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Fiscal Sustainability: Concept and Application	
Mr. Krishanu Pradhan	WP No. 005 October 2015 Pune.

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Fiscal Sustainability: Concept and Application

A Technical Note

Krishanu Pradhan

Assistant Professor
Symbiosis School of Economics
Symbiosis International University, Pune
krishanup@gmail.com ; +91-9403033919

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Abstract: Continuous assessment of fiscal sustainability is an essential macroeconomic policy research to identify the risk and vulnerability of a country's fiscal and macro structure, and suggesting appropriate policy to avoid abrupt macroeconomic crisis. In this context, this technical note is an attempt to provide theoretical and empirical backgrounds for assessing the soundness of a country's current and future fiscal policies.

1. Introduction

Fiscal sustainability is a multi-dimensional concept. It incorporates government solvency, stable and robust growth, buoyant and stable tax regimes, capacity to absorb adverse macroeconomic shock, and inter-generational equity. Solvency itself has several aspects. It entails ability of government to service current and future debt and other liabilities, which crucially depends on currency composition and maturity profile of debt, and over all macro balance including saving-investment and current account balance. Apart from such economic context, it has also social and political aspects and implications incorporating political business cycles, governance issues and transparency in fiscal policy. However, in the present context, we are more concerned about the economic aspects of fiscal sustainability resulting from high and un-sustainable public debt and deficits.

2. How to assess fiscal sustainability?

Sound public finance is pre-requisite for macroeconomic stability and essential for sustainable growth. However, assessment of soundness of public finance is not an easy task. It needs to operationalise the concepts and appropriate indicators to identify risk of *short term (ST) fiscal stability* and *long term (LT) fiscal sustainability* to enable policy makers to assume corrective measures. The ST aspects considers government's ability to honour its commitments to service upcoming obligations, while LT aspect requires fulfillment of inter-temporal budget constraint (IBC) which states that present value of all liabilities should not exceed the present value of assets or present discounted value (PDV) of all future primary surpluses (PS). This distinction does not mean that ST and LT aspects are mutually exclusive; rather they are linked via the behavior of financial markets. For example, uncertainty about government's LT commitments affects SR fiscal stability adversely and vice-versa and results in sovereign debt crisis (Giammarioli, *et.al* 2007). However, fiscal sustainability in LT aspect, wherein the investors assess potential risk for their credits with SR consideration like currency composition and maturity profile of public debt. In the present context, we would discuss the LT and SR aspect separately.

3. Long-term sustainability aspects - theoretical background

The inter-temporal budget constraint (IBC) can be developed by assuming the followings.

Let, D_t and D_{t-1} be the stock of debt at period t and t-1. Y_t, r_t, g_t and P_t are the GDP, interest rate on government borrowing (i.e. bond yield), nominal GDP growth rate and primary deficits respectively.

The inter-temporal budget constraint (IBC) is written as $D_t = (1+r_t)D_{t-1} + P_t$ …….. (1).

If we write (1) by dividing GDP, we have $dt = \{(1+r_t)/(1+g_t)\}d_{t-1} + p_t$ ….. (2).

Expressing (1) and (2) with forward looking recursive substation, we have

$$D_{t-1} = \prod_{j=1}^{N} (Z_{t+j})\, D_{t+j} - \sum_{i=1}^{N}\Big\{\prod_{j=1}^{i} (Z_{t+j})P_{t+j}\Big\} \text{............(1a) for finite period.}$$

$$\text{And } D_{t-1} = \prod_{j=1}^{\infty}(Z_{t+j})\, D_{t+j} - \sum_{i=1}^{\infty}\Big\{\prod_{j=1}^{i} (Z_{t+j})\, P_{t+j}\Big\} \text{..........(1b) for infinite period, where } Z = 1/(1+r).$$

Similarly, for (2), we can write

$$d_{t-1} = \prod_{j=1}^{N}\big(Z_{t+j})\, d_{t+j} - \sum_{i=1}^{N}\Big\{\Big(\prod_{j=1}^{i} (Z^*_{t+j})\, p_{t+j}\Big\} \text{.........(2a) for finite period.}$$

$$d_{t-1} = \prod_{j=1}^{\infty}\big(Z_{t+j})\, d_{t+j} - \sum_{i=1}^{\infty}\Big\{\prod_{j=1}^{i} (Z^*_{t+j})\, p_{t+j}\Big\} \text{.........(2b) for infinite period, where } Z^* = (1+g)/(1+r)$$

The fiscal sustainability requires that PDV of all future primary surpluses (PS) should not be less than that of the debt at present. That is in terms our equations, second term of RHS both (1a) & (1b) and (2a) & (2b) should be at least equal to the LHS of respective equations.

$$D_{t-1} = -\sum_{i=1}^{N}\Big\{\Big(\prod_{j=1}^{i} (Z_{t+j})\, P_{t+j}\Big\} \text{............(1c) for finite period.}$$

$$D_{t-1} = -\sum_{i=1}^{\infty}\Big\{\prod_{j=1}^{i} (Z_{t+j})\, P_{t+j}\Big\} \text{..........(1d) for infinite period,}$$

$$d_{t-1} = -\sum_{i=1}^{N}\Big\{\Big(\prod_{j=1}^{i} (Z^*_{t+j})\, p_{t+j}\Big\} \text{.........(2c) for finite period.}$$

$$d_{t-1} = -\sum_{i=1}^{\infty}\Big\{\prod_{j=1}^{i}(Z^*_{t+j})\, p_{t+j}\Big\} \text{.........(2d) for infinite period,}$$

In all the cases minus sign (–) of deficit is primary surplus (PS).

The essential implication for the first term of RHS of (1a), (1b), (2a) and (2b) are either non-positive or set to zero. This implies that PDV of net debt be zero at terminal point under *dynamic efficiency*.

$\prod_{j=1}^{N}(Z_{t+j})\, D_{t+j} = D_T \leq 0$ ……(1e) for finite period.

$\prod_{j=1}^{\infty}(Z_{t+j})\, D_{t+j} = 0$ ……….(1f) for infinite period.

$\prod_{j=1}^{N}(Z^*_{t+j})\, d_{t+j} = d_T \leq 0$ ………(2e) for finite period.

$\prod_{j=1}^{\infty}(Z^*_{t+j})\, d_{t+j} = 0$ ………(2f) for infinite period.

Four different terminal conditions. Less than zero refers to *super-solvency* and equal to zero is *exact-solvency*.

If the afore mentioned conditions are not strictly satisfied by the current and future fiscal policy behavior, fiscal policy is said to be un-sustainable under theoretical setup.

4. Application in empirical research

in practice and application, as it is extremely difficult to know the future time path of debt and PS and debt accurately, researchers follow the historical time series of PS (or deficits) and public debt (Buiter and Patel 1992, Wilcox 1989, Hamilton and Flavin 1986). Applying time series econometric application, the stationary properties are checked and assuming that if historical pattern continues, questions of sustainability or un-sustainability of fiscal policies is answered.

However, there are some limitations of the approach. Maintenance of inter-temporal budget constraint is highly technical, not easy to interpret and it assumes highly restrictive assumption like *dynamic efficiency*. At all points of time it is not possible to honour IBC and non-satisfaction of IBC for some years does not mean that government is facing immediate threat of solvency. It also assumes selection of appropriate discount rates and at terminal point, the PDV of debt be zero, which is very difficult to attain. That is why Buiter and Patel (1992) mentioned that honoring IBC is a *weak solvency criterion*. Instead, it is better to focus on the *strong and practical* aspects that determine solvency and fiscal stability, is the debt/GDP or debt/revenues and ratio of different debt servicing to either revenues or export or GDP. In this context maintaining low debt/GDP or other indicators as set by country’s feasible fiscal policy framework is the best indicators of fiscal sustainability. The ultimate requirement of sustainability asks that debt/GDP or other indicators like interest payment/revenue or GDP should not grow explosively and unboundedly. In this context also, researchers focus on the historical time series data on different fiscal variable and test for stationarity to conclude about the solvency or sustainability of fiscal policy. The main limitation of this aspect is that determination of appropriate level of debt/GDP and other variables, and analyzing past behaviour. Apart from studying time series properties of IBC or debt/GDP or other variables, there is one more strongly and practically relevant approach called the co-integration or co-movement of revenue and expenditures of government. In studying time series properties IBC or debt/GDP, it focuses on the stock side of the relevant variable and neglects the flow side of fiscal policy. As government revenue and expenditures are crucial fiscal flow variables, it is important to know their movement. If both variables move together with keeping constant or falling gap, the fiscal policy perused is called sustainable.

5. Fiscal Projections

So far whatever is discussed it is mainly based on the historically given time series data and that is why it is called *backward looking approaches*. Nothing is said about the future evolution of relevant fiscal variables for studying sustainability aspect. Considering this limitation of backward looking approaches, literatures have developed projection methodology of several fiscal variables to judge the LT sustainability of fiscal policy based on theoretical framework developed earlier. To highlight the importance of fiscal projection it is important to note that '*fiscal projections provide invaluable signposts to help current government to respond to known fiscal pressure and risk in gradual manner…. help future government to avoid abrupt policy change'* (OECD 2009, p 2). Fiscal projection to know future dynamics of fiscal policy is called *forward looking approaches*. To know the LT sustainability based on comprehensive fiscal projections, it is important to know the concept of *fiscal gap* (FG) analysis (Auerbach 1994). The fiscal gap is defined as immediate and permanent increase in PS to attain a pre-determined or current level of debt/GDP ratio in future. The FG conveys in a single number in terms of magnitude of $\overline{PS}$ necessary to avoid un-sustainable increase in debt/GDP or to maintain IBC requirement. The FG is also calculated both in finite and infinite time horizon to assess sustainability. Technically the FG is calculated in following manner. Let's assume that projected primary surplus is $\overline{PS}$. If the current debt level is unlikely to equal to PDV of all future PS, FG is difference between current debt level and projected primary balances. If FG is denoted Δ as a constant proportion of projected GDP, $\overline{Y}$ to make equality between debt level and PDV of PS, then

$$\Delta = \left\{ D_{t-1} - \prod_{j=1}^{N}(Z_{t+j})\, D_{t+j} - \sum_{i=1}^{N}\left\{ \prod_{j=1}^{i}(Z_{t+j})\, \overline{PS}_{t+j} \right\} \right\} \Big/ \sum_{i=1}^{N} \prod_{j=1}^{i} (Z_{t+1})\, \overline{Y}_{t+j} \ldots\ldots(1g)$$

$$\Delta = \left\{ D_{t-1} - \sum_{i=1}^{\infty}\left\{ \prod_{j=1}^{i} (Z_{t+j})\, \overline{PS}_{t+j} \right\} \right\} \Big/ \sum_{i=1}^{\infty} \prod_{j=1}^{i}(Z_{t+1})\, \overline{Y}_{t+j} \quad \ldots\ldots(1h)$$

FG calculation for absolute level of debt.

The FG calculation in term of debt/GDP ratio for finite period assumes that at the end of projection hypothetical debt/GDP is d*, then we have,

$$\Delta = \left\{ d_{t-1} - \prod_{j=1}^{N}(Z_{t+j})\, d^* - \sum_{i=1}^{N}\left\{ \prod_{j=i}^{i}(Z^*_{t+j})\, \overline{ps}_{t+j} \right\} \right\} \Big/ \sum_{i=1}^{N} \prod_{j=1}^{i} (Z_{t+1})\, \overline{Y}_{t+j} \ldots(2g)$$

FG calculation of Debt/GDP for finite and infinite horizon.

$$\Delta = \left\{ d_{t-1} - \sum_{i=1}^{\infty}\left\{ \prod_{j=1}^{i}(Z_{t+j})\, \overline{ps}_{t+j} \right\} \right\} \Big/ \sum_{i=1}^{\infty} \prod_{j=1}^{i}(Z^*_{t+1})\, \overline{Y}_{t+j} \quad \ldots\ldots(2h)$$

In FG or sustainability gap analysis finite horizon and infinite horizon aspects are called S1 and S2 indicators (Giammarioli, *et al* 2007, Blanchard, *et al* 1990).

6. Inter-generational Equity

Apart from fiscal parameters to GDP ratio, FG or sustainability gap analysis, the generational equity adds to a further dimension to the LT fiscal sustainability analysis. Previously outlined concepts and application of fiscal sustainability does not necessarily imply that the outcome will be also *generationally fair*. 'As with the concept of long term fiscal sustainability, there is no unique definition of what "*inter-generationally fair*" means, as it can be defined from different angles (HM Treasury, 2008, p 20). Generational equity can be defined when all generations pay same amount of net transfer or same share of their income to government. It can also be designed on the basis of ability to pay of different generations to government or that after net transfer utility of all generations remain the same. It is generally argued that as nation become richer and richer due to productivity gain and technological innovation, future generations should pay larger net transfer to government than the present generations paying now.

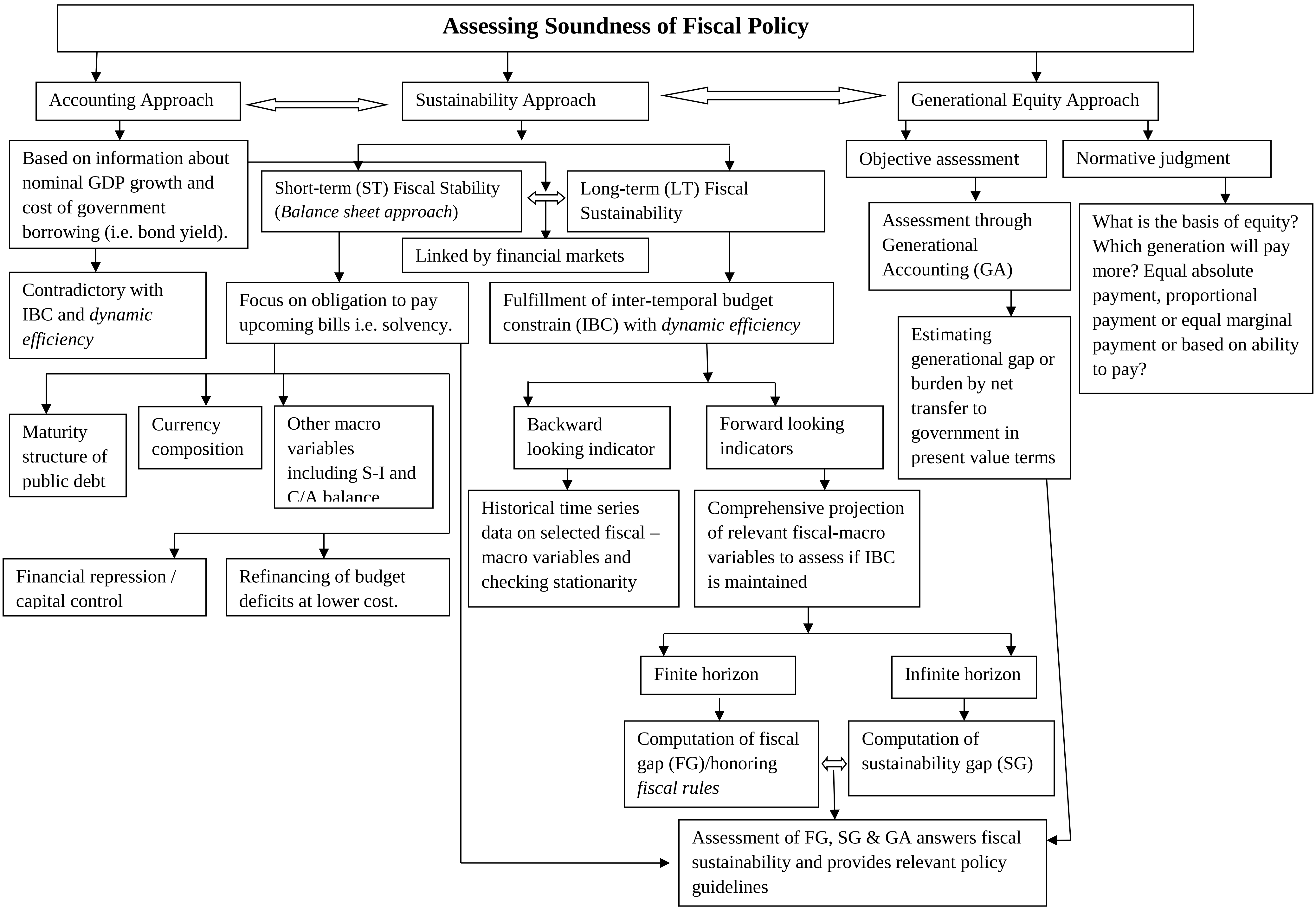
Generational equity is assessed based on *generational accounts* (GA) and defined as the present value of taxes paid net of transfer payments i.e. net transfer to government. Auerbach, Kotlikoff and Leibfritz (1999) are the pioneer of developing methodology of GA which is used for LT fiscal policy analysis and planning. Underlying projection methodology of GA is similar to fiscal projections (Giammarioli, *et al* 2007). In GA all living generations are used to compute total revenue and total expenditures in net present value terms. In similar fashion the FG or sustainability gaps are estimated, which are assumed to be borne by all future generations. But there are several limitations of GA. It is extremely data intensive as it needs information about different '*cohort*' groups and distribution of all current payments streams between government's accounts and households.

7. Short Run Fiscal Stability (Balance Sheet Approach)

It is already mentioned that SR fiscal stability and LT fiscal sustainability are linked to each other via behavior of financial markets. Without ST fiscal stability analysis, overall assessment of fiscal sustainability is incomplete. The ST aspects mainly focus on upcoming payment obligation of government. It crucially depends on government's access to financial market to refinancing deficits at lower costs, which again depends on currency composition, maturity profile of debt and government's ability to adjust budget imbalances via revenues and expenditures restructuring. Creditors' assessment about soundness of government finance, irrational behavior of investors or speculation about government's ability or the capacity to absorb exogenous negative shocks like banking crisis or other contingent liabilities are important factors to determine ST fiscal stability. How government's borrowing programme affects saving investment or current account balance, international financial market environment, government default history or assessment of government finance by several credit rating agencies also influence fiscal stability of a nation. Negative sign of fiscal stability initially reflects investors' unwillingness to subscribe government bonds leading to collapse of bond price and spike in bond yield to unsustainable level triggering sovereign debt crisis. Sometimes even if government finance is in bad shape with high level of debt and deficits persisting for long might not invoke debt crisis if other macro viable like high level of savings, investments, growth and comfortable forex reserve are maintained (Hausman and Purfield 2004).

8. Summary

For sound fiscal-financial policy, it is essential to assess both the ST and LT aspects of public finance to provide necessary policy input to avoid major macro crisis. Projection and studying time series properties of several fiscal variables are equally important. As the LT sustainability and ST stability are linked, and affect each other via the behaviour of financial markets, the combined study provides a wide array of information for necessary corrective measures in fiscal structures. Aspect of generational equity, which emerges as a frontier research area in public finance, is also important for better assessment of fiscal sustainability of a nation.


Assessing Soundness of Fiscal Policy
Accounting Approach
Sustainability Approach
Generational Equity Approach
Based on information about nominal GDP growth and cost of government borrowing (i.e. bond yield).
Short-term (ST) Fiscal Stability (Balance sheet approach)
Long-term (LT) Fiscal Sustainability
Objective assessment
Normative judgment
Linked by financial markets
Assessment through Generational Accounting (GA)
What is the basis of equity? Which generation will pay more? Equal absolute payment, proportional payment or equal marginal payment or based on ability to pay?
Contradictory with IBC and dynamic efficiency
Focus on obligation to pay upcoming bills i.e. solvency.
Fulfillment of inter-temporal budget constrain (IBC) with dynamic efficiency
Estimating generational gap or burden by net transfer to government in present value terms
Maturity structure of public debt
Currency composition
Other macro variables including S-I and C/A balance
Backward looking indicator
Forward looking indicators
Historical time series data on selected fiscal – macro variables and checking stationarity
Comprehensive projection of relevant fiscal-macro variables to assess if IBC is maintained
Financial repression / capital control
Refinancing of budget deficits at lower cost.
Finite horizon
Infinite horizon
Computation of fiscal gap (FG)/honoring fiscal rules
Computation of sustainability gap (SG)
Assessment of FG, SG & GA answers fiscal sustainability and provides relevant policy guidelines

Reference

Askari, M., R. Barnett, J. Danforth, C. Martier and S Tapp (2011), "Fiscal Sustainability Report 2011" Ottawa, Canada.

Auerbach, A. J. (1994), "The U.S. Fiscal Problem: "Where we are, how we got here, and where we're going" *NBER Macroeconomic Manual*, pp 141-75.

Blanchard. O., J. C. Chouraqui, R. P. Hagemann and N. Sartor (1990), "The Sustainability of Fiscal Policy: New answer to an old question", *OECD Economic Studies* # 15.

Buiter, W. and U. R. Patel (1992), "Debt, deficits and inflation: An application to the public finance of India", *Journal of Public Economics*, Vol (47), pp171 - 205

Giammarioli.N., C. Nickel, P. Rother and J.P. Vidal (2007), "Assessing Fiscal Soundness: Theory and Practice" *Occasional Paper Series* # 56, European Central Bank.

Hamilton, J.D., and M.A. Flavin (1986), "On limitations of government borrowing: A framework for empirical testing", *American Economic Review*, Vo. 76, pp 808-819.

HM Treasury (2008), "Long-term Public Finance Report: An analysis of Fiscal Sustainability", HM Treasury, United Kingdom (UK).

IMF (2011), "Modernizing the Framework for Fiscal Policy and Public Debt Sustainability Analysis", *Fiscal Affairs Department and the Strategy*. Policy, and Review Department.

Kotlikoff, L. J. (1999), "From Deficit Delusion to the Fiscal Balance Rule: Looking for an Economically Meaningful Way to Assess Fiscal Policy" *Generational Accounting around the World*, Edited by Alan J. Auerbach, Laurence J. Kotlikoff and Willi Leibfritz,

OECD (2009), "The benefits of long-term fiscal projections", *OECD Policy Brief*.

Wilcox, D.W., (1989), "The sustainability of government deficits: Implications for the present value borrowing constraint", *Journal of Money, Credit and Banking*, Vol. 21, pp 291-306.