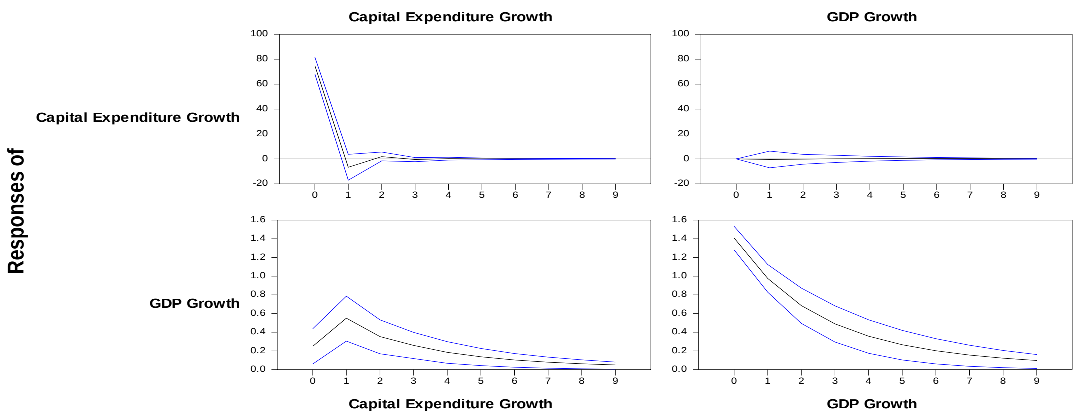
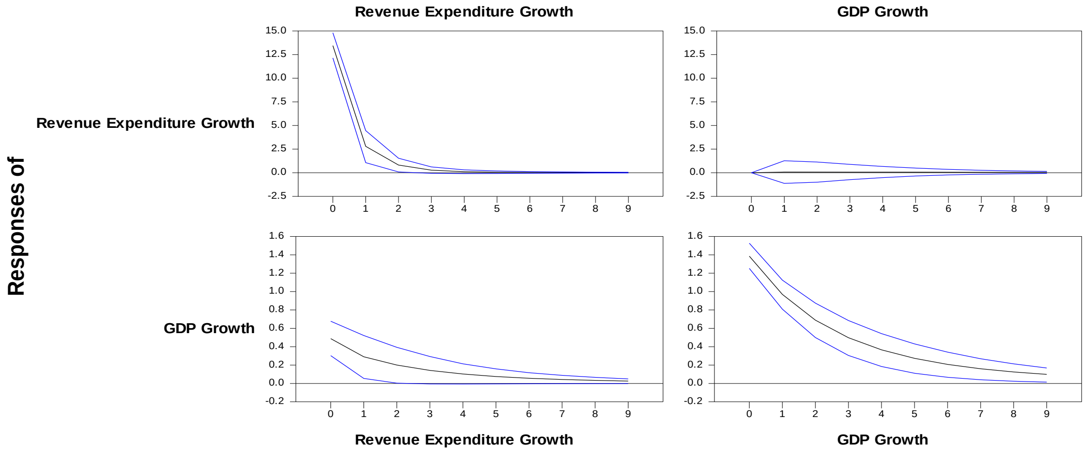


Figure 3(c): IRFs – Revenue Expenditure Growth and GDP Growth



Spilimbergo et. al (2009) define impact multiplier as the multiplier which evaluates the effect of an increase in spending on output over a shorter period. The peak multiplier measures the largest impact. The cumulative multiplier measures the cumulative change in output for a cumulative change in government expenditure over a horizon N. The average GDP to real total expenditure ratio for 1999 Q1 to 2014 Q2 was 9.309, for real revex it was 10.8671, for real capex the average ratio it was 75.014. Table 1(a) gives the derived multipliers and the ratio of the capex to the revex multiplier.

Table 1(a): Multipliers with short-run restrictions

	Total Expenditure	**Revenue Expenditure**	**Capital Expenditure**	**Capex/Revex Multipliers**
Impact Multiplier	0.26	0.39	0.28	0.72
Peak Multiplier	0.26	0.39	0.59	1.51
Cumulative Multiplier (for 2 years)	1.06	0.67	2.15	3.21

While the peak and the impact multipliers for total expenditure and revenue expenditure (which contributes most to total expenditure) are the same and occur within a one quarter lag[6], the peak multiplier of capital expenditure occurs with a 2 quarter lag after which it

[6] The totex multipliers (peak and impact) are lower than both revex and capex multipliers because although the impulse response of total expenditure is similar to revex in the short run, this is multiplied by the ratio of GDP to expenditure and GDP/total expenditure is less than GDP/revex. In the long run, however, the totex multiplier is higher than revex multiplier as the large multiplier effects of capex have a strong cumulative effect on the economy even as the effect of revex subsides.

diminishes. In the long run, which is taken as two years, capital expenditure has the largest multiplier effect on output. Longer-run capex multipliers always exceed revex multipliers.

5. Impact of Spending in Presence of Supply Shocks

Since supply shocks are frequent in the Indian scenario, it is useful to assess their impact on inflation and to see what happens to our multipliers after allowing for such shocks. India continues to suffer from high levels of poverty, making inflation a social as well as a political concern. We will now restrict the analysis to revex and capex, since totex largely follows revex.

In a labour-surplus country like India if short-term supply bottlenecks are released, output can expand without much change in wages, implying a horizontal supply curve in the long-run. With such a structure, the set of shocks that raise inflation and output are decomposed naturally into positive shocks to the aggregate supply (AS) curve and positive shocks to the aggregate demand (AD) curve respectively. Then only AS shocks will have a long run impact on inflation. Both shocks can have a long-run impact on output but the impact of AD shocks is expected to dominate. There are no restrictions on short-run impact. Goyal and Pujari (2005) find a horizontal supply curve (HSC) specification has more empirical support compared to a vertical supply curve (see section 2).

The structural long-run moving average representation of the 3-variable VAR system is:

$$\begin{matrix} \pi_t \\ y_t \\ g_t \end{matrix} = \begin{bmatrix} \gamma_{11} & 0 & 0 \\ \gamma_{21} & \gamma_{22} & \gamma_{23} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} \end{bmatrix} \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \end{bmatrix}$$

The long-run restrictions used here imply that supply shocks (u_{1t}) affect inflation but demand (u_{2t}) and fiscal shocks (u_{3t}) have no impact on inflation in the long run. Output growth rate in the long-run is affected by all three shocks. For both revenue and capital expenditure, we allow all the three shocks to have a long-run impact on the grounds that long-run spending decisions incorporate the various demand and supply shocks in order to cushion the economy from such shocks in the long-run. Political economy considerations dominate fiscal policy decisions, but the welfare loss from failing to account for large negative shocks in the spending decision may materialise in a loss of political power.

Apart from the two long-run restrictions given above, one more restriction is needed. We therefore, use our earlier short-run restriction and restrict the contemporaneous coefficient matrix as below:

$$\begin{matrix} e_t^{\pi} \\ e_t^{gdp} \\ e_t^{exp} \end{matrix} = \begin{bmatrix} B_{11} & B_{12} & B_{13} \\ B_{21} & B_{22} & B_{23} \\ B_{31} & 0 & B_{33} \end{bmatrix} \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \end{bmatrix}$$

The above specification allows for a positively sloped short run AS curve. That is, all shocks can affect inflation and output growth rate in the short-run when bottlenecks hold. An increase in revex because of the increase in wages and salaries of government employees might lead to increase in demand of goods and services, spurring a price increase. An increase in capital outlay, even though it would reduce structural bottlenecks in the long-run, may increase demand and price levels in the short-run.

5.1 Analysis of results

The Impulse Response Functions (IRFs) are presented in figures A1(a) and A1(b) (Appendix). The Variance Decomposition Analysis (VDA) given in tables A1(a) and A1(b) shows the contribution of each shock to the changes in a variable.

That demand should not affect inflation in the long run is imposed by the HSC identification, but the VDA clearly shows AS shocks affect inflation predominantly even in the short run and AD and fiscal shocks contribute much more significantly to GDP growth. This is not imposed and supports the HSC specification since it is not feasible under a vertical supply curve (see also Goyal and Pujari, 2005). Even in the short-run where there is no restriction, demand does not have much effect on inflation.

(i) The larger relative response of GDP growth to a shock in capex compared to revex growth rate is similar to the IRFs in the previous section. The VDA also shows the contribution of shocks to capex growth rate on GDP growth increases in the long run and is larger than the contribution of revenue expenditure, which diminishes in the long-run, consistent with the capex multiplier being the largest. The persistence of shocks to growth, suggests the short run influences the long run. In EMs there is no established steady-state growth rate. Trend growth can be volatile.

(ii) A positive shock to both capex and revex growth raises inflation in the IRFs, but it turns negative after two quarters and dies down in the long-run. Even so the effect of revex on inflation exceeds that of capex. The VDA clearly shows the contribution of capex growth rate shocks to inflation to be minimal in contrast to the large contribution of revex growth, under similar identifications.

(iii) A major finding from the IRFs is the sharp decrease in capex growth in response to a positive AS shock, which implies a rise in inflation. The decrease in revex growth is smaller, despite similar restrictions on the two expenditure components. The VDA also shows fluctuations in capex growth to be more strongly affected by shocks to AS than to AD, while the effect of AS shocks on revex is much lower.

(iv) Moreover, the response of capex growth rate to its own shock is also large. Such large fluctuations on its own account imply more discretion under this expenditure head instead of forward-looking commitments. The much smaller response of revex growth rate to its own shock implies more committed revenue expenditure.

In presence of a sudden inflation spike, following a positive AS shock, wages and salaries of government workers are difficult to reduce. Subsidies also increase. Since there is a pressure to keep the fiscal balances in check, it is easier to reduce an element of spending less visible (at least in the short-run) to the public eye. Figure 1 shows the declining ratio of capital to revenue expenditure. This is to be expected under frequent supply shocks.

The derived multipliers in the presence of supply shocks are presented in Table 1(b). The behaviour is similar to the previous section, with a marginal decline in the cumulative multiplier of revex and a marginal increase in the impact and peak multiplier of capex. The stabilization effectiveness of capex compared to revex is raised. The result follows because of the larger increase in inflation in the short-run in response to rise in revex, which also has a negative impact on GDP growth in the long-run. Although capex is more effective in the presence of supply shocks, such expenditure is also decreased more sharply in response to supply shocks, indicating the inadequacy of the policy response. Growth rate falls with a positive supply shock since it raises costs and reduces income. Thus aggregate demand falls.

Table 1(b): Fiscal multipliers in the presence of supply shocks

Multiplier	Revenue Expenditure	Capital Expenditure	Capex/Revex Multipliers
Impact	0.35	0.34	0.97
Peak	0.35	0.68	1.94
Cumulative	0.62	2.35	3.79

6. Impact of Spending Policy Allowing for the Monetary Response

In the previous two sections, real interest rate and the monetary policy stance are taken as exogenous to the system. This section will allow for shocks to short-term real interest rate[7], driven by shocks to monetary policy and inflation expectations. We will estimate the impact of spending shocks on GDP growth and the size of the multiplier, after allowing for the monetary policy response. Since interest rate shocks differentially impact revex (which includes interest payments by the Central Government) and capex (which comprises of public investment and can be severely affected by higher cost of borrowing), we follow different identifying restrictions for these expenditure heads.

6.1 Revenue expenditure

The long-run structural moving average representation is assumed to be:

$$\begin{matrix} y_t \\ r_t \\ g_t \end{matrix} = \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} \\ \gamma_{21} & \gamma_{22} & 0 \\ \gamma_{31} & \gamma_{32} & \gamma_{33} \end{bmatrix} \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \end{bmatrix}$$

Where, u_{1t} represents orthogonal structural GDP growth shocks, u_{2t} represents structural short-term real interest rate shocks and u_{3t} represents the structural shocks associated with revex growth.

The above specification implies that all shocks affect GDP and revex growth. But only shocks to GDP growth and own shocks, not revex shocks, affect the real interest rate in the long-run. The rationale is, with reduced fiscal dominance and the inflation centred approach of the RBI, monetary authorities tend not to accommodate revex changes. Market and inflation expectations also do not react much to revex shocks. Therefore revex shocks do not alter the real interest rate ($\gamma_{23} = 0$). Real interest rate shocks affect expenditure variables through an increase in costs of borrowing or/and increased interest payments.

[7] The real rather than the nominal interest rate is used since that is the variable that affects output and therefore the multiplier and fiscal stabilization, our focus here.

In order to have a just-identified structure, we need two additional restrictions. Therefore, the matrix of contemporaneous coefficients is specified as the following:

$$\begin{matrix} e_t^{gdp} \\ e_t^r \\ e_t^{exp} \end{matrix} = \begin{bmatrix} B_{11} & 0 & B_{13} \\ B_{21} & B_{22} & B_{23} \\ 0 & B_{32} & B_{33} \end{bmatrix} \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \end{bmatrix}$$

Where, the L.H.S represents the vector of reduced-form errors associated with GDP growth, real interest rate and government expenditure and R.H.S. represents the product of the matrix of contemporaneous coefficients in the structural equation and the vector of structural shocks.

The above restrictions imply, first, real interest rate shocks cannot affect GDP growth in the same quarter, since responses of investment, consumption and other components of AD to shocks in real interest rate would occur with a lag. This is a common identification strategy in VAR models with monetary shocks. Second, AD shocks have no effect on the expenditure variables in the same quarter assuming lags in the decision and implementation processes, while $r_t$can affect expenditure by raising interest payments.

6.2 Capital expenditure

We assume $\gamma_{23} \neq 0$, that is, shocks to growth in capex can have a long-run effect on real interest rate. Real interest rates are affected by inflation expectations, which in turn are reduced by the growth of capital expenditure in the long-run. Moreover, if the monetary authority observes that the fiscal authority is directing resources towards relieving structural bottlenecks, it may decrease short-term interest rates. This eliminates the only restriction used in the SMA representation in the revex case above.

The assumption implies while monetary policy is not affected by revex, it accommodates capex. Capex growth allows better fiscal-monetary coordination. As capex shift the long-run supply curve downwards, bringing down the long-run inflation rate the monetary authority may bring down the short-term real interest rates and thus the cost of borrowing. Inflation expectations may, however, rise in the short-run, that is, for at least 2-3 quarters due to an increased demand for labour and goods following increases in capex, in the presence of rigidities.

In order to have a just-identified structure, we need three restrictions in the short-run matrix. This fits in perfectly with the required theoretical restrictions on the contemporaneous coefficients in this system.

$$\begin{matrix} e_t^{gdp} \\ e_t^{r} \\ e_t^{exp} \end{matrix} = \begin{bmatrix} B_{11} & 0 & B_{13} \\ B_{21} & B_{22} & B_{23} \\ 0 & 0 & B_{33} \end{bmatrix} \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \end{bmatrix}$$

In addition to restrictions specified for revex, we assume $B_{32} = 0$ on the grounds that capex reacts to interest rate shocks with lags, as the cost of borrowing increases, and not contemporaneously, unlike revex.

6.3 Analysis of results

The IRFs presented in figures A2(a) and A2(b), and the VDA (Tables A2(a) and A2(b)) imply the following conclusions:

(i) The behaviour of GDP growth in response to a shock to capex growth is similar to the response presented in the previous two sections, with capex having higher long-run impact than revex in the IRFs. The VDA also shows both real interest rate shocks (monetary policy shocks) and capex growth shocks affect GDP growth in the long-run, with the effect of capex increasing with time. In contrast the effect of revex growth shocks on GDP growth decreases over time.

(ii) In the IRFs, shocks to capex growth have a negative impact on short-term real interest rate both in the long-run as well as the short-run, although only a long-run restriction is imposed, unlike the negligible impact of revex. The VDA shows real interest rate is significantly affected by shocks to capex growth rate and also by shocks to GDP growth, but not by shocks to revex growth rate, consistent with our specification and the IRF results above.

(iii) As before the VDA shows fluctuations in both capex and revex growth rates are driven mainly by their own shocks, with much larger variations in capex. Both over the long and the short-run, shocks to GDP growth and real interest rate have negligible contribution. Growth of revex responds positively to a positive real interest rate shock, reflecting an increase in interest payments. However, in the long-run, this effect dies, illustrating the committed nature of revex.

(iv) GDP growth falls with a positive shock to real interest rates, consistent with the HSC specification, even though there is no AS determining inflation in this model. Shocks to GDP growth, lead to negative short-run as well as long-run effect on real interest rates, implying monetary policy accommodation[8].

The derived revex and capex multipliers, after allowing for the monetary response, are presented in Table 1c. As before, the short-run revex multiplier is larger than the capex multiplier, but the peak capex multiplier is larger than the revex peak multiplier (achieved in the first quarter itself). The differential monetary accommodation makes the gaps between the long-run capex and the revex multiplier rise. Though there is monetary crowding out for the short-run multiplier, there is sufficient accommodation for capex for the long-run multiplier to be much larger. All other multipliers are smaller than those in Tables 1a and 1b, suggesting that if Indian monetary policy has the reaction function assumed it would enhance the long-run impact of capex, but reduce that of every other multiplier.

Table 1c: Fiscal multipliers in the presence of a monetary response

Multiplier	Revenue Expenditure	Capital Expenditure	Capex/Revex Multipliers
Impact	0.32	0.26	0.81
Peak	0.32	0.63	1.97
Cumulative	0.47	3.06	6.5

7. Impact of Spending in the Presence of Supply and Interest Rate Shocks

In this section, we extend our analysis to a 4-variable SVAR by including a short-term real interest rate variable r_t, as well as supply shocks. Structural shocks in the inflation equation are AS shocks and structural shocks in the output growth equation are AD shocks. So the AD shocks will now be separated from government spending and interest rate shocks. AD shocks will include tax shocks, external sector shocks and other private sector investment and consumption shocks. As before, the long-run and short-run coefficient matrices for analysis

[8] Since the Indian short rate did not adjust fully to volatile headline inflation, the real interest rate was often negative.

of revex and capex differ based on likely fiscal and monetary reactions in the presence of supply shocks. We continue with our earlier specification of a long-run HSC.

7.1 Revenue expenditure

The structural long-run MA representation is given as below:

$$\begin{matrix} \pi_t \\ y_t \\ r_t \\ g_t \end{matrix} = \begin{bmatrix} \gamma_{11} & 0 & 0 & 0 \\ \gamma_{21} & \gamma_{22} & \gamma_{23} & \gamma_{24} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} & \gamma_{34} \\ \gamma_{41} & \gamma_{42} & 0 & \gamma_{44} \end{bmatrix} \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \\ u_{4t} \end{bmatrix}$$

Where u_{3t} is the real interest rate shock. The above restrictions imply that inflation in the long run gets affected only by AS shocks, a consequence of the long-run HSC. GDP growth rate gets affected by all shocks in the long-run as does the real interest rate. The latter restriction differs from the 3 variable monetary policy SVAR of Section 6, since there r_t does not respond to revex. The reason is, there the CB reaction function prevented a fall in r_t in response to a rise in revex. Here $\gamma_{34} \neq 0$ allows monetary policy to tighten in response to revex under a positive supply shocks. AS and AD shocks affect revex growth in the long-run while the real interest rate does not. This restriction reflects more committed long-run revex, which has steadily increased in the past few years, despite high policy rates. A $\gamma_{43} = 0$ here prevents revex from falling when r_t rises under a positive cost shock, while the corresponding $\gamma_{32} \neq 0$ in section 3, allowed it to rise despite no change in r_t.

In order to have a just-identified structure, we need two restrictions in addition to the four specified above. We therefore specify the matrix of contemporaneous coefficients in the following way:

$$\begin{matrix} e_t^{\pi} \\ e_t^{gdp} \\ e_t^{r} \\ e_t^{exp} \end{matrix} = \begin{bmatrix} B_{11} & B_{12} & B_{13} & B_{14} \\ B_{21} & B_{22} & 0 & B_{24} \\ B_{31} & B_{32} & B_{33} & B_{34} \\ \gamma_{41} & 0 & \gamma_{43} & \gamma_{44} \end{bmatrix} \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \\ u_{4t} \end{bmatrix}$$

Where the L.H.S. represents the vector of reduced-form errors associated with inflation, GDP growth, real interest rate and growth of revenue expenditure and the RHS represents the product of the matrix of the contemporaneous coefficients in the structural form and the vector of structural disturbances.

The above restrictions imply that the real interest rate shock cannot affect GDP growth in the same quarter, since response of investment and consumption to interest rate changes occurs with a lag. We have allowed for $B_{13} \neq 0$ since although inflation rates react with a lag, inflation expectations can adjust rapidly, causing a contemporaneous impact of r_t on inflation. We have allowed for AD shocks to have no effect on revex in the short-run assuming lags in the decision and implementation processes to changes in growth rate of output while r_t can affect revex by increasing interest payments, which have been steadily increasing in India's case.

7.2 Capital expenditure

The structural MA representation for capex is given as follows:

$$\begin{matrix} \pi_t \\ y_t \\ r_t \\ g_t \end{matrix} = \begin{bmatrix} \gamma_{11} & 0 & 0 & \gamma_{14} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} & \gamma_{24} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} & 0 \\ \gamma_{41} & \gamma_{42} & \gamma_{43} & \gamma_{44} \end{bmatrix} \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \\ u_{4t} \end{bmatrix}$$

Where u_{3t} is the real interest rate shock. The above restrictions differ from the previous section. Inflation in the long run gets affected by AS shocks as well as shocks to growth of capex, since it eliminates structural bottlenecks and shifts the supply curve downward over the long run. All shocks affect GDP growth rate in the long-run. AS and AD shocks affect the long-run stance of the monetary policy, while capex does not directly. This restriction, unlike the response allowed in the 3 variable monetary policy SVAR, limits monetary accommodation of a rise in capex to no rise unlike a possible fall in that SVAR. The reason is monetary policy is in an inflation fighting mode when supply shocks occur. We allow capex to be affected by real interest rate shocks since these would affect resources available for investment.

In order to have a just-identified structure, we need three restrictions in addition to the long-run restrictions specified above. We therefore specify the matrix of contemporaneous coefficients in the following way:

$$\begin{matrix} e_t^{\pi} \\ e_t^{gdp} \\ e_t^{r} \\ e_t^{exp} \end{matrix} = \begin{bmatrix} B_{11} & B_{12} & B_{13} & B_{14} \\ B_{21} & B_{22} & 0 & B_{24} \\ B_{31} & B_{32} & B_{33} & B_{34} \\ \gamma_{41} & 0 & 0 & \gamma_{44} \end{bmatrix} \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \\ u_{4t} \end{bmatrix}$$

Where the L.H.S. represents the vector of reduced-form errors associated with inflation, GDP growth, real interest rate and capex growth and the R.H.S represents the product of the matrix of the contemporaneous coefficients in the structural form and the vector of structural disturbances.

The above restrictions are similar to the contemporaneous restrictions specified for revex except for restricting the impact of real interest rate shock on capex growth to be zero in the same period, since capital expenditure reacts to increases in interest rates with a lag and not in the same period like revenue expenditure.

7.3 Analysis of results

The IRFs corresponding to the specifications in 7.1 and 7.2 presented in figures A3(a) and A3(b) and the VDA in tables A3(a) and A3(b)suggest that:

(i) The impact on GDP growth of spending shocks is as before, with both capex and revex raising GDP growth, except that the impact to a shock in revex growth stays for a longer period of time, perhaps because of lower real interest rates for revex.

(ii) Capex has a negative accumulated impact on inflation over the long-run consistent with our restriction $\gamma_{14} \neq 0$, exceeding that of a revex shock. The VDA also shows shocks to capex growth have a substantial contribution to inflation over the long-run, while there is negligible impact of revex shocks. The contemporaneous impact of an increase in r_t seems positive on inflation and turns negative only after 2 quarters. This may reflect a rise in borrowing costs and an expected rise in overall costs in the economy, which materializes as an increase in inflation in the short-run. The VDA shows fluctuations in inflation rates are mainly affected by the shocks to real interest rate, possibly through the supply channel. The impact of monetary policy on output is negative and the fall in demand has a softening effect on inflation in the long-run.

(iii) As before fall in growth of capex (as compared to growth of revenue expenditure) is stronger in response to supply shocks. The impact of interest rate shocks and AD shocks on growth of revex is negligible throughout the short and long-run and the impact of AS shock is negative in the first quarter, after which it dies down to zero. This reinforces the committed revex view. AD shocks and real interest rate shocks have a negligible impact on capex growth as well, both in the long-run as well as the short-run while the AS shocks lead to a sharper decline in growth of capex as compared to that of revex. This is consistent with far greater historical declines in capex, despite it being more effective in dealing with supply bottlenecks.

(iv) There is a similar effect of AS and AD shocks on short-term real interest rates, with a larger increase in response to supply shocks and hardly any short-run positive response to positive demand shocks, implying that monetary policy tightens relatively more in response to AS shocks and not in response to AD shocks. In fact, over the long-run, the latter response is negative, reflecting the pro-cyclicality of real interest rates with respect to demand shocks.

A shock to growth in revex has a negative impact on r_t after the first quarter, perhaps because of the concomitant rise in inflation expectations, and continues to be the same throughout until it eventually dies off. The VDA shows real interest rates are mainly affected by shocks to inflation rates with negligible contribution of revex growth. Revex has a larger effect on inflation. Shocks to capex growth do have a significant contribution to real interest rates, which may be due to inadequate monetary response to falling inflation expectations as capex grows[9]. The contemporaneous impact of real interest rate to shocks in capex growth is positive, it turns negative but less than that for revex as the Central Bank accommodation is restricted, and inflation expectations are lower than those for

[9] A 4 variable SVAR where monetary policy is allowed to respond to capex in the long-run shows half the impact of capex on the real interest rate but it is still positive and qualitatively similar. Thus monetary policy does accommodate capex but the accommodation is lower compared to for revex because it neglects the impact of rising capex in reducing inflation expectations, while overall tightening occurs in response to the supply shocks. Results are available on request.

revex. The positive contemporaneous impact may be because when capex is rising inflation expectations are falling. Since the CB tightens in response to an AS shock, when capex also falls sharply, covariance is high for the two variables. The fact that monetary tightening accompanies a decline in public capex implies an aggravation of supply shocks.

The main contribution of AD and policy shocks on GDP growth as well as that of supply shocks on fluctuations in inflation is consistent with long-run HSC and its short-run volatility. But high error bands in the 4 variable SVAR IRFs suggest a more general equilibrium approach is required and interpretations can only be suggestive.

The derived multipliers for revex and capex after allowing for monetary and supply shocks are presented in Table 1(d). The long-run cumulative multiplier for capex is still much larger than that for revex, although the latter also rises to take on a value of greater than 1. We see that even though the impact multiplier for capex is smaller due to a possible crowding out from monetary policy response to supply shocks in the short-run, the long-run multiplier increases by a greater magnitude. This is possible due to a long-run supply-side response.

Table 1(d): Fiscal multipliers in the presence of supply shocks and endogenous monetary response

Multipliers	Revenue Expenditure	Capital Expenditure	Capex/Revex Multipliers
Impact	0.41	0.22	0.54
Peak	0.41	0.58	1.42
Cumulative	1.69	4.02	2.38

8. Policy Suggestions and Conclusion

While the Indian Government received credit for substantially reducing its fiscal deficit, there was a less obvious short-sighted approach towards expenditure composition. There was a sharp decrease in capex over the 2003-2007 'boom' period, which may have contributed to the later stagnation in GDP growth rate.

Our results support the above claim. Capex not only has a much larger long-run positive impact on output, compared to revex, but it also has a smaller short-run impact on inflation and reduces inflation volatility, since it eliminates structural bottlenecks. The results suggest evaluation of spending policy in India should be disaggregated, since analysis of total expenditure gives an incomplete picture of the fiscal impulse.

The impact of macroeconomic variables on revex is low since the latter is strongly committed due to political factors. Revex is thought to have larger short-run benefits since it contributes to re-election. However, capital expenditure shows greater impact on GDP growth within 2 years, that is, within the electoral cycle. The government, therefore, should have strong incentives to push up capex. Sharper decrease in capital compared to revenue expenditure in response to supply shocks is short-sighted.

Government capex can also, however, be poorly designed and wasteful. Devarajan et. al (1996) show in an endogenous growth model, that if the share of capex falls below its output elasticity, then increasing capex increases growth. India has probably reached that situation. They also show the productivity of government spending is higher if revex and capex are closer substitutes. This suggests careful choice is required in the components of each item. For example, ICT technology enables capex to substitute for revex in the provision of public services. There is an argument in India that central transfers to States should be counted as capex since they are revenue expenditure for the centre but states use them for capex, or for health and education which builds human capital. Our results, however, suggest states are not doing this effectively, since we classify transfers as revex and find it behaves differently from capex[10]. But careful studies of the revex or capex-like properties of further disaggregated expenditure heads would be useful. Types of capex can also be distinguished—what is more effective, and triggers more private capex, thus leveraging the initial government spending many times.

At the aggregate level our results support a fiscal institution that could change the composition of government expenditure towards capex and more productive types of capex, For example, a floor on capex could restrict extreme reductions during supply shocks, while expenditure reduction should be directed towards wasteful elements in revex.

[10] As a referee points out teachers' salaries (revex) could be as important as school buildings (capex) for generating long-run income streams, but we follow the government definition based on long run assets and find that revex and capex behave differently.

The composition of public spending should change towards goods and services that build capacity and create strong externalities, together with robust medium-term fiscal consolidation. Such a change would improve fiscal and monetary coordination, since it would reduce the volatility of aggregate supply. Monetary policy can then be more accommodating, factoring in the future inflation reducing impact of capex. It can also calibrate its response to a supply shocks to an assessment of how sustained the shocks are. These policy improvements will facilitate lower inflation and higher growth, or enable disinflation at least output sacrifice.

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Appendices

A1. Stationarity of variables used in estimation

Variable	t-statistic	p-value
Capex growth	-8.38117***	0.00
Real interest rate	-3.239939**	0.0224
GDP growth	-2.70917*	0.0783
Revex growth	-3.53444**	0.0103
Totex growth	-6.63957***	0.00
Inflation	-4.90293***	0.0001

*** - significant at 1% level of significance, ** - significant at 5% level of significance, * - significant at 10% level of significance.

Capex growth – Growth Rate of Central Government Capital Expenditure.

Revex growth – Growth Rate of Central Government Revenue Expenditure.

Totex growth – Growth Rate of Central Government Total Expenditure.

Inflation – WPI Inflation Rate

Real interest rate – Short-term real interest rate

The CMMR variable is stationary at 5% level of significance using the DF-GLS test.

Null Hypothesis: CMMR has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-2.231382
Test critical values:	1% level	-2.602794
	5% level	-1.946161
	10% level	-1.613398

A2. Structural VAR Analysis

Figure A1(a): IRF Capex: Including supply shocks

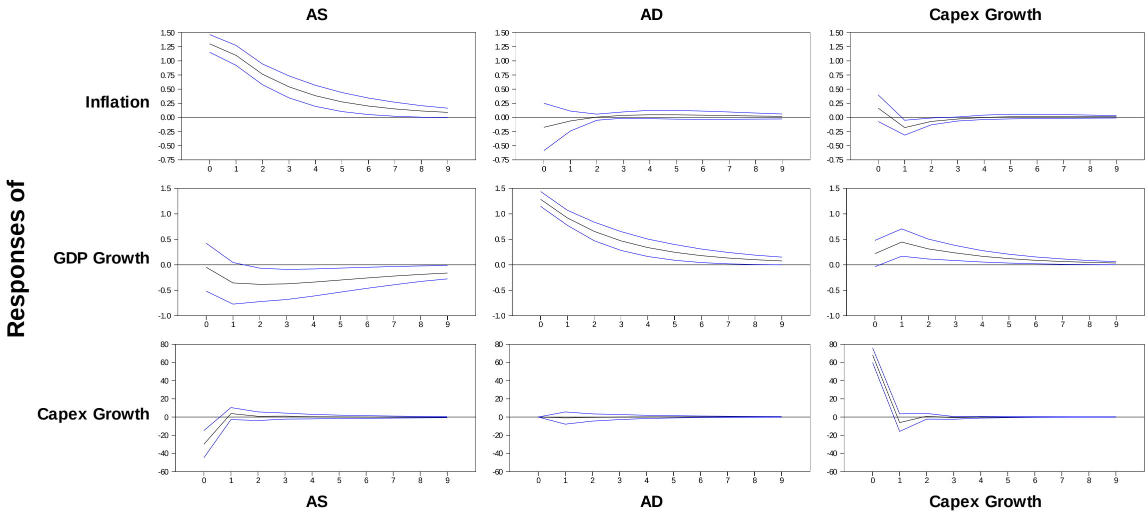

Table A1 (a) – VDA Capex: Including supply shocks

Decomposition of Variance for Series 'Inflation'				
Step	Std Error	AS shocks	AD shocks	Capex Growth shocks
1	1.312979	95.456	2.248	2.295
2	1.6748549	96.111	1.609	2.28
3	1.8050817	96.524	1.388	2.088
4	1.8581852	96.677	1.327	1.996
5	1.8800232	96.709	1.339	1.952
6	1.8889654	96.692	1.374	1.934
7	1.8925984	96.662	1.41	1.928
8	1.8940699	96.634	1.439	1.927
9	1.8946715	96.614	1.458	1.927
10	1.8949246	96.6	1.471	1.929
Decomposition of Variance for Series 'GDP Growth'				
Step	Std Error	AS shocks	AD shocks	Capex Growth shocks
1	1.3027513	0.064	95.941	3.995
2	1.6931268	3.881	86.474	9.645
3	1.8748531	6.582	82.674	10.744
4	1.9706245	8.667	80.229	11.104
5	2.0222303	10.149	78.64	11.211
6	2.0500828	11.136	77.633	11.231
7	2.0649777	11.757	77.019	11.224
8	2.0728312	12.131	76.657	11.212
9	2.0769042	12.347	76.452	11.201
10	2.0789798	12.467	76.339	11.194

Decomposition of Variance for Series 'Capex Growth'				
Step	Std Error	AS shocks	AD shocks	Capex Growth Shocks
1	70.0588299	17.076	0	82.924
2	70.431612	17.427	0.02	82.553
3	70.4588316	17.485	0.025	82.49
4	70.4741001	17.518	0.027	82.455
5	70.4808801	17.533	0.027	82.44
6	70.4838994	17.54	0.027	82.433
7	70.4852157	17.543	0.027	82.43
8	70.4857789	17.544	0.027	82.429
9	70.4860154	17.545	0.027	82.428
10	70.486113	17.545	0.027	82.428

Figure A1(b) – IRFs Revex: Including supply shocks

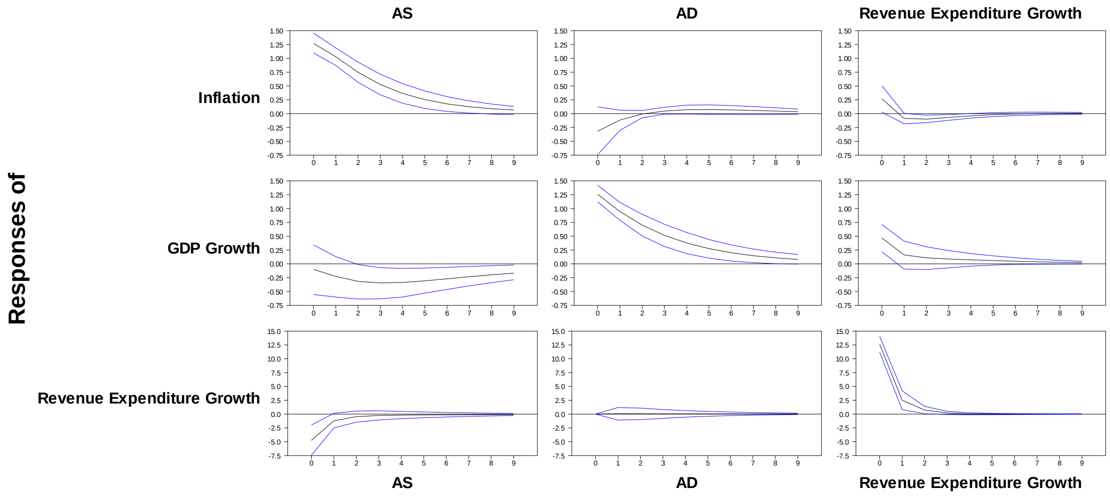

Table A1 (b) – VDA Revex: Including supply shocks

Decomposition of Variance for Series 'Inflation'				
Step	Std Error	AS shocks	AD shocks	Revex Growth
1	1.3175637	88.571	6.285	5.144
2	1.627381	91.743	4.731	3.526
3	1.7532123	92.596	4.084	3.32
4	1.8043979	92.814	3.908	3.278
5	1.8249227	92.792	3.948	3.261
6	1.8330853	92.691	4.059	3.25
7	1.8363804	92.586	4.171	3.243
8	1.8377888	92.503	4.258	3.239
9	1.8384566	92.446	4.317	3.237
10	1.8388137	92.411	4.354	3.236
Decomposition of Variance for Series 'GDP Growth'				
Step	Std Error	AS shocks	AD shocks	Revex Growth

1	1.3376872	0.444	88.357	11.199
2	1.663639	1.866	90.029	8.105
3	1.8316565	3.98	89.058	6.961
4	1.9262654	6.072	87.469	6.459
5	1.9804077	7.766	86.014	6.22
6	2.0110465	8.982	84.916	6.103
7	2.0279925	9.783	84.172	6.044
8	2.0371067	10.278	83.707	6.015
9	2.0418628	10.566	83.433	6.001
10	2.0442685	10.725	83.281	5.994

Decomposition of Variance for Series 'Revex Growth'

Step	Std Error	AS shocks	AD shocks	Revex Growth
1	12.6379142	12.928	0	87.072
2	12.9067621	12.952	0.004	87.045
3	12.919049	12.959	0.007	87.035
4	12.9198762	12.961	0.008	87.031
5	12.9200331	12.961	0.009	87.029
6	12.920099	12.962	0.01	87.029
7	12.9201327	12.962	0.01	87.028
8	12.9201504	12.962	0.01	87.028
9	12.9201594	12.962	0.01	87.028
10	12.920164	12.962	0.01	87.028

Figure A2(a) IRFs Revex: Including monetary shocks

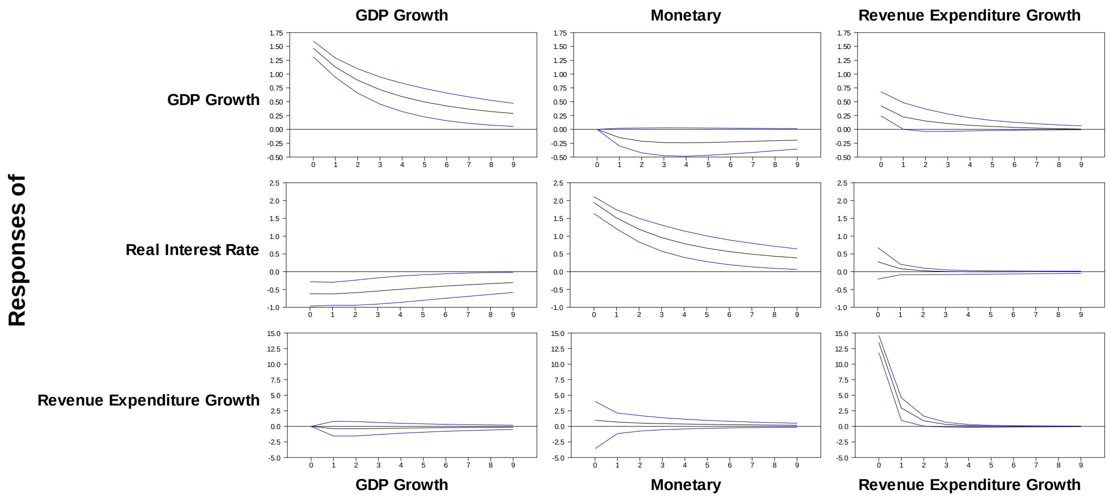

Table A2 (a) - VDA Revex: Including monetary shocks

Decomposition of Variance for Series 'GDP Growth'				
Step	Std Error	GDP Growth shocks	Monetary policy shocks	Revex Growth shocks
1	1.4289237	91.77	0	8.23
2	1.789351	92.804	0.414	6.782
3	1.9781653	92.788	1.118	6.094
4	2.0900098	92.385	1.904	5.712
5	2.1603978	91.877	2.647	5.477
6	2.2062948	91.389	3.288	5.323
7	2.2368887	90.968	3.812	5.22
8	2.2575685	90.628	4.222	5.15
9	2.2716715	90.363	4.536	5.101
10	2.2813437	90.163	4.77	5.067
Decomposition of Variance for Series 'Real Interest Rate'				
Step	Std Error	GDP Growth shocks	Monetary policy shocks	Revex Growth shocks
1	1.903931	8.854	89.832	1.314
2	2.4187233	11.006	88.136	0.858
3	2.6955502	12.814	86.496	0.691
4	2.8614365	14.276	85.107	0.616
5	2.9662197	15.424	83.996	0.58
6	3.0344843	16.303	83.135	0.562
7	3.0798349	16.963	82.485	0.553
8	3.1103507	17.451	82.001	0.548
9	3.1310605	17.808	81.647	0.546
10	3.1451969	18.066	81.39	0.544
Decomposition of Variance for Series 'Revenue Expenditure Growth'				
Step	Std Error	GDP Growth shocks	Monetary policy shocks	Revex Growth shocks
1	12.7241453	0	0.03	99.97
2	13.025273	0.065	0.16	99.776
3	13.0498405	0.139	0.273	99.588
4	13.059365	0.199	0.353	99.449
5	13.0657556	0.243	0.406	99.351
6	13.0701766	0.275	0.441	99.284
7	13.0732274	0.297	0.465	99.238
8	13.0753314	0.313	0.48	99.206
9	13.076783	0.324	0.491	99.184
10	13.0777852	0.332	0.498	99.169

Figure A2 (b) - IRFs Capex: Including monetary shocks

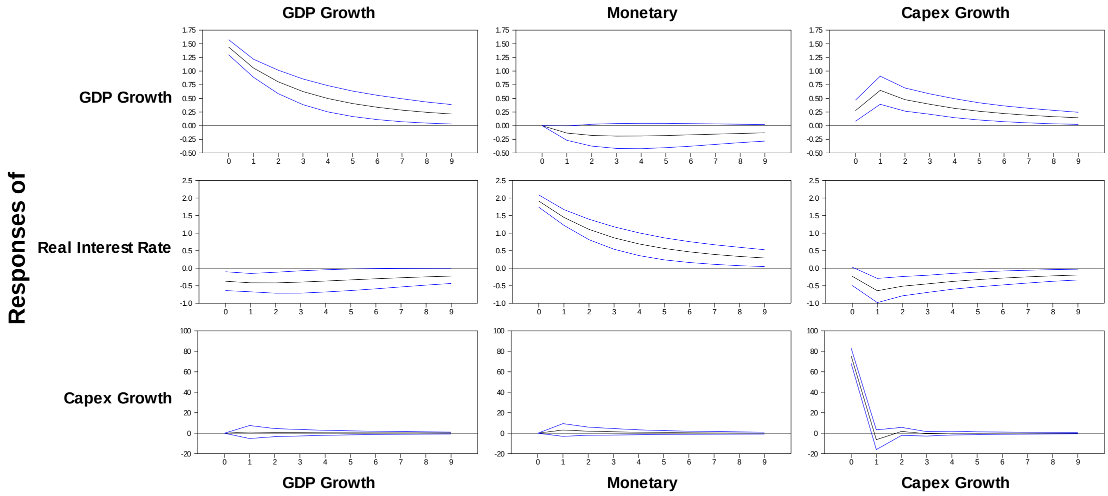

Table A2(b)- VDA Capex: Including monetary shocks

Decomposition of Variance for Series 'GDP Growth'				
Step	Std Error	GDP Growth	Monetary policy shocks	Capex Growth shocks
1	1.3713185	96.729	0	3.271
2	1.7973393	86.589	0.506	12.904
3	1.9994638	83.693	1.143	15.164
4	2.1131943	81.951	1.789	16.26
5	2.1809041	80.788	2.362	16.85
6	2.2227058	79.978	2.832	17.191
7	2.2491057	79.408	3.198	17.395
8	2.266029	79.008	3.472	17.519
9	2.2769854	78.73	3.673	17.597
10	2.2841258	78.538	3.817	17.645
Decomposition of Variance for Series 'Real Interest Rate'				
Step	Std Error	GDP Growth shocks	Monetary policy shocks	Capex Growth shocks
1	1.8594661	3.326	95.271	1.403
2	2.4185089	4.464	88.523	7.014
3	2.7003742	5.64	85.629	8.731
4	2.8643574	6.635	83.637	9.728
5	2.9647534	7.428	82.219	10.353
6	3.0281027	8.033	81.204	10.763
7	3.0687961	8.482	80.482	11.036
8	3.095226	8.807	79.974	11.219
9	3.1125106	9.038	79.62	11.342
10	3.1238633	9.201	79.375	11.424
Decomposition of Variance for Series 'Capex Growth'				
Step	Std Error	GDP Growth shocks	Monetary policy shocks	Capex Growth shocks
1	70.1724257	0	0	100

2	70.487992	0.022	0.174	99.804
3	70.5135648	0.027	0.241	99.732
4	70.5267076	0.028	0.276	99.697
5	70.5333795	0.028	0.293	99.679
6	70.5369944	0.028	0.303	99.669
7	70.5390426	0.028	0.308	99.664
8	70.5402528	0.028	0.311	99.661
9	70.5409923	0.028	0.312	99.659

Figure A3(a): IRFs Revex: Including monetary and supply shocks

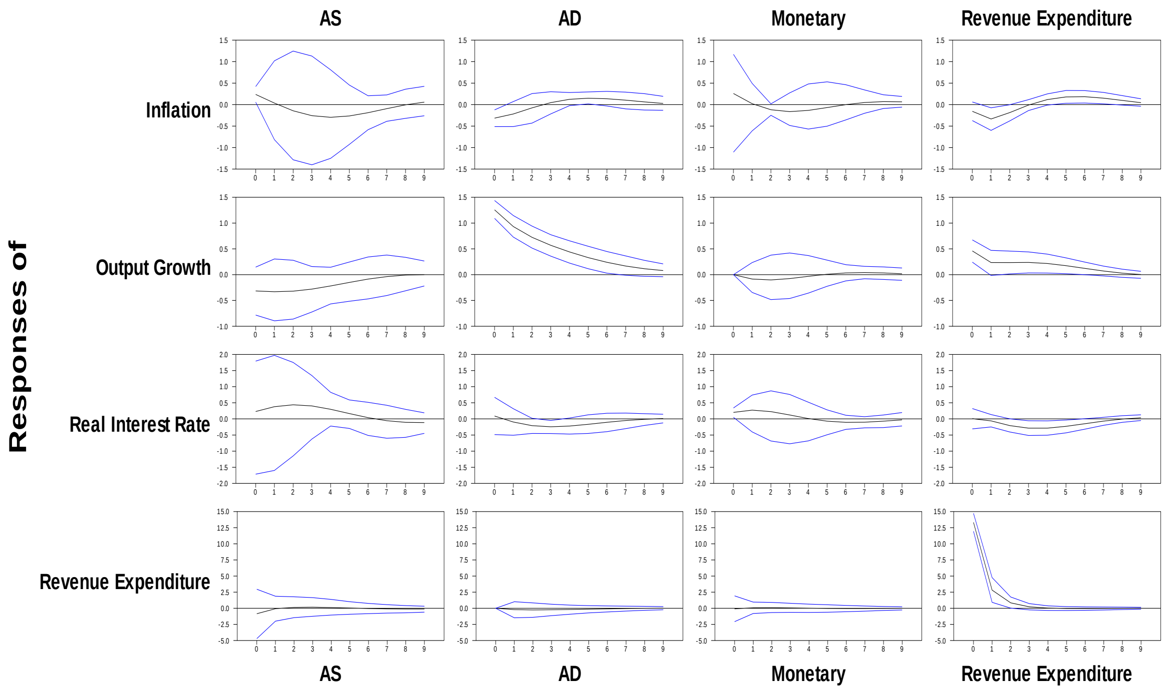

Table A3(a): VDA Revex: Including monetary and supply shocks

Decomposition of Variance for Series 'Inflation'					
Step	Std Error	AS shocks	AD shocks	Monetary policy shocks	Revex Growth shocks
1	1.1138234	0.148	8.74	89.115	1.997
2	1.4931165	28.337	7.21	59.115	5.339
3	1.8780462	53.795	4.756	37.395	4.054
4	2.1934338	63.582	3.533	29.906	2.979
5	2.3907955	64.786	3.287	29.092	2.835
6	2.485803	63.108	3.502	30.205	3.185
7	2.5224648	61.479	3.804	31.121	3.596
8	2.53954	60.92	3.989	31.259	3.832
9	2.5555255	61.187	4.026	30.91	3.877

Step	Std Error	AS shocks	AD shocks	Monetary policy shocks	Revex Growth shocks
10	2.5721393	61.63	3.987	30.548	3.836
		Decomposition of Variance for Series 'GDP Growth'			
Step	Std Error	AS shocks	AD shocks	Monetary policy shocks	Revex Growth shocks
1	1.3375128	1.972	86.461	0	11.566
2	1.721546	7.364	81.615	2.024	8.996
3	1.9554904	9.621	76.988	5.012	8.378
4	2.0915299	9.448	74.593	7.428	8.53
5	2.1645062	8.825	73.602	8.725	8.847
6	2.2048922	8.954	72.95	9.069	9.027
7	2.2313227	9.882	72.145	8.953	9.02
8	2.2506117	11.02	71.262	8.805	8.914
9	2.263685	11.854	70.544	8.788	8.813
10	2.2709163	12.254	70.117	8.867	8.762
		Decomposition of Variance for Series 'Real Interest Rate'			
Step	Std Error	AS shocks	AD shocks	Monetary policy shocks	Revex Growth shocks
1	1.6438239	99.514	0.312	0.159	0.015
2	2.3522072	94.539	0.303	5.021	0.137
3	2.7464057	88.089	0.829	10.346	0.736
4	2.9281296	82.492	1.527	14.399	1.582
5	2.9974527	79.003	2.128	16.555	2.314
6	3.0298776	77.754	2.469	17.066	2.712
7	3.0600826	77.843	2.561	16.793	2.804
8	3.0911631	78.195	2.531	16.512	2.761
9	3.1157388	78.29	2.492	16.494	2.724
10	3.1300356	78.142	2.483	16.643	2.732
		Decomposition of Variance for Series 'Revenue Expenditure Growth'			
Step	Std Error	AS shocks	AD shocks	Monetary policy shocks	Revex Growth shocks
1	12.7220791	2.444	0	0.395	97.161
2	13.0256864	2.829	0.017	0.378	96.777
3	13.052676	3.041	0.041	0.404	96.514
4	13.0635702	3.129	0.066	0.452	96.353
5	13.0692437	3.146	0.086	0.491	96.276
6	13.0718792	3.145	0.099	0.511	96.245
7	13.0734736	3.153	0.106	0.516	96.225
8	13.0749254	3.17	0.108	0.516	96.205
9	13.0762276	3.188	0.109	0.517	96.186
10	13.0771469	3.199	0.109	0.52	96.172

Figure A3 (b): IRFs Capex: Including monetary and supply shocks

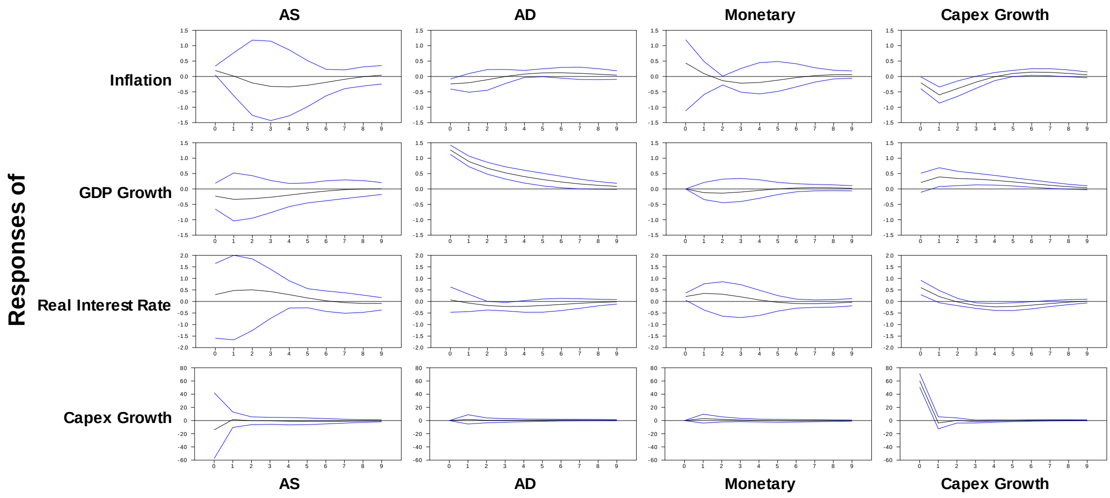

Table A3(b): VDA Capex: Including monetary and supply shocks

Step	Std Error	AS shocks	AD shocks	Monetary policy shocks	Capex Growth shocks
Decomposition of Variance for Series 'Inflation'					
1	1.1127364	0.128	5.254	91.132	3.486
2	1.4737843	14.582	4.855	60.366	20.196
3	1.8715276	41.067	3.287	37.662	17.983
4	2.213028	53.903	2.355	29.945	13.797
5	2.4222081	57.525	2.13	28.824	11.521
6	2.5161187	57.368	2.275	29.463	10.894
7	2.5477355	56.405	2.513	29.981	11.100
8	2.5607743	55.919	2.677	29.958	11.446
9	2.5737986	56.013	2.73	29.658	11.599
10	2.5873669	56.3	2.719	29.411	11.571
Decomposition of Variance for Series 'GDP Growth'					
Step	Std Error	AS shocks	AD shocks	Monetary policy shocks	Capex Growth shocks
1	1.2894221	2.378	94.302	0	3.320
2	1.7434241	13.497	77.885	1.978	6.641
3	1.9951487	17.149	70.76	4.203	7.888
4	2.1315183	17.454	67.697	5.735	9.114
5	2.1990011	16.712	66.62	6.413	10.255
6	2.2328116	16.248	66.152	6.515	11.084
7	2.2526957	16.361	65.699	6.421	11.519
8	2.2658565	16.756	65.223	6.363	11.657
9	2.2739113	17.099	64.858	6.386	11.657
10	2.2778113	17.268	64.662	6.44	11.630
Decomposition of Variance for Series 'Real Interest Rate'					
Step	Std Error	AS shocks	AD shocks	Monetary policy shocks	Capex Growth shocks

1	1.6065861	81.782	0.076	0.5	17.642
2	2.3608242	84.401	0.167	5.89	9.541
3	2.7741145	81.899	0.583	10.608	6.910
4	2.9554014	78.637	1.142	13.725	6.497
5	3.0174154	76.169	1.655	15.138	7.038
6	3.0431526	75.01	1.976	15.336	7.678
7	3.0677069	74.813	2.093	15.097	7.997
8	3.0927854	74.936	2.095	14.945	8.024
9	3.1113192	75.001	2.072	14.978	7.950
10	3.1208961	74.952	2.062	15.083	7.903

Decomposition of Variance for Series 'Capex Growth'

Step	Std Error	AS shocks	AD shocks	Monetary policy shocks	Capex Growth shocks
1	69.6472917	36.32	0	0	63.680
2	70.287146	36.912	0.048	0.417	62.623
3	70.3641117	36.881	0.053	0.572	62.494
4	70.3883756	36.873	0.054	0.601	62.472
5	70.4301186	36.934	0.055	0.601	62.411
6	70.4822551	37.008	0.057	0.613	62.322
7	70.522645	37.052	0.06	0.637	62.250
8	70.5440046	37.063	0.065	0.657	62.215
9	70.5522585	37.06	0.068	0.667	62.205
10	70.5556282	37.056	0.071	0.67	62.203

A3. Robustness Checks:

1. *Introduction of additive dummy variable for the crisis period between 2008Q1 to 2009Q4*

The GFC of 2008, triggered by the sub-prime mortgage crisis in the U.S. and the collapse of Lehman Brothers, saw an increase in fiscal expenditure by the Government in order to insulate the economy from the headwinds of downturn. It is thus necessary to check if this fiscal expansion and its exit, however slow and partial, starting 2010, influence the multiplier analysis.

A dummy variable 'Crisis_Dum' is introduced in the basic two-variable SVARs to see if the values and the behaviour of the multipliers and the IRFs change drastically once the crisis-led fiscal expansion is accounted for as an exogenous event in the model.

Figure A4(a): IRFs – Total Central Expenditure Growth and GDP Growth

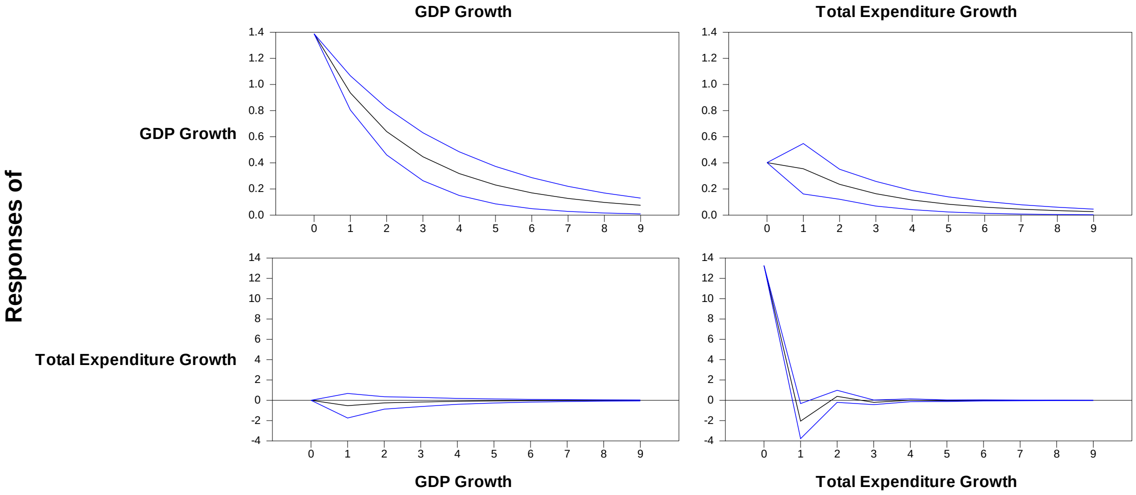

Figure A4(b): IRFs– Capex Growth and GDP Growth

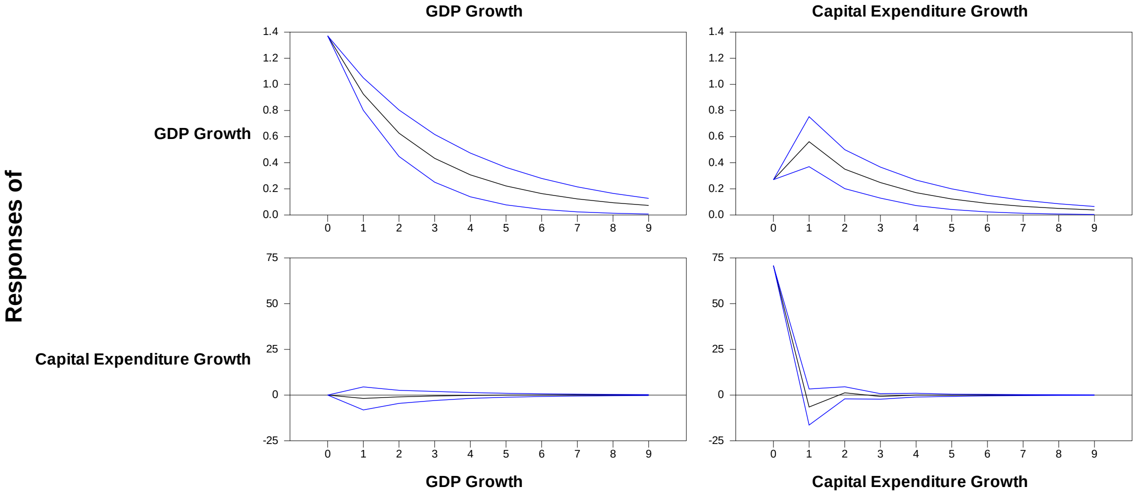

Figure A4(c): IRFs – Revenue Expenditure Growth and GDP Growth

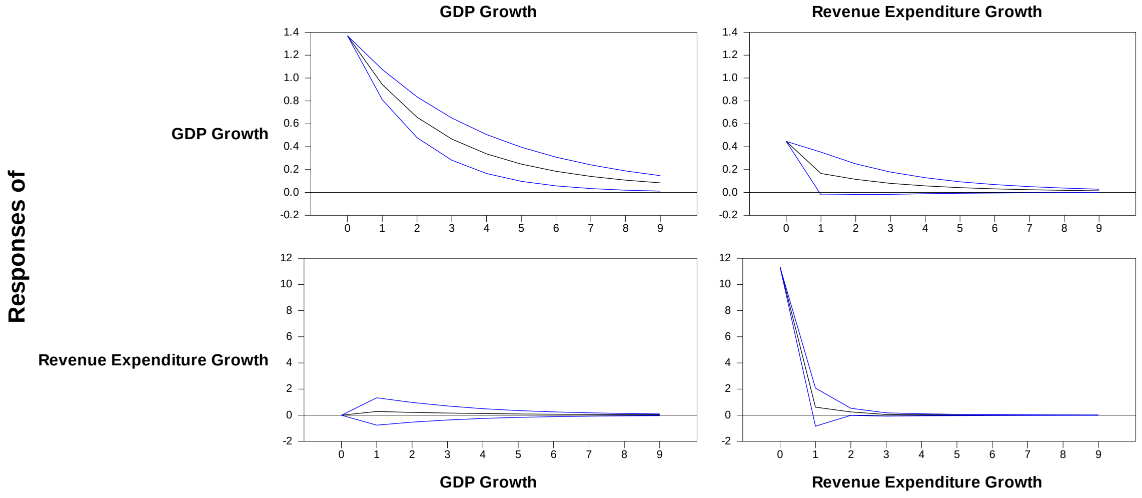

Table A4: Multipliers with short-run restrictions

	Total Expenditure	Revenue Expenditure	Capital Expenditure	Capex/Revex Multipliers
Impact Multiplier	0.28	0.43	0.29	0.67
Peak Multiplier	0.28	0.43	0.59	1.37
Cumulative Multiplier (for 2 years)	1.20	0.85	2.18	2.57

Accounting for this variable marginally increases the impact and peak multipliers for revex and leads to a significant increase in the cumulative multiplier. This increase can be attributed to the reduction in the fluctuations in impulse responses of revex to shocks to itself, since the crisis dummy accounts for a significant amount of movement in the revex growth (which is not the case for capex growth).

It is evident that despite accounting for the crisis dummy variable, the peak and cumulative multipliers for capex are larger than revex, implying that the long-run cumulative impact of capex is stronger even in the face of adverse exogenous shocks to the economy. The inclusion of this variable in the model does not alter the nature and magnitude of the impulse response of GDP growth to shocks in expenditure variables either.

2. *Analysis with expenditure series deflated by GDP deflator series*

The implicit GDP deflator series for the period 1998Q1 – 2014Q2 has been retrieved from the St. Louis Federal Reserve Bank's Economic Research website (https://fred.stlouisfed.org/series/INDGDPDEFQISMEI). The base year is 2010-11 and the series has been seasonally adjusted.

The growth variables are derived from the expenditure variables deflated by the above series. The average GDP to real total expenditure ratio in this scenario for 1999 Q1 to 2014 Q2 was 3.39, for real revex it was 3.97, for real capex the average ratio it was 25.93. The ratios are lower than that for WPI deflated series due to the differences in the values of WPI series (base year = 1993-94) and the implicit GDP deflator series (base year = 2010-11).

The Impulse Response Functions (IRFs) to structural one standard deviation innovations and two standard deviation error bands are given in figures A5(a, b and c).

Figure A5(a): IRFs – Total Central Expenditure Growth and GDP Growth

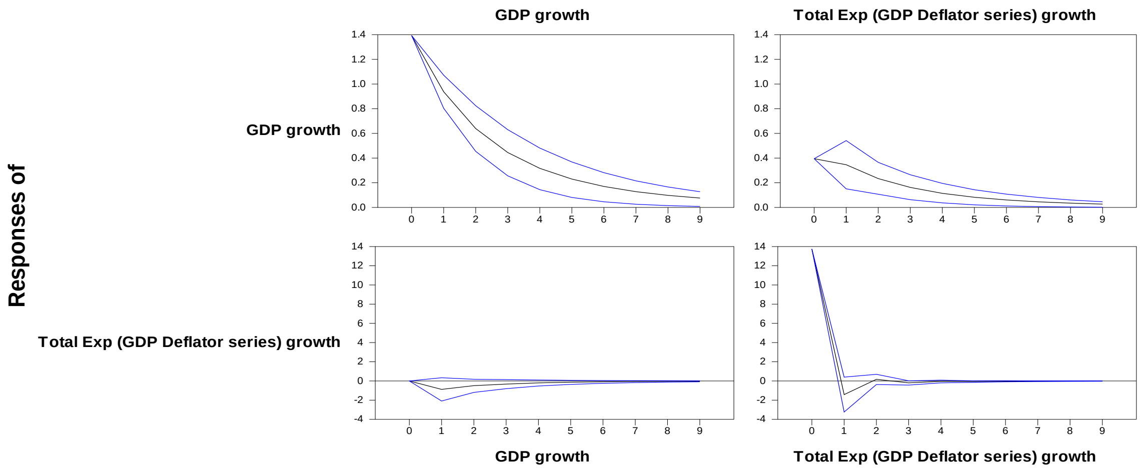

Figure A5(b): IRFs– Capex Growth and GDP Growth

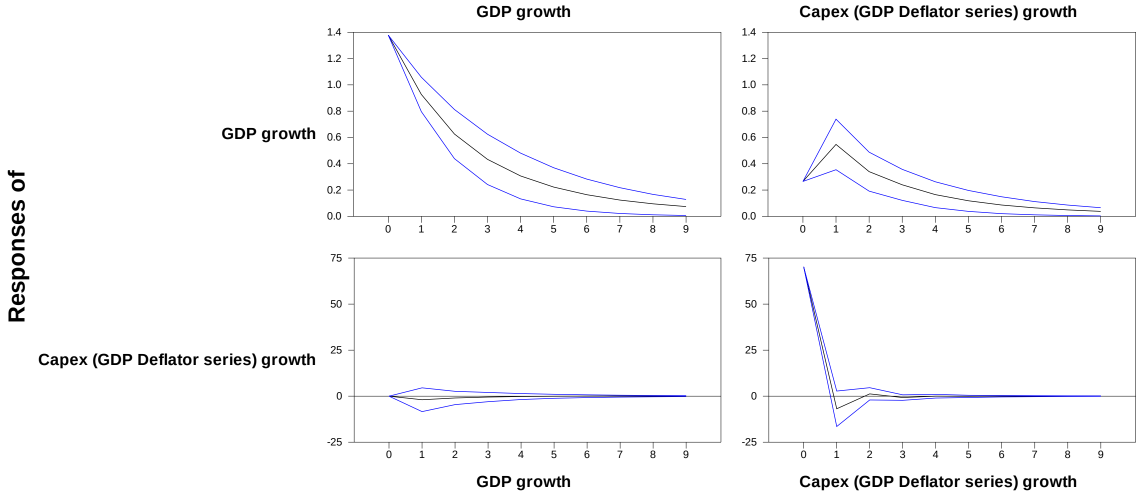

Figure A5(c): IRFs – Revenue Expenditure Growth and GDP Growth

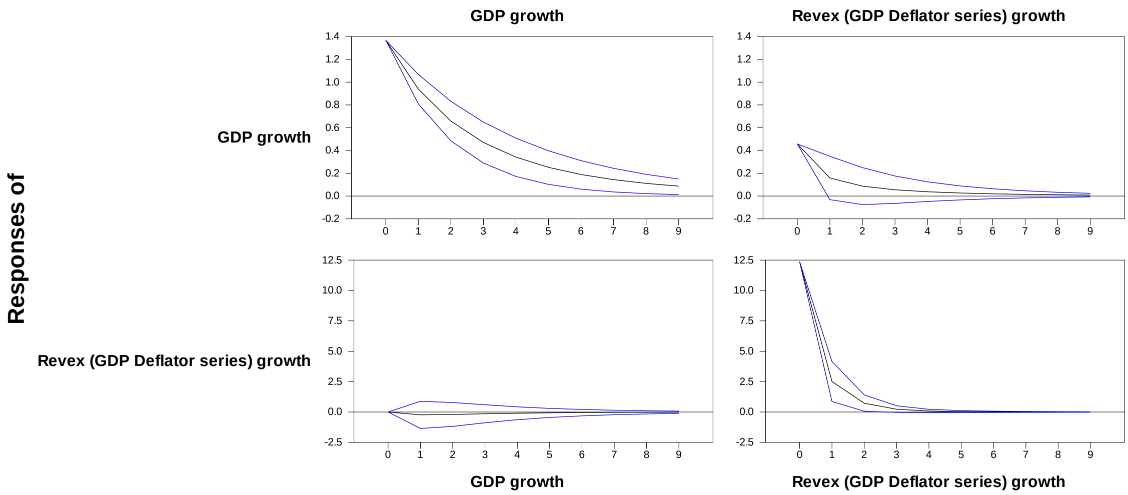

Table A5: Multipliers with short-run restrictions

	Total Expenditure	Revenue Expenditure	Capital Expenditure	Capex/Revex Multipliers
Impact Multiplier	0.10	0.15	0.10	0.67
Peak Multiplier	0.10	0.15	0.20	1.33
Cumulative Multiplier (for 2 years)	0.40	0.21	0.74	3.43

The IRFs do not show any marked difference in direction and magnitude from the original real expenditure variables (deflated by WPI series). The multiplier values also show the same behaviour, with the ratio of Capex Multipliers to their Revex counterparts being in the same range as observed in Table 1(a). The values are lower on account of lower magnitude of average output to spending ratio. Nevertheless, this analysis also confirms our major finding that the capex multipliers are much larger in the long-run as compared to revex multipliers.