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Abstract

We first assess the fiscal space and cyclicality of total Indian Central Government expenditure and its major components. Next we estimate multipliers for total, capital, and revenue expenditure. We extend the Structural Vector Auto-Regression (SVAR) to include supply shocks and the monetary policy response sequentially and together. The long-run capex multiplier is much larger than the revex. Capex also reduces inflation more over the long-term. Despite this, capex is more volatile. Monetary policy accommodates capex and tightens in response to revex, but absence of active accommodation during supply shocks reduces the capex multiplier. Implications follow for fiscal-monetary coordination.

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

JEL Code: C32, E31, E62, E63, H50

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1. Introduction

Pro-cyclicality tends to limit the use of fiscal policy as a stabilization tool. Optimal counter-cyclical policy, fiscal and/or monetary, requires adequate fiscal and monetary space, especially for Emerging Market Economies (EMEs) that face limits on borrowing. The tendency for an increase in government expenditure in a business cycle upswing and a reversal in a slump can be due to political pressures as well as fund constraints.

For example, in India populist fiscal policy tended to raise inflation and reduce growth, when fiscal policy could have been very productive if it removed structural constraints on growth. Though fiscal dominance reduced after scrapping of automatic monetization and implementation of the Fiscal Responsibility and Budget Management (FRBM) act in 2003, effective monetary-fiscal coordination was still elusive. An example was the delayed exit of fiscal stimulus after the 2008 Global Financial Crisis (GFC), forcing excessive monetary tightening. There was steady reduction in capital expenditure (capex) in response to the pressure to reduce total expenditure while revenue expenditure (revex) grew steadily. Spending policy was sub-optimal. It is not merely the direction of the fiscal policy that matters, but its composition, and its relative impact on output in the long compared to the short run. Frequent supply shocks and the monetary policy response also constrain fiscal policy impact.

The fiscal multiplier is a key statistic to calculate 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. It also makes it possible to incorporate and explore the impact of aspects of Indian structure, such as an elastic supply curve subject to frequent supply shocks, and the differential response of capex and revex. 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, the relevant question is: the impact of differential monetary accommodation on the relative size of capex and revex multipliers, with the differential policy reaction function used for identification.

We develop indices of fiscal space and then assess the cyclicality of total expenditure of the Central Government and that of its major components. We then 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 using SVAR. 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. Impulse Response Functions and Forecast Error Variance Decomposition are used to analyze response to shocks. We further estimate separate multipliers for capital as well as revenue expenditure. We extend the analysis to assess the differential impact of revenue and capital expenditure on inflation after allowing for frequent AS shocks as well as their interactions with monetary policy.

We find that although fiscal and monetary space had increased before the GFC, and macro-policy had even become counter-cyclical, capex became strongly pro-cyclical after the crisis and policy space deteriorated. Capex shows much more volatility compared to revex. 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. Monetary policy tends to accommodate capex and tighten in response to revex, but the combination of a direct cut in capex and monetary tightening in response to a supply shock, reduces the capex multiplier. The difference between the two multipliers falls with a supply shock and a monetary policy response if the latter does not actively accommodate capex. The total expenditure multiplier follows the revex, which is the largest component. The absolute values are consistent with the results of many studies (see section 2) that find spending multipliers to be unity or less, but they can rise in special circumstances, while cumulative investment multipliers can reach 4.

The estimates of multipliers are consistent with the impulse response and variance decomposition, which shows large variation in capex to own and supply shocks, while revex is more committed and stable. 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 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 GDP growth than on inflation.

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. 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.

2. Literature Survey

After the global financial crisis (GFC) major new developments have occurred in the analysis of fiscal and monetary policies, and their interactions. Two major reasons identified for sub-optimal fiscal policy cyclicality in EMEs are first, lack of access to international financial markets and second, political distortions (Frankel, Vegh and Vuletin, 2012). Monetary policy tends to be pro-cyclical because in times of worsening internal and external conditions, EMEs face a depreciation of the national currency, which aggravates the domestic economic conditions by spurring capital market outflows. This has led to an increase in interest rates in order to defend the currency, creating pro-cyclicality. Structural changes have, however, enabled some reversal in this tendency.

Sufficient fiscal and monetary space is a precondition for better fiscal and monetary policies. A lower level of existing public debt or larger primary surplus could allow expenditure to increase in a downturn. A current account balance and a high level of foreign reserves reduce the need for an interest rate defense. Vegh and Vuletin (2013) estimate fiscal and monetary readiness indices and show that an improvement in fiscal and monetary space was positively correlated with 'promotion' of countries from being less counter-cyclical to more counter-cyclical. Countercyclical policies also reduced the duration and intensity of crises. Ilzetzki and Vegh (2008) use IV estimation, GMM and VAR for a panel of 49 countries, with a quarterly dataset covering the period 1960-2006, to establish the procyclical and expansionary nature of fiscal policy in developing countries.

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 the crisis significantly raises post-crisis GDP growth and the increase is more than that brought about by a higher share of public consumption, which leads to crowding. However, this relationship weakens if the initial economic conditions are poor.

The 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 more popularly, 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 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 point of interest 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 countries 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 unit. 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 the SVAR technique to identify taxation and spending shocks and assess their impact on GDP using Impulse Response Functions along with introducing 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 internalise 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 effects of fiscal policies varying over business cycles to account for the difference in size of spending multipliers in recession and expansions (with it being 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 since the 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. However, such analysis is not possible for India, in the absence of high frequency professional forecasters' surveys for fiscal variables. Such forecasts were started for some 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-run and long-run supply curve. Blanchard and Quah (1989) use a bivariate SVAR on output and unemployment with a long run identification restriction scheme 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 AD-AS shocks with causality from demand to supply shocks since simultaneous shifts in AD and 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) supply curve. The evidence supports an elastic long run supply curve with supply shocks contributing largely to inflation and demand shocks largely to output growth. This is intuitive since the economy is far from full employment. But short run bottlenecks may hinder utilization of the labour surplus. Using exogenous shocks in the post GFC period, Goyal (2012) establishes that short run supply is also not inelastic in India's case. However, it is volatile 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, identified domestic supply and demand shocks, and government consumption to finally conclude that the 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 that while both deficits and expenditures react counter-cyclically to temporary shocks, there was no evidence of a pro-cyclical expenditure response to permanent shocks. Policies which can cushion the impact of these shocks or reduce adverse demand and supply shocks are required.

3. Methodology and Data

3.1 Analysis of fiscal, policy and structural vector auto-regression

Blanchard and Perotti (2002) argue the SVAR approach is well suited to the study of fiscal policy, since output stabilization is rarely a pre-dominant reason for the movement of budget variables. Moreover, 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. Using systematic information on tax, transfer and spending systems, it is possible to construct estimates of automatic effects of unexpected movements in activity on fiscal variables, which capture fiscal policy shocks, while controlling for the cycle. 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:

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

Where,

$\boldsymbol{z_t} = (\mathrm{N} \times 1)$ 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 $\mathrm{j} = 1,2, \dots, \mathrm{p}$, and

$\boldsymbol{\epsilon_t} = (N \times 1)$ vector of reduced form errors with expectation 0 and a symmetric covariance matrix Ω

VAR models have often been criticized for being 'atheoretical' since they are purely data-based. The Structural VAR (or SVAR) model addresses this problem, by introducing restrictions on contemporaneous effects based on structure. 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 $\mathrm{j} = 1,2, \dots, \mathrm{p}$, 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, $c = B_0^{-1} c^*$

$\phi_s = B_0^{-1} B_s$

$\epsilon_t = B_0^{-1} u_t$

Which 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:

$\Omega = B_0^{-1} E(u_t u_t')(B_0^{-1})'$

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.

The restrictions can be defined on the basis of economic theory underlying the structural model. Short-run restrictions, that is, exclusion restrictions on the $\boldsymbol{B_0}$ matrix, but one can also restrict the matrix of long run responses of variables to shocks, which allows one to use the long-run properties of the models. We use different mixtures of long-run and short-run restrictions to identify the impact of fiscal shocks on output and distinguish between the impacts of revenue and of capital expenditure.

3.2 Data

Revenue expenditure 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, so they are included under Revenue Expenditure.

Capital expenditure 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 the programs formulated under the ongoing/previous Five Year Plan (Plan Expenditure) or schemes and issues outside the purview of the Planning Commission and the Five Year Plans (Non-Plan Expenditure), give us total expenditure of the Central Government.

Figure 1: Revenue and capital expenditure

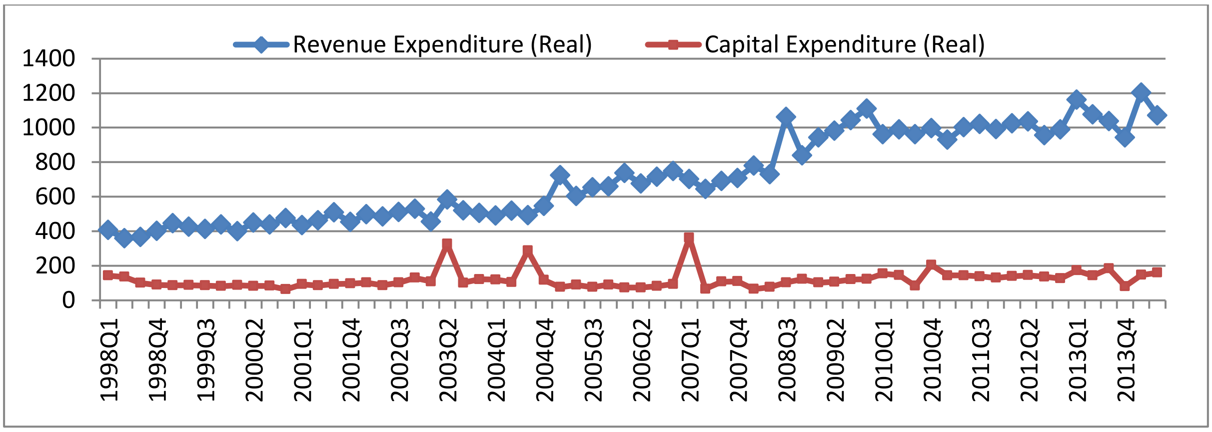
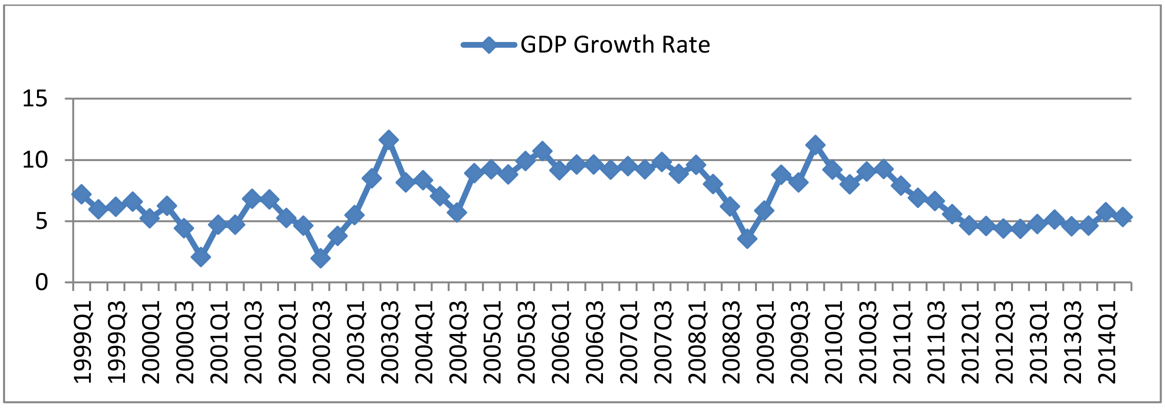


Figure 1 shows revenue expenditure has dominated total Government expenditure (totex) in India and increased steadily compared to capital expenditure, which shows a flatter trend over time, with significant increases being followed by decreases of equal or even greater magnitude, implying sharp fluctuations around the mean. These sharp fluctuations in capital expenditure growth rates manifest in a large variance of the series.

Despite a slight upward shift in the capital expenditure series since 2011, the gap between real revenue expenditure and real capital expenditure 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 capital expenditure which declined to 1.8% of the GDP in 2008-09 from 6.2% in the 1980s while revenue expenditure continued to show a rising trend throughout[1]. Figure 2 shows the fluctuations and stagnation in GDP growth rate this may have been responsible for.

Figure 2: GDP growth rate



We use quarterly data on 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/), Gross Domestic Product (GDP) at constant prices (available at dbie.rbi.org.in), for the period 1998-Q1 to 2014Q3. 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) series (at 1993-94 base year) and the quarterly GDP series. In order to control for monetary policy stance, quarterly averages of call money market rates (CMMR) have been used (Source: dbie.rbi.org.in). To account for business cycle fluctuations, a traditional measure of output gap, the cyclical component of real GDP, is obtained using the Hodrick-Prescott Filter. Annual data for GDP, WPI and total, revenue and capital expenditure is sourced from Database for Indian Economy, RBI.

The data on GDP and fiscal variables have been de-seasonalised using the X-12 technique of the Census Bureau of USA and converted into logarithms. All of these variables, converted into growth rates, were stationary at 5% level of significance using the Augmented Dickey Fuller (ADF) test. The output gap and WPI inflation rate series are stationary, using ADF test, at both 5% and 1% levels of significance.

CMMR is stationary at 10% level of significance. We also define the real interest rate variable as the difference between the short term nominal interest rate and expected inflation

[1] Following the Sixth Pay Commission, wages and salaries of government employees increased along with subsidies and interest payments on account of higher fiscal deficit.

rate. Because of larger scale data dissemination in India now, it is easier for individuals and firms to have information to build up current expectations regarding future inflation rate. We assume expectations are realized, therefore:

$$r_t = i_t - \pi^e_{t+1}$$

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

3.3 Analysis of cyclicality of expenditure policy

Following Vegh and Vuletin (2013), the measure of fiscal policy cyclicality is estimated by the correlation of cyclical component of real total general government expenditure and the cyclical component of real GDP, both computed using the Hodrick-Prescott filter.

$\text{corr}(g_{cyc}, y_{cyc}) > 0 \rightarrow \text{pro} - \text{cyclical fiscal policy}$

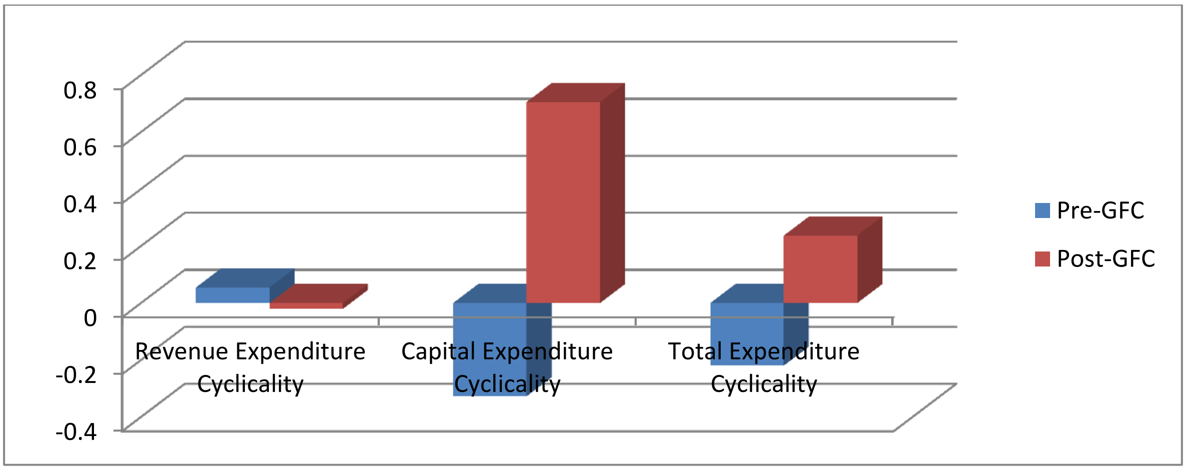
$\text{corr}(g_{cyc}, y_{cyc}) < 0 \rightarrow \text{counter} - \text{cyclical fiscal policy}$

Where g_{cyc} = cyclical component of general government expenditure

y_{cyc} = cyclical component of real GDP

A negative correlation coefficient amounts to counter-cyclical fiscal policy, with the Government Expenditure increasing during a downturn in the business cycle, considered to be an optimal policy stance. However, in order to pursue counter-cyclical fiscal/monetary policy, there should be enough fiscal and monetary space. Policy readiness indices give an indication of such space.

Figure 3: Cyclicality of expenditure and its components



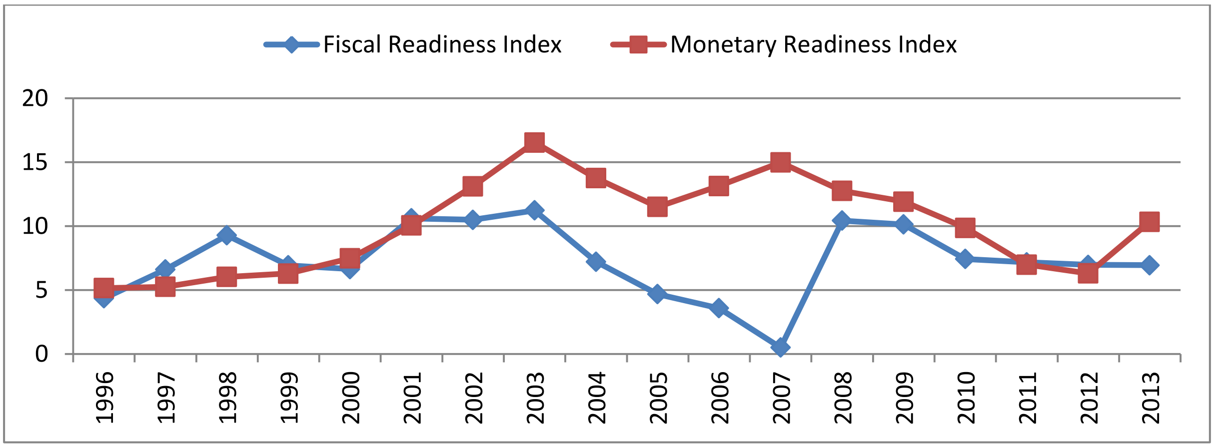
Fiscal Readiness Index is defined as the sum of two components- (i) Fiscal deficit as a percentage of GDP and (ii) External debt (both private as well as public) as a percentage of GDP. Both indicators are normalized on a scale of 0 to 10 and therefore, the overall fiscal readiness index is measured on a scale of 0 to 20 with 0 being the highest level of readiness and 20 the lowest. A lower level of existing public debt or larger primary surplus would also keep the debt servicing costs in check and the authorities could comfortably increase expenditure in the face of a downturn.

Monetary Readiness Index is defined as the sum of two components- (i) Foreign Reserves as a percentage of GDP and (ii) Current Account Balance as a percentage of GDP – both normalized on a scale of 0 to 10. The overall monetary readiness index is measured on a scale of 0 (lowest monetary readiness) to 20 (highest monetary readiness). High level of foreign reserves and Current Account Balance will ensure that the monetary authorities in EMEs do not have to increase interest rates during slumps in order to avoid capital outflows.

To distinguish between the response of Central Government revex and capex in the business cycle, we compute cyclical components of both expenditure heads as well as total central government expenditure. Figure 3 displays the results of the analysis. Before the GFC, total government expenditure was counter-cyclical. This result probably holds because of the reduction in total expenditure that was carried out after the implementation of FRBM in 2003-04, coinciding with a boom. Post the GFC, the total expenditure policy of the Central Government became pro-cyclical, since the rollback of the post GFC fiscal stimulus was delayed.

However, separate analysis of capital and revenue expenditure brings out finer details. Figure 3 shows that before the GFC hit the global economy, India had a pro-cyclical revenue expenditure and counter-cyclical capital expenditure policy. This is not so surprising, given post the implementation of FRBM, capital expenditure as a percentage of GDP declined sharply as compared to the average 1980s level, while revenue expenditure grew to 15% in the same period from 11.2% in the 1980s. The counter-cyclicality of total expenditure manifested in a decrease in capacity-building investments during the period of output growth.

Figure 4: Indices of Indian fiscal and monetary readiness



After the GFC, revenue expenditure policy turned weakly counter-cyclical, mostly driven by the tax cuts and increase in subsidies during the sharp downturn. As the effect of the downturn faded, however, the stimulus exit was incomplete, with only partial rollback of the tax cuts. This resulted in high revenue deficit even as 2011-12 saw a slowdown in output growth. Throughout 2011-14, the GFD to GDP ratio continued to be high. Capital expenditure policy became strongly pro-cyclical. These results reinforce our claim that there has been a very strong bias towards revenue expenditure as compared to capital expenditure, both in the periods of slump and boom.

Figure 4 presents the monetary and fiscal readiness indices for India for the period 1996-2013. The estimates are consistent with the above results on cyclicality. Post 2003, there was a steady improvement in the fiscal space as well as the monetary space, with the fiscal conditions being at their pinnacle in 2007. Feasibility of counter-cyclical policy allowed the fiscal authorities to tackle the GFC in an appropriate manner. However, the delayed exit from the fiscal stimulus resulted in a decline in the fiscal space, which also explains the pro-cyclicality of total expenditure post GFC. Monetary space also deteriorated as the current account deficit widened.

4. Derivation of Spending Multipliers Using Short-Run Restrictions

In order to estimate government expenditure multipliers, we use SVAR, restricting the matrix of contemporaneous restrictions to identify the structure as follows:

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

Where the LHS represents vector of reduced form shocks and the u_t vector represents the structural shocks. B is the matrix of contemporaneous coefficients. The restriction implies the spending variables will impact output in the short run but not vice-a-versa. Fiscal decision and implementation lags justify such as 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.

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

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

Figure 5(a): IRFs – Total Central Expenditure Growth and GDP Growth

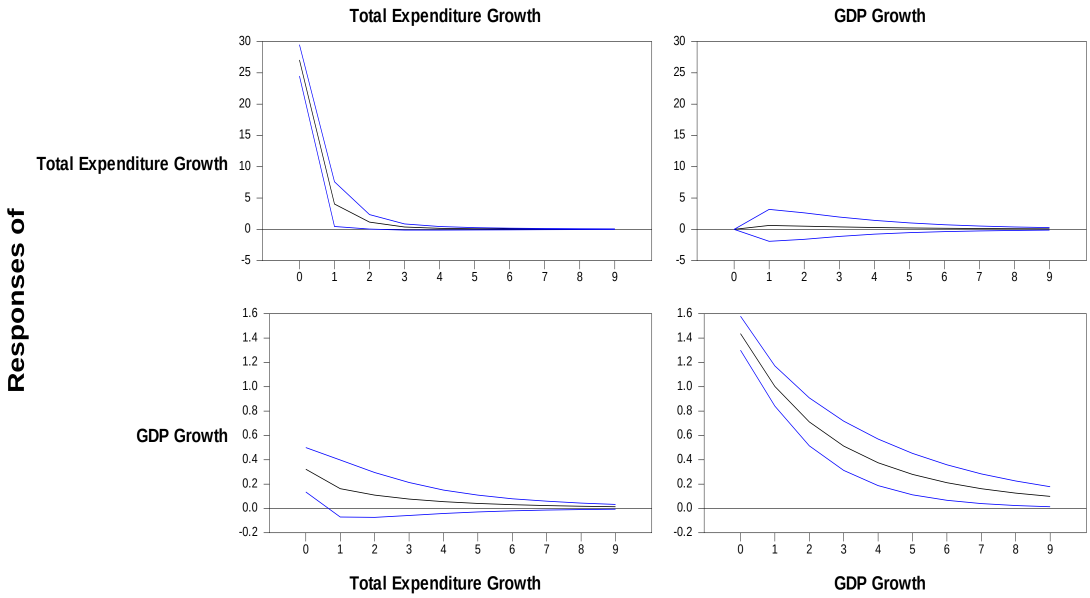


Figure 5(b): IRFs– Capex Growth and GDP Growth

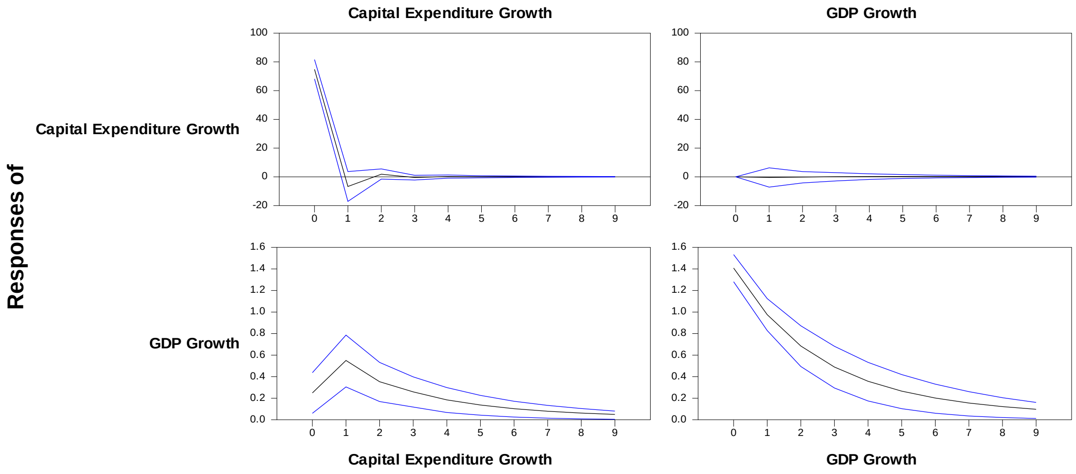
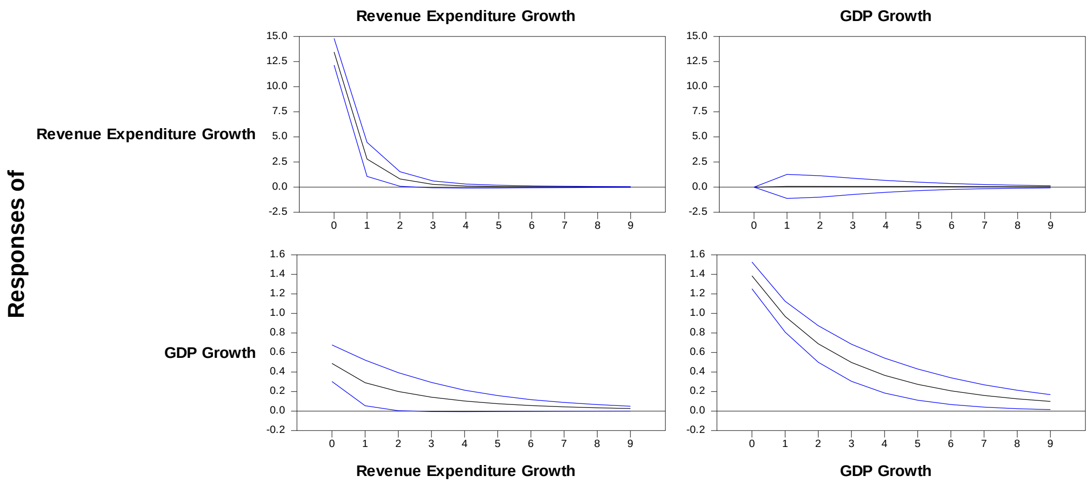


Figure 5(c): IRFs – Revenue Expenditure Growth and GDP Growth



The Impulse Response Functions (IRFs) to structural one standard deviation innovations and two standard deviation error bands are given in Figure 5.

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 9.063, for real revex it was 10.8063, for real capex the average ratio it was 73.39. 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	0.10	0.35	0.24	0.69
Peak Multiplier	0.10	0.35	0.59	1.69
Cumulative Multiplier (for 2 years)	0.23	0.70	2.36	3.37

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[2], the peak multiplier of capital expenditure occurs with a 2 quarter lag after which it diminishes. In the long run, which in this case is two years, capital expenditure has the largest multiplier effect on output. Longer-run capex multipliers always exceed revex multipliers.

5. Impact of Spending Policy in Presence of Supply Shocks

Since supply shocks are frequent in the Indian scenario, we need to assess their impact on our multipliers. Moreover, since India continues to suffer from high levels of poverty, inflation is a social as well as political concern. It is therefore important to see the impact of the two expenditure heads on inflation as well. We will now restrict the analysis to revex and capex, since totex largely follows revex.

The supply curve specification will be taken as the Horizontal Supply Curve (HSC). In a labour-surplus country like India if short-term supply bottlenecks are released, output can expand with negligible change in wages, implying a horizontal supply curve in the long-run. Goyal and Pujari (2005) find empirical support for this specification. According to the HSC, shocks to inflation and output can be decomposed into aggregate supply (AS) and aggregate demand (AD) shocks. Only AS shocks have a long run impact on inflation while both shocks are allowed to have a long-run impact on output with the impact of AD shocks expected to

[2] The total multipliers are lower than both revex and capex multipliers because although the impulse response of totex is similar to revex, this is multiplied by the ratio of GDP to expenditure and GDP/totex is less than GDP/revex.

dominate. The structural moving average representation of system in 3-variable VAR cases 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 inflation is mainly determined through supply shocks (u_{1t}) and that demand shocks (u_{2t}) have no impact on inflation in the long run. Output growth rate in the long-run is determined by supply, demand (u_{2t}) and fiscal shocks(u_{3t}). 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. Although political economy considerations dominate fiscal policy decisions, 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 aggregate supply curve. That is, both demand and supply shocks affect inflation and output growth rate in the short-run when constraints hold. But since bottlenecks affect prices at every output level and shift up the curve, the AS curve may be elastic even in the short-run, although subject to volatile shocks. These shocks would impact short run prices and output more strongly than in the long-run. Furthermore, we have allowed for the spending variables to have a short-run impact on inflation. While an increase in revenue expenditure 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 directed at eliminating the structural bottlenecks precluding long-run output growth, may increase the price levels in the short-run by increasing demand for labour as well as capital, required to complete large-scale projects.

5.1 Analysis of results

The Impulse Response Functions (IRFs) presented in figures A1(a) and A1(b) (Appendix) show the response of a variable to a shock in one variable over the consecutive periods. 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.

The results are consistent with the long-run HSC specification since AS shocks affect inflation predominantly and AD and fiscal shocks contribute much more significantly to GDP growth than to 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.

(ii) A positive shock to both capex and revex growth rate raise 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 shocks to capex growth rate to inflation to be minimal in contrast to the large contribution of revex growth.

(iii) A major finding from the IRFs is the sharp decrease in capex growth in response to a positive AS shock. 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 a more forward-looking commitment. The much smaller response of revex growth rate to its own shock implies more committed revenue expenditure.

In presence of a sudden inflation spike, wages and salaries of government workers are difficult to reduce and subsidies increase because of a 'pandering' effect. 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 that can therefore be expected under frequent supply shocks.

The derived multipliers in the presence 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 revenue expenditure and a marginal increase in the impact and peak multiplier of capital expenditure. This raises the stabilization effectiveness of capex compared to revex. The results follow because of the larger increase in inflation in the short-run in response to rise in revenue expenditure, which also has a negative impact on GDP growth in the long-run. Although capital expenditure is more effective in the presence of supply shocks, it also decreases more sharply in response to supply shocks, indicating the inadequacy of the policy response.

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 a 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[3], driven by shocks to monetary policy. 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 revenue expenditure (which includes interest payments by the Central Government) and capital expenditure (which comprises of public investment and can be severely affected by higher cost of borrowing), we follow different identifying restrictions for these expenditure heads.

[3] 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.

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 revenue expenditure growth.

The above specification implies that while both interest rate and fiscal shocks affect GDP growth, only shocks to GDP growth and own shocks affect the real interest rate in the long-run, since in the long-run monetary authorities will not accommodate revenue expenditure changes, consistent with reduced fiscal dominance and inflation and growth centred approach of the RBI. Real interest rate shocks affect expenditure variables through an increase in costs of borrowing or/and increased interest payments.

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 aggregate demand (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 affected by the growth of capital expenditure. Moreover, if the monetary authority observes that the fiscal authority is directing resources towards unplugging the structural bottlenecks, it might decrease the short-term interest rates. This eliminates the only possible restriction in the SMA representation in the first case above.

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 revenue expenditure, we assume $B_{32} = 0$ on the grounds that capital expenditure reacts to interest rate shocks with lags, as the cost of borrowing increases, and not contemporaneously, unlike revenue expenditure.

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

These results imply that monetary policy is not affected by revex in the long-run, but accommodates capex. An increase in capital expenditure releases supply constraints and reduces inflation expectations in the long-run. However, inflation expectations may rise in the short-run, that is, for at least 2-3 quarters due to an increased demand for labour and capital consequent to increases in capex, in the presence of rigidities. Capex growth allows optimal 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. The negative impact on the real interest rates even in the long-run implies the monetary policy stance and inflation expectations move in the same direction in the long-run, that is, downward.

(iii) As before the VDA shows fluctuations in both capex and revenue expenditure 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 revenue expenditure 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 revenue expenditure.

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

The derived revenue and capital expenditure 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 Indian monetary policy enhances the long-run impact of capex, but reduces 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 Policy in 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 of revex and capex differ. 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 and the real interest rate get affected by all shocks in the long-run[4]. 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.

[4] The restriction is the reverse in the 3 variable monetary policy SVAR of Section 6, since there r_t does not respond to revex and responds to capex in the long-run. That restriction prevents monetary policy tightening in response to revex, while it can do so here.

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 revenue expenditure in the short-run assuming lags in the decision and implementation processes to changes in growth rate of output while r_t can affect revenue expenditure 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 capital expenditure, which 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 capital expenditure does not directly[5]. We allow capital expenditure 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 RHS 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 revenue expenditure except for restricting the impact of real interest rate shock on capital expenditure 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, except that the impact to a shock in revenue expenditure growth stays for a longer period of time.

[5] This restriction, the reverse in the 3 variable monetary policy SVAR, limits monetary accommodation of a rise in capex by preventing a fall in r. The reason for the switch is to examine the effect of supply shocks on capex without active monetary accommodation.

(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 revenue expenditure 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 revenue expenditure 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 revenue expenditure 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 revenue expenditure. This is consistent with the strong pro-cyclicality of capex after the GFC. Capex has seen a decline far greater in magnitude in periods of large supply shocks, despite it being more effective in dealing with supply shocks.

(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 AD shocks. In fact, over the long-run, this response is negative, reflecting the pro-cyclicality of real interest rates with respect to demand shocks. A shock to growth in revenue expenditure 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 revenue expenditure growth. 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[6]. The contemporaneous impact of real interest rate to shocks in capex growth is positive, it turns negative and stays so over the long run as the Central Bank accommodates reduction in structural constraints. The positive contemporaneous impact may be because capex is rising when supply shocks are absent and 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 capital expenditure 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.

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

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

[6] 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. This shows monetary policy does accommodate capex and tightens for revex, but the accommodation is still inadequate because rising capex may be reducing inflation expectations which are not adequately internalized. Results are available on request.

monetary accommodation in the form of lower interest rates as well as lower inflation in the long-run.

8. Policy Suggestions and Conclusion

While the Indian Government received accolades for substantially reducing its fiscal deficit, the short-sighted approach towards expenditure composition was less obvious. The bias towards short-termism materialized in a sharp decrease in capital expenditure over the 2003-2007 'boom' period. Deficit reduction increased fiscal policy space for response to the GFC and also boosted confidence of financial markets. But the economy bore the brunt of reduced capex post 2008, in the form of a stagnating GDP growth rate.

Our results support the above claim. Capital expenditure not only has a much larger long-run positive impact on output, compared to revenue expenditure, but it also has a smaller short-run impact on inflation and reduces inflation volatility, since it eliminates structural bottlenecks. An increase in capital expenditure also has a negative impact on short-run real interest rate, as monetary authorities accommodate capacity-building initiatives of the government. In contrast, an increase in revenue expenditure has a strong short-run positive impact on real interest rate. 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 revenue expenditure is low since it is strongly committed due to political factors. Revenue expenditure 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. Decisions have not been optimal.

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. 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 capital expenditure could restrict extreme reductions during supply shocks, while expenditure reduction should be directed towards wasteful elements in revenue expenditure.

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 underlying variables

Variable	t-statistic	p-value
GR_CAPEX	-8.38117***	0.00
REALINTRATE	-3.239939**	0.0224
GR_GDP	-2.70917*	0.0783
GR_REVEX	-3.53444**	0.0103
GR_TOTALEXP	-6.63957***	0.00
WPI_INF_RATE	-4.90293***	0.0001
CYC_GDP	-2.99005**	0.0414

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

GR_CAPEX – Growth Rate of Central Government Capital Expenditure.

GR_REVEX – Growth Rate of Central Government Revenue Expenditure.

GR_TOTALEXP – Growth Rate of Central Government Total Expenditure.

WPI_INF_RATE – WPI Inflation Rate

REALINTRATE – Short-term real interest rate

CYC_GDP – Cyclical component of GDP estimated using HP filter

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. Hodrick-Prescott Filter

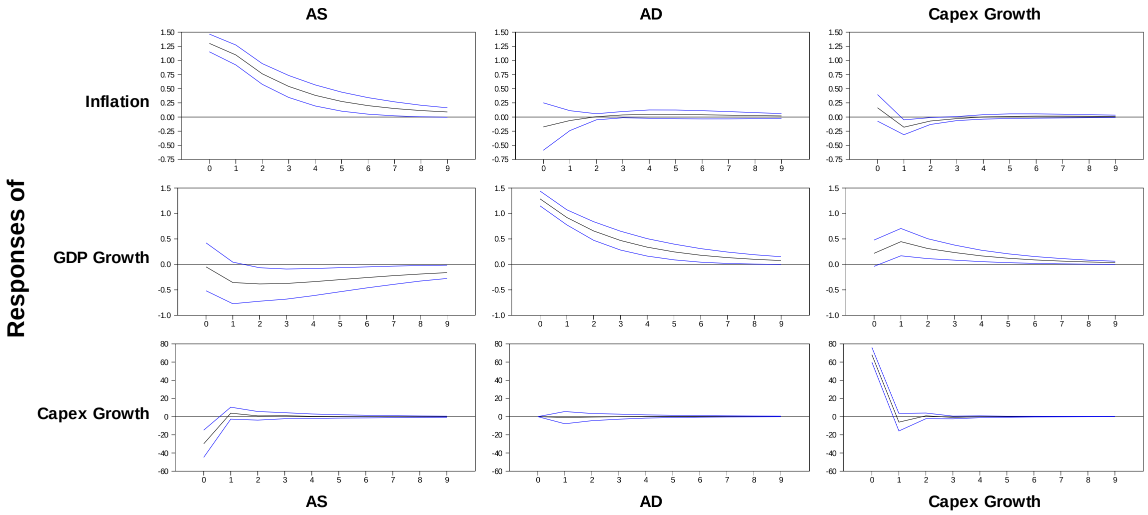
The Hodrick-Prescott (HP) filter is a technique widely used in macroeconomics to obtain a smooth estimate of the long-term trend component of the series.[7] HP filter is a two-sided filter that estimates a smoothed series *t* of a time series *z* by minimizing the variance of *z* around *t*, subject to a penalty that constrains the second difference of *t*, i.e. the HP filter chooses *t* to minimize:

$$\sum_{t=1}^{T}(z_t - t_t)^2 + \lambda \sum_{t=2}^{T-1}((t_{t+1} - t_t) - (t_t - t_{t-1}))^2$$

λ is also known as the 'penalty' parameter, which controls the smoothness of the series. Larger the λ, the smoother the series. As $\lambda = \infty$, t approaches a linear trend. For annual data, $\lambda = 100$ and for quarterly data, $\lambda = 1600$.

A3. Structural VAR Analysis

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



[7]Hodrick, Robert; Prescott, Edward C., "Postwar U.S. Business Cycles: An Empirical Investigation", *Journal of Money, Credit, and Banking*, Vol. 29(1), pp. 1-16 (1997).

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

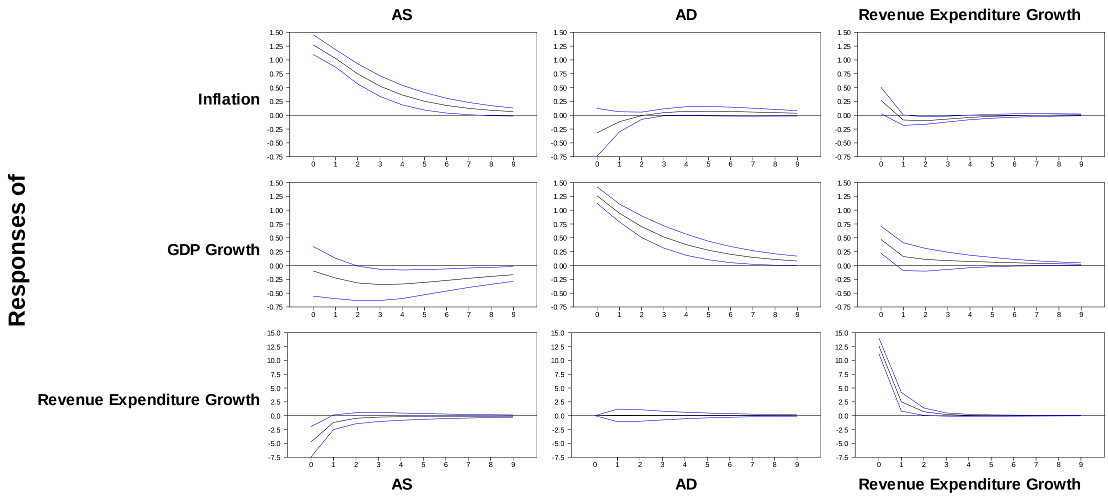


Table A1 (b) – VDA Revex: Including supply shocks

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

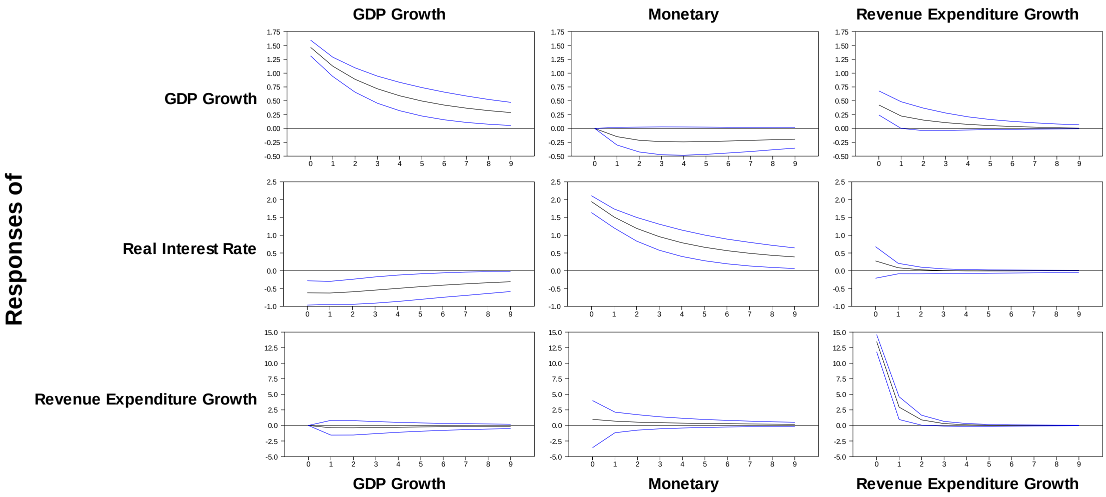


Table A2 (a) - VDA Revex: Including monetary shocks

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

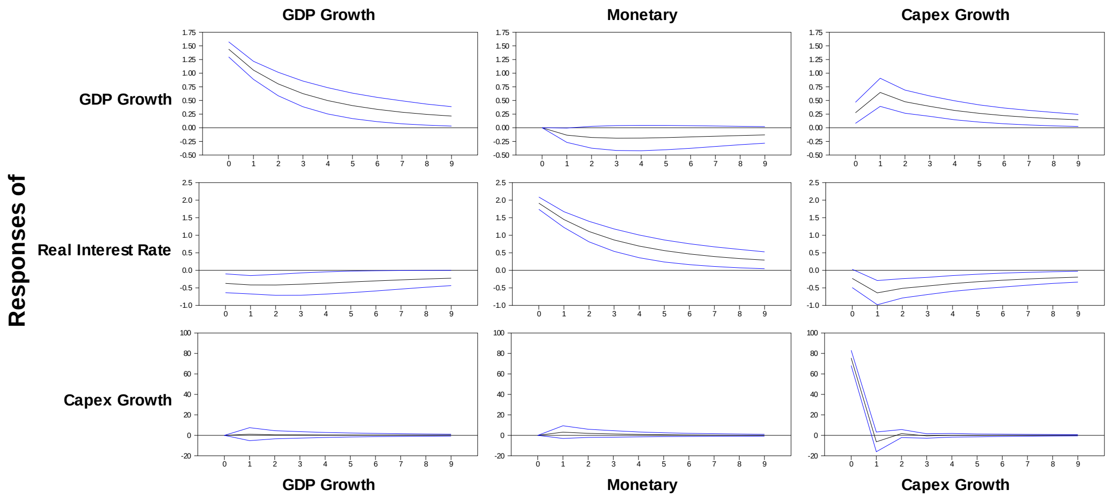


Table A2(b)- VDA Capex: Including monetary shocks

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

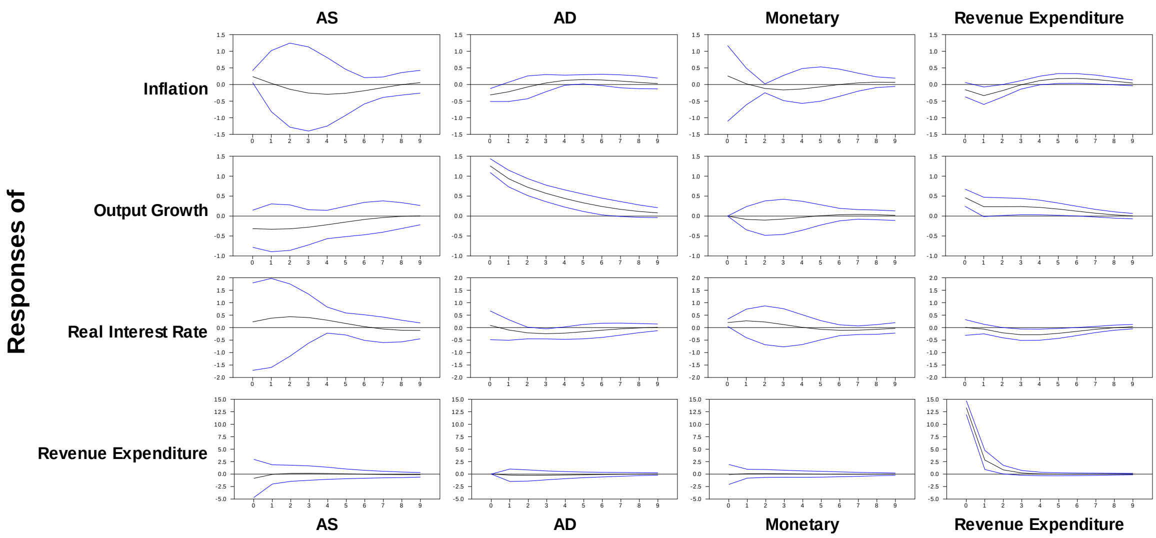


Table A3(a): VDA Revex: Including monetary and supply shocks

		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
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

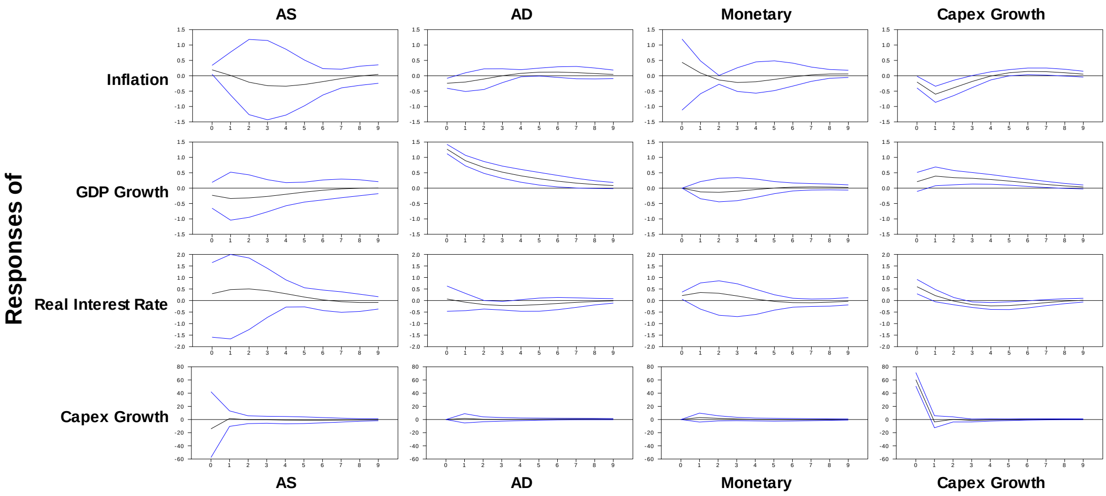


Table A3(b): VDA Capex: Including monetary and supply shocks

Decomposition of Variance for Series 'Inflation'					
Step	Std Error	AS shocks	AD shocks	Monetary policy shocks	Capex Growth shocks
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