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Evaluating the Sustainability of Public Debt in the Presence of Current and Fiscal Accounts Deficit in Developing Countries

Abstract *We estimate the public debt sustainability for 53 developing countries divided into different regions using data from 1996 to 2017. Sustainability of public debt calculation is based on theoretically derived models with necessary and sufficient conditions. Current study empirically validates the importance of least evident saving-investment gap along with other variables in public debt sustainability issue. Findings show that current account, fiscal account and saving-investment gap imbalances cause unsustainable public debt for all different regions which is a matter of great concern for each region. Policy makers of the developing countries must bring policies to promote investment activities backed by saving not by debt.*

Key Words: Debt Sustainability, Current Account, Fiscal Account, Saving Investment Gap, Developing Countries.

Introduction

To discuss the sustainability conditions one usual question that comes to mind in evaluating the importance of domestic imbalances and external imbalances is whether the country under consideration is solvent or not. Solvency is generally defined as the ability of a country to generate sufficient surpluses (domestic and/or external) in the future to repay the existing debt. This notion of solvency is widely used in literature to evaluate the sustainability of current account deficit (or surplus), fiscal deficit (or surplus) and public debt sustainability. Theoretically solvency is defined in relation to an economy present value of budget constraint mean a country is solvent if the present discounted value of future surpluses (current account, budget and saving investment gap) equals current indebtedness. On the other hand, sustainability condition, can be defined as a situation is sustainable if it does not violate solvency condition in indefinite future. Now based on the solvency condition sustainability of public debt can be defined as the capability of a country to pay its current and forth coming debt servicing obligations without rescheduling the course of debt servicing or accumulation of more outstanding and without compromising growth. It means that how efficiently the country utilizes the debt to generate enough current and future surpluses to pay his debt obligation and satisfy his economy's intertemporal budget constraint.

The fiscal solvency condition implies that the present discounted value of future fiscal surpluses is equal to the current amount of public debt. So, fiscal policy option is sustainable if it does not violate the solvency constraint of budget in indefinite future. This may indicate that fiscal sustainability can be associated with the direction and decision of policy related to the taxation and government expenditures. The solvency of fiscal policy option can be traced form Corsetti and Roubini (1991). The authors postulate that fiscal solvency evaluation can be done by considering of continuous indefinite future of the current policy option keeping the relevant macroeconomic environment

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constant. The fiscal policy optimal level of responsiveness to changing aggregate economic conditions and increasing public debt is important for economies to remain stable and generate surpluses and remain solvent. The risk of reducing economic activities with *fiscal fatigue* and moving away an economy from its sustainable path can be corrected by large and sustained fiscal action to ensure sustainability (Eichengreen & Panizza, 2016).

The current account sustainability in terms of solvency is a bit more complex because it contains both the domestic and foreign sector involvement. Mean current account imbalances can also be explained that it reflects the interaction between domestic private individuals and government regarding the saving investment decisions, as well as the foreign investors' lending decisions. So, question whether a current account is sustainable or not depends on the policy option. A current policy option can cause a huge policy shift such as policy tightening may cause a large recession or may cause a crisis like exchange rate collapse leading to increase in the value of external outstanding and generate inability to serve it. If such a policy is in action unsustainability case is occurring. A sustainable current account is one which helps the country to produce surpluses enough to stabilize the country situation in an international scenario (see Milessi-Ferretti & Razin, 1996; Mann, 2002; Obstfeld & Rogoff, 2007).

Applied macroeconomic studies were stimulated to evaluate the sustainability of public debt mainly after the 1980's. Different testing methods were proposed by researchers to estimate the sustainability of public debt and to estimate sustainability of public debt literature show that mostly two macroeconomic determinants namely fiscal account and current account measures were used see (Hamilton and Flavin, 1986; Wilcox, 1989; Trehan and Walsh, 1991; Hakkio and Rush, 1991; Blanchard et. al, 1990; Bohn, 1995, 1998; Jayme Jr, 2001; Mann, 2002; Polito & Wickens, 2005; Bohn, 2008; Obstfeld and Rogoff, 2007; Chan-Lau & Santos, 2010; Greiner 2013a). However, the saving investment gap to our knowledge is least evident in literature about it's important in the public debt sustainability prevalence or not. Saving-investment gap refers to the situation where domestic savings either exceeds or falls short of the domestic investment in an economy (DeLisle Worrell, 2016). This research study attempt to estimate the sustainability of public debt in the presence of macroeconomic variables like current account surplus (deficit), fiscal surplus (deficit) and saving- investment gap along with economic growth for a panel of 53 different developing countries of the world. The panel is further divided into different regions as per world bank latest division of countries region wise namely South Asia and Pacific (SA&P), Europe and Central Asia (E&CA), Sub Sahara Africa (SSA) and Latin America (LA). The model used in this study is basically drawn from Jayme Jr. (2001) but in a modified and simplified way. Focused is made on the average yearly outcome of each macroeconomic variables in calculating sustainability of public debt. Current study contributes to literature in two ways, first it estimates sustainability of public debt for developing countries from different regions in the presence of saving-investment gap, second it calculates the sustainability of public debt for each year in the regions which can draw more policy insights about the importance and impacts of macroeconomic variables on debt.

Rest of the study has four parts. Theoretical model is part 2 and method and data is in part 3. Section 4 is the results and discussion which is followed by last section conclusion and policy recommendations.

Theoretical Model

Considering a small hypothetical open developing economy consisting of four sectors (i.e. households, business, government and foreign). This open economy is formulized basically on the foundation of Irving Fisher, (1930) two-period microeconomic model of saving which consumes a single good. In current study the economy is modified to many time periods and consumption involves two goods. The individuals in the economy are assumed to be of N numbers. Every individual in the economy possessed an initial endowment. The model looks very simple but it is quite helpful in founding building blocks for more realistic models.

The Individual's Consumption's Problem

The N number of individuals try to maximize their lifetime utility U_N, which depends on different level of consumptions C_i consumed in the life time. The life time utility of the individuals with discount of time preference factor can be expressed as:

$$U_{N,j} = \sum_{j=1}^{\infty} \beta_j^t \; U(C_{N,j}) \dots\dots\dots\dots\dots\dots\dots\dots (1)$$

where U is utility, N is number of individuals and j represents the number of goods consumed. The utility is in additive form and it depends on consumption bundle individual consumed $U(C_{N,j})$ and the time discounted factor β_j^t which measure the impatience of individuals regarding his decision about current and future consumption opportunities. Further it is assumed that utility is time separable mean that we can compare one-time utility of individual to its other time utility. Also, the individual prefers current consumption decision over future as the discounted factor explains the situation.

A representative individual utility is derived from the N individual's joint utility function with some assumption and modifications. The representative individual choices, consumption, saving etc. represent overall N number of individuals in the economy. It is assumed that analysis is done for the current time and the representative individual consumed two goods necessities and luxuries. Necessities are daily life goods and are available in the economy in two types i.e. necessities produced in home country and necessities imported from foreign country. The luxuries are also available in homemade form and foreign made imported form. In current analysis focused will be made on the foreign imported necessities and luxuries. Both imported goods will enter in to the utility of the representative individual. The representative individual utility can be derived from (1) as:

$$U_{R,i} = \sum u(C_{R,i}) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2)$$

where U represent utility, C is consumption bundle, i mean necessities and luxuries and R is representative individual. It is assumed that utility function $u(C_{R,i})$ is increasing in consumption and strictly concave: $u'(C_{R,i}) > 0$ and $u''(C_{R,i}) < 0$. Further both goods are available in domestic market and the aim of the representative individual is to maximize the utility.

Let the representative individual produced output. The income channel can be described as, starting from the aggregate production function possibilities set. This set represents vector of all feasible net output for the whole economy as $Y = \sum_{j=1}^{K} Y_j$. Production function is the sum of all individual possibility production set. The net output shows that representative inhabitant can either consumed or sell what he produced or both can occur. An individual firm production plan y is included in the aggregate set if and only if Y can be given as $y = \sum_{j=1}^{K} y_j = y_R$. Aggregate profit maximization can be achieved if each firm's production plan y maximizes its individual profit then aggregate production plan Y maximizes aggregate profit. Mean a profit maximizing firm will choose the following profit function.

$$\pi_j = \sum_{j=1}^{K} py_j = \pi_R \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3)$$

where p represent a vector of output prices and π_j represent income of every individual. At the same way, this equation yields the income of the representative inhabitant which is π_R.

Given the preferences and income of representative individual one can set the Lagrange optimizing function for obtaining the optimal solution sets of both necessities and luxuries as;

$$\zeta = u\left(C_{R,NE,LU}\right) - \varphi\left(pC_{R,NE,LU} - \pi_R\right) \dots\dots\dots (4)$$

The optimal solution of equation (4) generates the following demand function for necessities $C_{R,NE} = D(p_{NE}, \pi_R)$ and luxuries $C_{R,LU} = D(p_{LU}, \pi_R)$. Now the aggregate demand function of representative individual for necessities is given as $C_{R,NE}(p) = \sum_{q=1}^{Z} p_{NE,q}\, \pi_{R,q}$ and in case luxuries the demand function is $C_{R,LU}(p) = \sum_{q=1}^{Z} p_{LU,q}\, \pi_{R,q}$. Now the overall aggregate demand function can be given as;

$$C(p) = \sum_{q=1}^{Z} C_{R,NE,LU}\left(p_{NE,LU}\right)\pi_R \ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$

Deriving Aggregates

Since our representative individual represents all N number of individuals in the economy. One can assume that all individuals are identical in the economy with size equal to N. By dropping the subscript can give us the quantities of variables in national aggregate quantities. Let C represent the aggregate consumption and Y represent the aggregate output with the assumption of identical population of size N implies that $C_{R,NE,LU} = C_t$ and $\pi_R = Y_t$ from equation (5) and (3) respectively. For all N inhabitant in the economy at time t. This national inhabitant tries to follow a flat aggregate consumption over the time. Although this national inhabitant may look implausible at first but it is a common device used in modern macroeconomics modeling. The national inhabitants can give a useful insight into the macro economy either involving in domestic exchanges or international exchanges. Further the representative inhabitant use for aggregate behavior can be justified from Deaton and Muellbauer (1980) that it is not wise to assume that all inhabitants are homogenous in behavior and aggregate consumption will behave like that on inhabitant that is selected but under strict preferences assumptions inhabitant's behavior can be exactly aggregated.

Introducing Current Account

In open economy consumption is no longer tied up to domestic production only. Current account can be shown for the economy as;

$$CA_t = Y_t - C_{T,t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

where current account at time t is represented by CA_t, GDP by Y_t and total consumption by $C_{T,t}$. Further $C_{T,t}$ is composed of $C_{D,t}$ which is domestic consumption and $C_{I,t}$ is consumption of imported and is defined as; $C_{T,t} = C_{D,t} + C_{I,t}$.

Introducing Investment

Countries borrowed abroad to finance productive investment which could be difficult to finance from saving of domestic economy only. In the model investment id introduced as, a production function is characterized by using capital only which can be accumulated as investment and it is assumed that labor is supplied infinitely in-elastically by individual. Production function for economy is given as;

$$Y = f(K) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(7)$$

The production is also increasing in capital but at a diminishing rate as $f'(K) > 0$ and $f''(K) < 0$. To introduce investment, it is assumed that individuals saving flow into capital and foreign asset, further the foreign asset possessed by domestic individuals are non-interest earning assets. In term of foreign assets current account can be given as:

$$CA_t = FA_{t+1} - FA_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(8)$$

where foreign asset of the home economy at the end of the period is represented by FA_{t+1} and at the start of period by FA_t. Now $FA_{t+1} + K_{t+1}$ is the total private wealth at the end of the period t is where K_{t+1} is domestic capital stock. With zero capital depreciation capital accumulation process occur which is $K_{t+1} = K_t + I_t$. Mean at time $t+1$ that stock of capital is sum of K_t existing capital at time t and I_t investment occur in time t. Now change in total domestic wealth can be given as $FA_{t+1} + K_{t+1} - (FA_t + K_t) = Y_t - C_t$ by rearranging and substituting the terms value current account can be written as

$$CA_t = Y_t - C_t - I_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(9)$$

where equation (9) shows current account in such a way when investment is done in both home and in foreign country and is negative like consumption in the identity. Using $Y_t - C_t = S_{P,t}$ private

saving $S_{P,t}$ the current account can be represented in a useful way of private saving as.

$$CA_t = S_{P,t} - I_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (10)$$

equation (10) can be explained as that if private saving is greater than domestic investment net foreign assets accumulation can be increased.

Introducing Government Consumption Component (G)

With assumption of no transfer payments the intertemporal budget constraint of government can be given as:

$$Y_t + (1+t)D = T - G \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (11)$$

where income is represented by Y_t, debt collection and payments is represented by $(1+t)D$, government consumption expenditure is given by G and T represent collections of taxes. A balanced budget is assumed here so $(1+t)D = 0$ and the difference of $T - G = 0$ mean that $G = T$. Since G is beyond the control of private sectors. Considering output Y^* as endowment of private sector, net of government consumption become $Y^* - G$. So, G enter to the current account as:

$$CA_t = Y_t - C_t - I_t - G_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (12)$$

The effect of G on CA can be explained by the taxes that affect the income, which affect the optimal consumption choices and saving. So, increase (decrease) in taxes affects the saving-investment identity and it affects the current account. Now national saving $S_{N,t}$ in current account situation is given as:

$$CA_t = S_{N,t} - I_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (13)$$

The Macroeconomic Relationships

This section is about the theoretical relationship between macroeconomic variables such as current account, fiscal account and saving-investment gap and public debt.

Current Account and Debt Relationship

Considering the empirical work of Sawada, (1994) the relationship between current account and debt can be explained. The budget constraint in case of open economy can be expressed as;

$$Y_t + D_{T,t} + TR_t = C_{D,t} + rD_{t-1} + NR_t + SD_t \dots (14)$$

where in equation (14) the gross domestic product (GDP)is represented by Y_t, $D_{T,t}$ stand for total debt, net transfer receipts are represented by TR_t, $C_{D,t}$ is domestic absorption, nominal interest rate due on the debt is r, NR_t is the national reserves held by central bank of a country at time t and statistical discrepancies SD_t is an additional term added to Sawada, (1994) model. Statistical discrepancies may occur over time in calculation of the identities. Since, equation (14) is a derived identity and introduction of this SD_t term makes equation (14) feasible for empirical analysis. In literature, it is also named as the errors or residuals see (Campos et al., 2006; Weber, 2012). Now rearranging terms in equation(14) yield;

$$CA_t = rD_{t-1} - TR_t - D_{T,t} + NR_t + SD_t \dots\dots\dots (15)$$

where CA_t is current account. The dynamic budget equation describing the debt evolution can now be given as;

$$D_{T,t} = rD_{t-1} - NIS_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (16)$$

where NIS_t in (16) mean non-interest surpluses and is composed of $CA_t + TR_t - NR_t + SD_t$. NIS_t can be utilized in the debt repayments. Assuming $TR_t = 0$, $SD_t = 0$ and $NR_t = 0$. So, $NIS_t = CA_t$ and replacing the values in equation (16) we get

$$D_{T,t} = rD_{t-1} - CA_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (17)$$

equation (17) measure the impact of current account outcome of an economy on the debt accumulation.

Saving-Investment Gap and Debt Relationship

Using the definition of private and national saving and taking equation (10) and (13) equation (17) $D_{T,t}$ can be given as;

$$D_{T,t} = rD_{t-1} - \left(S_{P,t} - I_t\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (18)$$
$$D_{T,t} = rD_{t-1} - \left(S_{N.t} - I_t\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (19)$$

equation (18) and (19) helps in measuring the impact of saving- investment gap situation on the public debt.

Fiscal Account and Debt Relationship

In a closed economy the national accounting identity showing debt accumulation of government can be given in Hamilton and Flavin, (1986) form as;

$$D_{T,t} = rD_{t-1} + G_t - T_t - RMS_t + SD_t \ldots\ldots\ldots (20)$$

In equation (20) $D_{T,t}$ is the market value of public debt in real term, real interest rate is given by r, G_t represents real government expenditures, T_t show real tax revenue, represent real money stock is represented by RMS_t and statistical discrepancies that occurs is measure by SD_t see (Seiferling, 2013). Rearranging equation (20) yield;

$$D_{T,t} = rD_{t-1} - NIS_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (21)$$

where NIS_t mean non-interest surpluses and is composed of $T_t + RMS_t - G_t + SD_t$. Now assumed that $RMS_t = 0$ and $SD_t = 0$, we get $NIS_t = T_t - G_t$ where $T_t - G_t = FA_t$, FA_t is fiscal account at time t. So, we get that $NIS_t = T_t - G_t = FA_t$ and equation (21) can be rewrite as;

$$D_{T,t} = rD_{t-1} - FA_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (22)$$

equation (22) measure the debt situation of an economy in case fiscal account.

Public Debt Sustainability and Macroeconomic Variables

In this section the approach to measure sustainability is discussed in detail.

Current Account and Public Debt Sustainability Conditions

Referring to equation (17) the current account CA_t and debt D_t with nominal interest rate r can be expressed as;

$$D_t - D_{t-1} = rD_{t-1} - CA_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (23)$$

Now using P_tY_t as GDP and dividing equation (23) by it we get the following results

$$\frac{D_t}{P_tY_t} - \frac{D_{t-1}}{P_tY_t} = \frac{rD_{t-1}}{P_tY_t} - \frac{CA_t}{P_tY_t}$$
$$d_t = \frac{(1+r)D_{t-1}}{P_tY_t} - ca_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4)$$

Now using the fact that $P_tY_t = (1+\delta)P_{t-1}Y_{t-1}$ where δ represent the real growth rate equation (24) can be modified as

$$d_t = \frac{(1+r^*)}{(1+\delta)}d_{t-1} - ca_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (25)$$

where in equation (25) d_t is debt to GDP ratio, r^* is real foreign interest rate and δ is the real GDP growth rate. The equation 3.24 can be explain in term current account importance as, when the $ca_t = 0$ the debt to GDP ratio will increase at the rate $(1+r^*)/(1+\delta)$. With a current account deficit,

i.e. $ca_t < 0$ than the ratio will increase at a faster rate than $(1+r^*)/(1+\delta)$. A surplus current account $ca_t > 0$ will decrease the debt to GDP ratio.

Conditions for Sustainability

The occurrence of public debt sustainability required some conditions to hold.

Necessary condition: The necessary condition for an economy to attain solvency is that $\delta > r^*$. Mean the rate of GDP growth is greater than rate of interest so that a stabilize debt ratio holds, Otherwise, if the $\delta < r^*$ then there is instability in the debt accumulations until the required sufficient condition for sustainability of debt met.

Sufficient condition: The sufficient condition to keep the debt to GDP ratio at the steady state level the current account condition $ca_t \geq 0$ must hold.

Saving-Investment Gap and Public Debt Sustainability Conditions

Referring to equation (18) and (19) and modifying it as;

$$SID_t - SID_{t-1} = rSID_{t-1} - \left(S_{T,t} - I_{T,t}\right) \ldots\ldots (26)$$

where SID is, the same debt represented in equation (26). The name is modified to make differentiation in analysis of public debt. Dividing equation (26) by P_tY_t which represent GDP

$$\frac{SID_t}{P_tY_t} - \frac{SID_{t-1}}{P_tY_t} = \frac{rSID_{t-1}}{P_tY_t} - \frac{\left(S_{T,t} - I_{T,t}\right)}{P_tY_t}$$

$$sid_t = \frac{(1+r)SID_{t-1}}{P_tY_t} - \left(s_{T,t} - i_{T,t}\right) \ldots\ldots\ldots (27)$$

Now using GDP growth rate and taking $\left(s_{T,t} - i_{T,t}\right) = sig_{it}$ where sig_{it} mean saving-investment gap and substituting it in equation (27) yield;

$$sid_t = \frac{(1+r)}{(1+\delta)} sid_{t-1} - (sig_{it}). \ldots\ldots\ldots\ldots\ldots, (28)$$

where in equation (28) sid_t is debt to GDP ratio, r is real foreign interest rate and δ is the real GDP growth rate. The saving-investment gap condition can influence the debt to GDP ratio in different ways. If $(sig_{it}) > 0$ mean savings are greater than investment so the debt to GDP ratio will decline by more than $(1+r)/(1+\delta)$. Otherwise, if the $(sig_{it}) < 0$ this condition represent extra debt accumulation and debt to GDP ratio will grow by more than $(1+r)/(1+\delta)$.

Sustainability Conditions

For an economy to attain solvency in debt accumulation some conditions are necessary to hold.

Necessary condition: The necessary condition for sustainability of public debt is that $\delta > r$. It means that ratio of $(1+r)/(1+\delta) < 1$ and the dynamic of debt is convergent and remain sustained over the time. If $\delta < r$ with suppressing real GDP growth in front of real interest rate growth leads to unsustainable debt until the required sufficient condition holds.

Sufficient condition: The sufficient condition for sustainability of debt is that $(sig_{it}) \geq 0$. This condition clarifies that the long run debt will remain sustained on the steady state level.

Fiscal Account and Public Debt Sustainability Conditions

The intertemporal budget constraint of a small developing country where G_t represent government expenditures, T_t is the tax revenue, B_t is used for debt (Borrowing) over time, r is the interest rate can be given as;

$$\Delta B_t = rB_{t-1} - T_t - G_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (29)$$

Now using P_tY_t as GDP and dividing equation (29) by it we get the following results

$$\frac{B_t}{P_tY_t} - \frac{B_{t-1}}{P_tY_t} = \frac{rB_{t-1}}{P_tY_t} - (\tau_t - g_t)$$

Rearranging the above equation yield the following results

$$b_t = \frac{(1+r)B_{t-1}}{P_tY_t} - (\tau_t - g_t) \dots\dots\dots\dots\dots\dots\dots\dots (30)$$

Now using the fact that growth rate in GDP can be given as $P_tY_t = (1+\delta)P_{t-1}Y_{t-1}$where δ is the real growth rate of GDP, and replacing $(\tau_t - g_t) = fa_{it}$ where fa_{it} mean fiscal account so equation (30) can be given as

$$b_t = \frac{(1+r)}{(1+\delta)}b_{t-1} - (fa_{it}) \dots\dots\dots\dots\dots\dots\dots (31)$$

where in equation (31) b_t is debt to GDP ratio, $(\tau_t - g_t)\ or\ fa_{it}$ is government primary budget balance, r is the real foreign interest rate, δ represent real GDP growth and $(1+r)/(1+\delta)$ are discount rates. The fiscal account can affect the debt to GDP ratio in different ways. If $(fa_{it}) > 0$ mean that either government collect more revenue over expenditures or there is a cut on the expenditures. Both situations will decrease the debt to GDP ratio by more than $(1+r)/(1+\delta)$, Otherwise, if $(fa_{it}) < 0$ than the ratio of debt to GDP will increase by more than the ratio of the discount rates.

Sustainability Conditions

Regarding the prevalence of sustainability of public debt in the presence of fiscal account needs some conditions to hold.

Necessary condition: The necessary condition for the attainment of solvency for an economy is that $\delta > r$. If the given condition when real growth rate exceeds the real interest rate holds. The ratio of $(1+r)/(1+\delta) < 1$ and the debt to GDP ratio will converge and remain sustained over the time, On the other hand, if $\delta < r$ than an explosive debt dynamic can be experienced by the economy until the sufficient condition remains intact.

Sufficient condition: The sufficient condition for sustainability of public debt is that $(fa_{it}) > 0$. Mean that the fiscal budget primary surplus is positive.

Method and data

Based on the theoretical model the following empirical models are used to estimate the conditions of public debt sustainability.

Current Account and Public Debt Sustainability

The sustainability of public debt conditions in case of current account is empirically estimated by equation (25) as;

$$d_t = \frac{(1+r^*)}{(1+\delta)}d_{t-1} - (ca_t) \dots\dots\dots\dots\dots\dots\dots\dots (32)$$

Saving-investment Gap and Public Debt Sustainability

The empirical estimation of public debt sustainability conditions in case of saving-investment gap is estimated by equation (28) as;

$$sid_t = \frac{(1+r)}{(1+\delta)}sid_{t-1} - (sig_{it}) \dots\dots\dots\dots\dots\dots (33)$$

Fiscal Account and Public Debt Sustainability

The conditions of public debt sustainability in case of fiscal account are empirically estimated by equation (31) as;

$$b_t = \frac{(1+r)}{(1+\delta)} b_{t-1} - (fa_{it}) \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (34)$$

Data Structure

Source of data are World Bank Development Indicators (WDI) data set (2019) and International Monetary Fund (IMF). The data is in percent of GDP. Further the data has been restructured for estimation by taking averages of variables over the time in each region.

Results and Discussion

This section of the study represents the empirical results region wise.

South Asia and Pacific Region Results

The results for South Asia and Pacific (SA&P) are presented in table 1. Only in year 1998 both the necessary and sufficient conditions have been violated indicating the time of East Asian crisis due to which most of the East Asian and South Asian countries suffer. Rest of the result show that on average all region cannot fulfill the sufficient condition of saving-investment gap and fiscal account, while in case of current account only few selected years does not violate the sufficient condition. Overall selected result shows that most of the time the debt remains unsustainable for this region.

Table 1. South Asia and Pacific (SA&P)

Years	Necessary Condition	Sufficient Conditions					
	$\frac{(1+r)}{(1+\delta)} < 1$	$ca_{it} \geq 0$	Conclusion	$sig_{it} \geq 0$	Conclusion	$fa_{it} \geq 0$	Conclusion
1996	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
1997	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
1998	> 1	> 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
1999	< 1	> 0	Sustainable	<0	Unsustainable	<0	Unsustainable
2000	< 1	> 0	Sustainable	<0	Unsustainable	<0	Unsustainable
2001	>1	> 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2002	< 1	> 0	Sustainable	<0	Unsustainable	<0	Unsustainable
2003	< 1	> 0	Sustainable	<0	Unsustainable	<0	Unsustainable
2004	< 1	> 0	Sustainable	<0	Unsustainable	<0	Unsustainable
2005	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2006	< 1	> 0	Sustainable	<0	Unsustainable	<0	Unsustainable
2007	< 1	> 0	Sustainable	<0	Unsustainable	<0	Unsustainable
2008	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2009	< 1	> 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2010	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2011	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2012	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2013	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2014	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2015	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2016	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2017	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable

Europe and Central Asia Region Results

The E&CA region results are in table 2. The necessary condition is not fulfilled in 1990's. This shows the hardship time of the newly emerged countries from the breakup of USSR (Union of Soviet Socialist

Republics) and European monetary system (EMS) crisis. When on average, the region face raising inflation, stagnant growth, declining exports etc. problems and affect the progress of the region (see Gros, D. 2014; Batsaikhan, U., & Dabrowski, M. 2017). Sufficient condition of current account is violated in the entire selected time periods. Saving-investment gap and fiscal account both sustained the debt from 2005 to 2007 and further sustained debt can be seen under the necessary and sufficient condition (SIG) fulfillment in 2014 and 2017.

Table 2. Europe and Central Asia (E&CA)

Years	Necessary Condition	Sufficient Conditions					
	$\frac{(1+r)}{(1+\delta)} < 1$	$ca_{it} \geq 0$	Conclusion	$sig_{it} \geq 0$	Conclusion	$fa_{it} \geq 0$	Conclusion
1996	> 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
1997	> 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
1998	> 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
1999	> 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2000	< 1	> 0	Sustainable	<0	Unsustainable	<0	Unsustainable
2001	>1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2002	< 1	< 0	Unsustainable	>0	Sustainable	<0	Unsustainable
2003	< 1	< 0	Unsustainable	>0	Sustainable	<0	Unsustainable
2004	< 1	< 0	Unsustainable	>0	Sustainable	>0	Sustainable
2005	< 1	< 0	Unsustainable	>0	Sustainable	>0	Sustainable
2006	< 1	< 0	Unsustainable	>0	Sustainable	>0	Sustainable
2007	< 1	< 0	Unsustainable	>0	Sustainable	>0	Sustainable
2008	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2009	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2010	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2011	< 1	< 0	Unsustainable	>0	Sustainable	<0	Unsustainable
2012	< 1	< 0	Unsustainable	>0	Sustainable	>0	Sustainable
2013	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2014	< 1	< 0	Unsustainable	>0	Sustainable	<0	Unsustainable
2015	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2016	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2017	< 1	< 0	Unsustainable	>0	Sustainable	<0	Unsustainable

Sub-Sahara Africa Region Results

In table 3 sub-Sahara Africa results are given. In SSA region necessary condition is not fulfill in 1998, 1999 and 2008 (Calamitsis, E. A.1999). In case of sufficient conditions all condition result in unstained situation except fiscal account in 2006 sustained the public debt for the region.

Table 3. Sub-Sahara Africa (SSA)

Years	Necessary Condition	Sufficient Conditions					
	$\frac{(1+r)}{(1+\delta)} < 1$	$ca_{it} \geq 0$	Conclusion	$sig_{it} \geq 0$	Conclusion	$fa_{it} \geq 0$	Conclusion
1996	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
1997	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
1998	> 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
1999	> 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2000	> 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2001	<1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2002	>1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable

2003	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2004	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2005	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2006	< 1	< 0	Unsustainable	<0	Unsustainable	>0	Sustainable
2007	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2008	> 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2009	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2010	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2011	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2012	< 1	< 0	Unsustainable	<0	Unsustainable	>0	Sustainable
2013	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2014	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2015	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2016	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2017	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable

Latin America Region Results

The LA region banking sector crisis in 1990's may be the reason violating the necessary condition of debt sustainability in 1998 and 1999 Alicia, G, (1997) and case of 2008 could be due to global recession. In sufficient conditions, fiscal account leads to unsustain public debt for all the selected years. Sustainable public debt can be seen for 2005 and 2006 in case of current account condition. In selected years saving-investment gap show most achieving sustainable public debt i.e. from 2005 to 2008.

Table 4. Latin America (LA)

Years	Necessary Condition	Sufficient Conditions					
	$\frac{(1+r)}{(1+\delta)} < 1$	$ca_{it} \geq 0$	Conclusion	$sig_{it} \geq 0$	Conclusion	$fa_{it} \geq 0$	Conclusion
1996	> 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
1997	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
1998	> 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
1999	> 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2000	> 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2001	>1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2002	>1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2003	> 1	< 0	Unsustainable	>0	Sustainable	<0	Unsustainable
2004	< 1	< 0	Unsustainable	>0	Sustainable	<0	Unsustainable
2005	< 1	> 0	Sustainable	>0	Sustainable	<0	Unsustainable
2006	< 1	> 0	Sustainable	>0	Sustainable	<0	Unsustainable
2007	< 1	< 0	Unsustainable	>0	Sustainable	<0	Unsustainable
2008	> 1	< 0	Unsustainable	>0	Sustainable	<0	Unsustainable
2009	> 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2010	< 1	< 0	Unsustainable	>0	Sustainable	<0	Unsustainable
2011	< 1	< 0	Unsustainable	>0	Sustainable	<0	Unsustainable
2012	< 1	< 0	Unsustainable	>0	Sustainable	<0	Unsustainable
2013	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2014	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2015	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2016	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable
2017	< 1	< 0	Unsustainable	<0	Unsustainable	<0	Unsustainable

Concluding Remarks and Policy Recommendations

Current study estimates the public debt sustainability for 53 different developing countries of the world divided into different regions (SA&P, E&CA, SSA, LA) categorized by World Bank over a period of 1996 to 2017. The variables of interest are public debt, Current account, fiscal account, saving-investment gap, economics growth, interest rate. Average series were obtained for each variable in each region except interest rate and then sustainability of public debt was calculated for each region under the necessary and sufficient condition discussed in theoretical model section. In almost all regions the necessary condition of public debt sustainability violation occurs due to either global or regional crisis. The saving investment gap situation as one of the sufficient conditions for public debt sustainability along with current account and fiscal account does play a vital role in deciding whether the public debt is sustainable or not. For SA&P region both saving investment gap and fiscal account persistently caused an unsustainable public debt while current account does contribute to having a sustainable debt in some years. In case of E&CA region current account results in unsustainable public debt for the selected years further, saving investment gap and fiscal account dose lead to a sustainable public debt in some years. SSA region story is quite different. Both current account and saving investment gap for all mentioned years result in unsustainable public debt while fiscal account does manage to give a sustainable public debt in a single year. Situation of LA region shows that fiscal account consistently leads to unsustainable debt while current account and saving investment gap gives mixed results of both sustainable and unsustainable outcome.

Regarding the policy options current study proposed that to control the enlargement of public debt to GDP ratio policy makers of the developing countries must bring policies to promote investment activities backed by saving not by debt. The persistence cause of public debt in developing countries is budget deficit either from expenditures or revenue side. Increase in the tax base can increase government savings and can reduce the dependency on debt. Along with-it promotion of investment backed by saving can increase output and economy can produce over its domestic absorption and can improve its current account position.

References

Batsaikhan, U., & Dabrowski, M. (2017). Central Asia—twenty-five years after the breakup of the USSR. *Russian Journal of Economics*, *3*(3), 296-320.

Blanchard, O. J., Chouraqui, J. C., Hagemann, R., & Sartor, N. (1991). The sustainability of fiscal policy: New answers to an old question. *NBER Working Paper*, (R1547).

Bohn, H. (1995). The sustainability of budget deficits in a stochastic economy. *Journal of Money, Credit and Banking*, *27*(1), 257-271.

Bohn, H. (1998). The behavior of US public debt and deficits. *the Quarterly Journal of economics*, *113*(3), 949-963.

Bohn, H. (2008). The sustainability of fiscal policy in the United States. *Sustainability of public debt*, 15-49.

Calamitsis, E. A. (1999). Adjustment and growth in sub-Saharan Africa: the unfinished agenda. *Finance and Development*, *36*(1), 6.

Campos, C. F., Jaimovich, D., & Panizza, U. (2006). The unexplained part of public debt. *Emerging Markets Review*, *7*(3), 228-243.

Chan-Lau, M. J. A., & Santos, M. A. (2010). *Public Debt Sustainability and Management in a Compound Option Framework* (No. 10-12). International Monetary Fund.

Corsetti, G., & Roubini, N. (1991). Fiscal deficits, public debt, and government solvency: Evidence from OECD countries. *Journal of the Japanese and International Economies*, *5*(4), 354-380.

Deaton, A., & Muellbauer, J. (1980). *Economics and consumer behavior*. Cambridge university press.

Dim, C., & Ezenekwe, U. (2014). Capital flight to savings gap in Nigeria: An assessment of the socio-economic determinants. *International Journal of Economics and Finance*, *6*(2), 75-85.

Eichengreen, B., & Panizza, U. (2016). A surplus of ambition: can Europe rely on large primary surpluses to solve its debt problem? *Economic Policy*, *31*(85), 5-49.

Greiner, A. (2013a). How to test for debt sustainability? Some theoretical reflections on an empirical test. *Economic Bulletin, 33(3)*, 2357–2364

Gros, D. (2014). The EMS crisis of the 1990s: Parallels with the present crisis? *CEPS Working Document No*, *393*.

Hakkio, C. S., & Rush, M. (1991). Is the budget deficit "too large?". *Economic inquiry*, *29*(3), 429-445.

Hamilton, J. D., & Flavin, M. A. (1986). "On the Limitations of Government Borrowing: A Framework for Empirical Testing.". *American Economic Review*, *76*(4), 808-19.

Irving, F. (1930). *The Theory of Interest*. New York: New York Macmillan.

Jayme Jr, F. G. (2001). External debt sustainability: Empirical evidence in Brazil. *Texto para discussão*, *154*.

Milesi-Ferretti, G. M., & Razin, A. (1996). Persistent current account deficits: a warning signal? *International Journal of Finance & Economics*, *1*(3), 161-181.

Obstfeld, M., & Rogoff, K. (2007). The unsustainable US current account position revisited. In *G7 current account imbalances: Sustainability and adjustment* (pp. 339-376). University of Chicago Press.

Reinhart, C. M., & Rogoff, K. S. (2008). *This time is different: A panoramic view of eight centuries of financial crises* (No. w13882). National Bureau of Economic Research.

Sawada, Y. (1994). Are the heavily indebted countries solvent? Tests of intertemporal borrowing constraints. *Journal of Development Economics*, *45*(2), 325-337.

Seiferling, M. M. (2013). *Stock-flow adjustments, government's integrated balance sheet and fiscal transparency* (No. 13-63). International Monetary Fund.

Shuo FENG, X.-F. H. (2014). *Study on Sustainability of American Double Gaps and its External Debt*. Paper presented at the International Conference on Management Science and Management Innovation.

Trehan, B., & Walsh, C. E. (1991). Testing intertemporal budget constraints: Theory and applications to US federal budget and current account deficits. *Journal of Money, Credit and banking*, *23*(2), 206-223.

Vito, P., & Wickens, M. R. (2005). V Measuring Fiscal Sustainability. In *V CDMA Conference Paper Series* (Vol. 503).

Weber, A. (2012). *Stock-flow adjustments and fiscal transparency: A cross-country comparison* (No. 12-39). International Monetary Fund.

Wilcox, D. W. (1989). The sustainability of government deficits: Implications of the present-value borrowing constraint. *Journal of Money, credit and Banking*, *21*(3), 291-306.