Cyclically Adjusted Primary Balance for Centre and States in India

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1. Introduction

Fiscal management in India got highlighted with the enactment of Fiscal Responsibility and Budget Management Act, 2003 (FRBMA). The Act brought forth rules to install fiscal prudence by placing ceilings on deficits and borrowings for governments at Centre and States. Consequently, in the post-FRBMA era curtailment of fiscal deficit at the prescribed limit was the focus. The approach adopted for determining a prudent deficit limit was based on the overall/general budget balance.[1] However, assessment of fiscal sustainability on the basis of overall/general fiscal balance neglects the impact that cyclical position of an economy may have on the government budget. The general fiscal balance or the *narrow balance* approach assumes that changes in the budget balance result entirely due to government's discretionary fiscal policies (the internal factors), and so neglect cyclical fluctuations. As economic fluctuations subject government budget balance to subsequent rise and fall, it is important that laws of fiscal surveillance account for the impact of economic cycle on public finance. This *broader approach* adjusts for changes caused by internal, external and financial factors so as to remove the cyclical fluctuations which beyond the direct control of the authorities.

The Government of India's fiscal strategy laid down in the FRBM Act 2005 commits to achieve stable fiscal balance. In this context, it would be desirable for the Centre and State government's budgets to be adjusted to economic cycle. This implies ensuring a measure of budget balance that reflects whether the fiscal situation prevailing in the country and the states is adequate to fulfill the surveillance targets set under the FRBM Act. In other words, an indicator that examines whether the existing fiscal situation is strong enough to ensure that the current budget deficit does not contravene the disciplinary targets during the trough phase of the cycle. For this purpose, a cyclical adjustment balance (CAB) may serve as a measure of budget balance that

[1] Overall budget balance is measured as the difference between current revenue and current expenditure. This balance may be surplus or deficit.

reflects the underlying or the structural budgetary position. CAB is indicative of the government's fiscal policy stance as it accounts for the economy's position along the business cycle. A budget balance adjusted for cycles thus reveals whether or not fiscal policies are counter cyclical i.e., governments undertake expansionary policies during recession and pursue fiscal consolidation and structural reforms during boom. Apart from being informative about the responsiveness of budget balance to cycles, CAB also 1) highlights the automatic and discretionary changes in the budget balance, 2) enables effective short and medium-term budget management/planning by identifying the cyclical budget disturbances, 3) targets economic stability by balancing out the effects of automatic stabilizers from the budget balance, and 4) optimizes the private sector behavior by enabling formulation of expectations on the basis of cyclically neutral deficit (Muller and Price 1984).

Estimation of CAB involves computation of cyclically adjusted component of the budget balance so that the effects of business cycles on fiscal balance can be separated. This further entails the assessment of economy's potential output or the trend output and identification of different components of the budget that react to economic fluctuations, such as interest payments and fiscal policies. Additionally, the CAB approach is augmented to account for transitory factors that might influence fiscal balances on top of business cycles. The resulting estimate is called structural fiscal balance. The measure accounts for adjustment of output composition effect, one-off effects that temporarily increase/decrease the revenue/expenditure and changes in asset prices, commodity prices or terms of trade (Misra and Trivadi 2015).

Although, targeting the cyclically adjusted fiscal balance promotes fiscal transparency and enhances credibility of fiscal laws by making them counter-cyclical, its application as an indicator of structural budgetary position is limited by the difficulties in estimation of trend output and choosing an appropriate estimation method among several alternative methodologies. Nonetheless, several advance economies like Canada, the United States, New Zealand etc., along with international agencies such as IMF, OECD and EC[2] compute cyclically-adjusted balance (CAB) and incorporate it in the fiscal laws to make the policies counter-cyclical. IMF has been computing CAB for G7 countries since 1990 and has extended

[2] Since 2005 EU reforms of Stability and Growth Pact, CAB has taken the centerstage in fiscal surveillance.

this analysis to emerging and developing market economics since 2010 (Fedelino et. al., 2009; Bornhorst et al., 2011). In case of emerging economies, the decision to adopt the CAB has largely remained a topic of discussion and research among the academic community. In India, literature shows that fiscal policies are mainly pro-cyclical, *albeit* attempts to make policies counter-cyclical in the aftermath of 2008-09 global financial crisis are gaining ground (Misra and Gosh, 2014; Misra and Trivadi, 2015).

In estimation of cyclically adjusted fiscal balance, the overall fiscal balance (OB) is separated into two components- cyclical balance (CB) and cyclically-adjusted balance (CAB). As documented in the literature, the above decomposition staged the development of two methodological approaches in estimation of CAB. These are broadly identified as the IMF approach and the OECD and European Commission (EC) approach (Bouthevillain et al., 2001; Bornhorst et al. 2011; Fedelino et al. 2009). The fundamental difference between these approaches lies in their treatment of the budget items. IMF approach estimates CAB as the gap between cyclically adjusted total revenue and cyclically adjusted total expenditure while the EC approach calculates CAB as the difference between the overall balance and the cyclical balance.

Under the IMF approach, cyclically adjusted revenue and cyclically adjusted expenditures are derived as a ratio to potential output and respective revenue/expenditure elasticity to output gap. The EC approach computes cyclical balance by using the gap of different macroeconomic variables from their potential levels, which are further assumed to be directly related to the respective budget categories and elasticities. Since IMF approach does not distinguish between the various components of revenue and expenditure, these budget items are treated as aggregate variables to separate the effects of the cycles. EC approach on the other hand accounts for the component-wise break up of macroeconomic variables and elasticities corresponding to the budget categories and hence treats the budget items at disaggregate level for cyclical adjustments (Martin and Turrini 2009; Girouard and Andre 2005; Bouthevillain et al., 2001). The literature on these two broad methodologies has evolved into various extensions that differ in terms of approaches adopted to compute potential output; adjusting for one-off changes in budget items; elasticity of revenues/spending to output gap, and exclusion of budget items that are not significantly affected by the cycles.

Against this backdrop, this report estimates the cyclically adjusted fiscal balance for the Central government and average of all State governments in India for the post 1990's period. The report explores the following research issues:

- Systematic review of the literature documenting the concept and measures of cyclically adjusted fiscal balance
- Methods adopted by advanced and emerging economies to estimate cyclically adjusted fiscal position
- Review of the methods employed to determine the output gap
- Review of the methods adopted to account for uncertainty about the cycle
- To develop a simple method to estimate a cyclically adjusted fiscal balance for India
- Challenges and issues in implementing a cyclically adjusted fiscal deficit for India

In line with the methods adopted for estimation of cyclically adjusted fiscal balance, the report attempted to empirically estimate the automatic impact of business cycles on the fiscal balance of the Center major States. The methodology involves adjusting for one-off fiscal measures. The CAB is computed from the cyclically adjusted revenue and expenditures that are the functions of ratio of actual and potential output (the output gap), elasticities of (total) revenue and (total) spending, respectively, to output gap. The report estimates the potential output using alternative econometric methods such as Hodrik Prescott (HP) filter, the Band Pass (BP) filter of Christiano-Fitzgerald (CF), and the production function approach. In the estimation of elasticities for the Union and State governments' revenue and expenditure to output gap, the elasticities are computed at the aggregate level. However, the report does not consider correcting the fiscal balance of the Union and the States for other macroeconomic fluctuations that have strong fiscal impact, but are not related with the business cycles.

The empirical analysis in the study is based on the data retrieved from various issues of the *Reserve Bank of India State Finances: A Study of Budgets, CSO, NSSO*; *Handbook of Statistics,* and RBI and Union and State Budgets.

The rest of the report is organized as follows: Section 2 presents a systematic review of the existing definitions and quantitative measures of CAB. It examines the evolution of CAB methods and those adopted by the advanced and emerging economies. Section 3 discusses the alternative methodology adopted for the assessment of cyclically adjusted fiscal balance for Central government and average of all-State governments in India. Section 4 presents the sources of the data the challenges involved in measuring CAB for India at the Center and State-levels. Section 5 summarizes the main findings and advocates the use of alternative measures that provide a more comprehensive quantitative evaluation of CAB. Section 6 forecasts CAPB. Section 7 concludes the report.

2. **Literature Review**

2.1 Review of the concept

The deficit question that has dominated the debates over fiscal policy relates to whether government must consolidate aggressively or gradually. Fiscal policy must strike balance between maintaining stability (through steadily declining debt and deficit) and buying time against growth slowdown.[3] Aggressive fiscal consolidation is vital for the government to maintain credibility by keeping its commitment to reduce debt and deficit for sustaining growth. However, gradual fiscal consolidation is important when growth outlook across the globe remains uncertain and higher expenditures on account of infrastructure obligations are imminent.

In the 1980s and 1990s, deficit concerns led economists and policymakers to downplay the feasibility of a policy for fiscal stabilization.[4] Monetary policy became the preferred stabilization tool. The monetary policy seemed adequate to the task during the period of relative stability from the mid-1980s to 2006, which was termed the "great moderation." The financial crisis in 2008 revived the need for Keynesian fiscal stabilization policies,[5] as the

[3] Economic Survey, 2015-16.
[4] See Box IV.5, Report on Currency and Finance, 2008-09, Global Financial Crisis and The Indian Economy, RBI.
[5] The US Senate enacted the Emergency Economic Stabilization Act of 2008 authorizing the US Secretary of Treasury to spend up to $700 billion to purchase troubled assets, particularly mortgage-backed securities, and supply cash directly to banks. Additionally, the American Recovery and Reinvestment Act was approved by the US Congress in February 2009, enabling the Obama administration to spend $720 billion dollars for the first three fiscal years.

United States and other major world economies undertook stimulus programs to stave off the recession. However, the stimulus programs resulted in a situation of growing deficit and high inflation leading to the debate about their usefulness. As the management of money supply to control inflation is the prerogative of the monetary authorities, monetary policy was stretched to try unconventional and untested new instruments for stabilizing the economy.[6] For governments committed to achieving the macroeconomic goals,[7] the tradeoff between tightening of the monetary policy and expansionary fiscal policy acquired an important role in policy decision-making during the slowdown.

The use of cyclically adjusted balance (CAB) assumed importance in understanding the efficacy of fiscal policy as a stabilization tool. In order to understand the concept of CAB, it is important to understand the linkage between business cycles and budget balances. In order to do so, we discuss the significance of automatic stabilizer in the fiscal policy by studying the relationship between different items of budget balance and changes in output levels.

The government budget contains three components that affect macroeconomic goals: government purchases of goods and services, government transfer payments (including devolution), and government tax receipts. Therefore, how the level of national income affects items in the budget becomes an interesting question. In doing so, it is essential to observe how changes in the government budget work as automatic stabilizers for steering economic activities. Automatic stabilizers are changes in government transfer payments and taxes that occur due to change in the level of income. The automatic stabilizer role of the budget is a crucial factor in evaluating the relative merits of fiscal policy by rules versus discretion.

The mechanism of automatic fiscal stabilization works in the following manner: Since the schedule of tax rates is exogenously set, the net tax collections depend on the level of income. Given this fact, it follows that as income rises, net tax collections increase, and the government budget surplus increases (or the deficit declines). At higher levels of economic activity, more tax revenue is collected for any given set of tax rates. The positive correlation between net tax revenues and economic activity is because of decline in transfer payments, especially

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[6] See Table 4.5: Select Unconventional Measures by EME Central Banks, Report on Currency and Finance, 2008-09, Global Financial Crisis and The Indian Economy, RBI.

[7] Low unemployment, price stability and economic growth are the three main macroeconomic policy goals.

payments for unemployment compensation. In the absence of discretionary policy shifts, there is no reason to expect government spending (G) to respond to changes in the level of economic activity. Therefore, government spending as exogenous can be maintained. Consequently, the net effect of a rise in income is to increase the budget surplus or decrease the size of an existing deficit. An expansion in economic activity, therefore, causes fiscal policy, as measured by the budget surplus, to become more restrictive. This more restrictive policy restricts the expansion. Similarly, a shock that causes economic activity to decline, automatically results in a rise in deficit or a decline in the budget surplus that cushions the fall in income. Thus, fiscal policy can stabilize the economic activity through the natural linkage between budget balances and business cycles.

Some elements of government budget are directly dependent on the business cycles. They make the fiscal policy automatically expansionary during recession and contractionary during economic boom. Alternatively, fiscal policy can also act as a stabilizing force through discretionary changes in government spending and taxation in response to business cycles. The automatic stabilizer role of the budget is a crucial factor in evaluating the relative merits of fiscal policy by rules versus discretion. Relying only on overall fiscal balance to determine fiscal policy is marred with problems due to cyclical factors. Given the vital role of business cycles on fiscal policy, it is pertinent to review the fiscal policy by separating the impact of business cycles on fiscal variables. Brown (1956) argued, for the first time, that it is essential to make a distinction between "automatic" and "discretionary" policies in order to correctly measure the stance of fiscal policy. However, Brown did not propose any method to adjust budget balances.[8] Since Brown's paper, a single indicator to measure the orientation of the fiscal policy was sought-after by the policymakers and economists. It is in this context CAB has assumed importance and is being used by almost all multilateral organizations to monitor fiscal performance of different countries. In the following discussion we examine the policy advantages of computing CAB and the limitations associated with them (Muller and Price 1984;, Blanchard 1990; Chouraqui, Hagemann, and Sartor 1990; Buiter 1993).

[8] With respect to Keynesian model of economy, Brown argued that various components of revenue and expenditure be treated differently.

Assessing Discretionary Changes in Fiscal Policy

Cyclical movements in tax revenue are expected because most economies rely on statutory tax rates that are based on various types of economic activity. Likewise, in many countries transfer programs are spontaneous to business cycle movements. From a theoretical standpoint, it seems reasonable to treat that factors that drive the business cycle determine the cyclical movements of tax revenues and transfers. Alternatively, policy interventions, like changes in government expenditure and alteration in tax rates, may themselves lead to changes in aggregate demand in the economy. Automatic stabilizers may obscure these deliberate policy interventions. By distinguishing between the cyclical and discretionary (non-cyclical) changes in fiscal balance, the CAB helps in determining the orientation of the fiscal policy, for example, it can be indicative of the contribution to savings that the government is seeking to make. This way CAB provides quantitative estimates and can monitor total effects of smaller changes in policy (Burnside and Meshcheryakova 2004).

The discretionary change in fiscal policy are important indicators to assess whether the government intends to improve its budgetary position. For instance, there is a possibility that fiscal policy becomes too relaxed during a strong economic boom. This happens when a rise in tax revenues conceals the expansionary change in the fiscal policy. In this case, the true change in fiscal policy may only be revealed by observing the discretionary change in the budget, thus preventing procyclical fluctuations (Alesina, Campante and Tabellini 2008) [9].

The government may use an active stabilization policy to reduce the fluctuations in GDP growth or keep unemployment low. Hence, it is natural to expect contractionary fiscal policies in upturns and vice versa in downturns. When fiscal policies are countercyclical, the effect from variability in GDP growth would be positive and correlated with discretionary changes in fiscal policies that affect the budget balance.[10]. Over the course of a business cycle, the

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[9] A fiscal policy is 'procyclical' when it involves increases in taxes and reduction in spending during a recession, and involves increase in government spending and reduction in taxes during economic boom. On the contrary, a 'countercyclical' fiscal policy advocates reduction in spending and increase in taxes during economic boom, and cutting taxes and increasing spending during a recession.

[10] During a downturn, the tax revenues would fall due to decrease in output level. This is induced effect of fluctuations in GDP on the budget balance. An expansionary fiscal policy to enhance economic activity is generally followed by government during a downturn, causing an increase in government expenditures. This is

induced effect of fiscal policy is smaller than the total effect of changes in GDP growth. In this context, CAB helps to assess the extent to which countercyclical fiscal policies affect fiscal balances in lieu of fluctuations in GDP.

2.2 Advantages of CAB

CAB Serves as an Index of Fiscal Sustainability

CAB helps in understanding whether the fiscal policy can be sustained without extraordinarily increasing or massively reducing debt. It is pertinent to know whether a large deficit will naturally disappear in time, or will have to be eliminated through stringent adjustments. Cyclical movements in the fiscal balance even out over the cycle.[11] Hence, CAB is suitable tool the stabilization of fiscal policy.

Assess the Economic Impact of Fiscal Policy

Eisner and Peiper (1984) proposed that CAB be used as an indicator to assess the consequence of fiscal policy on economic activity. Since CAB separates the component of fiscal policy that is determined by the business cycle from the part that is exogenous with respect to business cycle, it can be used as a statistic to measure the potential impact of discretionary actions of the government on economic activity. The debate around the efficacy of CAB as a good measure of fiscal impact shall be discussed below in this section.

Blanchard (1990) maintains that the CAB gives an incomplete and needlessly controversial answer while assessing the discretionary changes in fiscal policy. The CAB tackles issues of macroeconomic fluctuations that are not only tricky and contentious but also completely irrelevant to the objective at hand. Given this objective, there is no reason to focus on output changes and exclude changes in real interest rates and inflation. By constructing a trend, it determines whether there are cycles around a stable trend, whether the economy will return to lower unemployment, etc. Any benchmark would distinguish between induced and

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the effect of discretionary changes in fiscal policy on budget balance. Herein, both induced effect of fluctuations in GDP and discretionary changes in fiscal policy tend to increase the budget deficit.

[11] When the economy expands, the revenues automatically increase; government spending is reduced, leaving a deficit or surplus at the peak of the cycle. This may be termed as "structural" budget balance. As the output gap closes with boom and bust, the "built-in stabilizer" component of the deficit should negate one another, so that it is temporary and non-structural. For more on this, see Muller and Price (1984).

discretionary fiscal policy changes. For example, induced changes in fiscal policy can be defined as changes that occur due to changes in inflation, real interest rates and output growth over the previous year or over previous decade average value. Choosing a benchmark to answer this question does not require one to take a stand on where the economy would or should return.

CAB as a sustainability index is incomplete because there are several observable and unobservable factors that influence composition of the government budgets such as changes in inflation, output, real interest rates; maintenance of infrastructure (which requires higher investment); social insurance as well as effects of changing demography and emerging imperatives like loss of revenue as fossil fuels disappear.

The lack of clarity about the efficacy of CAB as a good measure of fiscal impact arises partly due to the confusion and partly due to the complexity of the question itself. In order to clear the confusion, it is important to get some issues out of way:

(i) Fiscal policy affects the economy through two channels: The first is the set of distortions implied by the tax/incentive structure on individual decisions. The second is the effect of fiscal policy on aggregate demand, which would arise even if all the taxes were lumpsum. It is apparent that the CAB is only aimed at the second channel.

(ii) It is important to distinguish between a) the impact effect of fiscal policy, i.e., what is the effect of fiscal policy at a given level of income, interest rate and exchange rate and b) final effect of fiscal policy, i.e., general equilibrium effect on output, interest rates and so on, after those variables are allowed to adjust[12]. CAB is used to measure the final effect of fiscal policy and not the impact effect of fiscal policy.

With the above-mentioned issues out of the way, we can rephrase the question with respect to CAB being a good measure of fiscal impact. That is, ignoring distortion effects, what is the

[12] For instance, whether an increase in government spending causes an increase in interest rate without any change in output, or an increase in output without any increase in interest rate, or an increase in exchange rates without any change in output, depends on labor market conditions, transmission of monetary policy, presence or absence capital account convertibility and a host of other factors. For more on this, see Blanchard (1990).
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impact effect of fiscal policy on aggregate demand? Given this question, Blanchard (1990) argues that there is a little justification for using CAB as a measure of fiscal impact.

If we consider the simplest IS model, wherein consumption depends on current income net of taxes, the CAB does not come out to be a natural measure of fiscal impact because with a marginal propensity to consume less than one, changes in taxes have less impact on demand than changes in government spending, so that CAB, the difference between the two, is not a sufficient statistic. Additionally, consumption does not depend only on current income. Observing only current taxes and transfers can be misleading as asset values and expectations also influence consumption. The complexity surrounding the interaction between the fiscal policies and expectations has led some to argue that deficit measures should not be used to assess the impact of fiscal policy (Buiter 1985); Auerbach and Kotlikoff 1987; Kotlikoff 1988a).

In addition to complexity in conceptual issues, literature suggests several methods to compute CAB. Basically, the computation of CAB involves three steps. First, adjustment of the budget for business cycles essentially involves the decomposition of output into some trend component and some deviation from trend. The trend component is the potential output and the deviation from the trend is usually referred to as the cyclical component. Subsequently, sensitivity of the budget items (i.e., elasticity of revenue and expenditure) relative to the output gap is computed. Then, the estimated elasticities are used to make cyclical adjustments to the revenue and expenditure components of the budget. While computing CAB, an important assumption needs to be made with respect to the components of revenue and expenditure in the automatic category and those which are in the discretionary category. Literature suggests considerable difference in the estimation techniques for computing potential output, elasticities of revenue and expenditure relative to output gap, and adjustment of revenue and expenditure items for the business cycle. These are discussed in Section 2 and 3. Despite the differences involved in the computation of CAB, it is still used as one of the supporting structural indicators to assess fiscal performance of countries along with other indicators.

Multilateral organizations like the IMF and the OECD have conducted extensive research on Cyclically Adjusted/Structural Balance. These organizations' technical notes and manuals impart understanding of the underlying causes of fiscal positions that became clear in the aftermath of the subprime crisis. They seek to provide operational guidance on how to compute cyclically adjusted and structural fiscal balances (Bornhost et al. 2011; Fedelino et al. 2009; Girouard and Andre 2005). In the light of the existing literature, many advanced and developing countries have been using this concept of Cyclically Adjusted Balance in their assessment of fiscal policy. However, a few countries have adopted this concept in the rules governing their fiscal policy. Nevertheless, the Cyclically Adjusted Balance has become pertinent in the revised EU framework of fiscal surveillance due to the adoption of the Stability and Growth Pact (SGP) reform, 2005. Structural Fiscal Balance can be obtained by adjusting Cyclically Adjusted Balance for other non-structural elements like transitory financial sector or movement in asset prices, tax base cycles and other one-off changes in revenues/expenditures. Structural fiscal balance is the primary indicator for evaluating medium-term fiscal objectives of a country under the "preventive arm" of the SGP. Under the "corrective arm" of the SGP, fiscal adjustment is imposed on the countries that have excessive deficit position under structural fiscal balance. Using Cyclically Adjusted Balance, the fiscal stance can be disaggregated into two components: a) automatic effect of the budget on fluctuation in economic activity, and 2) discretionary fiscal policy. EU member countries were required to adopt Structural Balance Rule in their legal framework by 2014 (Mourre et al, 2013).

Many advanced economies, like Canada, New Zealand and the United States have incorporated cyclically adjusted budget balance in assessing their fiscal policies. Further, some other countries have taken the next step of adopting CAB into their fiscal rules. Transparency in operation of fiscal policy is promoted by revealing cyclically adjusted forecasts of budget balance, thereby improving the quality of policy decisions (Farrington *et al.* 2008). Therefore, incorporating cyclically adjusted balance in fiscal rules imparts the stabilizing character, making the fiscal policies countercyclical i.e., expansionary during recession and consolidation and reform-oriented during boom (Bova et al 2013).

Except for Chile, Colombia and Panama, there is little research on cyclically adjusted balances for emerging economies. It may be the case that the automatic stabilizers are smaller in emerging economies, thus, leading to a smaller difference between the actual and cyclically adjusted balances. None of the nations in the BRICS group have taken into account cyclically adjusted balances while assessing their fiscal policy or rules governing them. However, both OECD and IMF methodologies have been used for Brazil to compute budget balances adjusting for both variability of GDP and oil revenues (Mello and Moccero 2006, Gobetti, Gouvêa, and Schettini 2010). There also exists extensive literature on computing the CAB in the Caribbean region.

Economic Survey 2013-14, Government of India, observed that a new FRBM Act[13] should take into account business cycles in its fiscal policy framework. Economic Survey 2014-15, went a step ahead and categorically included cyclical considerations and one-off factors as short-term issues in the fiscal framework. The literature with respect to cyclically adjusted budget balance in India primarily focuses on existence of cycles in fiscal policy. During the 1980s and 1990s, some attempts were made to compute the structural balances by applying HP filter on the data series of revenue and expenditure to obtain the variables that were cyclically adjusted (Rangarajan and Srivastava 2005; RBI 2001). Since the debt-GDP ratio remained high in the 1980s and 1990s, cyclical adjustment of fiscal policy was not acceptable in policy circles (Rangarajan and Subbarao 2007).

Empirical evidence indicates that the fiscal policy in India has remained pro-cyclical in the long-term. However, the pro-cyclicality seems to have reduced in recent times due to the countercyclical measures taken by the central government during the 2008 financial crisis (Reserve Bank of India 2013). The extent of automatic stabilizer in India was estimated to be near 0.5% of GDP in 2008–09 (Reserve Bank of India 2009). While this was comparable with those in Emerging Markets and Developing Economies, it was smaller with respect to advanced countries (RBI 2012). Using the aggregate approach proposed by IMF to quantify CAB, the elasticity parameter for India was estimated at 1.5. Evidence points out that CAB

[13] Fiscal Responsibility and Budget Management Act (FRBMA) was passed by the Indian Parliament in 2003. Under the FRBMA, the central government framed rules. The Act and the Rules required that revenue deifict be eliminated by 2008-09, and reducing the fiscal deficit to the level of 3 percent of GDP.

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increased considerably during the crisis period. In the post-crisis period (2009-11), the expansionary stance of CAB was not withdrawn completely in the face of an increase in (positive) output gap and subsequent increase in inflation, and a reduction in fiscal impulse (Misra and Ghosh 2014). The disaggregate approach proposed by OECD/ECB was used to analyze the fiscal balance for India.

2.3. Methodology to compute Cyclically Adjusted Balance

Various approaches are proposed to calculate the cyclically adjusted balance. These approaches cover differences over theoretical issues like impact of wage earnings, employment, and aggregate demand on budget balance. The uncertainties involved in different estimates may lead to inappropriate policy response. Therefore, it is pertinent to review the methodologies involved in calculating cyclically adjusted balance by stating the basic formulations followed and discussing their extensions.

2.3A. IMF approach

The overall fiscal balance is equal to primary balance minus interest payments. Primary balance reflects whether the funds are adequate to pay back the interest payments. The primary balance comprises of 1) cyclical primary balance i.e., the component of primary balance which is affected by the business cycle, and 2) cyclically adjusted primary balance i.e., after adjusting for cyclical primary balance. The second component of primary balance reflects the true nature of fiscal policy. Since interest payments are reflection of past debts, it is neither exogenous nor endogenous in the current period. Therefore, it is not considered in the calculation of fiscal stance.

The overall fiscal balance can be disaggregated into: (i) the automatic reaction of fiscal variables to variability in output; (ii) the reaction of fiscal variables to variation in discretionary policy; and (iii) changes in interest payments.

Overall Balance (OB) = Primary Balance (PB) – Interest Payment (INT)

= Cyclically Adjusted Primary Balance (CAPB) + Cyclical Primary Balance (CPB) – INT ....(1)

In order to compute the difference in Overall Balance between two consecutive years, *t* and *t+1,* equation 1 may be transformed as:

$\Delta OB = \Delta CPB + \Delta CAPB - \Delta INT$ ....(2)

In order to review and evaluate the nature of fiscal policy for a business cycle(s), the cyclically adjusted primary balance is considered. There are two main approaches to calculating the Cyclically Adjusted Balance. Regression based estimation can be used to compute cyclically adjusted variables of expenditures and revenues. This can further be used to derive cyclically adjusted primary balance. After adjusting revenues (R*) and expenditure (G*) for the business cycle actual revenues (R) and actual expenditures (G) can be obtained by following equations:-

$Ri = Ri^* (Y/Y^*)^{\varepsilon i}$ …………………………(3)

$G = G^* (Y/Y^*)^{n}$…………………………(4)

where ε_i is the elasticity of revenue group *i* with respect to output gap (Y/Y^*) and *n* is the elasticity of expenditure with respect output gap (Y/Y^*). It may be noted that when $Y=Y^*$, $Ri = R_i^*$. Nevertheless, a thriving economy, i.e., $Y \geq Y^*$ implies $Ri \geq R_i^*$, which leads to more revenue and vice versa.

On the basis of regression equations 3 and 4, the cyclically-adjusted balance (b^*) can be computed as:

$$b^* = \frac{\left[\sum R_i^* - G^* + \xi\ \right]}{Y^*}$$

$$b^* = \frac{\left[\sum R_i \left(\frac{Y^*}{Y}\right)^{\varepsilon_i} - G\left(\frac{Y^*}{Y}\right)^{n} + \xi\right]}{Y^*} \quad ....(5)$$

where ξ represents revenue and spending groups that are excluded like net interest spending.

Since CAB measures the extent of fiscal balance when the output was at its potential, the cyclically adjusted primary balance (b*) is calculated with respect to potential output. Typically, analysis of fiscal policy is based on ratios to nominal GDP (Fedelino et al. 2009). Equations (3) and (4), show that three unknown variables are estimated to obtain CAB*: (i) potential output Y*, (ii) ε, the revenue elasticity to output gap, and (iii) *n*, the elasticity of spending to output gap.

Estimation of the reference output path i.e., potential output is marred with problems. Despite the existence of various methods for calculating potential output and related output gap, they are marred with major shortcomings. For this reason, output gap estimates are subject to considerable uncertainty.

In order to calculate potential output, the estimation method based on Hodrick-Prescott (HP) filter is used by IMF. Primarily, HP filter is a data smoothing technique over all the data points of actual GDP using weighted moving averages. The deviations calculated by subtracting actual output from estimated trend output are symmetric over the business cycle, irrespective of any structural breaks. This estimation method is simple because it only requires data on actual GDP. It is easy to reproduce the trend estimates due to discretionary changes in fiscal policy.

HP trend estimation method assumes revenue elasticity (ε_i) to be equal to one i.e., for each percentage increase in the output gap there is an equal percentage change in revenue. It also assumes that expenditure elasticity (*n)* to be equal to zero i.e., cyclically adjusted expenditure is equal to true expenditure, G^* = G, wherein the expenditure levels are not affected by business cycle. Since expenditure is regarded as discretionary, the second assumption is plausible. While this may be a reasonably good approximation, some items of expenditure (e.g., unemployment expenditure) will display a cyclical pattern.

Although various components of revenue and expenditure are not discerned by this approach, the inaccuracy may be acceptable. There exists some empirical evidence supporting the aggregated one-zero elasticity assumptions to be a good estimate of the weighted average of elasticity estimates using disaggregated approach (Girouard and André, 2005). However, it is better to use elasticities for overall revenue and expenditure for the respective country, either from the literature or estimated through a regression approach.

Two more concepts are important to understand in the IMF approach:-

(i) Fiscal stance - It quantifies management of aggregate demand through a discretionary fiscal policy. It also shows the nature and magnitude of the discretionary component of variations in fiscal policy.

FS = (-) CAPB

If CAPB is less than 0, then FS is greater than 0 (expansionary)

If CAPB is greater than 0, then FS is less than 0 (contractionary)

If CAPB is equal to 0, then FS is equal to 0 (neutral)

(ii) Fiscal impulse - Instead of finding out the impact of the budget on the overall economy, it determines the extent of the change in budgetary stance i.e., whether budgets are becoming expansive or contractive. If an expansionary (contractionary) budget becomes more expansionary (less contractionary), both will yield a positive fiscal impulse. Fundamentally, the first difference of the fiscal stance is called Fiscal Impulse (Heller *et al*, 1986) i.e., FI= ΔFS.

2.3B. OECD approach

The most widely used alternative to the IMF approach is the OECD methodology or the disaggregated approach. Here, the individual revenue and expenditure categories are adjusted for business cycles.

The cyclically adjusted balance can be written as:

$$CAB = (\sum_{i=1}^{N} R_i^{CA}) - G_{cur}^{CA} + R^{NCA} - G^{NCA} \text{ …………………….. (6)}$$

where R_i^{CA} represents the component of the i-th revenue category that is adjusted for business cycles, G_{cur}^{CA} represents current primary expenditures that is adjusted for business cycles, while R^{NCA} and G^{NCA} contains all those categories of revenue and expenditure that are not required to be adjusted for business cycles, e.g., non-tax revenue, capital, and net interest expenditures (Girouard and André, 2005). Here, only one category of expenditure, i.e., current expenditure, is assumed to have a cyclical component.

When output is below (above) trend, borrowing requirements increase (decrease). This leads to cyclical fluctuations in interest expenditures, and thus fiscal deficits. However, countercyclical movements in interest rates are likely to balance the cyclical behavior in borrowing requirements, resulting in a small net effect (Farrington et al., 2008).

Subsequently, a two-stage procedure is adopted to determine elasticity of each revenue category and elasticity of current expenditure categories. With respect to the revenue component, the elasticity of each category of revenue can be disaggregated into two factors. The elasticity of revenue with respect to output ($\mathcal{E}_{tY}$) is equal to the product of the elasticity of the tax revenues (t), relative to the respective tax base (tb), ($\mathcal{E}_{t\,tb}$), and the elasticity of the tax base relative to the output gap, $\mathcal{E}_{tb\,Y}$.

$$\varepsilon_{tY} = \varepsilon_{t\,tb} * \varepsilon_{tb\,Y} \text{ …………………… (7)}$$

Using equation 7 in the computation of cyclically adjusted revenue yields: -

$$R_i^{CA} = R_i((\frac{Y^*}{Y})^{\varepsilon_{tb\,Y}})^{\varepsilon_{t\,tb}} \text{ …………………… (8)}$$

First, the value of the tax elasticity relative to its base is either assumed or derived. The second step involves econometric estimation of the respective tax base relative to the output gap, which necessitates that macroeconomic proxies for the tax bases be specified, like wages, corporate income taxes. Generally, elasticities are higher for personal income tax and corporate taxes because they are progressive, because the statutory tax rates increase with taxable income. The elasticity will be one for proportional taxes. Still, there are several tax rates which have elasticity more than one (progressivity) or less than one (regressivity). For social security contributions, the elasticity should be less than one because they are generally levied at a constant rate up to an upper limit, making them reasonably regressive. Ad Valorem indirect taxes like VAT may have a progressive component because higher rates are applicable to those parts of the tax base which are more income- elastic. VAT elasticity with respect to GDP tends to increase during economic boom and tends to fall during recessions in some emerging market economies. The contribution of automatic stabilizers may be overstated when one/zero elasticity assumption is used to estimate automatic stabilizers (Snack et al. 2009). There are some taxes which are only ascertained by real consumption and do not take into account movements in asset prices. Such taxes may be regressive. The complexity of elasticity of the tax base relative to a cyclical indicator depends on the choice of the base, income, expenditure or employment, because its behavior varies across cycles. For instance, the elasticity of the corporate tax base relative to the output gap may be influenced by the mix of wage income and profits.

Similarly, with respect to the expenditure component, the elasticity of each category of current expenditure consists of two factors. Transfer payments like unemployment benefits are likely to have cyclical behavior. On the other hand, nominal spending on other items like goods and services is likely to be autonomous, not requiring any adjustment for business cycle. The elasticity of expenditures with respect to output, ($\varepsilon_{G_{cur}\,Y}$) is the product of the elasticity of current expenditures relative to the respective base i.e., unemployment, ($\varepsilon_{G_{cur}\,U}$), and that of the base relative to the output gap, ($\varepsilon_{U\,Y}$).

$$\varepsilon_{G_{cur}\,Y} = \varepsilon_{G_{cur}\,U} * \varepsilon_{U\,Y} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(9)}$$

Using equation 9, we can compute cyclically adjusted expenditure as: -

$$G_{cur}^{CA} = G_{cur}((\frac{Y^*}{Y})^{\varepsilon_{U\,Y}})^{\varepsilon_{G_{cur}\,U}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(10)}$$

First, the value of the expenditure elasticity with respect to the respective base is assumed or derived[14]. Then, elasticity of unemployment with respect to the output gap can either be estimated under a regression framework or obtained from literature.

The disaggregated approach requires more data points, thereby being more stable[15]. This approach also reveals those items in revenue and expenditure that affect the cyclical balance. This provides insights into the composition of automatic stabilizers. The impact of business cycle on fiscal balance is calculated by using indicators that capture the deviations between actual and potential output and between actual and structural unemployment. Since estimation of potential output and structural unemployment are fraught with complications, this calculation is subject to measurement errors. Temporary factors that are not directly associated to the business cycle, like one-off operations, classification errors, creative accounting and cyclical movement in asset prices may affect the cyclically-adjusted fiscal position. Finally, this methodology comprises of approximation because it does not take into account the forces that drive the business cycle. These forces vary over time, with implications on revenues and spending.

2.3C. The European Commission Methodology

The European Commission (EC) computes budget balance semi-elasticity[16] taking a weighted average of the individual elasticities. Subsequently, the budget balance semi-elasticity is applied to the output gap to compute the CAB (Mourre et al., 2014). The concept of semi-elasticity is of strategic interest because it measures the overall stability that has been built in the fiscal system. It is also useful to explain how the structural balances[17] are derived from the tax and expenditures components.

The budget balance semi-elasticity relative to the output gap can be defined as (Price et al. 2015):

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14 If the expenditure category includes only unemployment benefits, then elasticity of expenditure relative to the respective base, unemployment, may be assumed to be one.

15 Average elasticity can lead to instability in the aggregated approach; greater stability may be provided if tax and expenditure specific elasticity is considered.

16 Elasticity relates to a proportional change of a tax (or spending) category to a proportional change in the output gap level. However, semi-elasticity measures the extent of absolute change in the ratio of the budget balance-to-GDP due to a percentage change in GDP as a result of business cycle.

17 Adjusting the Budget balance for the business cycle, one-off factors and policy measures of a temporary nature leads to structural balances.

$$b^* - b = -\mathcal{E} * \frac{(Y - Y^*)}{Y^*} = -\mathcal{E} * (GAP) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (11)$$

where b = $\frac{R}{Y} - \frac{G}{Y}$ represents budget balance ratio, R = government revenues, G = government expenditure and $\mathcal{E} = \frac{db}{\frac{dY}{Y}}$ represents aggregate semi–elasticity. The aggregate semi-elasticity captures the first difference in the budget balance ratio due to a percentage change in. The semi–elasticity of the budget balance to GDP ratio can be expressed as:

$$\mathcal{E} = (\mathcal{E}_{r.y} - 1)\left(\frac{\mathrm{R}}{\mathrm{Y}}\right) - (\mathcal{E}_{g.y} - 1)\left(\frac{\mathrm{G}}{\mathrm{Y}}\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$$

where, the first component of the right–hand side is total revenue elasticity ($\mathcal{E}_{r.y}$) minus 1 and the second component is the total expenditure elasticity ($\mathcal{E}_{g.y}$) minus 1. The total revenue elasticity ($\mathcal{E}_{r.y}$) is a weighted average of the individual tax elasticity. The total expenditure elasticity ($\mathcal{E}_{g.y}$) is a weighted average of the individual expenditure elasticity. Elasticity for capital taxes and non-tax revenues should be zero. Therefore, total revenue elasticity can be stated as:-

$$\mathcal{E}_{r.y} = \sum_t \mathcal{E}_{t.y} \omega_{t.r} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (13)$$

where $\omega_{t.r}$ represents the share of t-th category of tax in total revenue.

The expenditure elasticity is derived by taking the weighted average of the current primary expenditure elasticity by using the share of current primary expenditure in total expenditure. Elasticity of debt interest payments and capital expenditures should be zero. Therefore, total expenditure elasticity can be stated as:-

$$\mathcal{E}_{g.y} = \mathcal{E}_{pg.y} \omega_{pg.g} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (14)$$

where $\omega_{pg.g}$ represents the share of current primary expenditure in total expenditure.

Since OECD applies individual elasticities for respective tax bases, which are then aggregated to compute the cyclically adjusted measure of revenue, the actual weights and the implicit semi-elasticity would vary in each period. Since the weights are set and based on a historical average, the semi-elasticity becomes constant.

2.3D. The ECB Methodology

The ECB approach considers the effects of output composition. The ECB approach is similar to the OECD methodology. However, the ECB approach requires that the cyclical components of individual tax and expenditure bases be estimated separately (Bouthevillain et al., 2001). Output gap is marred with constraints when there are significant variations in the composition of output. Let us consider two scenarios of economic growth: 1) driven by consumption, and 2) driven by exports. In both scenarios, same output gap implies same level of cyclical adjustment. Assuming that consumption is taxed more than exports, the actual fiscal impact of the same expansion may be more when the output gap is due to consumption driven expansion rather than being export driven.

This difference arises because different types of taxes are levied on the basis of different components of GDP. For instance, consumption and wage cycle may differ from overall business cycles and can also differ from each other.

Since consumption is the base for indirect taxes and wages are the base for income taxes, this might have different fiscal implications. Hence, adjusted revenues can be as stated as:

$$R^* = \sum R_i (\frac{B_i^*}{B_i})^{\varepsilon_i} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (15)$$

where B_i represents the relevant tax base for revenue category i.

With respect to the expenditure component, if current expenditure is regressed on the unemployment gap, then current expenditure is adjusted for unemployment trends despite the output gap. Instead of using the output gap measure combined with a measure of unemployment, the ratio of structural unemployment to actual unemployment provides the direct relation between the expenditure and the respective base through the following equation:

$$G_{cur}^{CA,OA} = \sum G_{CUR} (\frac{U^*}{U})^{\varepsilon_{G,U}} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (16)$$

Since this kind of adjustment goes beyond business cycles, we call adjusted revenues as structural revenues and the deficit obtained is called structural balances. Studies for European economies have shown that characterization of fiscal policy changes in certain episodes when changes in the composition of output were taken into account (Bouthevillain et al., 2001). When the same methodology was applied to South Africa, it was observed that there is improvement in fiscal balances when the growth rate of consumption and corporate profit is more than the growth in GDP (IMF 2006).

Yet, another approach is to adjust the domestic absorption (defined as the sum of consumption, gross investment and government expenditure) for output composition effects. As the tax obtained from the consumption component is high and that from customs is generally low, a shift in the composition of output between these two aggregates may lead to significant variation in fiscal revenues. To determine these effects, it is necessary to adjust indirect tax revenue for the effect of the output gap and absorption gap, while adjusting other revenue only for output gap. This approach may be appropriate for economies that are highly dependent on trade.

The effect of absorption on fiscal balances is nearly 1½ percent of GDP for advanced euro area countries (Sweden) and nearly 4 percent for new entrants to euro area (Bulgaria)[18]. The external balance of Bulgaria increased significantly from negative 6 percent of GDP to 12 percent of GDP during 2002-07. In the same period, the output gap changed by only 4 percentage points[19]. This growth was driven by an increase in consumption, which increased the indirect tax receipts. Since 2003, the conventional measures of fiscal stance reveal, the fiscal policy has remained contractionary. After controlling for increasing absorption gap, the fiscal stance turns out to be neutral (IMF 2007). Dobrescu and Salman (2010) present a cross-country analysis showing the effect of increase in absorption on fiscal policy.

When the effect of different components of output is considered for Canada, the output composition effects seem to be less because there is high correlation between various economic cycles. The correlation coefficients between unemployment and output cycles is about -0.9. The correlation coefficient between the wage gap and consumption gap is about 0.8. As there is high correlation between different gap measures and the output gap, there

18 The European Commissions' Report on Public Finances (European Commission 2010) applies this methodology to European economies.

19 External balance defined as the actual current account deficit minus the estimated equilibrium current account deficit.

should not be much difference between adjustment resulting from output composition effects and the adjustment for the output gap.[20]

2.3E. Extensions - Adjusting for Asset and Commodity Prices

The variability in GDP can also arise due to other disturbances like boom-and-bust cycles of asset or commodity prices. In addition to removing the effect of one-off fiscal operations, the structural balance should correct for all macroeconomic fluctuations. If there is no correlation between the variations in GDP and business cycle, it may become necessary to go beyond cyclical adjustment if there is significant impact of changes in asset prices, terms of trade, or commodity prices on fiscal balances. There may be a temporary increase in the commodity prices because of surges in global demand. Or, there may be a price bubble in the financial or the real estate sector. When fiscal balances are closely associated with the revenue obtained from commodity exports or with the terms of trade, it is necessary to correct the variation in these prices to determine the underlying fiscal position. Adjustment methodology should also look into indirect effects of commodity price trends (for example, increasing profitability of firms may lead to higher corporate income tax receipts). The underlying fiscal position is also affected by real estate and equity prices. it was estimated that in the United Kingdom the cyclically adjusted tax receipts increased between 0.1 and 0.4 percent of GDP annually due to a permanent increase of 10 percent in asset and house prices (Farrington et al. 2008).

The asset and commodity price adjustment can be done via both aggregated and disaggregated approach. Cyclical adjustment through aggregated approach also incorporates the deviation of asset prices relative to the benchmark level, denoted as the asset price gap$(\frac{A^*}{A})$:

$$R^{CA,A} = R(\frac{Y^*}{Y})^{\varepsilon_{R,Y}} * (\frac{A^*}{A})^{\varepsilon_{R,A}} \text{ .... (17)}$$

where $R^{CA,A}$ represents revenues obtained after adjusting for both output gap and asset price gaps.

20 For more detail, see Box 7 in Bornhorst et al 2011.

When the elasticity of revenues with respect to the asset price gap is zero, $\varepsilon_{R,A} = 0$, equation 17 is identical to the standard cyclical adjustment. The asset price gap affects structural revenues for elasticity greater than zero. Elasticity can be tested empirically by adopting this approach. This approach accommodates different output and asset price cycles. This approach also takes into account both the direct and indirect effects[21]. It is important to compute joint estimation of the elasticities because there may be correlation between the output gap and the relevant commodity or asset-price cycles. Therefore, using the estimate for elasticity of revenue with respect to output gap, $\varepsilon_{R,Y}$, from standard cyclical adjustment equation may lead to over adjustment.

Cyclical adjustment using the disaggregated approach includes a term for the asset price gap. To understand this, we can consider the impact on corporate income taxes because they may be related to asset prices in case of a large financial sector. After adjusting for the output gap and the asset price gap, corporate income tax receipts $R_{CIT}^{CA,A}$ is a function of (i) corporate income tax receipts, (ii) elasticities of the tax base relative to the output gap ($\varepsilon_{B_{CIT},Y}$) and relative to the asset price gap ($\varepsilon_{B_{CIT},A}$), and (iii) the elasticity of corporate income tax receipts relative to the base ($\varepsilon_{R,B_{CIT}}$)[22]:

$$R_{CIT}^{CA,A} = R_{CIT}\left(\left(\frac{Y^*}{Y}\right)^{\varepsilon_{B_{CIT},Y}} \left(\frac{A^*}{A}\right)^{\varepsilon_{B_{CIT},A}}\right)^{\varepsilon_{R,B_{CIT}}} \ldots\ldots\ldots\ldots\ldots\ldots.. (18)$$

The above equation simplifies to (8) when the effect of asset prices on revenue is marginal. Since wealth effect may affect private consumption, it is important to capture indirect taxes by adjusting the asset price gap to include other taxes, especially indirect taxes.

2.4 Estimation of Output Gap

2.4A.The notion of Potential Output

21, The impact of the wealth on output can be observed by computing the standard cyclical adjustment term $(\frac{Y^*}{Y})$. T he additional impact can be observed from the asset price gap term.

22, For representation of the unified approach see Bornhorst et al., 2011.

The concept of potential output and output gap is very significant in the economics discipline. Besides indicating the standard of living, the potential growth is also important for structural reforms. Since output gap indicates inflationary tendencies in the economy, it is crucial in formulating monetary policy. However, both potential output and output gap are not observable. Therefore, it is necessary to estimate them. Significant policy errors have been made in the past due to wrong perceptions about these concepts. It is thus imperative to delve deeper into the methodologies that are followed to estimate the output gap.

Potential output can be understood from both statistical and economic perspectives. Statistically speaking, it is the trend element of actual output. Based on a purely economic rationale, it can be seen as the growth rate of output that is sustainable without generating inflationary pressures (see Borio et al., 2013). The Congressional Budget Office (see CBO, 2004) interprets the trend level of output as a purely statistical concept. Since it does not take into account economic variables like capacity utilization and inflation, it cannot be interpreted as the maximum output that is sustainable. When there is a positive output gap, i.e., potential output is less than the actual output, there is an increase is aggregate demand. When supply side factors are assumed to be constant in the short-run, inflationary pressures may arise due to increase in aggregate demand. Output gap, on the other hand, is measured at levels rather than growth rates. When the economy recovers after a recession, it grows much faster relative to its potential. Yet, such a growth is not inflationary because the output gap level is still negative at the trough.

2.4B. Overview: Output Gap

According to the World Economic Outlook (IMF, October 2018), advanced economies have reported above-trend growth during 2015-17. Following this, the output gaps have closed or are set to close in most cases. With decreasing slackness and higher capacity utilization constraining supply, the growth rate of output is projected to start decreasing towards its potential, particularly in Japan and some members of the euro zone. However, the US economy has proved to be an important exception to this pattern, and is expected to grow above its potential until 2020, aided by substantial fiscal stimulus.

Both statistical methods and production function approach have been extensively used to estimate potential output. The recurrent limitations of the statistical methods lie in their reliance on statistical detrending of outputs and inputs, and in their narrow focus on output and input variables. In the face of large supply side shocks and ensuing inflationary pressures during the 1970s and 80s, relying on statistical approach proved inappropriate. During this period, expansionary macroeconomic policies were encouraged due to overestimation in potential output. Since then, many estimation techniques of potential output have been formulated. However, economic developments after 1980s do not provide strong evidence that policymakers were greatly aided by the abundance of literature surrounding output gap.

The OECD uses Cobb-Douglas production function assuming Harrod neutral technical progress to estimate potential output and output gaps for member countries[23]. This approach relies on economic relationships (like NAIRU) and univariate filters (generally, the HP filter) to calculate trend component in the participation rates, hours worked and total factor productivity. Kalman filter is used to derive the NAIRU (see Cotis et al., 2008). With the exception of Germany, the correlation between output gap estimated under this approach and the output gap generated by the HP filter is close to 0.9 percent for all G7 countries.

The EU Commission originally used the reference method to evaluate the stability and convergence programs. Recently, it adopted the OECD method for estimating potential output (see Denis et al., 2002). The estimations adopted by the EU Commission do not incorporate hours worked. Also, the EU Commission estimates a NAWRU using a wage Phillips curve rather than a NAIRU. The wage Phillips curve involves the equation relating unemployment to the rate of wage inflation. The trend component of the TFP is obtained by using a bivariate filter, along with a capacity utilization measure (see Denis et al., 2006).

The IMF estimates of potential output can be obtained from the World Economic Outlook. Since these estimates are not based on any formal method, they may be subject to judgments by the relevant country desks. In most cases, the IMF estimates potential output using the production function approach, but the underlying assumptions differ across countries (see de

23 For description, see Giorno *et al.* (1995).

Masi, 1997; Epstein and Machiarelli, 2010; Konuki, 2008) [24]. In case of the United States, the IMF uses different methods like the split time trend, the HP filter, the band pass filter and the production function to estimate potential output (see IMF, 2002). IMF uses the estimates of potential output to provide insights on the impact of specific supply shocks (e.g. the terrorist attacks in the United States).

2.5 Methodologies to Estimate Potential Output

Statistical method of estimating potential output basically involves splitting output into a trend and a cyclical component. Structural method of estimating potential output involves production function approach, which takes into account the supply side of the economy.

2.5A Statistical (Filtering) Techniques - Univariate

2.5A.1. Hodrick-Prescott filter

Under the univariate approach, the trend is extracted from output series alone. The Hodrick-Prescott (or HP) filter is extensively used under the univariate approach (see Hodrick and Prescott, 1997). In the time domain, the HP filter extracts the trend component of output by minimizing the squared deviations of the trend from actual output subject to the smoothness constraint. The smoothness constraint is the square of the change in the growth rate of the trend.

$$\underset{\widehat{y_t}}{Min} \sum_{t=1} (y_t - \widehat{y_t})^2 + \lambda \sum_{t=2} [(\widehat{y_{t+1}} - \widehat{y_t}) - (\hat{y}_t - \widehat{y_{t-1}})]^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \; 19$$

where y_t is the real GDP series in natural logarithms and $\widehat{y_t}$ is the trend calculated subject to the smoothness constraint λ. The smoothness constraint controls the variation around the trend series. Lambda determines the weights of the trend and cyclical components. Smoothness of the trend depends on the choice of the λ . If we choose a low value for λ, then the trend will closely follow the actual output. If we choose a high value for λ, then the trend is likely to remain insensitive to the short run changes in actual output. Therefore, λ also determines how

24 The IMF uses multivariate filter approach to estimate potential output for some economies.

quickly actual output is equal to the potential output and the duration of the business cycle on average. For quarterly data, λ= 1600 is suggested [25].

However, the HP filter is marred with end-point bias. End-point bias arises because the trend closely follows the actual output toward the end of the sample period. In case the latest GDP figures reveal pronounced recession, then the trend will be pulled downwards towards the path of actual output. The trend will be pulled upwards, if the latest GDP figures show a robust expansion. Hence it is crucial to correctly interpret the present situation and near future. Otherwise, relying on HP filter alone poses a problem to the policy making process. In order to tackle this problem, forecasted output levels for extended sample period should be considered.

Another problem with HP filter is about the difficulty in singling out large and sudden changes in the level of output. The HP filter smoothens the structural breaks by moderating them when they occur and spreading their impact over several years. Confidence bands cannot be created to determine the uncertainty of the estimation by using this filter. Over time, the sum of output gaps and the cyclical components of the budget equal to zero. This is assured by the symmetry property. However, rapid structural changes in the economy may be misrepresented. In reality, the cyclical developments are irregular and asymmetric. Some events may be considered cyclical in nature initially but due to inertia and lagged effects may become structural over time. Actual output may also deviate from potential output for reasons other than purely cyclical.

The deterministic nature of this statistical method does not include information on the constraints faced in the production process. These constraints may relate to the availability of factors of production or other endogenous stimulus. Given the changes in capital stock, labor supply or total factor productivity, the trend output growth projected by HP filter may be inconsistent. It may also be unsustainable due to inflationary pressures. Nevertheless, this method is very popular because of its simplicity. For a wide range of smoothing values, the output gaps turn out to be stationary.

25. λ= 1600 should be used when the relevant cycle length is for eight years. Since the duration cycles of the Indian Economy are longer, λ= 1600 is consistent.

2.5A.2. Band Pass Filter

Another example of univariate approach is the Band Pass (or BP) filter (see Baxter and King, 1999). A two-sided weighted moving average of the figures is computed when the frequency of cycles is within a band. This filter separates the fluctuations that are long-term from those that are short-term in the frequency domain. Long-term fluctuations correspond to low frequency, and are associated with the trend. Short-term fluctuations correspond to high frequency, and are associated with the business cycle. Thus, the BP filter can be stated as (Baxter and King, 1995):

$$cycle_t = \sum_{t=-3}^{3} \alpha_i \, y_{t-i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots 20$$

where cycle is a two-sided weighted moving average of actual output (y_t) for 3 years and α_i relates to the weights of frequency response function. The weights have been derived from the inverse Fourier transformation. Under this filter, it is not possible to estimate output gap or cycle for the first and last 3 years of the sample. To tackle this problem, Christiano – Fitzgerald (2003) modified the BP filter which can be used for the full sample period. The weights on the lags and leads are of the equal length and are time-invariant under the BP filter proposed by Baxter and King. However, the weights on the lags and leads have different length and are time-varying under the BP filter proposed by Christiano and Fitzgerald. While applying the BP filter proposed by Christiano and Fitzgerald, the critical frequency band that is assigned to the cycle should be independently determined. According to standard practice, the band for the cycle is selected as 6 to 32 quarters. The non-cyclical component produced by the BP filter contains irregularity and, therefore, should not be strictly treated as trend.

2.5A.3. Beveridge – Nelson Decomposition

In order to separate the trend and cycle from the series, Beveridge and Nelson made the following assumptions (Beveridge and Nelson, 1981):

a) the series is an ARIMA process

b) the long-term forecast of the series is identical to the trend

c) both the cyclical and trend components are affected by a mutual (unknown) shock, and

d) the ARIMA specification is correct

The ARIMA model can be specified as follows:

$c_t = E_t(\Delta y_{t+s} + \Delta y_{t+s-1} + \cdots + \Delta y_{t+1}) - s\hat{\alpha}$ …………………. 21

where, *s* is the horizon, *t* is the time period, and $\hat{\alpha}$ is a constant of the estimated model. Since it is a backward-looking filter, there is no end-point bias. However, the cycles generated under this technique are very noisy. Sometimes, estimated cycles are negatively correlated with the growth of the observed series.

2.5A.4. Unobserved Components (UC) Model

Harvey (1985) and Clark (1987) introduced the Unobserved Components (UC) approach. This approach results in a very smooth trend and a highly persistent cycle having large amplitude. Under the assumption of Beveridge-Nelson decomposition, the shocks to the trend and cycle are negatively correlated. Under the Unobserved Components model, the shocks to trend and cycle are assumed to be uncorrelated. The UC model separates the output y_t into two components: a stochastic trend component, τ_t, and a cyclical component, c_t.

$y_t = \tau_t + c_t$ ……………. 22

The stochastic trend $\{\tau_t\}$ is assumed to be a random walk with mean growth rate μ.

$\tau_t = \mu + \tau_{t-1} + \eta_t,\ \eta_t \sim i.i.d. N\ (0, \sigma_\eta^2)$ ………………..23

The cyclical component $\{c_t\}$ is assumed to be a stationary and invertible ARMA (p,q) process[26].

26. Harvey op. cit., Clark op. cit. and Harvey and Jaeger (1993) suggested that p=2 and q=0. Under this specification, the cycle process is periodic with a peak in its spectral density function.

$$\phi_p(L)c_t = \theta_q(L)\varepsilon_t, \varepsilon_t \sim i.i.d.N(0,\sigma_\varepsilon^2), \; Cov(\eta_t, \varepsilon_{t\pm k}) = \begin{cases} \sigma_{\eta\varepsilon} \; for \; k = 0 \\ o \; otherwise \end{cases} \text{..........24}$$

This set up implies that there is no correlation between trend and cycle components. Thus, the model can be modified to include the condition $\sigma_{\eta\varepsilon} = 0$. Therefore,

$c_t = \phi_1 c_{t-1} + \phi_2 c_{t-2} + \varepsilon_t; \; \varepsilon_t \sim i.i.d.N(0,\sigma_\varepsilon^2)$, and

$E[\eta_t, \varepsilon_s] = 0$, for all t and s.

where the roots of $(1 - \phi_1 L - \phi_2 L^2) = 0$ lie outside the unit circle. If τ_t and c_t are unobserved state variables, this model could be written in the matrix form as:-

$$y_t = \begin{bmatrix} 1 & 1 & 0 \end{bmatrix} \begin{bmatrix} \tau_1 \\ c_t \\ c_{t-1} \end{bmatrix}$$

$$\begin{bmatrix} \tau_1 \\ c_t \\ c_{t-1} \end{bmatrix} = \begin{bmatrix} \mu \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 \\ 0 & \phi_1 & \phi_2 \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} \tau_{t-1} \\ c_{t-1} \\ c_{t-2} \end{bmatrix} + \begin{bmatrix} \eta_t \\ \varepsilon_t \\ 0 \end{bmatrix}$$

This model can be estimated by using the Kalman filter and maximum likelihood. Bordoloi et al. (2009) have also formulated the Multivariate Unobserved Components (MUC) model using Monetary Condition Index (MCI) to estimate potential output.

2.5B. Statistical (Filtering) Techniques - Multivariate

The drawbacks of relying exclusively on the observed GDP series are overcome by Multivariate models. These approaches have become popular in recent years because they better reflect the data-intensive environment in which policy makers operate. While deriving the trend of the output, these approaches take into account the information from other (related) series, like unemployment, and their empirical association to that trend, which is modeled by a Structural Vector Autoregression[27] (SVAR) or the Kalman filter.

2.5B.1. Structural Vector Autoregression

27. A regression of variables on the past values of their own and other variables.

While considering the Structural Vector Autoregression approach, association between growth and inflation is used to differentiate between permanent and temporary movement in output. If the economy experiences faster growth with lower inflation, then it is operating below potential. Output is above potential when the economy experiences inflation along with growth. The variations in GNP and unemployment can be interpreted by two types of disturbances (Blanchard and Quah, 1989). They assume that these disturbances are uncorrelated with each other, and that neither has a long-run effect on unemployment. However, the first disturbance is assumed to have a lasting effect on output (supply disturbances), while the second disturbance does not (demand disturbances). These disturbances are defined by the identification restrictions.

In the study done by Bordoloi et al. (2009)**,** the estimate of SVAR is obtained by adopting the methodology prescribed by Blanchard and Quah (1989). Instead of using unemployment rate, rate of inflation is used in this study. Identification restrictions are imposed on the association between inflation and output. The first restriction imposes that the demand shocks affect the price level in the long-run, but not the output level. The second restriction requires that the supply shocks have lasting effects on both price levels and output. Thus, there is a permanent increase in the GDP level under a positive supply shock. On the other hand, a positive demand shock leads to higher output in the short-run.

Thereafter, for each period of inflation and output, the regression residuals are separated into the effects of supply shocks and effects of demand shocks. The component of the forecast error of output that is attributed to the demand shock, that is the shortfall or surplus of output with respect to potential output due to demand shock per se, is called output gap. Under the unrestricted VAR methodology, the effects of shocks are left unconstrained for all variables at all horizons. However, the restrictions on the long-run effects of shock on output and inflation are identified under SVAR approach. In the short-run, the effects of both supply and demand shocks are left unconstrained.

2.5B.2. Dynamic Stochastic General Equilibrium (DSGE) Approach

This model includes many characteristics of the real business cycle and permits the market rigidities and imperfections. Herein, potential output is defined as the level of output that an economy can attain if wages and prices were fully flexible, that is the rigidities in the labor market were removed. DGSE defines potential output as a flexible price equilibrium, that is potential output is that level of output where rate of inflation is zero.

However, there are important differences between DGSE approach and other conventional approaches for estimating potential output. Earlier models of real business cycle considered business cycles to be an efficient response to shocks received by the economy. Therefore, in many DSGE models, there can be huge variation in potential output over the business cycle. Moreover, variations in potential output can occur due to changes in preferences with regard to saving and consumption, and labor and leisure, fiscal policy shocks, and terms-of-trade shocks. On the other hand, production function approach generally assumes that such shocks do not have relevant effect on potential output relative to frequencies of business-cycle (Mishkin, 2007). Consequently, estimates obtained by production function approach have relatively smaller variations.

2.5B.3. Kalman filter

Kalman filter involves a two-step algorithm to project an unobserved variable with the help of various observed variables. Kalman filter uses a linear function of the priori estimate of the state variable to estimate a posterior value of a state variable. In the linear function, it considers the difference between the actual measurement and the formerly predicted value of the state variable. In the first step, Kalman filter predicts the unobserved variables by using the initial values for the unobserved state vector. In the second step, the estimates are updated based on the prediction errors. Based on the size of the measurement error, projected value of the state variable is adjusted. When the measurement error is large, the Kalman filter attaches a smaller weight.

The Kalman filter estimates the state variable by combining all the data that are measured with prior knowledge about the paths of the unobservable variables (the “state” equations), thereby minimizing the statistical error. Once all observations are processed, lower weight is given to observations that are more uncertain (i.e. which have a higher variance).

In the univariate Kalman filter, the output (y_t) is decomposed into a trend component (potential output, y_t^*), and a cyclical component (output gap, c_t):

$y_t = y_t^* + c_t$……………..22

The stochastic trend is modeled as local linear trend.

$y_t = y_{t-1}^* + g_{t-1} + \varepsilon_t^{y^*}$………………….. 23

$g_t = g_{t-1} + \varepsilon_t^{g}$…………………. 24

Where g_t stands for potential growth

Here, it is assumed that the cyclical component is stationary and follows and autoregressive process.

$c_t = \alpha_1 c_{t-1} + \alpha_2 c_{t-2} + \varepsilon_t^{c}$ ……………..25

It must be noted that $\varepsilon_t^{y^*} \backsim N(0, \sigma_{y^*}^2)$, $\varepsilon_t^{g} \backsim N(0, \sigma_g^2)$ and $\varepsilon_t^{c} \backsim N(0, \sigma_c^2)$.

To apply the Kalman filter to estimate the potential output, a system of behavioral equations consisting of IS curve, Phillips curve, Okun's law and/or a wage equation is constructed. With respect to the stochastic properties of potential output, assumptions need to be represented in the form of state equations[28].

2.5 C. Economic Method – The Production Function Approach

This is the one of the most widely used approach to calculate potential output. The objective of this approach is to build a model of the supply side in the economy by taking into account the structural factors. This approach relies on using the economic theory to explain the key economic drivers of output and growth in the medium-term. The production function establishes a relationship between output and level of technology and factor inputs, usually labor and capital. There can be many function types in the production function. The Cobb-Douglas type and Constant Elasticity of Substitution (CES) type production functions are extensively used.

28. For technical exposition of the multivariate Kalman filtering techniques, refer to Box 1 in Anderton et al., 2014: 'Potential Output From A Euro Area Perspective'.

The estimation of potential output involves following steps:

(1) Based on historical data, labor share is estimated or determined

(2) Trend total factor productivity (TFP) is obtained as the trend component of filtered GDP growth's Solow residual (i.e. output minus weighted sum of labor and capital inputs),

(3 Trend of TFP and potential labor and capital are derived, and

(4) potential output is estimated based on the trend values obtained in step 3

The production function is assumed to take the functional form of Cobb-Douglas function, with a constant-returns-to-scale. The level of output (Y) is dependent of two factor inputs: labor (L) and capital (K). Additionally, output is also dependent on Total Factor Productivity (TFP). TFP is measured as the Solow residual.

The Cobb-Douglas production function and the TFP are given by the following equations:-

$$Y = TFP(L)^{\alpha}(K)^{1-\alpha} \quad \text{..........................26}$$

where *Y* is real GDP; *L* is input of labor; *K* is a capital stock; *TPF* is total factor productivity, and α = average labor share. Since we have assumed constant returns to scale and perfect competition, the equation 26 implies that the elasticity of output with respect to the two-factor input equals the factor shares in output. Output elasticity with respect to labor is represented by α and elasticity of output with respect to capital is 1-α. The elasticity of substitution between labor and capital is 1 under Cobb-Douglas production function. In order to calculate the potential level of output, it is important to calculate the trend components of variables defined in the RHS of equation 26.

The trend component of filtered GDP growth's Solow residual is used to obtain the trend TFP series.

$$TFP_t = \frac{Y_t}{L_t^{\alpha}K_t^{1-\alpha}} \quad \text{...................28}$$

Finally, potential output is calculated by combining smoothened (HP filtered) series of total factor productivity, capital stock, and employment using the same production function.

$$lnY^* = lnTFP^* + \alpha lnl^* + (1-\alpha)lnK^* \ldots\ldots\ldots..29$$

With respect to empirical implementation of the production function approach, measurement of various inputs is a key challenge. A few assumptions have to be made about the functional type of production function, potential labor and capital. Proxies for trend components of the various inputs are found by means of statistical filter, i.e. detrending procedures like the HP filter used to obtain potential labor or trend productivity. This has a significant bearing on the gap estimate as this method shifts the end-point bias problem of HP filter to capital, labor and TFP components of the production function. That is, the estimates of potential output would be inconsistent during the periods of a major structural change in the economy. It is not possible to assume that production function remains stable over time, or that the unemployment fluctuates around some stable value of NAIRU. Despite the apparent difficulties, the information on structural breaks[29] can be more easily included in the production function framework than in the trend estimation method using HP filter.

2.6 Empirical Literature in Indian context

Different statistical filters have been used to estimate the potential output in Indian context. In order to estimate potential output, Bordoloi et al. (2009) select the appropriate method by both spectral analysis and regression analysis. Out-of-sample forecasts were assessed from the regression equation of potential output explaining inflation based on specific statistical criteria. Spectral analysis uses larger proportion of spectral mass in the range of business cycle frequencies. For monthly data, the estimates of the potential growth rates converge within the range of 9.4% to 9.7% under HP-filter, BP-filter, UUC model and the two SVAR methodologies. For quarterly data, estimates of the potential growth rate vary in the range of 8.1% to 9.5%. Since this study was conducted during the period of high growth, the estimates seem to be on the higher side and biased.

India's potential output growth was estimated by Mishra (2013) using filtering techniques, production function approach along with sensitivity analysis. For statistical filters, quarterly real GDP (2004 prices) at market prices is seasonally adjusted by X12 Arima procedure. The

29. Examples of structural breaks are changes in productivity, capital stock, labour markets, production structure, and technology.

production function approach is applied using annual data from Haver Analytics for 1980-2011. Potential growth increased from 5.1% in 2002 to 9.0% in 2007 across all methodologies. All methods indicate that output gap is positive in 2011 (0.7% of GDP) and potential growth is in the range of 7.7-8.2%.

In addition to the statistical filtering methods and production function approach, Anand et al. (2014) uses macroeconomic model-based multi filter method to estimate potential growth. Bayesian estimation method is used so that estimation of trend growth is consistent with the observed values of other key macroeconomic variables. This method is not simple to analyze the relation between various causes and trend growth. This method is not apt for estimating future trend growth while incorporating short-term time-series dynamics. They estimated potential growth in India at 8% before 2008 and 6 - 7% after 2008. They noted that due to heightened uncertainty in the regulations and policies, delay in approving and implementing projects, continued bottlenecks in the energy sector, and reform setbacks led to decline in trend TFP growth and slowdown in investment.

Blagrave et al. (2015) estimate potential growth and output gaps by considering annual data on real GDP growth, CPI inflation, and the unemployment rate for 16 countries. Bayesian estimation techniques and maximum likelihood estimation were used to estimate parameter values and the variances of shock terms. They found out that growth in India's potential output has declined from around 8% to below 6% during 2007 - 2012. Since 2012, output gap has turned negative.

Ranjan et al. (2007) estimated the production function by using data from 1980 to 2004 to provide growth in potential output. They found that the growth in potential output for India was 6.6%. Oura (2007) adopted standard growth accounting framework with Cobb-Douglas production function, and estimated growth in India's potential output at 8.0% for the medium-term. However, volatility in productivity gains and investment generate risk for the medium-term potential growth estimates. Based on Bosworth and Collins (2003), Rodrik and Subramanian (2004) assumed capital share of 0.35% and growth rate of TFP to be 2.5% per year to project India's potential growth of over 7.0%. Based on production function approach, estimates of long-term output growth is in the range of 6.5% to 8.0% in different time periods[30].

3. Methodology

In this section we discuss the methodology adopted to examine the cyclically adjusted fiscal balance of India. The methodology is broadly framed as per the IMF approach, which is modified to account for the relevant one-off factors in the Centre and State budgets as well as estimation of relevant elasticities to output gap as outlined in the EC approach. The methodology is thus a self-effacing amalgamation of both the IMF and EC approach.

The following discussion outlines the key steps underpinning the estimation of the CAB for India:

3.1 Estimating Cyclically Adjusted Primary Balance

$OB = PB - INT = CAPB + CPB - INT$ [31]

Where,

Primary balance (*PB*) is overall balance (*OB*) net of the interest payments (*INT*). We estimate cyclically adjusted primary balance (*CAPB*) to keep INT out of the estimation of CAB. This is done in line with the aggregate approach (Fedelino, 2009; Bornhort, 2011) which excludes interest payment from the CAB estimation as these are neither autonomous nor discretionary in any given time period. CPB is the cyclical primary balance; it captures the part of the fiscal overall balance that automatically reacts to the business cycle. CAPB is the cyclically adjusted

30.Refer Table 1 in Bhoi and Behera, 2016: 'India's Potential Output Revisited,' RBI Working Paper Series No. 05.

[31] In case of the budget terminologies followed in India, government overall deficit is termed as the fiscal deficit (FD), from which it follows that the primary deficit is fiscal deficit net of interest payments.
i.e. PD=FD-INT
-PB = -FB-INT
FB=PB-INT
Substituting OB for FB gives
OB=PB-INT

primary balance; it represents the part of the overall balance that is left after cyclical movements are eliminated.

Following the aggregate approach, CAPB is estimated as the difference between cyclically adjusted total revenue (R*) and cyclically adjusted total net government expenditure (G*). Unlike the disaggregate approach, we do not categorize revenue and expenditure into different components, which are thus taken as overall variables.

CAPB= R-G*.*………………………… (1)

Where

$R^* = R(\frac{Y^*}{Y})^{\varepsilon_{R,YGap}}$………………………… (2)

$G^* = G(\frac{Y^*}{Y})^{\varepsilon_{G,YGap}}$…………………… (3)

R* and G* are obtained by adjusting actual revenues and expenditure (nominal R and G) for the effect of the deviation of potential from actual output ($\frac{Y^*}{Y}$), with the revenue and expenditure elasticity to output gap ($\varepsilon_{R,YGap}$ and $\varepsilon_{G,YGap}$).

CAPB is finally estimated as a ratio of potential output in order to assess whether fiscal policies were pro-cyclical or counter cyclical. [32] A comparison of the actual and cyclically adjusted primary balance is made to understand the deviation of policy from cycles.

3.2 Adjusting for one-off factors

As the next step we adjust primary balance to any large, non-recurrent government operations. This is done to correct fiscal balances for impact of government operations that are observed for a single financial year. These may include budgetary support to ailing banks or companies or re-capitalization of state-owned enterprises, acquisition of a single, large capital item, such

[32] See Fedelino et al., 2009 on scaling of CABP.

as the purchase of military equipment, financing for recovery from an environmental or natural disaster, and clearance of budgetary arrears, including for wages or suppliers

3.3 Estimating Output Gap

Output gap measures the business cycle by decomposing output into the trend and cyclical component. The output gap is computed as the difference between actual to potential output to potential output (Y-Y*/Y*). Here output (Y) is the gross domestic product of India at the Centre and the average of 14 major states of India. The estimation of potential output (Y*) is carried out using three alternative methodologies *vis.*, Hodrik Prescott (HP) filter, the Band Pass (BP), Christiano-Fitzgerald filter (CF), and the production function approach. [33]

3.4 Estimating Aggregate Revenue Elasticity and Expenditure Elasticity to Output Gap

Revenue and expenditure elasticities to output gap capture the responsiveness of government revenue and expenditure to business cycles. In other words, elasticities measure the percentage change in revenue and expenditure to one percentage in output gap. Under the IMF approach, aggregate revenue elasticities to output gap is assumed to be one and aggregate expenditure elasticity is assumed to be zero. These assumptions are applied to be closer to empirically estimated aggregate elasticities (Bornhorst et al., 2011).

Apart from following the IMF-suggested assumptions on elasticities, this report also estimates the aggregate elasticities of revenue and expenditure with respect to output gap for the Centre and average state of India. The elasticities are estimated using the following regression equations.

Revenue elasticity to output gap

$$log\, R \;=\; \alpha + \varepsilon_{R,Ygap}\, log\left(\frac{Y}{Y^{*}}\right) + \mu \ldots\ldots\ldots\ldots \quad (4)$$

Expenditure elasticity to output gap

[33] These methods are detailed in section 2 of the report.

$$log\,G = \alpha + \varepsilon_{G,Ygap}\, log\left(\frac{Y}{Y^*}\right) + \mu \ldots\ldots\ldots\ldots\ldots (5)$$

The standard econometric method applied for estimation of elasticities has been tailored to account for certain control variables. Primarily these include a control for time trend and two dummy variables to control for tax reforms and policy change *viz.*, 1) introduction of VAT system of tax collection in FY 2004 (*VAT*), it takes value one for the FYs from 2004 and zero otherwise, 2) initiation of FRMB Act, 2003 (*FRMB*), it takes value one for the FYs from 2003 and zero otherwise.

4. Data Sources and Challenge

In order to compute year-on-year growth in national income, the GDP series at factor cost with constant (04-05) prices and with current prices were obtained from National Account Statistics published by Ministry of Statistics and Programme Implementation (MOSPI). The series of Capital Stock at constant (2004-05) prices and with current prices were also obtained from National Account Statistics published by MOSPI. The data for computing the year-on-year growth in labor employment was extracted from 43rd (1987-88), 50th (1993-94), 55th (1999-2000), 61st (2004-05), 64th (2007-08), 68th (2011-12) rounds of Employment and Unemployment Survey conducted by NSSO. Since the data available in these rounds represented the situation of employment in the respective years, the year-on-year growth rate in labor employment was interpolated and extrapolated using compound annual growth rate between different rounds for the entire duration of 1990-91 to 2016-17.

Data on total revenue receipts, total expenditure and interest payment for the Central government were obtained from Handbook of Statistics of Indian Economy published by Reserve Bank of India. Similar data for the states were obtained from Finances of State Government, RBI and Economic and Political Weekly Research Foundation. Net expenditure was calculated after subtracting interest payment from total expenditure.

The NSSO calculates the average wage earnings received by regular wage/salaried employees/ casual wage laborers in rural/urban area by taking a weighted average of wage earnings in each type of operation using estimated person days as the weights. Except for the 66th round (2009-

10), estimated person days for regular wage/ salaried employees is not available in the Employment and Unemployment survey reports for all the rounds. The estimated person days for casual wage laborers are reported in all the NSSO rounds. As estimated person days were available for both regular wage/salaried employees and casual wage laborers in the survey report of 66th round (2009-10), the ratio of average wage earnings received by regular wage/ salaried employees to the average wage earnings received by casual wage laborers in rural, urban, and rural plus urban area was found out to be equal to three. This value i.e., 3 was used as the multiplier along with the average wage earnings received by casual wage laborers to arrive at the average wage earning of regular wage/ salaried employees for other rounds. The final average wage earnings for each round was obtained by calculating the average of average wage earnings received by regular wage/ salaried employees and that received by casual wage laborers. Again, the year-on-year growth rates in average wage earnings were interpolated and extrapolated using compound annual growth rate between -different rounds for the period 1990-91 to 2016-17.

Indian labor market is difficult to analyze. A large part of the labor force is in the informal sector, where information is very difficult to collect on a monthly basis. The quinquennal Employment /Unemployment Survey conducted NSSO is inadequate in providing high frequency data on employment because these surveys are not held every year and there is a time lag for release of estimates. The extraction of data related to employment and wage earnings from different NSSO rounds is marred with issues around multiplier. The coverage of sectors has also expanded in subsequent series, which makes it difficult to completely rely on interpolation and extrapolation. Further the sample size varies to the extent that the estimations are not consistent for every round.

Interpolation and extrapolation with respect to data on employment and wage earnings for Andhra Pradesh, Bihar, Madhya Pradesh and Uttar Pradesh is difficult because they were divided to carve out new states. The data on Capital Stock is not available at the State level.

5. Results

This section of the report describes the estimation results of potential output, output gap, the revenue and expenditure elasticities to output gap and the estimated CAPB of Center Government of India (GoI) and for average of 10 State governments.

As the first step in estimation of CAPB, the report adopts three alternative methods to estimate potential output. As elaborated in the previous sections, these can be categorized as the statistical methods – HP and CF-BP Filter, and economic method—production function (Prod.Fn.), estimated using Cobb-Douglas production function under the assumption of constant return to scale. In the second step, estimations of revenue and expenditure elasticities to output gap are carried out, results of which are compared with corresponding estimates reported in the literature. In the final step, estimated CABP under various models are compared with the actual primary balance. The discussion that follows presents the results at the national and sub-national level in the above order.

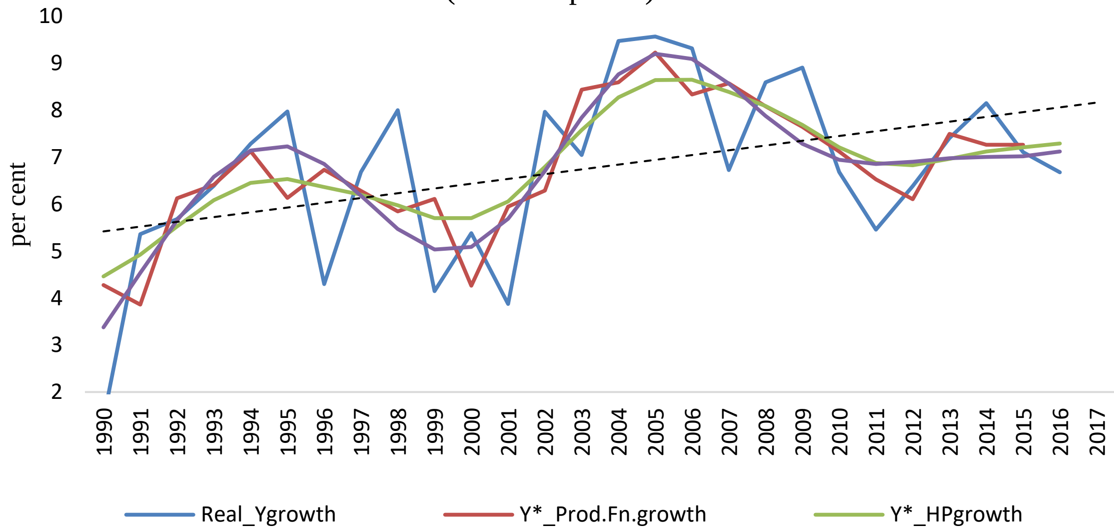
5.1. Actual-Potential GDP and Output Gap: All India (Real and Nominal)

5.1a: All India: Comparing Real- potential GDP Growth and Output gap to Potential Output

Figure 5.1 presents real and potential GDP during the period 1990 to 2017. *Actual_Ygrowth* plots the YoY growth in real GDP of India. *HP_Y*growth* plots growth rate in growth in potential GDP estimated by Hodrick Prescott method. Potential Output from HP filter are obtained by setting value of smoothing parameter as 6.25 following the frequency power rule given by Ravn and Uhlig (2002). The HP series is corrected for end point bias by fitted an ARIMA (2,2,0) model. *BP_Y*growth* is growth in potential GDP, estimated by BP-CF filter (Christiano Fitzgerald, 2002) with specifications- minimum period as 2, maximum period as 8 and symmetric moving average is taken as 2. CAGR of real GDP over the study period was found to be 6.7, for potential GDP (real) series obtained from employing HP filter and from BP-CF filter was found to be around 6.8.

Growth in potential GDP obtained from the economic method of production function ($Y^* = A^*(L^{*\alpha})^*(K^{*(1-\alpha)})$) is presented as *Prod.Fn.Y*growth*. Where, A is Total Factor Productivity (TFP) estimated as the residual i.e. $A= Y/(L^{\alpha}*K^{1-\alpha})$. L is labor income, computed as a product of average annual wage and total labor employed and K is net capital stock in constant price. α is labor share obtained as a ratio of labor income to GDP and (1-α) is capital share. BP-CF methodology was used to de-trend the parameters of production function in order to arrive at the potential TFP (A*), labor (L*) and capital (K*).

Figure 5.1: All India: Growth Rate of Real GDP and Potential GDP (2011-12 prices)



Note: GDP figures are annual (1990 to 2017) at constant price (2011-12) taken from NAS published by MoSPI.

Literature calculating TFP series for the Indian economy using different methodologies have mainly confined to TFP estimates at constant prices over the selected study periods. For the sake of comparison, this study estimated TFP and labor share at 2011-12 constant prices as well as at current prices by using published data from two sources *viz.*, NSS and Census for different rounds. Table 5.1 presents the estimates of TFP, labor share and capital share under alternative specifications vis-à-vis those reported in the literature. Real TFP Growth estimates for India during the periods 1990-91 to 2017-18 were found to average around 4.8 per cent using NSS data and 2.4 per cent using Census data on labor employment. In estimation, TFP estimates obtained from NSS employment data were used to arrive at the potential GDP.

Table 5.1: Labor Share, Capital Share and Total factor Productivity of All India and Average State vis-à-vis Literature

Source	Years	Capital Share(1-α)	Labor Share(α)	TFP Growth (CAGR)

Literature: India, Constant prices				
Bhoi & Behera (2016)	1980-2014	0.69	0.31	1.7
Ranjan (2007)	1980-2004	0.76	0.24	1.3
Rodrik Subramnium (2004)	1960-2000	0.35	0.65	2.45
Bosworth & Collin (2007)	1993-2004	0.4	0.6	2.3
Sanjoy Saha (2014)	1961-2008	0.3	0.7	1.49
Poddar & Yi (2007)	2003-2005	0.33	0.67	3.3
Mishra (2012)	1982-2011	0.3	0.7	3.6
All India Estimates				
Real (2004-05 prices)				
***NSS_ estimates**	1990-91 to 2017-18	**0.32**	**0.68**	**4.8**
Census _estimates		0.54	0.46	2.4
Nominal				
***NSS_ estimates**	1990-91 to 2017-18	**0.32**	**0.68**	**3.9**
Census _estimates		0.56	0.44	2.23

Note: * indicates to the selected method and data source in estimation of potential output under the production function methodology.

Table 5.2: All India: Slow Downs and Upturns in Output

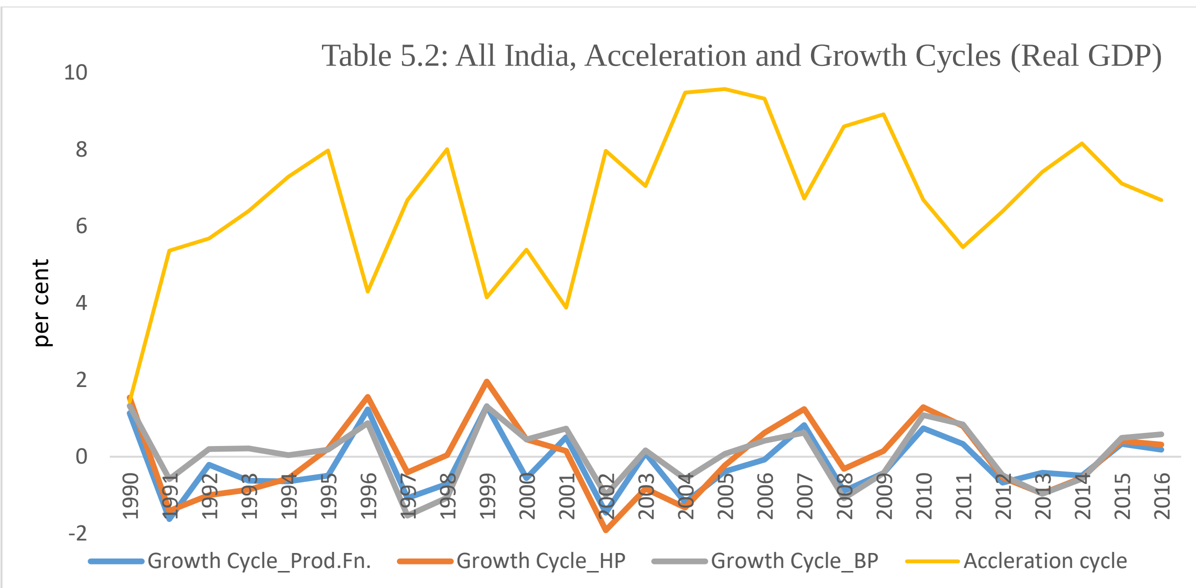
Movement	Cycle	Year	Real Y	Y*	Central Government Debt Stock
			(average percentage growth)		
Expansion	1st	1991-1995	6.5	5.9	64.4
Recession		1996-2001	5.4	5.8	60.2
Expansion	2nd	2002-2009	8.4	8.2	64.5
Recession		2010-2013	6.5	6.8	53
Recovery	Beginning of Recent Recovery	2015-2016	7.3	7.3	51

Note: Y* is potential output obtained from production function approach; Debt Stock is outstanding liability as a percentage of GDP.

Evident from the plot of growth in potential GDP vis-à-vis the growth in real GDP in figure 5.1, after removing the short term fluctuations, the long term trends or boom and bust cycles seem to clearly show the downturn/recession and upturn/expansion phases of the Indian economy. Details of these phases are presented in a Table 5.3. Against the long run trend in economic growth, table 5.3 illustrates the expansionary and recessionary phases of the economy and the corresponding growth in central government debt stock. The increasing growth in government debt stock during the expansionary phase and decline in the recessionary phase observed till 2013 gives a tentative indication to the pro-cyclicality of government expenditures. However, in the recent recovery phase some sign of acyclicality seem to appear with retained decline in debt stock growth. Detail analysis of the overall impact of business cycles on Centre government's primary balance is dealt with in the following sections. For now it is evident that the fiscal pro-cyclicality, prior to the recent recovery, has been an amplifier to the shock. In contrast, creating fiscal capacities for countercyclical policies would be ideally instrumental in preventing the economic hardships during recession.

5.1b: All India: Acceleration and Growth Cycle (Real GDP, 1990-2017)

Figure 5.2 illustrates the growth cycle of real GDP of India vis-a-vis the acceleration cycle during the period 1990 to 2016.



Note: Acceleration or growth rate cycle is calculated as growth rate of the actual output (e.g. real GDP); Growth cycle is defined as the difference between actual output and potential output expressed as a per cent of potential output.

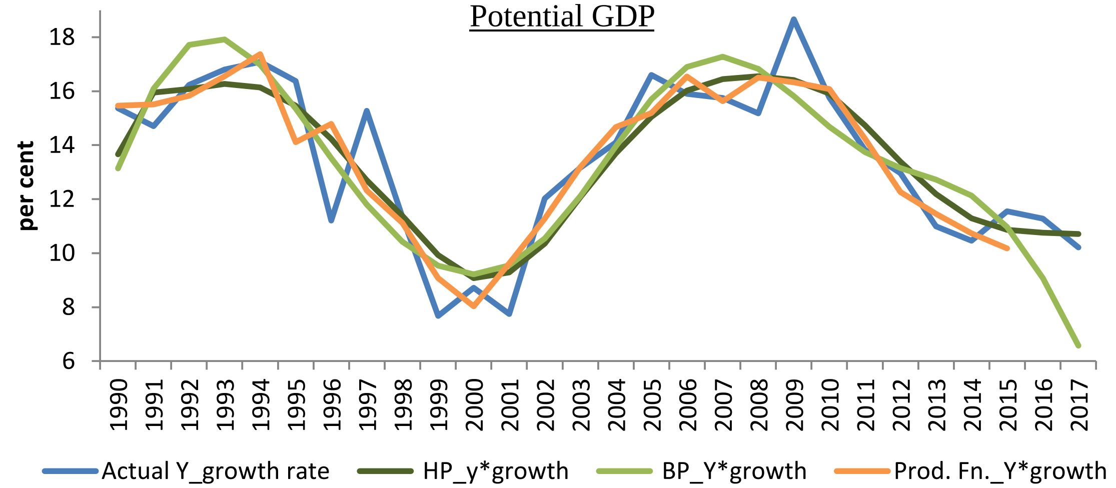
5.1 c: All India: Comparing Nominal - potential GDP Growth and Output gap to Potential Output

Figure 5.3 compares growth of actual GDP and potential GDP series estimated using alternative methods, at current price for India during 1990-91- 2016-17.[34] *Actual Y_growth* rate plots the growth rate of nominal GDP, CAGR of the series was found to be 13.27%. With

[34] Refer to Annexure figure A1 for comparison of actual and potential GDP of India at constant prices, 2004-05.

respect to the potential GDP estimated by statistical methods, *HP_Y*growth* plots the growth in potential GDP estimated by Hodrick-Prescott (HP) Filter. Following Ravn & Uhlig 2002, the value of smoothing parameter (λ) was taken as 6.25. Potential GDP series from HP filter was further corrected for the end point bias by fitting an ARIMA model (0,2,0). [35] The corresponding CAGR of the nominal GDP series was found to be 12.99%. *BP_Y*growth* represents growth in potential GDP estimated using the Bandpass-Christiano Fitzgerald (BP-CF) filter. CAGR of the BP-CF potential output series over the estimation period was found to be 13.43 %.

Figure 5.3 All India: Percentage Growth in Nominal GDP and Potential GDP



*Prod.Fn.Y*growth* presents growth of potential GDP estimated by Cobb-Dogulas production function under the assumption of constant return to scale (ie. $Y = A*L^{\alpha}*K^{1-\alpha}$). As reported in table 5.1, in the case of nominal TFP growth, the estimates average growth of 3.9 per cent using NSS data and 2.23 per cent using Census data over the study period. In estimation, TFP estimates obtained from NSS employment data were used to arrive at the potential GDP. CAGR of potential GDP (nominal) by production function was found to be 13.43%.

Growth rates of actual and potential GDP as the classical measure of business cycle, termed as *acceleration cycles* are presented in figure 5.3. These illustrate the sequence of downturns and

[35] ARIMA specification is carried using the Box-Jenkins methodology of identification, estimation and diagnostic test. The corresponding results of Unit Root test for identification of stationary and alternative specifications for ar(q) and ma(p) at the All India Level are presented in Annexure Table A1 and A2.

upturns in the economic activities over the period of 29 years analysed in the report, and are indicative of the booms and busts. For in the case of India, peak years in national income (nominal) are observed during 1992-93 to 1993-94 and 2010-11 to 2011-12 while the troughs seems to be appearing during 2000-01 to 2001-02 and most recently in 2016-17. The years between the peaks and the trough indicate to the period of recession and subsequent recoveries. In the next section of the report we will explore the possibilities of economic recovery beyond the trough observed in 2016-17. This is attempted by carrying out an ARIMA forecasting for the period 2018 to 2023.

Although, acceleration cycles are indicative of recurrent fluctuations that the economy experienced, it neglects the long run trend in GDP. As trend in the income series may govern the fluctuations, it is suggestive to de-trend the series so as to detect the underlying path, not directed by the cyclical fluctuations. For this purpose, *growth cycles* are used to lay down the structural path on which the economy is moving.

As discussed earlier in the report, growth cycles can be measured as output gap to potential output in percentage i.e. ((Y- Y*)/Y*)x100. Figure 5.4 presents the growth cycles estimated using alternative methodologies viz., HP, BP-CF and production function. Output gap by productions functions is estimated using the parameter specifications obtained under the NSS_estimations (table 5.1). As evident from the graph, at the all India level, alternative output gap to potential output series depict co-movement *albeit* varying momentums and amplitude. The alternative growth cycles show similar time periods of peaks and trough.

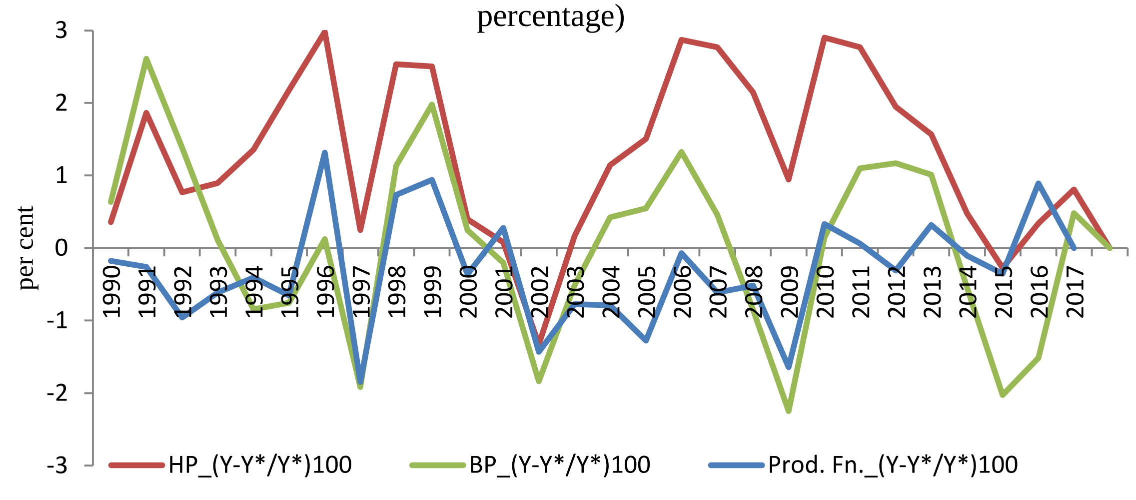


Figure 5.4: All India:Output Gap as a ratio of Potential GDP(Nominal, percentage)

To create an in-depth understanding of the economic path explained by the acceleration and growth cycles, in the following discussion we further explore these cycles by comparing the business cycle (given by actual and potential GDP, nominal), acceleration cycle (given by percentage growth rate of actual GDP, nominal) and growth cycle (given by output gap as per cent of potential output).

5.1d: All India: Business, Acceleration and Growth Cycle (Nominal GDP, 1990-2017)

A positive/negative output gap to potential output is expected to occur when actual output (GDP) is more/less than full-capacity. Typically, actual GDP drops below potential GDP during a recession, which creates a negative output gap, and rises above its potential level during boom to create a positive output gap. Utilizing deviation of actual to potential, captured by the output gap, growth cycles illustrated the persistence in economic down-turns and up-turns.

Figure 5.5 plots the actual GDP of India vis-à-vis potential and the corresponding figure 5.6 illustrates the acceleration and growth cycle for the period 1990-2017.

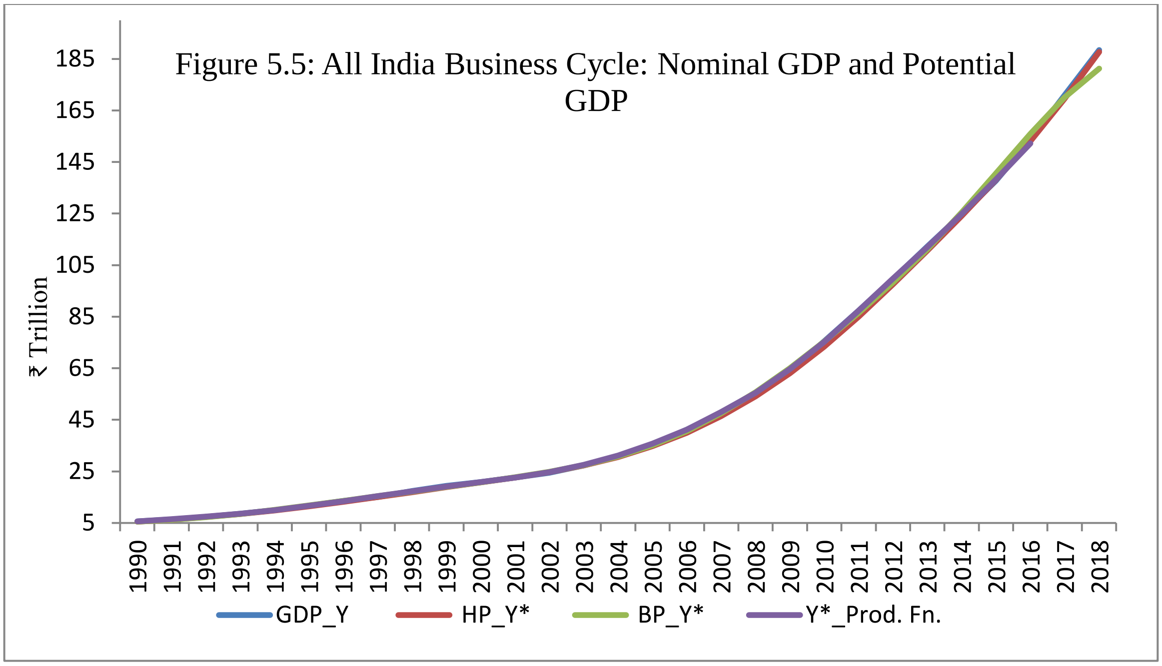


Figure 5.5: All India Business Cycle: Nominal GDP and Potential GDP

Note: Business Cycle plotted as nominal GDP and Potential GDP in Rs Trillion

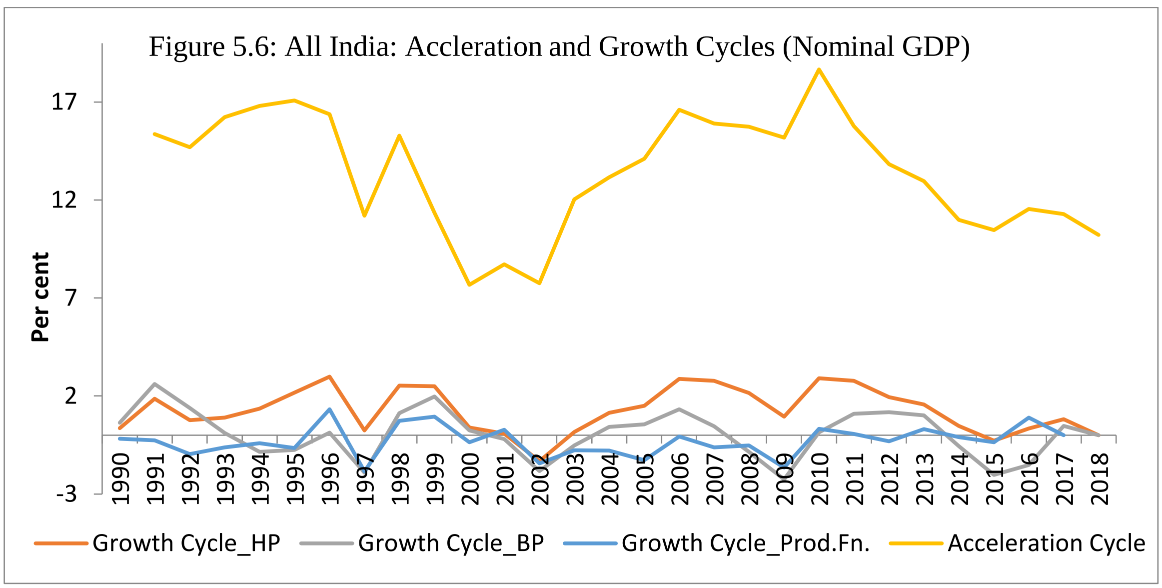


Figure 5.6: All India: Accleration and Growth Cycles (Nominal GDP)

In the case of All India, in figure 5.3 business cycles shows an economic upturn during 1998-1999; an economic down turn during 2000 to 2003 and an economic recovery from 2007 onwards. However, the business cycles are not indicative of the period for which these fluctuations persisted. For this we study the growth cycles, in order to study the persistence of downturns and upturns in output. As evident in figure 5.6, the rise/fall in the growth cycles continues for longer than that warranted by the peaks/ troughs in acceleration cycle. This implies that the downturns usually persist for long in the output gaps than in the simple growth rates.

5.2. Actual-Potential GDP and Output Gap: Average State (Real and Nominal)

5.2a: Average State: Comparing real- potential GDP Growth and Output gap to Potential Output

Figure 5.7 presents compares the real average GSDP and potential GSDP of major States of India. As mentioned in earlier, this report attempts to estimate output gap at the sub-national level using the statistical methods *viz.*, BP-CF and HP filter. The economic method of production function was dropped in the case of average states due to non-availability of state wise data on net capital stock. The real average GSDP of 10 states included in the study i.e. Goa, Gujarat, Haryana, Karnataka, Kerala, Maharashtra, Odisha, Punjab, Rajasthan and Tamil Nadu is denoted as Y_Real while the estimated potentials (from Statistical Methods) are denoted as Y*_HP and Y*_BP. The corresponding Figure 5.8 illustrates the acceleration and growth cycles and Table 5.4 presents a detail explanation of expansion and recession phases of State economies.

Figure 5.7: Average State: Growth Rate of Real GSDP and Potential GSDP

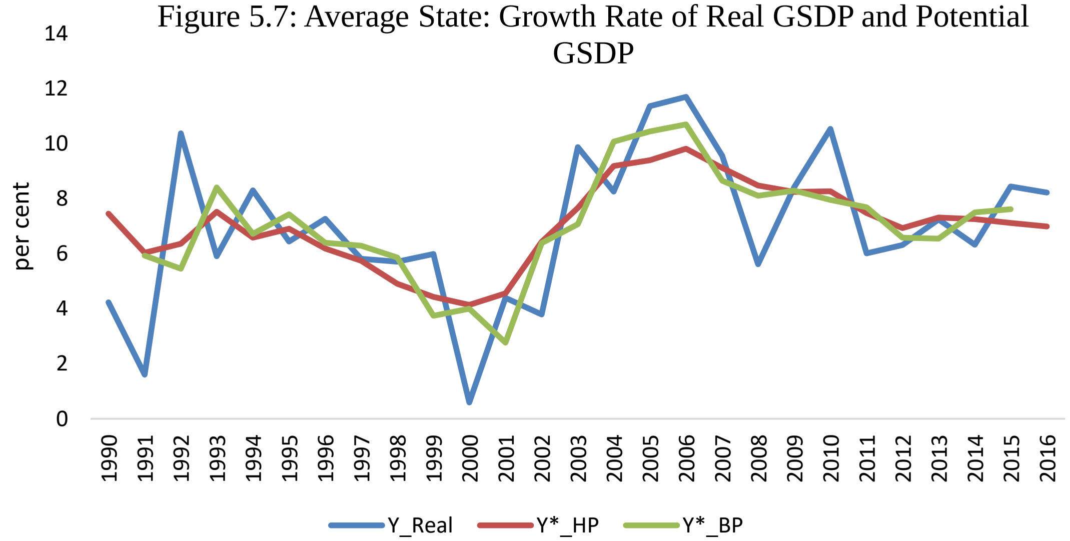
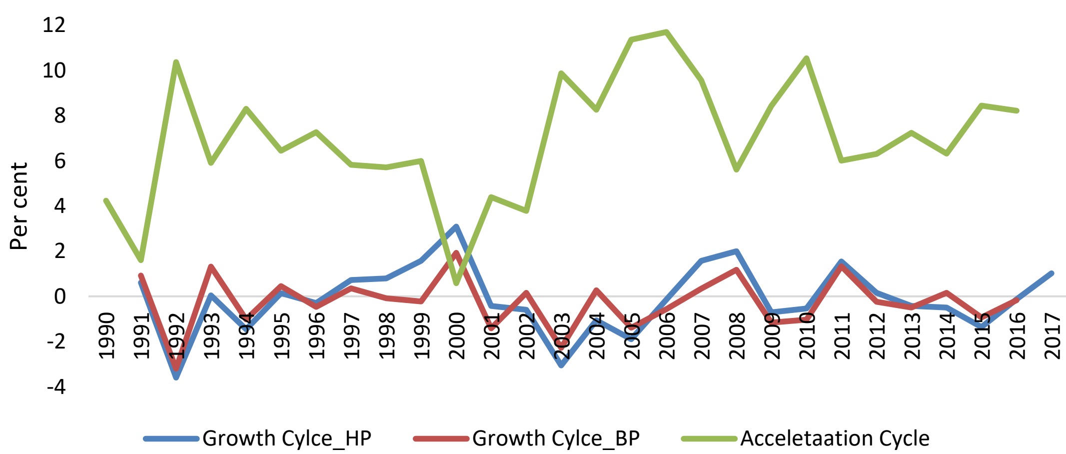


Table 5.3: Average States: Slow Downs and Upturns in Output

Movement	Cycle	Year	Real Y	Y*	State Government Debt Stock
			(average percentage growth)		
Expansion	1st	1990-1994	6.08	6.7	17.9
Recession		1995-2002	5	5.4	18.5
Expansion	2nd	2003-2007	10.2	9	19.2
Less Steep Down Turn		2008-2016	7.5	7.6	10.5

Note: Y* is potential output obtained from production function approach; Debt Stock is average outstanding liability as a percentage of average GSDP of 10 major States

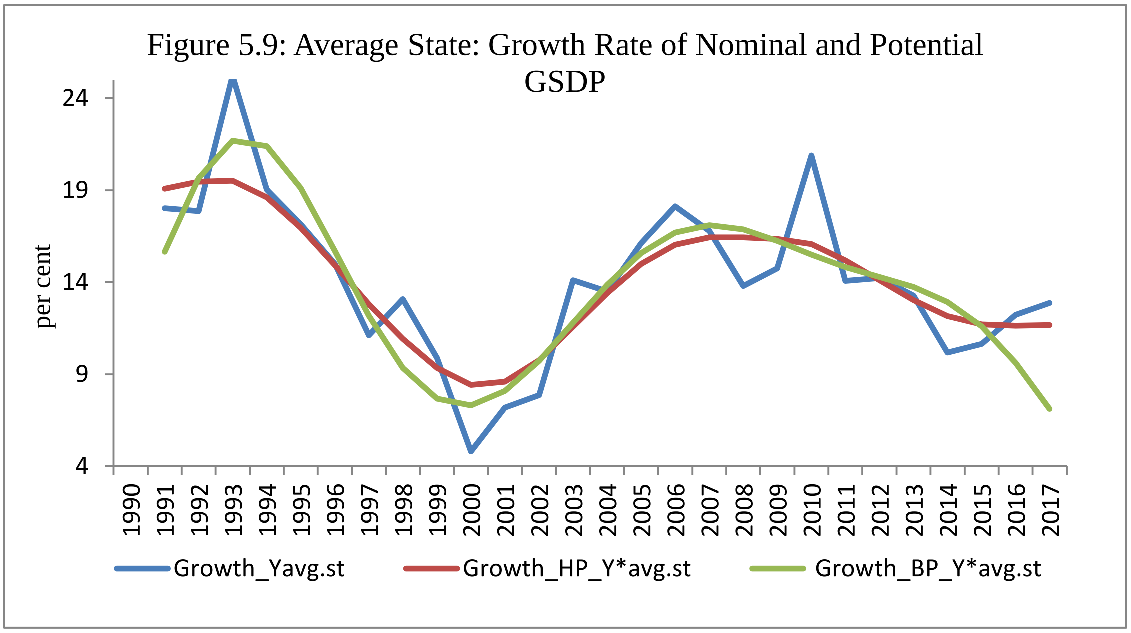
Figure 5.8: Average State, Acceleration and Growth Cycles (Real GSDP)



Over the study period, at the sub-national level, real GSDP saw an expansionary phase from 1990 to 1995 and during 2003 to 2007. The slowdown of the sub-national economy was observed in 1995 to 2002 and 2008 to 2016. A rather less steep recessionary phase seems to have occurred in the recent decade at the state level. As far as the fiscal pro-cyclicality at the state level is concerned, sub-national fiscal policy seem to have moved from acyclical (1st cycle) to pro-cyclical (2nd cycle) fiscal stance.

5.2b: Average State: Comparing Nominal- potential GDP Growth and Output gap to Potential Output

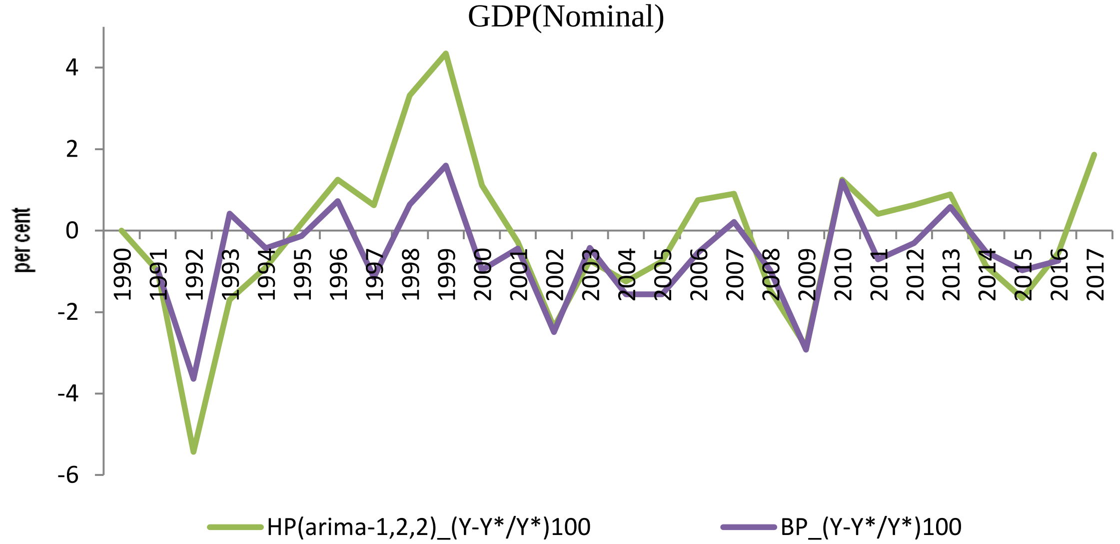
Figure 5.9 illustrates the *acceleration cycles* i.e. growth in nominal average GSDP vis-à-vis and potential average state GDP during 1990-91 to 2016-17. The nominal average GSDP of 10 states is denoted as *Growth Y_avg.st*. CAGR of actual average GSDP was found to be 13.43%.



Statistical filters separate actual GDP in cyclical component and trend or the potential component. *Growth_HP_Y*avg.st* plots the growth in potential GDP estimated by HP filter. The value of the smoothing parameter (λ) was taken as 6.25. Potential GSDP series obtained on application of HP filter were adjusted for the end-point bias by fitting an ARIMA model of specification (3,1,1) for (p,d,q). CAGR of this series was found to be 13.8 per cent. *Growth_BP_Y*avg.st* is growth in potential GSDP estimated by BP-CF filter. The specification to the filter includes- min period as 2 and maximum period as 8. Symmetric moving average is 1 (following Ravn & Uhlig 2002). The corresponding CAGR of the series was found to be 13.51%.

Figure 5.10 plots the *growth cycles* i.e. output gap as a percentage of potential output estimated for average states' income under alternative methods, calculated as ((Y- Y*)/Y*)x100. At the state level, output gap series estimated from the alternative methods depict co-movement with identical years of peaks and troughs. However, unlike the cycles observed at the All India level, cyclical components seem to observe relatively similar amplitude for output gap series of average State GDP. Major dips are observed in 1992, 1997, 2002, 2009 and 2014, 2015 and 2016 indicating average GSDP to be less than the potential in for the respective FYs.

Figure 5.10 Average States' Output Gap as a Ratio of Potential GDP(Nominal)



5.2c: Average State: Business, Acceleration and Growth Cycle (1990-2017)

In figure 5.11 and 5.12 plots the actual GSDP of Average State vis-à-vis potential and the corresponding figure 5.4 illustrates the acceleration and growth cycle for the period 1990-2017.

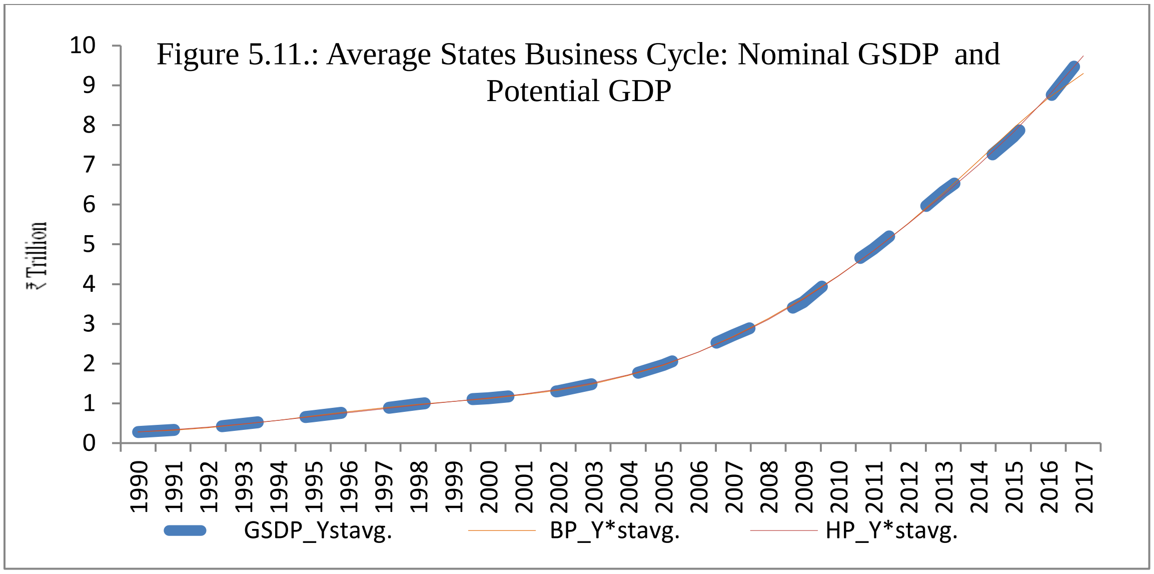


Figure 5.11.: Average States Business Cycle: Nominal GSDP and Potential GDP

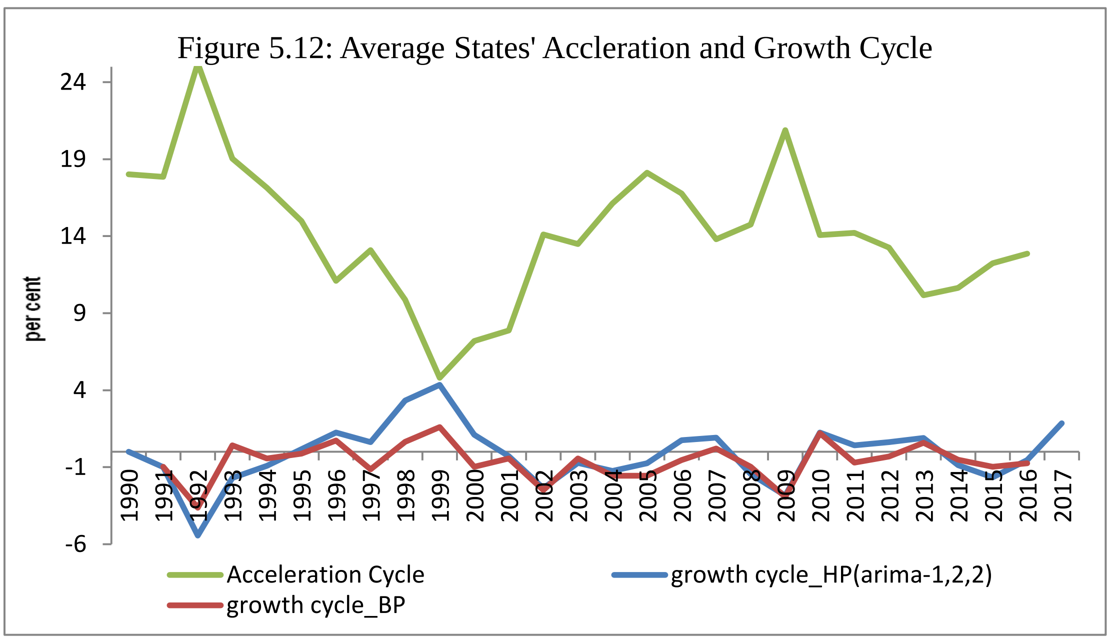


Figure 5.12: Average States' Accleration and Growth Cycle

As observed in figure 5.11, the actual average GSDP seems to overlap with the potential GSDP throughout the study period. Thought the nominal GSDP depicts an upward trend of rising GSDP over the study period, a slight swing in the business cycle of rising output in 1998 and subsequent falling output is visible between 2000 and 2005.

As far as the persistence in the upturns and downturns are concerned, figure 5.12 shows rising/ falling growth cycles against the declining/ recovering acceleration cycles. This again indicates to the down turns and recoveries in the growth cycle retain their impact for a longer time than those shown by the peaks and trough of the acceleration cycle.

5.3 Revenue and Expenditure Elasticity to Output Gap and Estimated CAPB: Central Government and Average of the State Governments

As the second step to estimation of CAPB, revenue and expenditure elasticities to output gap were estimated using the regression approach for the Centre and average of 10 major States. Table 5.5 reports the estimated elasticities obtained under the alternative specifications.

Computation of revenue and expenditure elasticities to output gap involved estimating log-log regression (equation 4 and 5). Under the regression approach Ln (Revenue)/Ln (Expenditure) is regressed on Ln (output gap) and time trend, where Ln (Revenue) is logarithm of revenue and Ln (Expenditure) is logarithm of expenditure net of interest payment. Output gap (Y-Y*) is logarithm of output gap calculated by subtracting actual output with potential output under alternative specifications.

Table 5.4: Estimation of Revenue and Expenditure elasticity to Output Gap

Output gap(Ln(Y/Y*))	Ln(Revenue)	Ln(Expenditure)
	Revenue Elasticity	Expenditure Elasticity
IMF Approach	1	0
Regression Approach		
GoI		
HP Filter	3.909 ***	1.682
	[0.000]	[0.254]
BP-CF Filter	2.19 *	0.3686
	[0.015]	[0.791]
Production Function	2.90 *	.8565
	[0.065]	[0.720]
10 State Average		
HP Filter	0.61080	0.74019
	[0.422]	[0.117]
BP-CF Filter	1.571*	1.439*
	[0.031]	[0.088]
Odisha		
BP-CF Filter	1.22*	0.76
	[0.019]	[0.194]
HP Filter	1.31*	0.83

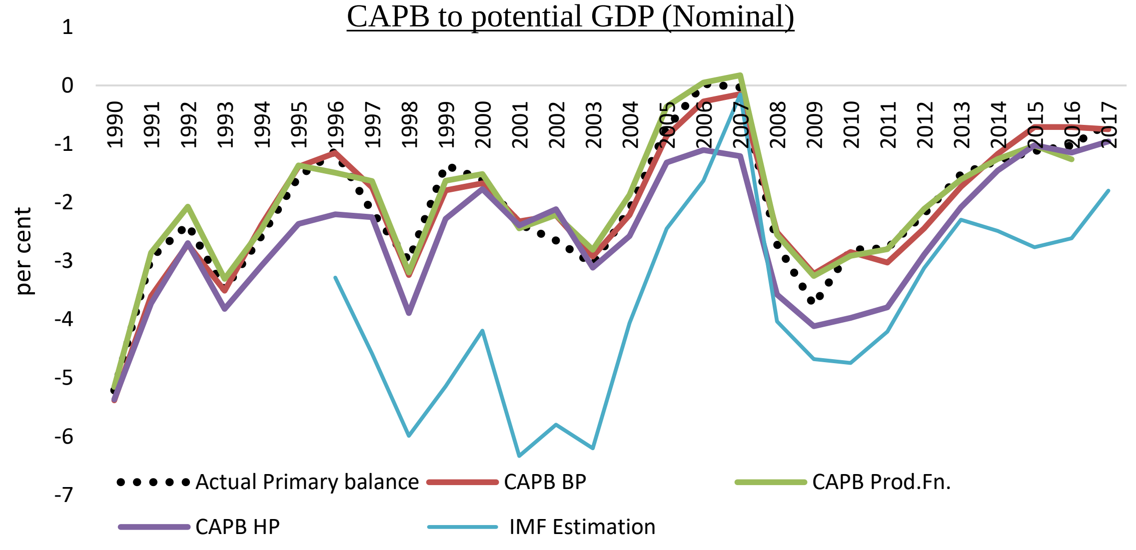
	[0.002]	[0.179]
Punjab		
BP-CF Filter	2.18**	0.86
	[0.060]	[0.491]
HP Filter	1.7	1.56
	[0.166]	[0.782]

Note: p value in parenthesis. *, **, *** represents the 1 % significant test, 5% significant value and *** represents 10 % level of significance.

The estimates obtained using revenue, expenditure and GDP series at current prices suggest statistically significant revenue elasticity to output gap ranging between 2.9 to 3.9 across the specifications for the GOI and of about 1.57 for the average State governments. With respect to individual states, estimated revenue elasticity to output gap for Odisha was around 1.3, significant and for Punjab 2.18, significant. The estimates of expenditure elasticity to output gap were found to be insignificant except for in the case of average 10 States under the specification BP-CF filter. Under this specification, employed for estimation of output gap at the sub-national level, the estimate suggests an expenditure elasticity of 1.43 for average major States. Further potential revenue and potential expenditure were computed by substituting relevant estimates in equation 2 and 3 given in the methodology section of the report.

In the final step to estimation of CAPB, the potential revenue, expenditure and respective elasticities to output gap were substituted in equation (1) presented in the methodology section. Figure 5.13 plots the cyclically adjusted primary balance (CAPB) estimated using different approaches (Statistical methods and production function method) for the Central government. *Actual Primary Balance* (nominal) is the gap between total revenue receipt and total expenditure net of interest payments taken as a proportion of nominal GDP. *CAPB* is cyclically adjusted primary balance (estimated as potential revenue-potential expenditure)/potential output) estimated by alternative methods for estimation of potential output denoted as *CAPB BP, CAPB Prod.Fn. and CAPB HP*. For the sake of comparison corresponding IMF estimates retrieved from IMF web source are plotted along with our estimates.

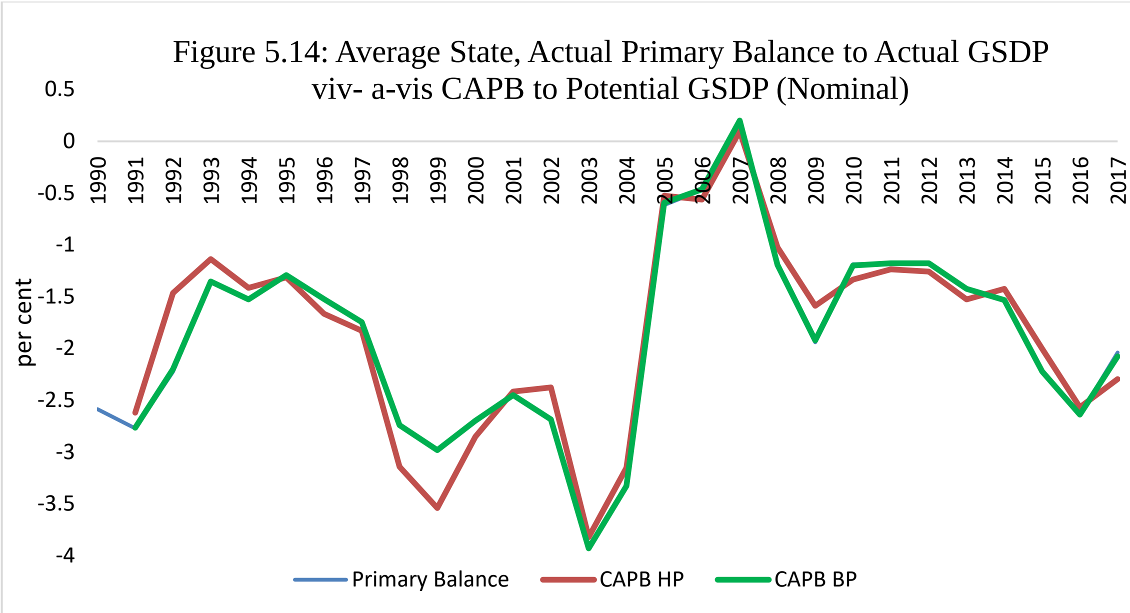
Figure 5.13: GoI, Actual Primary Balance to actual GDP vis-a-vis CAPB to potential GDP (Nominal)



As is evident from the figure, all the alternative CAPB series show co-movement with the actual primary balance series. For most of the study period both actual primary balance and CAPB have remained in deficit. Significant improvement in primary balance is observed during the period 2003 to 2007, with rising PB to report positive balance. This seems to be on account of the initiation of FRBM Act in 2003-04.

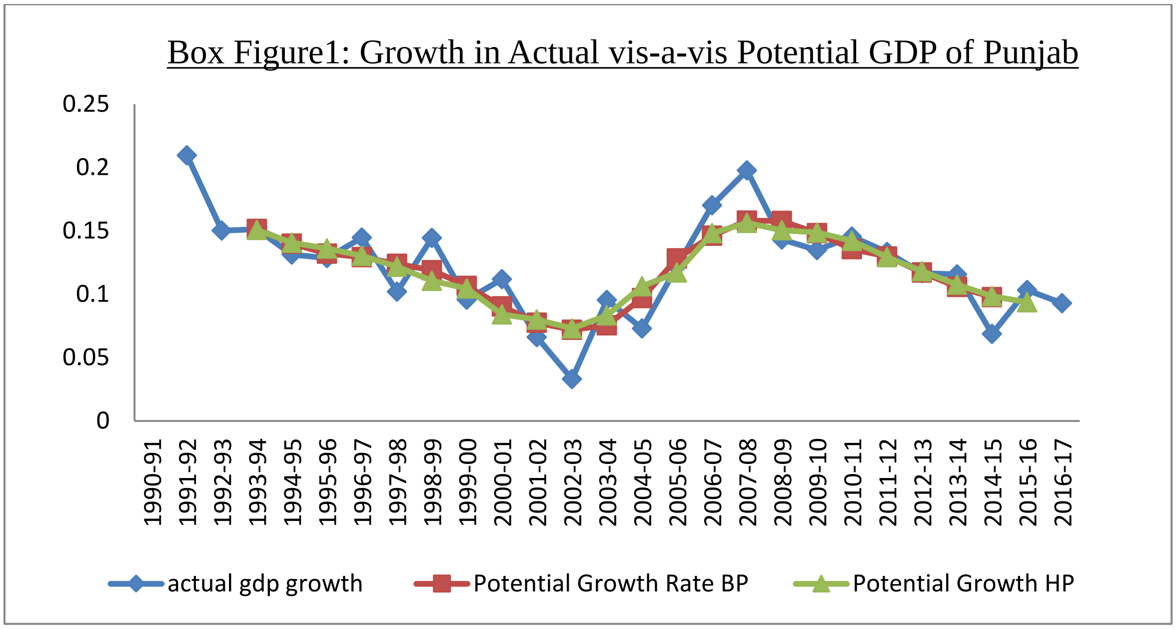
The co-movement in actual and cyclically adjusted primary balance is also indicative pro-cyclicality of the central government balances over the study period. However, sign of counter- cyclicality in the center’s balance is visible in the 2015 and 2016. For these years actual balance and CAPB seem to be on opposite paths. This is observed during the recovery phase (2013 onwards), CAPB shows downward movement, while primary balance continues to improve.

At the sub-national level, Figure 5.14 compares the actual primary balance vis-à-vis the CAPB calculated by the different methods. The estimation procedure is similar to that adopted for estimation of CAPB of Central Government.



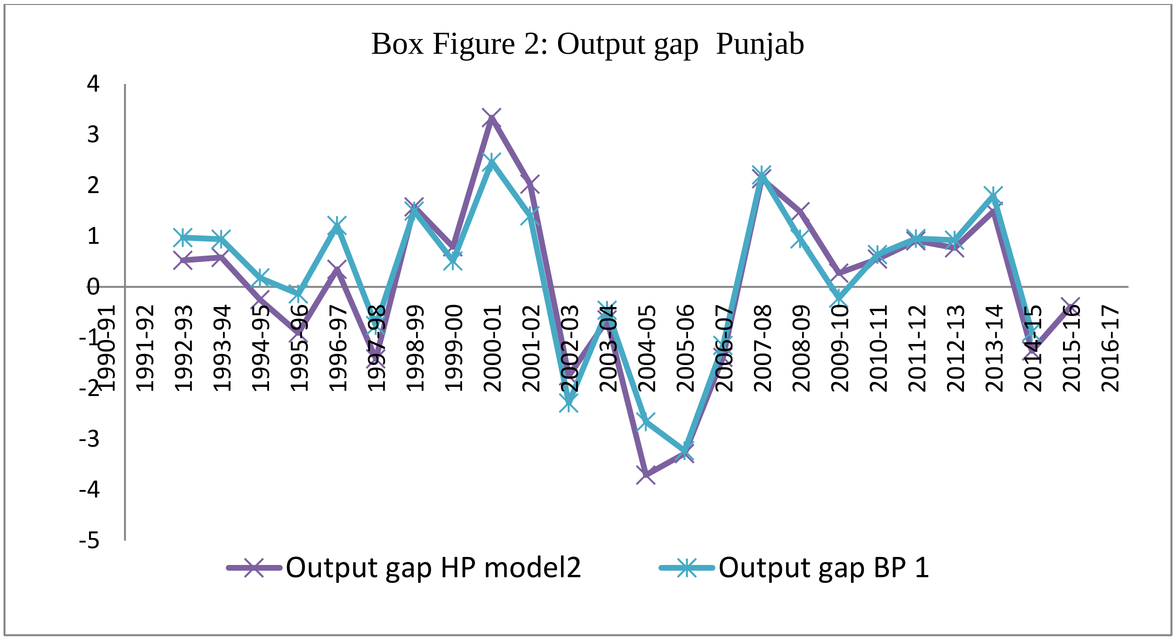
For the average State, revenue and expenditure elasticities to output gap are taken as 1 and 0 respectively, following IMF approach and as 1.57 and 1.39 respectively following the regression estimation approach. CAPB series for the average states show co-movement with actual average primary balance over the study period, clearly indicating the pro-cyclical nature of fiscal policies at the sub-national level. As in the case of central government, average state primary balance shows improvement from 2003 to 2007 and 2008. However, unlike the center, state balances remain pro-cyclical for the recent years. For the years- 2014 to 2016, both average state primary balance and CAPB show deterioration followed by a 0.5 per cent improvement in year 2017.

Box1. Case Study- State of Punjab and Odisha



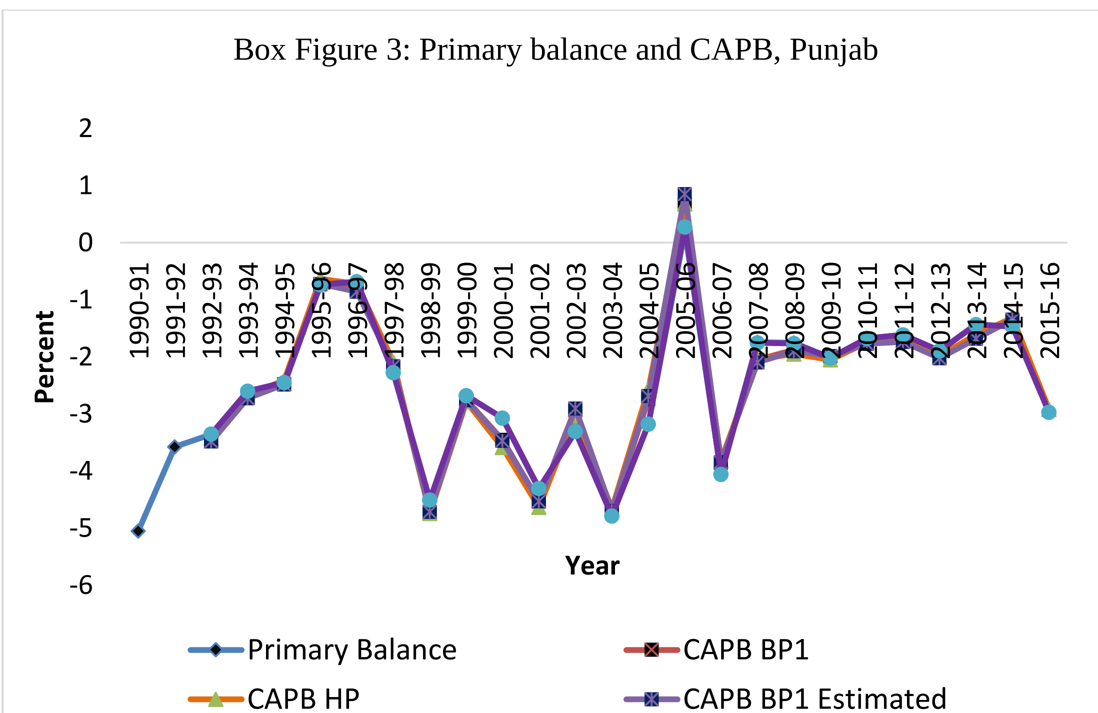
Note: Calculation is based on GSDP data for Punjab taken from Handbook of Statistic on Indian States published by RBI. Author estimated potential GSDP by using statistical filters (HP and Bandpass (CF)). STARTSTART

Box Figure 1 illustrates growth rate of actual Potential GDP of Punjab, where GDP is Punjab's GSDP at current price. Compounded annual growth rate (CAGR) of actual GDP is 12.16%. Annual growth in potential GDP BP is year on year growth rate of potential GDP estimated by Bandpass (Christiano Fitzgerald) Filter. In that model we have chosen min period as 2 and maximum period as 8. Symmetric moving average is 2 (). Compounded annual growth rate (CAGR) is 11.96 %. Annual growth in potential GDP HP is year on year growth rate of potential GDP estimated by Hodrick Prescott (HP) Filter. In this model smoothing parameter (λ) is 6.25. Both of these filters separate actual GDP in cyclical and trend component. Trend component is also known as potential (cyclically adjusted). Cyclical component is difference of actual and potential GDP. HP end point biasedness is removed by ARIMA model and its specification is (1, 2, 2) for (p, d, q). CAGR of this model is 11.68%.



Note: Output gap is computed by using statistical filters (HP and Bandpass filters) on GSDP data of state of Punjab.

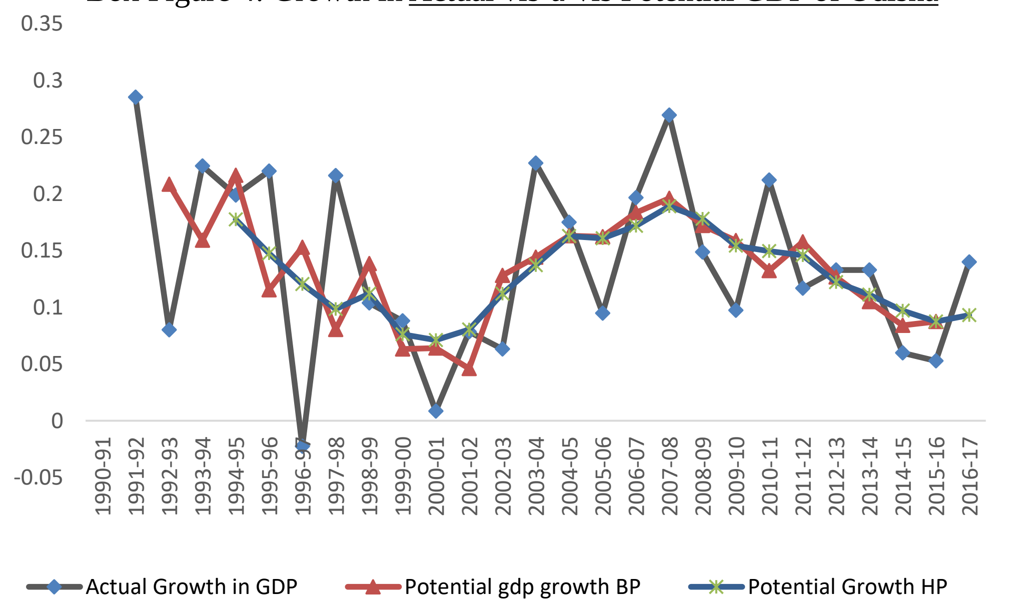
Box Figure 2presents output gap of Punjab state and it is calculated as ((Y- Y*)/Y*) x100. Where Y is actual GDP of Punjab and Y* is Potential output, calculated by two methods, Band Pass filter and Hodrick Prescott (HP) filter. Major dip can be seen in 1995-96, 1998-99, 2003-04, 2005-07 and 2010-11.



Box Figure 3 plots the actual primary balance and cyclically adjusted primary balance for Punjab. Cyclically adjusted primary balance is computed by using statistical methods (HP and Bandpass (CF) filter). Actual Primary Balance is defined as ratio of difference of revenue receipt and net Govt. expenditure and actual GDP. Net Govt. expenditure refers total expenditure by state minus interest payment.

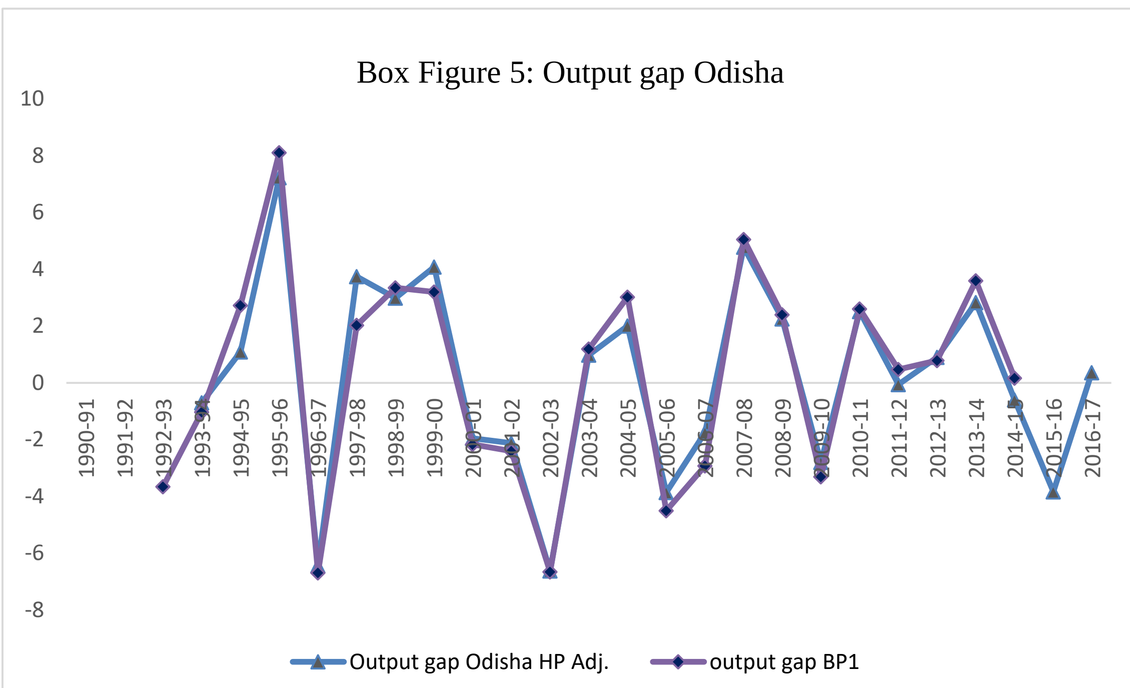
CAPB HP is cyclically adjusted primary balance estimated as (Potential revenue- Potential Expenditure)/Potential output estimated by HP Filter method. Potential Revenue is $(R^*(y^*/y)^\wedge\varepsilon_{rY^*})$. Potential Expenditure is $(G^*(Y^*/Y)^{\varepsilon rY^*}$. Y^* is potential GDP obtained by HP filter, Y is actual GDP. E_{rY^*} is revenue elasticity which is taken as 1 and E_{gY^*} is expenditure elasticity which is taken as 0 for computing CABP by IMF approach and it has taken as (1.7 & 1.56 both are insignificant) respectively as revenue elasticity and expenditure elasticity (own estimation). Elasticities are computed by regressing log revenue on log of output gap. CAPB BP is cyclically adjusted primary balance estimated as (Potential revenue- Potential Expenditure)/Potential output following the same procedure as above. Output is estimated by BP Filter method. For model CAPB BP1, elasticities are taken as 1 & 0 respectively. And for model CAPB BP estimated elasticities are taken as (2.18 & 0.76 significant).

Box Figure 4: Growth in Actual vis-a-vis Potential GDP of Odisha



Note: Potential and actual GSDP series of state of Odisha for the period 1990-91 to 2016-17.

Box Figure 4 presents year on year growth of actual GDP where GDP is Odisha's GSDP at current price. Compounded annual growth rate (CAGR) of actual GSDP is 13.35%. Potential GSDP growth BP is year on year growth rate of potential GSDP estimated by Bandpass (Christiano Fitzgerald) Filter. In that model we have chosen min period as 2 and maximum period as 8. Symmetric moving average is 2. Compounded annual growth rate (CAGR) is 12.90 %. Potential growth HP is year on year growth rate of potential GDP estimated by Hodrick Prescott (HP) Filter. In this model smoothing parameter (λ) is 6.25. Both of these filters separate actual GDP in cyclical and trend component. Trend component is also known as potential (cyclically adjusted). Cyclical component is difference of actual and potential GDP. HP filter has one disadvantage, it is biased at end point. End point biasedness is removed by ARIMA model and its specification is (2, 3, 2) for (p, d, q). CAGR of this model is 12.35%.

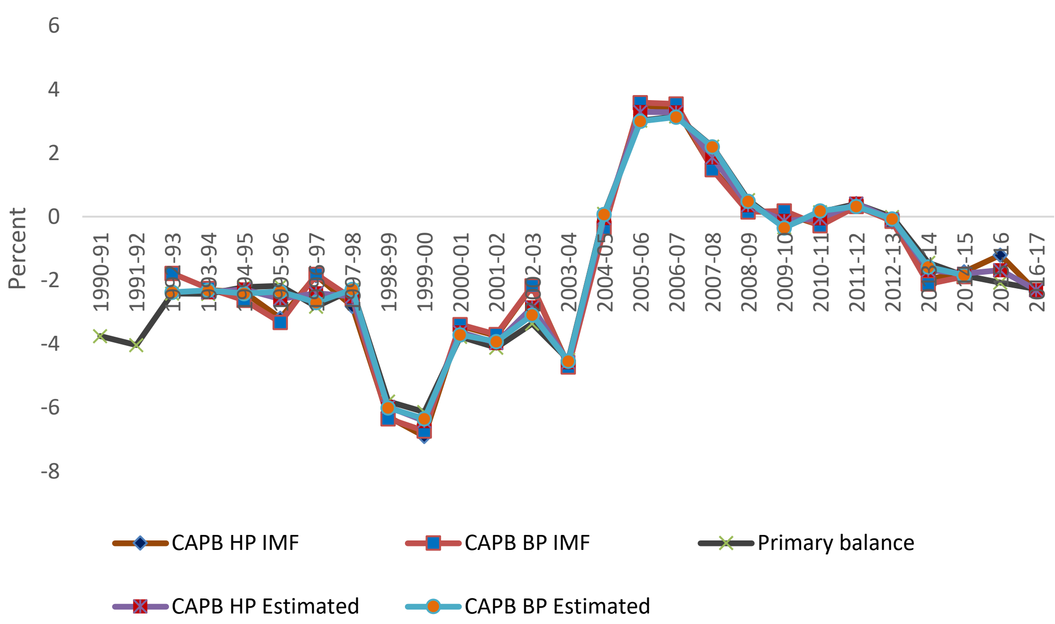


Box Figure 5: Output gap Odisha

Box Figure 5 illustrates output gap of state of Odisha, calculated as ((Y- Y*)/Y*)*100. Potential output is calculated by two methods, Band Pass filter and Hodrick Prescott (HP) filter.

Box Figure 6 plots primary balance and cyclically adjusted primary balance (CAPB), calculated by the different statistical methods. Actual primary balance is defined as ratio of difference of revenue receipt and net Govt. expenditure of Odisha. Net Govt. expenditure refers total expenditure by state minus interest payment.

Box Figure6: Primary balance and CAPB, Odisha



CAPB HP is cyclically adjusted primary balance estimated as (Potential revenue- Potential Expenditure)/Potential output estimated by HP Filter method. Potential Revenue is $(R^*(y^*/y)^{\wedge}\varepsilon rY^*)$. Potential Expenditure is $(G^*(Y^*/Y)\varepsilon rY^*$. Y^* is potential GDP obtained by HP filter, Y is actual GDP. ErY^* is revenue elasticity which is taken as 1 and EgY^* is expenditure elasticity which is taken as 0 for computing CABP by IMF approach and it has taken as (1.31 and significant & 0.83 insignificant) respectively as revenue elasticity and expenditure elasticity (own estimation). Elasticities are computed by regressing log revenue on log of output gap. CAPB BP is cyclically adjusted primary balance estimated as (Potential revenue- Potential Expenditure)/Potential output following the same procedure as above. Output is estimated by BP Filter method. For model CAPB BP, elasticities are taken as 1 & 0 respectively. And for model CAPB BP estimated elasticities are taken as (1.22 significant& 0.76 insignificant).

6. CAPB Forecast

This section presents the results of forecasted CAPB for the Centre and average State government of India. The forecast estimations are carried out for a period of five years from 2018 -2023. For this purpose, the report adopts a simple time series ARIMA forecasting technique which involves mathematically modelling the data generating process of past observations and thereafter using the model specifications for future forecasting.

ARIMA- Auto Regressive Moving Average modelling is a combination of two linear time series models i.e. AR- Autoregressive (p) and MA Moving Averages (q), along with the stationarity of the series given by the level of differencing (d). The model specifications are based on the Box-Jenkins methodology of identification, parameter estimation and diagnostic test.

The following mathematical formulation gives the standard textbook presentation of an ARIMA model.

$$\varphi(L)(1-L)^d y_t = \theta(L)\varepsilon_t$$

This can be rewritten as:

$$\left[1-\sum_{i=1}^{p}\varphi_i L^i\right](1-L)^d y_t = \left[1+\sum_{j=1}^{q}\theta_j L^j\right]\varepsilon_t$$

Were,

$Ly_t = y_{t-1}$ is the lag operator

p, d and q are integers greater ≥ 0, represents the order of the autoregressive, integrated, and moving average specifications of the model. Order identification of AR and MA terms is carried out using the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) analysis by plotting the respective correlograms against the consecutive time lags. Alternatively, the order of AR and MA can also be selected through Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC).

Based upon the optimal model order, a best fitted model is used to generate forecasts reflecting the series' historical pattern. Comparison between the models and forecast model accuracy can be tested through alternative performance measures. Some of the popular measures adopted in the literature include Mean Forecast Error (MFE), Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE), Mean Percentage Error (MPE), Mean Squared Error (MSE), Sum of Squared Error (SSE) etc.

The discussion that follows presents the ARIMA-forecasted estimates of the relevant parameters and CAPB series. These are computed under the alternative methodologies adopted in the report for both center and average states of India. These include forecast estimates of potential output, output gap, respective labour and capital share estimated using forecasted total employment series, revenue and expenditure elasticities to output gap using forecasted revenue, expenditure and output series.

The section is further organized as following. Section 6.1 presents the ARIMA-forecast estimate comparison of actual-potential output and output gap computed using different methods. Section 6.2 presents forecasted estimates of revenue and expenditure elasticity to output gap and section 6.3 discusses the forecast estimates of center and average state CAPB obtained using alternative methods.

6.1 Potential Output and Output Gap: All India and Average State

All India

Figure 6.1 plots the growth in actual and potential output (All India GDP, at current prices) for the period 1990 - 2023. For the sake of comparison, data points of forecasted potential output series constructed through alternative methods *viz.*, statistical method -HP and BP-CF and economic approach of production function have been presented together vis-à-vis the forecasted data points of actual output series. Out All India GDP data set contains 34 data points, of which 29 are taken for capturing the historical pattern and remaining 5 are taken for forecast. Table 6.1 gives the description of the order of (p, d, q) found to be most parsimonious ARIMA-model to the respective series for to further the purpose of future forecast.

Figure 6.1: Forecast: All India, Precentage Growth in Nominal & Potential GDP

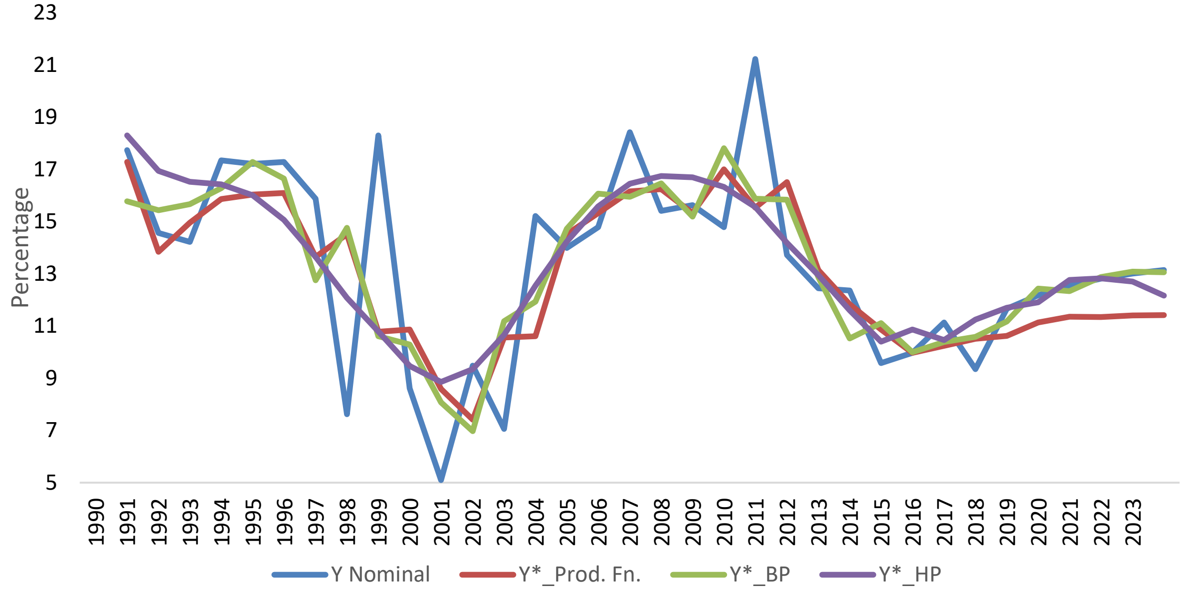
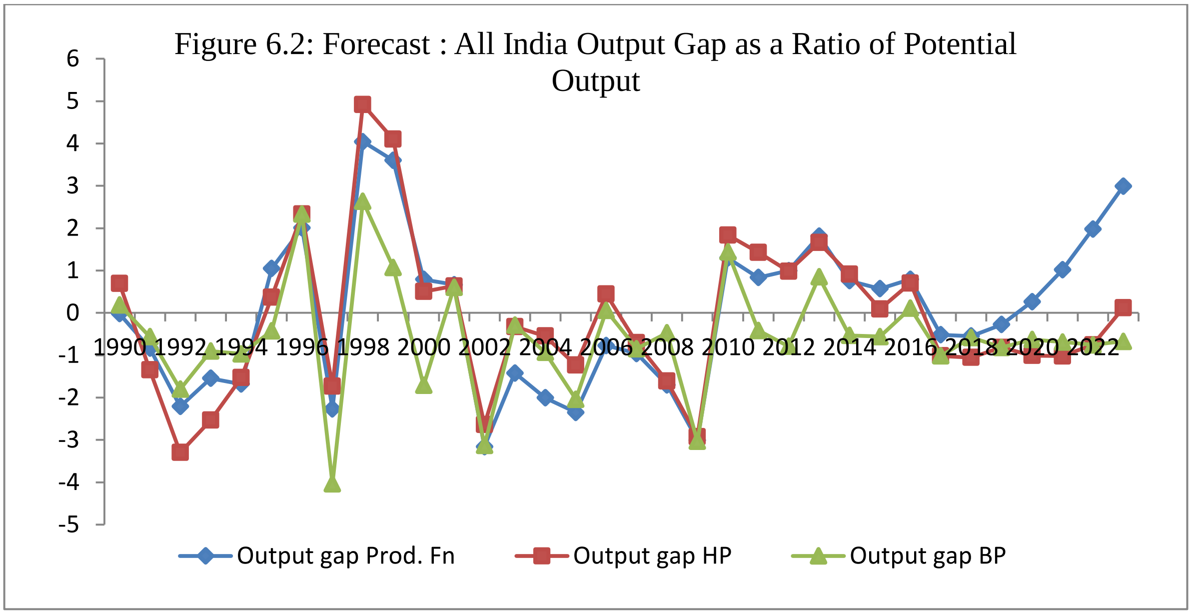


Table 6.1: ARIMA specification for All India GDP (1990-2023, current prices)

Series	ARIMA(p, d, q)	Min AIC/SBC
Nominal GDP	(1, 1, 0)	-137.25
Revenue	(0, 1,1)	-71.253
Expenditure	(0, 1, 1)	-80.76
Production function (α = 0.40, 1-α = 0.60)		
TFP	(0, 1,1)	-100.54
Capital	(1,1, 0)	-115.66
Labour	(0, 2, 0)	-206.19

As evident from figure 6.1, ARIMA forecasts of the actual and potential GDP for All India seem to suggest that the GDP is likely to move on the recovery path. Over the five forecasted data points, all the series depict co-movement with slight variation in amplitude. Of these, forecasted potential GDP points obtained through the HP and BF-CF method overlaps (except for 2022 and 2023 for potential GDP-HP) with the forecasted actual series indicating an ideal situation for the country. The forecasted potential GDP obtained by production function lies below the actual forecasts implying actual GDP growth above the full capacity. Given the variations in the alternative forecasts, the shrinking of negative output gap points (figure 6.2, presented as a percentage of potential output), as observed converging to the horizontal axis in case of potential GDP by HP and production function over the forecasted years indicated improvement and upward movement towards greater efficient levels of output.



Average of 10 Major States of India

We now turn to our discussion on comparing the forecast of actual GDP and potential GDP (obtained using alternative approaches) of average of 10 major Indian states. Figure 6.3 compares the historical and forecast points of the respective series and figure 6.4 plots the corresponding output gaps. Description of the best fitted ARIMA model is presented in table 6.2.

Due to data constraints, forecast points of potential GDP for average states has been estimated using statistical methods of HP and BP-CF. At the subnational level, figure 6.3 suggests growth in actual average GSDP to be higher than the potential GSDP over the forecast period. Though for two forecast points (2020 and 2021) BP-CF estimates seem to converge to the actual forecasts but diverges in the later years (2022 and 2023). These divergence in BP-CF estimated is also observable from the widening of negative output gap in the later years, as shown in figure 6.4. The presence of negative output gap indicates that the state economies are likely to working below potential in 2022 and 2023.

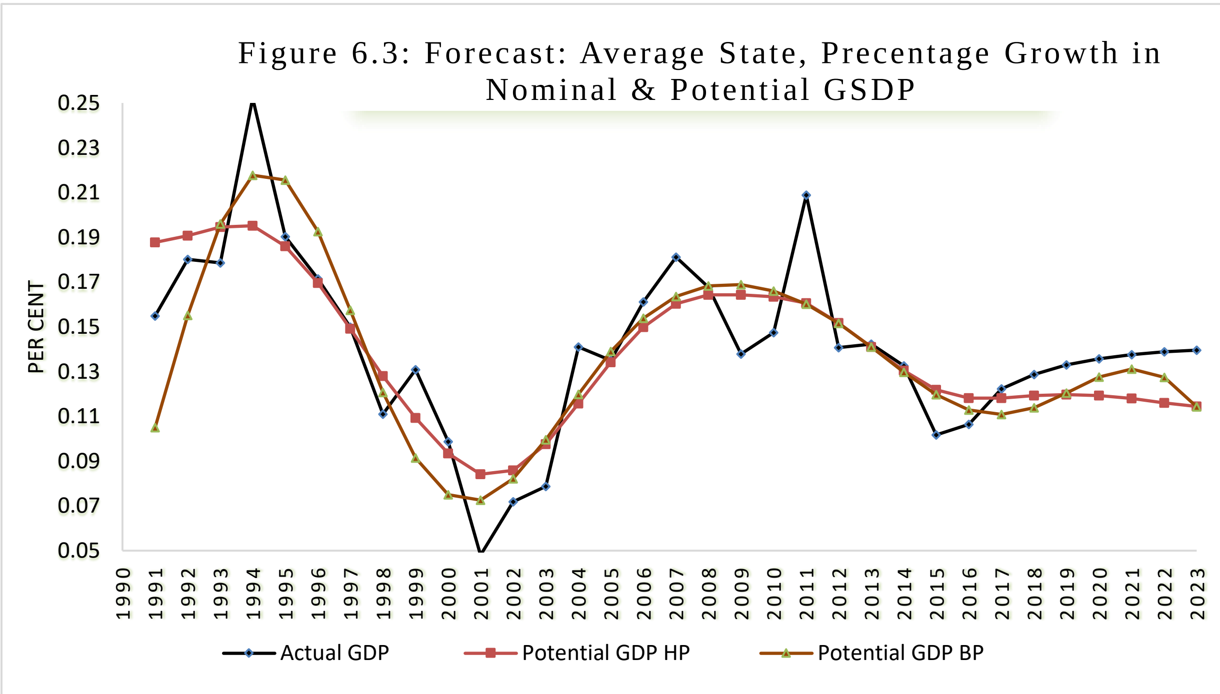
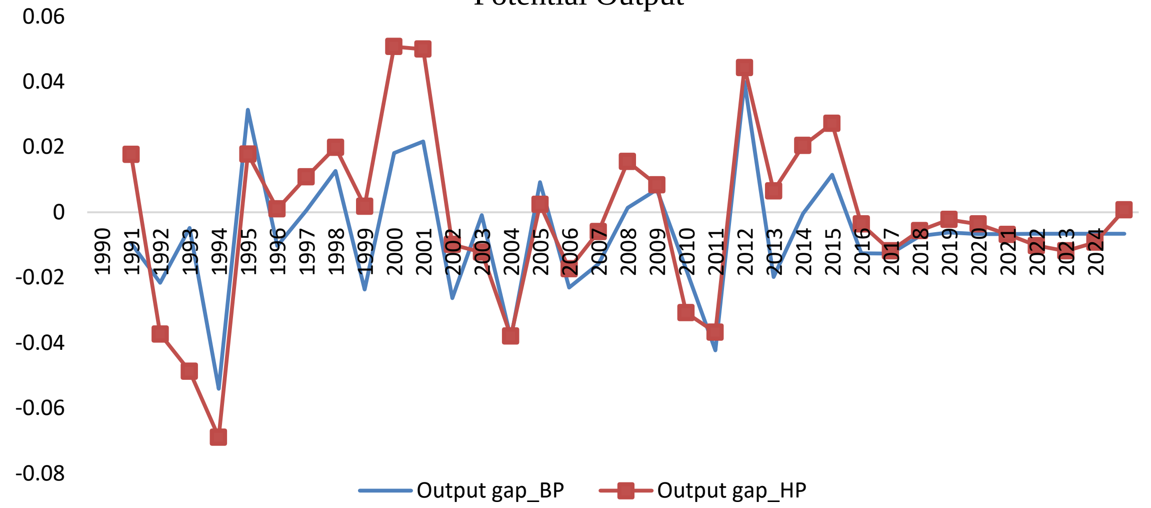


Table 6.2: ARIMA specification for 10 State Average GSDP (1990-2023, current prices)

Series	ARIMA(p,d,q)	Min AIC and SBC
Nominal GSDP	(1,1,0)	-115.97
Revenue	(0,1,0)	-85.073
Expenditure	(0,1,1)	-80.588

Figure 6.4: Forecast : Average State Output Gap as a proportion of Potential Output



6.2 Revenue and Expenditure Elasticity to Output Gap

Table 6.3 presents the estimates of elasticity of revenue and expenditure to output gap for the period 1990 to 2023. The elasticities have been estimated using the regression approach at the national and subnational level as elaborates in the previous section of the report. Across the alternative estimates of the elasticities, for Central government, the significance criteria (p-value) seem to suggest a revenue elasticity to output gap of 1.08 by the HP estimates and 6.2 by the production function estimates and expenditure elasticity to output gap to be insignificant. Going by the insignificant estimates, expenditure elasticity to output gap is taken to be zero in estimation of CAPB of the center.

Table 6.3: Estimation of Revenue and Expenditure elasticity to Output Gap(1990-2023)

Output gap(Ln(Y/Y*))	Ln(Revenue)	Ln(Expenditure)
	Revenue Elasticity	Expenditure Elasticity
IMF Approach	1	0
Regression Approach		
GoI		
BP-CF Filter	3.244	1.640
	[0.707]	[0.839]
HP Filter	1.08*	1.30
	[0.079]	[0.177]
Production Function	6.267**	5.85**

	[0.0335]	[0.0338]
10 State Average		
BP-CF Filter	1.052*	0.979*
	[0.075]	[0.089]
HP Filter	1.33**	0.851*
	[0.0069]	[0.085]

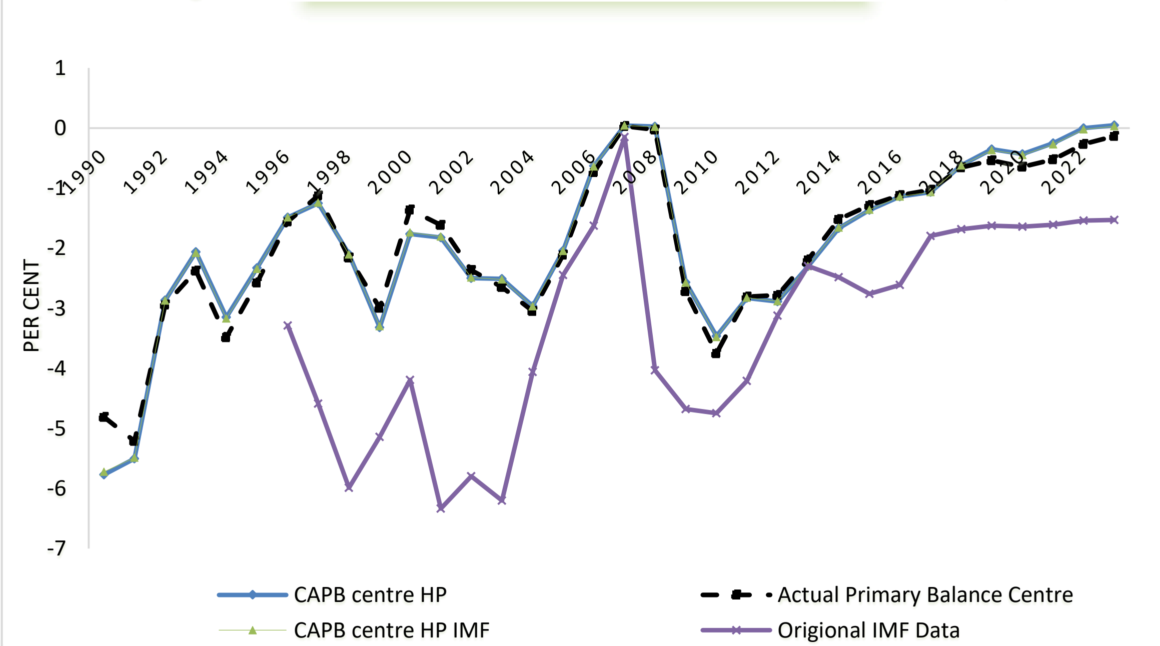
As far as the estimates of the respective elasticities is concerned at the sub-national level, significance criteria suggests a revenue elasticity to output gap ranging between 1.052 and 1.33 and an expenditure elasticity to output gap ranging from 0.851 and 0.979.

6.3 Forecast Estimates of CAPB for Central Government and Average of the State Governments

This section compares the ARIMA-forecast estimates of the actual primary balance and the cyclically adjusted primary balance for GoI and average primary balance of major states of India. Figure 6.5 plots these estimates at the national level and figure 6.6 compares them at the subnational level for the alternative models.

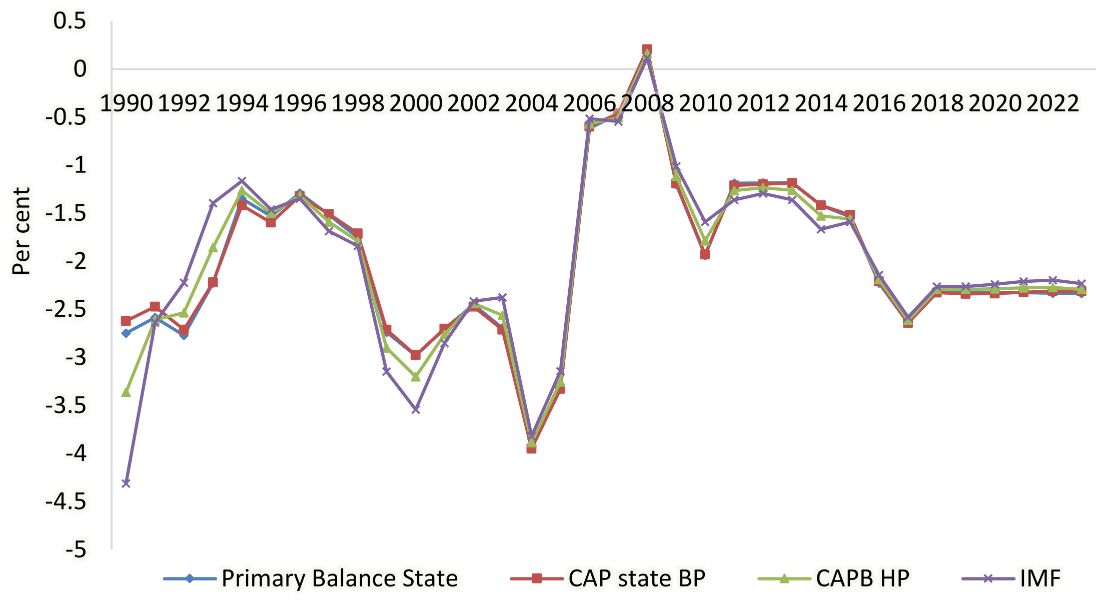
Centre Government of India:

Figure 6.5: GoI Actual PB vis-a-vis CAPB(1990-2023)



Average of 10 Major States of India

Figurte 6.6: Average State Actual PB vis-a-vis CAPB(1990-2023)



Over the forecast period, all the alternate series seem to depict co-movement and improvement in the primary balance. Primary balance of central government is likely to increase over the forecast period, in which the economy is expected to be on a recovery path (after the 2007-08 slow down). At the sub-national level, average state primary balance is likely to remain stable at (-ve) 2.5 per cent over the forecast period. This is indicative of pro-cyclicality of primary balance of the centre government in the recovery phase of country's GDP.

7. Conclusion

In this study, cyclically adjusted primary balances of central government and state governments have been estimated, using the IMF methodology, broadly. The basic framework has been further modified to account for the relevant one off factors and for estimation of revenue and expenditure elasticities to output gap, as outlined in EC approach, for the period

1990-91 to 2016-17. In addition, a similar methodology had been employed to estimate CABP for State of Punjab and Odisha, results of which are presented as a separate case study.

In an attempt to estimate CAPB, the report first estimates the output gap at the national and sub-national level. Output gap is computed as the difference between actual and potential output. In simpler terminology, potential output is maximum output an economy can achieve without putting pressure on the prices. In estimation of output gap, potential output (real and nominal) has been calculated using HP filter, BP filter and the production function approach. The first two approaches, which are also called statistical methods, decompose the long time series data into cyclical and trend component. At the sub-national level, alternative output gap were estimated using the statistical methods viz., BP and HP filters. The economic method of production function was dropped in the case of average of states due to non-availability of state wise data on net capital stock.

A major issue with HP Filter is that the trend component starts following the actual series towards the end of sample period. To remove this bias, HP series has been corrected for the end point bias by fitting an ARIMA model. The BP filter does not suffer from this though it drops data points from both the sides. With regard to production function method, the assumption of functional form is a concern which is linked to estimation of TFP and capital and labor share. To de-trend the cyclical component in the production function series, statistical filters like HP and BP are used to obtain potential output. Literature calculating TFP series for the Indian economy has mainly confined to TFP estimates at constant prices over the selected study periods. The report compares the estimated TFP and labor share at 2011-12 constant prices and at current prices by using published data from two sources viz., NSS and Census for different rounds. Real TFP growth for India during the periods 1990-91 to 2017-18 was found to average around 4.8 per cent using NSS data and 2.4 per cent using Census data on labor employment. In estimation, TFP estimate obtained from NSS employment data was used to arrive at the potential output under the production function method.

The actual output (real and nominal GDP) was compared with the potential output series (obtained from the alternative method) to illustrate the long term trend arrived at after removing the short term fluctuations. These identified the expansionary and recessionary phase of output at both the national and sub-national level. Using the estimated output gap, the report also compared the business cycles, acceleration cycles and growth cycles to show the short run fluctuations vis-à-vis the long run trend in the output series. Acceleration or growth rate cycle is calculated as growth rate of the actual output (e.g. real GDP). Growth cycle on the other hand is defined as the difference between actual output and potential output expressed as a per cent of potential output. Output gap estimated through various methods depict co-movement and identical turning points in the all year of sample period.

As the next step to obtain CAPB, the report estimates revenue and expenditure elasticities to output gap using log-log regressions. The estimates obtained using revenue, expenditure and nominal output & potential output give statistically significant estimates ranging between 2.9 to 3.9 across the specifications for the GOI and of about 1.57 for the average of state governments. For individual states, revenue elasticity was found to be 1.3 for Odisha and 2.18 for Punjab, both statistically significant. Estimated expenditure elasticity to output gap were found to be insignificant for the all the cases. The IMF has assumed this elasticity to be zero under the observation that the cyclical expenditure is not correlated to output gap. These results are in line with estimates computed for Brazil (Oreng 2012) and India (Mishra & Ghosh, 2016).

In the final step, the potential revenue, expenditure and respective elasticities to output gap have been substituted in equation (1) after adjusting for the one off factors. The estimated results obtained for CAPB under the alternative techniques have been compared with the IMF estimates (for center government), to confirm the robustness of the estimates.

For GoI, all the alternative CAPB series show co-movement with the actual primary balance series. For most of the study period both actual primary balance and CAPB have remained in deficit. Significant improvement in primary balance is observed during the period 2003 to 2007, with rising PB suggesting positive balance. This seems to be on account of the initiation of FRBM Act in 2003-04. The co-movement in actual and cyclically adjusted primary balance is also indicative of pro-cyclicality of the central government balances over the study period. However, sign of counter- cyclicality in the center's balance is visible in 2015 and 2016. For these years actual balance and CAPB seem to be on opposite paths. This is observed during the recovery phase (2013 onwards); CAPB shows downward movement, while primary balance continues to improve.

At the sub national level, CAPB series for the average of states show co-movement with actual average primary balance over the study period, clearly indicating the pro-cyclical nature of fiscal policies at the sub-national level. As in the case of central government, average state primary balance shows improvement from 2003 to 2007 and 2008, respectively. However, unlike the center, state balances remain pro-cyclical in the recent years. For the years- 2014 to 2016, both average state primary balance and CAPB show deterioration followed by a 0.5 per cent improvement in year 2017. Similarly, co-movement of actual primary balance and CAPB of Punjab and Odisha indicate pro-cyclical fiscal policy of the state governments.

The report has also attempted estimation of CAPB forecast for the Centre and average of state governments. The forecast estimations are carried out for a period of five years for 2018 -2023. For this purpose, the report adopts a simple time series ARIMA forecasting technique which involved mathematically modelling the data generating process of past observations and thereafter using the model specifications to obtain out of sample predications. Over the forecast period, all the alternate series seem to depict co-movement and improvement in the primary balance. Actual and cyclically adjusted primary balance of central government is likely to increase over the forecast period, in which the economy is expected to be on a recovery path. At the sub-national level, average state primary balance both actual and adjusted is likely to remain stable at (-ve) 2.5 per cent over the forecast period. This is indicative of pro-cyclicality of primary balances of center and state governments in the recovery phase of country's GDP growth.

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Annexure I

Estimates of Revenue and Expenditure Elasticity to Output Gap: Centre and Average State

Elasticity Estimates for the Central government

reg lnrev Gap_bp time

```
  Source |       SS           df       MS              Number of obs   =        28
-------------+----------------------------------       F(2, 25)        =   5129.49
   Model |  28.5146001         2     14.2573           Prob > F        =    0.0000
 Residual |   .06948698        25  .002779479          R-squared       =    0.9976
-------------+----------------------------------       Adj R-squared   =    0.9974
    Total |  28.5840871        27  1.05866989          Root MSE        =    .0527
------------------------------------------------------------------------------
    lnrev |      Coef.    Std. Err.      t      P>|t|      [95% Conf. Interval]
-------------+----------------------------------------------------------------
  Gap_bp |   2.195425   .8410846     2.61    0.015     .4631791    3.927671
     time |    .125701   .0012722    98.81    0.000     .1230809    .1283211
    _cons |   10.79395   .0210595   512.55    0.000     10.75057    10.83732
------------------------------------------------------------------------------
```

reg lnexp Gap_bp time

```
  Source |       SS           df       MS              Number of obs   =        28
-------------+----------------------------------       F(2, 25)        =   1759.52
   Model |  26.2155609         2  13.1077804           Prob > F        =    0.0000
Residual |  .186240604        25  .007449624           R-squared       =    0.9929
-------------+----------------------------------       Adj R-squared   =    0.9924
    Total |  26.4018015        27  .977844499          Root MSE        =    .08631
------------------------------------------------------------------------------
    lnexp |      Coef.    Std. Err.      t      P>|t|      [95% Conf. Interval]
-------------+----------------------------------------------------------------
   Gap_bp |   .3686766   1.376972     0.27    0.791     -2.46725    3.204604
     time |   .1199225   .0020827    57.58    0.000     .1156331    .1242119
    _cons |   11.07431   .0344773   321.21    0.000      11.0033    11.14531
```

reg lnrev gap_hp time

```
   Source |       SS           df       MS              Number of obs   =        28
-------------+----------------------------------       F(2, 25)        =   9813.58
    Model |  28.5477245         2  14.2738623          Prob > F        =    0.0000
 Residual |  .036362531        25  .001454501          R-squared       =    0.9987
-------------+----------------------------------       Adj R-squared   =    0.9986
```

Total	28.5840871	27	1.05866989	Root MSE	=	.03814	

lnrev	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gap_hp	3.909875	.6535216	5.98	0.000	2.563922	5.255828
time	.1249734	.0008924	140.05	0.000	.1231355	.1268113
_cons	10.75463	.017189	625.67	0.000	10.71923	10.79003

reg lnexp gap_hp time

Source	SS	df	MS			
				Number of obs	=	28
				F(2, 25)	=	1850.63
Model	26.2246683	2	13.1123342	Prob > F	=	0.0000
Residual	.177133171	25	.007085327	R-squared	=	0.9933
				Adj R-squared	=	0.9928
Total	26.4018015	27	.977844499	Root MSE	=	.08417

lnexp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gap_hp	1.682576	1.44239	1.17	0.254	-1.288083	4.653235
time	.1198228	.0019695	60.84	0.000	.1157664	.1238791
_cons	11.05401	.037938	291.37	0.000	10.97587	11.13214

reg lnrev gap_pf time FRBM

Source	SS	df	MS			
				Number of obs	=	27
				F(3, 23)	=	2674.66
Model	25.4820678	3	8.4940226	Prob > F	=	0.0000
Residual	.073041982	23	.003175738	R-squared	=	0.9971
				Adj R-squared	=	0.9968
Total	25.5551098	26	.982888838	Root MSE	=	.05635

lnrev	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gap_pf	2.903807	1.498812	1.94	0.065	-.1967231	6.004337
time	.1205814	.0029399	41.02	0.000	.1144997	.1266631
FRBM	.0680798	.0455886	1.49	0.149	-.0262274	.162387
_cons	10.83999	.0271527	399.22	0.000	10.78382	10.89616

reg lnexp gap_pf time FRBM

Source	SS	df	MS		
				Number of obs =	27
				F(3, 23) =	1000.47
Model	23.6409023	3	7.88030076	Prob > F =	0.0000
Residual	.181162573	23	.007876634	R-squared =	0.9924
				Adj R-squared =	0.9914
Total	23.8220649	26	.916233264	Root MSE =	.08875

lnexp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gap_pf	.8565759	2.360452	0.36	0.720	-4.026392	5.739544
time	.1173508	.00463	25.35	0.000	.1077729	.1269288
FRBM	.0482326	.0717967	0.67	0.508	-.1002901	.1967553
_cons	11.08969	.0427622	259.33	0.000	11.00123	11.17815

<u>Elasticity Estimates for Average State Government</u>

reg LogRev OutputGapHP time

Source	SS	df	MS		
				Number of obs =	27
				F(2, 24) =	2454.65
Model	26.4282121	2	13.214106	Prob > F =	0.0000
Residual	.129199304	24	.005383304	R-squared =	0.9951
				Adj R-squared =	0.9947
Total	26.5574114	26	1.0214389	Root MSE =	.07337

LogRev	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
OutputGapHP	.6108012	.7482891	0.82	0.422	-.9335915	2.155194
time	.1268271	.0018271	69.41	0.000	.1230562	.1305981
_cons	8.043919	.0310034	259.45	0.000	7.979932	8.107907

reg logExp OutputGapHP time, robust

Linear regression		
	Number of obs =	27
	F(2, 24) =	4032.24
	Prob > F =	0.0000
	R-squared =	0.9960
	Root MSE =	.06589

logExp	Robust Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
OutputGapHP	.7401905	.4558524	1.62	0.117	-.2006426	1.681024
time	.1249583	.0013955	89.54	0.000	.122078	.1278385
_cons	8.229457	.0207285	397.01	0.000	8.186675	8.272238

reg LogRev OutputGapBP time, robust

Linear regression

Number of obs	=	27
F(2, 24)	=	4563.00
Prob > F	=	0.0000
R-squared	=	0.9956
Root MSE	=	.07

LogRev	Robust Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
OutputGapBP	1.571561	.6872945	2.29	0.031	.1530547	2.990067
time	.1262276	.00145	87.05	0.000	.1232349	.1292204
_cons	8.058476	.0292652	275.36	0.000	7.998075	8.118876

reg logExp OutputGapBP time

Source	SS	df	MS
Model	25.6815779	2	12.8407889
Residual	.096741301	24	.004030888
Total	25.7783192	26	.991473814

Number of obs	=	27
F(2, 24)	=	3185.60
Prob > F	=	0.0000
R-squared	=	0.9962
Adj R-squared	=	0.9959
Root MSE	=	.06349

logExp	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
OutputGapBP	1.43929	.8099941	1.78	0.088	-.2324554	3.111036
time	.1244642	.0016201	76.83	0.000	.1211205	.1278078
_cons	8.241645	.0281617	292.65	0.000	8.183523	8.299768

Annexure II

Table AII1: Stationarity test for GDP Series- ADF test (1990-91 to 2016-17)

LogGDP	Level	Level at Lag(1)	First Difference	Second difference	Third Difference
All India	-1.938 [0.3143] (Unit Root)	0.222 [0.9735] (Unit Root)	-2.135 [0.2305] (Unit Root)	-2.27 [0.1897] (Unit Root)	-3.477** [0.0086] (No unit root)
State	-2.412 [0.1383] (Unit Root)	0.897 [0.993] (Unit Root)	-4.133* [0.0009] (No Unit Root)	-	-
Punjab	-2.18 [0.2135] (Unit Root)	0.305 [0.9667] (Unit Root)	-2.581 [0.0969] (Unit Root)	-2.882*** [0.0475] (No Unit Root)	-
Odisha	-1.995 [0.2886] (Unit Root)	0.32 [0.9783] (Unit Root)	-2.631 [0.1068] (No unit Root)	-2.529 [0.1085] (Unit Root)	-3.602** [0.0057] (No Unit Root)
Number of Observation	26	25	25	24	23
	Critical values				
1% Level	-3.75				
5% Level	-3				
10% Level	-2.63				

Note: Values in parenthesis are p value. *, **, *** represents the 1 % significant test, 5% significant value and *** represents 10 % level of significance.

Table AII2: ARIMA specification: GDP All India (1990-91 to 2016-17)

LogGDP	Model (1,3,1)	Model (1,3,2)	Model (2,3,2)	Model (3,2,2)
ar(L1)	0.75211* [0.000]	0.7161497* [0.004]	1.47871* [0.000]	0.871608 [0.393]
ar(L2)	-	-	-0.75359* [0.002]	0.233238 [0.874]
ar(L3)	-	-	-	-0.523079 [0.492]
ma(L1)	1.08919** [0.069]	0.9846246** [0.022]	0.1072156 [0.798]	0.885351 [1.000]
ma(L2)	-	0.0932042 [0.795]	0.1364288 [0.713]	-0.1146623 [1.000]
Log Likelihood	113.2357	113.3288	114.7978	115.844

Note: Values in parenthesis are p value. *, **, *** represents the 1 % significant test, 5% significant value and *** represents 10 % level of significance. Best fitted model is one which has highest log likelihood, maximum number of significant specification. Here we have used Model (1,3,2).

Table AII3: ARIMA specification: average GSDP of 10 major States (1990-91 to 2016-17)

LogGSDP	Model (1,1,2)	Model (2,1,2)	Model (3,1,1)
ar(L1)	0.9768087*	1.919767*	2.594688*
	[0.000]	[0.000]	[0.000]
ar(L2)	-	-0.9380378*	-2.260787*
		[0.000]	[0.000]
ar(L3)	-	-	0.6592719*
			[0.007]
ma(L1)	1.202713*	1.018444*	1.361248**
	[0.000]	[0.000]	[0.039]
ma(L2)	1.000001	1.000001	-
	[-]	[-]	
Log Likelihood	88.33223	101.4172	102.28

Note: Values in parenthesis are p value. *, **, *** represents the 1 % significant test, 5% significant value and *** represents 10 % level of significance. Best fitted model is one which has highest log likelihood, maximum number of significant specification. Here we have used Model (3,1,1).

Table AII4: ARIMA specification: GDP Punjab (1990-91 to 2016-17)

LogGSDP_punjab	Model (1,2,2)	Model (2,2,2)	Model (3,2,2)	Model (3,2,1)
ar(L1)	0.867184*	1.579545*	2.173685*	2.332484*
	[0.000]	[0.000]	[0.000]	[0.000]
ar(L2)	-	-0.73789*	-1.8029**	-2.03857*
		[0.000]	[0.033]	[0.001]
ar(L3)	-	-	0.566749	0.66618**
			[0.163]	[0.042]
ma(L1)	1.12345*	0.558005***	0.007668	-0.11284
	[0.000]	[0.091]	[0.990]	[0.813]
ma(L2)	0.818432**	0.384703	0.283798	-
	[0.019]	[0.323]	[0.539]	
Log Likelihood	109.8642	113.1835	114.1711	113.8946

Note: Values in parenthesis are p value. *, **, *** represents the 1 % significant test, 5% significant value and *** represents 10 % level of significance. Best fitted model is one which has highest log likelihood, maximum number of significant specification. Here we have used Model (1,2,2).

Table AII6: ARIMA specification: GDP Odisha (1990-91 to 2016-17)				
	Model (1,3,2)	Model (2,3,2)	Model (3,3,2)	Model (2,3,1)
ar(L1)	-0.56093	1.809464*	-0.61501	0.588724
	[0.202]	[0.000]	[0.105]	[0.514]
ar(L2)	-	-0.95116*	0.095275	-0.18923
		[0.000]	[0.785]	[0.713]
ar(L3)	-	-	-0.18062	-
			[0.536]	
ma(L1)	1.569591*	-1.97971*	1.754822*	0.131295
	[0.000]	[0.000]	[0.000]	[0.885]
ma(L2)	-	0.999994	1.000002	-
		[-]	[-]	
Log Likelihood	92.25867	95.73771	93.01557	89.0009

Note: Values in parenthesis are p value. *, **, *** represents the 1 % significant test, 5% significant value and *** represents 10 % level of significance. Best fitted model is one which has highest log likelihood, maximum number of significant specification. Here we have used Model (2,3,2).