Debt Indicators

This appendix aims to analyze and describe the most acknowledged vulnerability, sustainability and financial indicators, as well as their implementation's scope and benefits in public debt management.

I. INTRODUCTION

1. Three kinds of indicators are used for assessing risks related to public debt.
   - Vulnerability Indicators -- measure the risk that current economic conditions generate over public debt.
   - Sustainability Indicators -- evaluate the government's ability to face upcoming contingencies considering certain expected circumstances.
   - Financial Debt Indicators -- show the public debt's market performance.

2. Each group of indicators has a distinct feature. First, vulnerability analysis entails the need to create indicators that measure and prevent any situation hindering debt's payment, under the current circumstances. These indicators are usually static, which show pictures of the prevailing situation but do not allow outlining medium-term and long-term perspectives. Likewise, it is essential to continuously monitor debt's solvency and sustainability, and simulate debt's dynamic performance in adverse scenarios. In order to attain such objective, sustainability measures are used to analyze whether it is possible for the government to maintain the same fiscal position, or if it will need adjustments to keep any vulnerability indicator under control.

II. VULNERABILITY INDICATORS

3. Recognizing the importance of controlling variables that might threaten debt's sustainability, the International Monetary Fund (IMF) and the World Bank (WB) implemented a wide-scope program to define whether a country is vulnerable to monetary crisis afflicting several emerging market economies and, if so, to what extent. The program consists of guidelines, frameworks, and working papers on public debt which were built on earlier assessments of debt trends and vulnerabilities.

4. Most of the work on vulnerability carried out by international institutions involved improvements on data quality and transparency. The availability of appropriate and thorough data on international reserves, external debt, and capital flows, increase the ability to identify vulnerabilities, conferring policy makers enough time to carry out corrective measures. IMF, for instance, analyze macroeconomic data by carrying out stress tests or using early warning system models.

5. Given the potential limitations of traditional economic indicators, other indicators could prove to be more useful predictors of weakening macroeconomic fundamentals and fiscal vulnerability. These indicators are categorized into either public debt indicators or external debt indicators. They should not be seen as predictors of actual vulnerability but of potential vulnerability.

6. The most acknowledged indicators useful in vulnerabilities' management are as follows:

   a) Profile of maturing debts

7. This assessment requires a record of all of the instruments in circulation, both internal and external indicating their average maturity and duration. The profile should show debt characteristics regarding terms and time in which there will be a need for currency for its payment.

b) Portfolio diversification

8. In guaranteeing efficiency, governments must make sure that there exist enough negotiable titles with a range of expiring terms in the internal and external markets. Besides terms, portfolio diversification will offer choices regarding currency and payment conditions. The broader the diversification degree, the lesser the risk of increase in value of the lending country's currency value that might make the acquired debt more expensive.

c) Public debt / Gross domestic product (GDP)

9. The most generally used and common indicator is the debt-to-GDP ratio. It is calculated by dividing the total public debt outstanding at a point in time by the country's GDP. It measures the indebtedness level relative to the country's economic activity and assumes that all GDP resources are available to finance the debt burden, which may not be necessarily true. However, this indicator is recognized as the most relevant in measuring degree of indebtedness, stressing the government's solvency capability.

d) Fixed debt to floating debt

10. Fixed debt matures or re-financed in a period over 12 months while floating debt matures before a year. Analysis of ratio of debt placed at a term of less than one year and the one placed at a longer term shows the time government has to face its obligations in the maturity calendar. The longer the term, the longer the project maturation would be thus allowing making resources available for their payment.

e) Public debt / domestic government revenue

11. This measures indebtedness level relative to the government's payment capacity. It shows the number of required years to pay the total debt balance. This ratio shows the Government's possibilities to collect revenues compared to the debt burden.

Indicators regarding public debt service

a) Debt service / domestic government revenue

12. This indicator measures the government's ability to service the debt using domestic sources of revenue. It highlights the extent to which debt service hampers debtor countries in the use of their financial resources.

b) Debt service / exports

13. The public debt service to export revenues ratio is a useful measure of the external repayment ability of a government and of its economy. Where public debt is predominant in an economy (as in heavily indebted countries) the public debt service (including government guaranteed debt obligations) measured against export revenues could also be used as a predictor of potential public sector vulnerability.

c) Interest / domestic government revenue

14. This indicator measures the financial cost of the public debt as a proportion of the tax revenue. It is generally used as a measure of the public income tolerance to an

increase in unproductive expenditure (country`s possibilities to face other expenditures).

d) Interest / GDP

15. This indicator shows the burden of the interest on the public debt to the country. It can be interpreted as the country's possibilities to face unproductive expenditures.

e) Average residual maturity

16. A bond's maturity is the length of time until the principal must be paid back. Average residual maturity is indicator to track the maturity of public debt in an effort to monitor refinancing risk.

17. The aforementioned indicators are mostly static, since they are related to a certain period, and usually it is more useful to observe their evolution dynamically. This entails the existence of a correlation between interest rates and macroeconomic variables. The study of the indicators' dynamics allows us to analyze which relationships occur among these variables in time. The basic indicators have been complemented with macroeconomic variables in order to visualize vulnerabilities from other perspectives.

18. There is no consensus among international organizations with respect to setting minimal acceptable levels for debt indicators.   The following table portrays the minimal suggested levels for emerging countries, provided by different international institutions:

Vulnerability indicator	Thresholds, %	
	International Monetary Fund*	International Debt Relief**
Debt service/ domestic government revenue	25 – 35	28 - 63
Interest/ domestic government revenue	7 – 10	4.6 – 6.8
Public debt/GDP	25 - 30	20 - 25
Public debt/ domestic government revenue	90 - 150	92 - 167
*IMF, Foreign Affairs Department: Technical Note "Vulnerability Indicators", 2003		
**International Debt Relief: "Key aspects of Debt Sustainability Analysis", 2007		

External Debt Indicators

19. The prevailing approach to the definition of external debt assumes that debt liabilities owed by residents to nonresidents are external debt. External public debt includes external debt owed by the public sector and external debt guaranteed by the public sector. IMF and WB defines publicly guaranteed debt as debt liabilities of public and private sector units, the servicing of which is contractually guaranteed by public sector units.

a) External debt / GDP

20. Indicator relating debt to the country's resource base, reflecting the potential of shifting production to exports or import substitutes so as to enhance repayment capacity.

b) External debt / exports

21. Indicator of trend in debt that is closely related to the external repayment capacity of the country. The ratio shows the debt burden level over exports or the capability of

acquiring currencies. It must be used in conjunction with ratio of debt service obligations as a percentage of exports.

c) Short-term external debt / reserves

22. Indicator of vulnerability to economic and financial shocks, stemming from the amount of short-term external debt outstanding.

d) External debt service / revenue

23. This indicator may be split into two segments for analysis. One, it may be used as an external macroeconomic solvency indicator by combining external public debt and external private debt services divided by total revenue. Second, it may be used as external public sector vulnerability to foreign currency position by the ratio of external public debt service over the total revenue.

e) Average interest rate on external debt

24. Indicator relating to borrowing terms. In conjunction with debt/GDP and debt/export ratios and growth outlook, this is a key indicator for assessing debt sustainability.

f) Amortization / external debt payments

25. This ratio measures the debt amortization level as a proportion of the external debt payment. This indicator, understood as a revolving ratio, shows when a country is refinancing its debt with new issuances or borrowings. If this ratio exceeds 100, debt is not refinanced with new debt.

g) Net International Reserves/ External Debt

26. This ratio shows the number of times the external liabilities exceed the reserves. It is usually used in view of the rhythm of reserve accumulation. In that case, it is interpreted as the number of years required for the current foreign debt to be repaid, assuming a constant accumulation rhythm.

Debt indicators for low-income countries

27. International institutions published several studies devoted to debt indicators for low-income countries.[1]

28. IMF and WB suggest debt burden solvency and liquidity indicators for public and publicly guaranteed (PPG) external debt or public debt in low-income countries.[2]

29. PPG external debt includes both external debt owed by the public sector and external debt guaranteed by the public sector. Public debt covers total debt of the public sector, both external and domestic.

30. IMF and WB classify low-income countries into three policy performance categories (strong, medium, and poor), using the World Bank's Country Policy and Institutional

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[1] International Development Association International Monetary Fund Review of the Debt Sustainability Framework For Low Income Countries: Proposed Reforms August 22, 2017. Prepared by the staffs of the World Bank Group* and the International Monetary Fund Approved by Jan Walliser (WB) and Seán Nolan (IMF);

[2] Staff Guidance Note on the Application of the Joint Bank-Fund Debt Sustainability Framework for Low-Income Countries, IMF, 2013.

Assessment index, and use different indicative thresholds for external debt indicators depending on the performance category as presented in the table below.

Policy-based thresholds for external debt indicators for low-income countries

Indicator	Weak policy	Medium policy	Strong policy
	Thresholds, %		
External debt/GDP	30	40	55
External debt/exports	140	180	240
External debt service/exports	10	15	21
External debt service/revenue	14	18	23
International Monetary Fund review of the debt sustainability framework for low income countries: proposed reforms. August 22, 2017			

III. SUSTAINABILITY INDICATORS

31. Public debt indicators provide us with an approach regarding its sustainability. These ratios are ex-post indicators, that is, they provide historic facts. In contrast, ex-ante indicators provide us with information concerning the magnitude of the fiscal adjustment needed to achieve fiscal sustainability.

32. The inter-temporal relationship between fiscal balances, public debt and interest payment is thus expressed: $D_{t+1} = D_t (1 + r_t) + BP_t$, where D_t corresponds to public debt during the t period, r_t is the debt's interest rate and BP_t is the primary fiscal balance. Based on this ratio, the basic condition for sustainability emerges, establishing a consistency relationship between different policy variables, that is, between debt's growth, GDP's growth and the primary deficit, given a certain interest rate. The main indicators are listed below:

a) Fiscal Consistency Indicator

33. Blanchard (1990) proposed a sustainability indicator that takes into consideration the consistency of the current tax policy, while keeping the debt-to-GDP ratio constant. It is expressed as follows:

$$t_n^* - t = \frac{\sum_{}^{n} g}{n} + (r - q)d^* - t$$

where t*n is the fiscal burden which is assumed to be constant over a period of (n) years, the debt-to-GDP ratio in a level d*, g being the expenditure, r being the interest rate and q being the GDP's growth rate. In this sense, this indicator shows the tax level required to stabilize the debt-to-GDP ratio, given an expense level, a GDP increase path and an initial debt balance. If the relation is negative, the indicator shows that the economy's taxation pressure is too low to stabilize the debt-to-GDP ratio.

b) Buiter's Indicator

34. Buiter (1985) proposes an indicator that calculates the gap between the sustainable primary balance and the primary effective balance, where the sustainability condition

is defined starting from a wider net wealth concept than the one implicit in the debt / GDP ratio. Buiter's Indicator defines this gap as follows:

$$b^* - bt = (r - q)wt - bt$$

> where b* is the debt / sustainable GDP ratio, b is the debt / GDP ratio, wt is the net / real government wealth value as a GDP proportion, r is the interest rate and q is the product increase rate.

35. The use of Buiter's indicator is limited by the following: practical qualification is very difficult to come up with an accurate net government wealth measure; assets should include not only financial and real capital and lands and minerals but also the current value of future taxes; liabilities should include not only direct public debt but also current value of future expenses for social security and other benefits habilitated; and the adjusted value based on a risk of a series of contingent liabilities of difficult quantification.

c) Short term primary gap Indicator

36. The primary gap indicator provides the primary balance level needed to stabilize debt as a proportion of the GDP:

$$BP^* - BP = (rt - nt)b - BP$$

> where BP* is the primary balance needed to stabilize debt, BP corresponds to the prevailing primary balance, r is the real interest rate trend, n is the population growth's rate and b is the debt-to-GDP ratio.

37. If the permanent primary balance exceeds the current primary balance, the primary path is positive. This means that the fiscal policy is not sustainable; because it tends to increase the debt-to-GDP ratio. On the contrary, when the permanent primary balance is lower than the current primary balance, the fiscal policy tends to reduce the debt to GDP ratio.

d) Macro-adjusted primary deficit

38. Proposed by Talvi and Végh (2000), this indicator is motivated by the high volatility of macroeconomic variables which makes the deficit vary around the expected value under normal macroeconomic conditions. It is used to compare the macro-adjusted balance with the estimations of the current values. The challenge lies within the necessity to establish what a "normal economy condition" is.

$$I_t^M = \frac{(r - g)}{1 + g} b_{t-1} + d_t^M$$

> where r is the real interest rate for the analysis, g represents the analyzed year's real growth, and dMt is the primary macroadjusted balance.

e) Sustainable fiscal position Indicator

39. Croce and Juan-Ramón (2003) describes this indicator as a complement to the analysis on traditional sustainability indicators using a methodology that explicitly

evaluates the tax authority reaction when variables, linked to sustainability of debt, change over time.

40. The sustainable fiscal position indicator explicitly adds a reaction function of fiscal authority, and whose variation over time allows evaluating how the fiscal policy has reacted whenever the conditions have changed. The reaction function of the fiscal authority is defined as the ratio between the primary effective balance gap and the primary sustainable balance (or goal) as well as in the debt to GDP ratio. Statistically, it may be complementary to the indicators already discussed, and explains how income and expenditure policies (which define the primary balance) are pointed to create a convergence of the debt-to-GDP ratio, to an ex-ante sustainable (goal). On the other hand, dynamically, this ratio indicates how the tax authority has reacted from year to year (through innovations on its fiscal policies), while facing variations in the existing gap between the indebtedness level and sustainable level.

f) Currency availability Indicators

41. This indicator, proposed by Calvo, Izquierdo, and Talvi (2003), assumes that volatility of capital flows variables is higher than that of macroeconomic variables. It compares the external debt-to-internal debt ratio with the proportion of tradable goods related to the non-tradable goods in economy:

$$b = \frac{B + eB^*}{y + ey^*} \quad (a)$$

where b is the debt / GDP ratio , B is the debt in terms of non-tradable goods, e is the type of real exchange, B* is the debt in terms of tradable goods, y is the GDP of non-tradable goods and y* is the GDP of tradable goods.

g) Fiscal Sustainability Indicators with Long-Term Restrictions

42. Bagnai (2003) presents two indicators in keeping debt sustainability in view of possible events such as the agreed contingent liabilities or future interest payments, among others. The first indicator considers that, in the mid- and long-run, a country's generation will act as a source of government funding: debt (financial markets) and tax payment (macroeconomic).The objective of these considerations is to keep the debt-to-GDP ratio (B/y) stable in time. Dynamic fiscal stability will be reached only when the following two conditions are met:

$$\frac{B}{y} < \tilde{b} = k \left[\frac{\varepsilon (1 + n) \tau}{1 - \tau} \right] - \{n - r (1 - \tau)\} \Phi \quad (a)$$

$$\Phi \equiv 1 - \eta (1 - s) + \left[\frac{\varepsilon (1 + n)}{r (1 - \tau)} - \frac{s\delta (1 + \varphi)}{\varphi} \right] < 0 \quad (b)$$

where n is the population growth rate, τ is the income tax, s is the income proportion that is saved, r is the real tax rate, δ is the elasticity of savings related to the interest rate, ε is the investment elasticity related to the interest rate, η is the elasticity of consumption as a proportion of income, k is the capital-to-GDP ratio and φ is the elasticity of the product as a proportion of physical

capital, which means the response of output to changes in the stock of the country's infrastructure. If debt exceeds the b level, economic system is dynamically non-sustainable and debt will respond to any external shock following an explosive trajectory.

IV. FINANCIAL DEBT INDICATORS

43. The main risks faced by public debt portfolios relate to market risk and operational risk. The risk exposures of a public debt portfolio are determined by the composition of the debt portfolio, including the share of short-term debt versus longer-term debt in the portfolio, the variable interest rate debt relative to fixed rate debt, and debt denominated in foreign currency.

44. *Market risk* refers to the risk of increases in the cost of the debt arising from changes in market variables. Market risk includes interest rate risk and exchange rate risk, refinancing risk, liquidity risk, and credit risk. The most common types of market risk are the interest rate risk and exchange rate risk.

45. *Interest Rate risk/Refixing risk* refers to the risk of increases in the cost of the debt arising from changes in interest rates. For both domestic and foreign currency debt, changes in interest rates affect debt servicing costs on new issues when fixed rate debt is refinanced, and on existing and new floating rate debt at the rate reset dates. Hence, short-term or floating rate debt is usually considered to be more risky than long-term, fixed rate debt. Traditional measures of interest rate risk include duration, average time to refixing, and the share of floating rate debt to total debt.

46. The concept of interest rates is commonly used to describe the growth of an associated potential gain to an amount of money. These are the gain measures for those who decide to save. Capital markets provide an efficient mechanism to transfer capital between economic agents. The lender receives interest for the temporary use of his capital, for that reason, the efficient formation of interest rates for different terms depends on the efficiency of the money market. For the government, a more consolidated market represents the possibility of reaching better financing conditions at any term.

47. Therefore, it is necessary to know the interest rates for each type of financial instruments (securities, loans, etc.) and to determine a way to compare them on the same basis. This indicator is known as the yield curve, which can be increasing or decreasing and its slope can be explained in three different manners.

Position and Slope of the Yield Curve

Slope	Market Expectations Theory	Liquidity Preferences Theory	Market Segmentation Theory
Positive	It is expected that short term rates rise	Positive premium to liquidity	Excess of supply over demand in long term
Negative	It is expected that short term rates decrease	Negative premium (punishment) to liquidity	Excess of supply over demand in short term
Horizontal	It is expected that short term rates remain the same	No liquidity premium	Equilibrium between supply and demand in all terms

Concave	It is expected that short term rates rise and subsequently decrease	Positive premium to liquidity followed by a negative premium to liquidity	Excess of supply over demand in mid term

48. *Weighted Average Maturity and Duration* .These statistics measure the average length of time between debt servicing payments. The weighted average maturity has a limited use because it only considers payment dates of the principal, while the duration also includes the interest payment dates. The duration is obtained by calculating the average maturity of the bond relative to payment terms (coupons and principal), weighing each one of the terms associated to the referred flows with its respective amounts in present value.

49. As a rule, the longer the duration of a bond, the lower the associated risk, on average. Lower proportions of government debt will be adjusted to the interest rates new level.

50. The standard deviation indicates the average detachment between a data set and its average value. Larger and more frequent movements of interest rates (growing or lowering) lead to greater volatility which implies greater uncertainty. For instance, if the interest rate of a bond is 1.72% and its standard deviation is 0.23%, the average yield could vary between 1.49% and 1.95%.

51. *Exchange Rate risk/Currency risk* refers to the risk of increases in the cost of the debt arising from changes in exchange rates. Debt denominated in or indexed to foreign currencies adds volatility to debt servicing costs as measured in domestic currency owing to exchange rate movements. Measures of exchange rate risk include the share of domestic currency debt in total debt, and the ratio of short term external debt to international reserves.

52. *Refinancing risk/Rollover risk* refers to the risk that debt will have to be refinanced at an unusually high cost or, in extreme cases, cannot be refinanced at all. To the extent that refinancing risk is limited to the risk that debt might have to be financed at higher interest rates, including changes in credit spreads, it may be considered a type of interest rate risk. However, it is often treated separately because the inability to refinance maturing debt and/or exceptionally large increases in government funding costs can lead to or exacerbate a debt crisis. Further, bonds with embedded put options can exacerbate refinancing risk. Relevant indicators include average time to maturity, percentage of debt outstanding in 12, 24, and 36 months, and the redemption profile.

53. *Liquidity risk* refers (in the context of debt management) to a situation where the volume of liquid assets diminishes quickly as a result of unanticipated cash flow obligations and/or a possible difficulty in raising cash through borrowing in a short period of time.

54. *Credit risk* refers to the risk of non-performance by borrowers on loans or other financial assets, or by counterparty on financial contracts. This risk is particularly relevant in cases where debt management includes the management of liquid assets. It may also be relevant in the acceptance of bids in auctions of securities issued by the government as well as in relation to credit guarantees, and in derivative contracts entered into by the debt manager.

55. *Settlement risk* refers to the risk that counterparty does not deliver a security as agreed in a contract, after the country (other counterparty) has already made the payment according to the agreement.

56. *Operational risk* refers to a range of different types of risks, including transaction errors in the various stages of executing and recording transactions; inadequacies or failures in internal controls, or in systems and services; reputation risk; legal risk; security breaches; fraud risk, or natural disasters that affect the debt manager's ability to pursue activities required to meet debt management objectives.

57. *Reputation risk* refers to losses resulting from untaken financing opportunities, due to the issuer's bad reputation for a default or deteriorating fiscal situation. A country's reputation can be analyzed through credit ratings and sovereign indicators. A country's reputation can be analyzed through the following indicators:

Credit ratings

58. This variable represents the perception that the private agents have about the country's debt situation. The credit quality can be analyzed from two perspectives. On the one hand, there are rating agencies that assign a qualification to the debt based on established criteria. A high rate results when the rating agent finds few indications of future bankruptcy or liquidity problems that compromise the regular payments. On the other hand, a low rate represents a scenario that the commitments already contracted cannot be fulfilled.

Sovereign Risk indicators

59. *Sovereign Risk* is an index intended to measure the degree of risk operating within a country for foreign investments. It is a basic indicator of the economic situation of a country and is used by international investors as a supplementary element to make decisions. The sovereign index equals the over-rate that a country pays for its bonds as compared to those of the United States Treasury.

60. For barely developed countries within the global financial market, the sovereign risk index is used as an indicator of the county's economic situation and of the rating agencies' expectations regarding future economic evolution (debt payment capability, in particular); on the other hand, the sovereign risk is a reference of the indebtedness cost that the country can face. This indicator is therefore a crucial element with two major implications.

61. First, the more deteriorated the sovereign rating is, the larger the indebtedness cost will be; furthermore, the larger this cost is, the less economic policies can be handled and the larger the risk of default will be present, resulting again in increases of such sovereign index.

62. Second, high sovereign risk levels will have an impact on investment decisions, thus causing diminished fund flows and increasing interest rates within the country. In other words, not only the government's, but also the private sector's cost of debt is susceptible to increasing, with negative effects in the rates of investment, growth, and employment.

63. *Fraud risk* refers to the risk that an intentional act will be committed related to the fraudulent financial reporting or misappropriation of assets.

V. FINAL CONSIDERATIONS

64. The three major groups of indicators (vulnerability, sustainability, and financial debt) give us an opportunity to understand the public debt from different perspectives, thus allowing governments to control and manage public debt on a sound credit-practice basis.

65. SAIs can play an active role in promoting the implementation of best lending practices and debt management, including the use of various types of indicators discussed in this document. They can also encourage governments to focus more on monitoring of vulnerabilities, and to give high priority to risk management, production and publication of quality financial information. The improvement of regulation and supervision in the financial services sector in line with international standards should not be set aside. This will reduce the vulnerability of public debt to events affecting the private sector.