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STATE-CONTINGENT DEBT INSTRUMENTS FOR SOVEREIGNS—ANNEXES

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Annex I. Potential Benefits from SCDIs: Analytics and Numerical Simulations

This annex discusses how debt management can help to increase fiscal space for a given path of primary fiscal balances, and presents model simulations that illustrate the potential benefits in terms of debt sustainability that could emerge when sovereign debt is issued in state-contingent GDP-linked bonds or longer maturities. Two parallel exercises have been conducted, using a debt limits model. For the purpose of the exercise, stabilizing debt ratios against underlying uncertainty in debt dynamics and thereby reducing sovereign default risk is equivalent to creating fiscal space for a given path of primary fiscal balances. The first section explains the mechanism in play that underpins the benefits of GDP-linked or longer maturity debt, and gives the simulation results using data from advanced economies. The second section extends the debt limits model with a richer set of underlying shocks (to real GDP, exchange rates and fiscal primary balances), and presents the simulation results for the potential benefit of GDP-linked bonds across country groups with different macroeconomic fundamentals.

A. Expanding Fiscal Space through Debt Management[1]

1. This section argues that debt management policies can play an important role in expanding fiscal space for a given path of primary fiscal balances (i.e., without the need for fiscal contraction today or in the future). We set out the argument in the context of a model of fiscal space developed in Ostry and others (2010). We explore the role of two debt management policies in particular: issuance of GDP-linked debt; and issuance of longer-maturity debt. Our simulation results suggest that, by managing debt along these two dimensions, substantial gains in fiscal space on the order of 20-70 percent of GDP are plausible.

2. Concerns about limits to fiscal space at the present juncture raise the issue of how to make what is scarce more plentiful. The obvious way to raise fiscal space is to have a fiscal contraction and pay down the debt. But this runs counter to the goal of using fiscal policy to boost demand. Another approach is to promise to pay down the debt tomorrow through forward commitments. But markets might take these *cum grano salis*. Is there another approach to increasing fiscal space that does not require contractionary fiscal policy today or tomorrow? The approach adopted in this exercise is to ask whether debt management policies—especially the introduction of GDP-linked instruments to finance deficits and a lengthening of the duration of government debt—might provide a solution by reducing the risk that the sovereign may default *for a given path of primary fiscal balances*.

Fiscal Space and Growth Uncertainty

3. Ostry and others, (2010) develops a framework to determine a country's debt limit—the debt level beyond which fiscal solvency is in doubt—and its fiscal space, defined as the difference

[1] Contributors: Jonathan D. Ostry, Jun I. Kim (RES), based on their forthcoming paper, "Boosting Fiscal Space: The Roles of GDP-linked Debt and Longer Maturities."

between the current debt level and the debt limit. An underlying assumption of the model (and one that is supported by empirical evidence for many advanced and emerging market countries) is that governments normally behave responsibly in the sense that they increase their primary balance in response to rising debt in order to ensure that the debt ratio converges to some reasonable value. However, there are economic and political limits to how high primary balances can rise, which means that fiscal responsibility, defined in terms of the extent of the response to rising debt, cannot hold for all debt levels. When the debt ratio is very high, a further increase is unlikely to elicit a primary balance response sufficient to offset the rising interest bill (the primary balance cannot exceed GDP itself, and is infrequently more than a few percent of GDP). The concept of fiscal fatigue developed by Ostry and others (2010) accounts for this weakened fiscal responsibility when debt is high.

4. The notion of fiscal fatigue directly underpins the existence of a finite debt limit and the idea of fiscal space (as the difference between the current debt ratio and the debt limit). If the primary balance eventually cannot keep up with rising debt service as debt rises, there will be some debt level above which the debt dynamics become explosive. This is the case even if, counterfactually, lenders continue to lend at the risk-free rate up to the debt limit, which of course they will not do given the risk of default even before the debt limit. Rising default risk and interest rates (risk premia) feed on one another: rising default risk raises the interest rate which in turn leads to a higher probability of default—indeed, a crucial implication is that the interest rate charged on sovereign debt will be a convex function of the debt ratio, reflecting the interdependence between the default risk and the cost of borrowing as debt rises. One can search for a "fixed-point" of this problem among debt, the interest rate and the default risk: the point at which the problem has no solution at a finite interest rate defines the debt limit.

5. The evolution of sovereign debt ratios depends on the evolution of GDP, which is buffeted by random shocks. In good states when growth outcomes prove favorable (e.g., economic boom), sovereign debt ratios are pushed down because their denominator, GDP, is pushed up. In bad states (e.g., a financial crisis, a natural disaster), sovereign debt ratios are pushed up. Such stochastic variation in the debt ratio arising from growth uncertainty tends to raise the *average* interest rate charged on the debt because of the convexity discussed above—lenders faced with default risk (which leads to certain loss) need to charge a higher interest rate on average than in the absence of growth uncertainty, in order to break even. A higher average interest rate means higher debt service. For a given path of primary balances, therefore, debt service begins to exceed the primary balance systematically—i.e., debt dynamics become unsustainable—at a lower debt ratio than otherwise. This implies that growth uncertainty leads to a lower debt limit than when growth uncertainty is absent. Since the average interest rate will be increasing in the extent of uncertainty, the debt limit will be lower the larger the extent of growth uncertainty.

Expanding Fiscal Space through Debt Management

6. The above argument indicates that reducing stochastic variation in the debt ratio would help to increase the debt limit and, by implication, fiscal space. One way to do this involves reducing the underlying growth uncertainty itself. This is essentially the realm of macroeconomic policies—countercyclical fiscal and monetary policies. An alternative way is to insulate debt dynamics against uncertainty. Debt management can play a useful role in this regard. One fruitful approach, we argue in our forthcoming paper, involves the issuance of state-contingent debt such as GDP-linked bonds

(GLBs). By linking debt payments directly to the issuing country's growth rate, GLBs provides the sovereign a break on its debt service in bad times, in exchange for increased debt service obligations in good times (to keep the lender's expected profit the same). This contractual feature tends to stabilize the debt ratio in the presence of growth uncertainty by enabling efficient risk sharing between sovereign and private investors. Greater stability in the debt ratio results in lower default risk and a higher debt limit. If the entire debt is issued in GLBs, debt dynamics may be fully insulated against the impact of growth uncertainty, in which case an equivalence result obtains such that fiscal space afforded by GLBs under growth uncertainty is identical to that afforded by nominal debt in the absence of growth uncertainty.

7. Another way to increase fiscal space through debt management involves increasing the (average) maturity of the debt. Longer-maturity debt is not a state-contingent instrument but nevertheless has several advantages over short-term debt, all of which tend to reduce stochastic variation in the debt ratio and default risk. First, debt service is spread out more evenly over time. As a result, debt service is less sensitive to shocks to the growth rate than in the case of short-term debt. Second, longer-maturity debt provides some hedging benefit to the borrower. As default risk rises, for example, the market price of long-maturity debt falls. This will lead to a larger increase in the debt ratio since more debt needs to be issued to meet a given debt service. At the same time, however, the market value of the remaining debt also falls. These offsetting movements in debt dynamics help to stabilize the debt ratio. Last but not least, the pricing of longer-maturity debt confers a risk-sharing benefit to the issuer, much like equity does, reducing the default premium. For longer-maturity debt, the current price will depend on the expected value of future prices, which means that future shocks, both good and bad, matter for the current price. But the potential for good shocks will matter more than the potential for bad shocks because when shocks are bad enough to result in default, the investor receives only a predetermined amount (the recovery value), whereas for symmetrically equal or larger upside shocks, the feedthrough to the market price of debt is not censored (up to a point where future prices hit the risk-free price). As a result, a negative current shock has less negative impact on the price of longer-maturity debt because there is the possibility of redemption through possible future positive growth surprises. This mechanism—through which favorable shocks underpin the market value of debt whereas unfavorable shocks that result in default do not have an offsetting adverse effect on the market value of debt—implies that both the bond price and the debt ratio will be more stable in the case of longer-maturity debt than short-term debt (for which no feedback from future prices is at work in the pricing). This greater stability leads to lower average borrowing costs and a higher debt limit for the sovereign, in much the same way that GLBs lowered average borrowing costs and conferred a higher debt limit as a result of the greater stability of the debt ratio they engendered.

Numerical Illustration

8. How significant in practice is the impact on fiscal space of issuing debt in GLBs or longer maturities? The simulation results suggest that substantial gains in fiscal space are plausible by managing debt along these two dimensions.

GDP-linked Bonds

9. The simulation is undertaken for a representative advanced economy. The model is parameterized based on historical data for advanced economies, and specified according to the estimates reported by Ostry and others (2010). The distribution of the real GDP growth rate is constructed by using histograms obtained from a sample of 23 advanced economies over 1980–2020 (where the projected data for 2016 onward is from the IMF's *WEO*). In order to gauge the effect of uncertainty on fiscal space, two histograms with the same mean (μ) but different standard deviations (σ) are constructed using the cross-country average growth rates or the more-variable individual country growth rates. The low and high uncertainty cases are parametrized as follows: (i) low uncertainty (μ = 2.4 percent, σ = 1.4 percent); and (ii) high uncertainty (μ = 2.4 percent, σ = 2.5 percent).

10. Simulation results show that if debt is issued in nominal terms, the effect of growth uncertainty in reducing fiscal space may be quite significant even for advanced countries where growth is arguably less volatile in comparison to emerging market economies. If debt is issued in GLBs, the simulations reveal that fiscal space can be increased by 15–25 percent of GDP under low growth uncertainty and by some 30–60 percent of GDP when uncertainty is high (the range reflects *inter alia* assumptions about the cyclical response of fiscal policy to output gap). In intermediate cases where both GLBs and nominal debt coexist (so that insulation against growth uncertainty is only partial), the potential gains in fiscal space is correspondingly smaller. Nevertheless, as the *marginal* impact of GLBs on fiscal space is diminishing in the share of GLBs, the initial gain from issuing GLBs tends to be larger rather than being proportional. For example, the initial gain from increasing the share of GLBs from 0 to 25 percent accounts for about 40 percent of the total gain accrued from the total elimination of nominal debt (and its replacement by risk-sharing instruments).

Longer-maturity Debt

11. The model used for the simulation assumes that debt is issued as a *long-duration* bond with infinite maturity, the primary balance is constant as a share of GDP, and growth outcomes follow a truncated normal distribution. In addition, the simulation exercise focuses on finding a *lower bound* of the debt limit, which is computationally less challenging than finding the debt limit itself. The simulation results are suggestive of a significant role of maturity (or duration) management in expanding fiscal space. For example, fiscal space increases by 15–40 percent of GDP when duration of the debt increases from one year to 10 years. If duration increases to 20 years, gains in fiscal space are larger - on the order of 50–70 percent of GDP.

B. Debt Limits Model by Country Groups[2]

The Debt Limits Model: An Extension

12. This section presents a structural model of sovereign default, calibrated on data from country groups with differing fundamentals. The model is based around a primary balance reaction function combined with the automatic drivers of debt—the effective interest rate minus GDP

[2]Prepared by Alex Pienkowski (SPR).

growth—to derive a debt limit. If a sovereign's debt breaches this debt limit, default occurs. The model incorporates shocks to growth, exchange rates and the primary balance.

13. Sovereign debt follows the standard debt accumulation equation:

$$\Delta d_t = \frac{(r_t - g_t)}{1 + g_t} . d_t - pb_t \quad (1)$$

where d_t is the debt level as a proportion of GDP; r_t is the real interest rate on debt; g_t is the real GDP growth rate; pb_t is the primary balance as a proportion of GDP. All debt has a maturity of one-year. Around this debt dynamics equation, each of the drivers of debt—the interest rate, the primary balance, and growth—are determined by separate behavioral equations. Exchange rate shocks to foreign currency denominated debt are also introduced. Each component is explored in turn.

14. The sovereign reacts to the debt level by adjusting the primary balance to help ensure solvency. As the debt level rises, the primary balance will increase as the sovereign seeks to stabilize debt. However, there is a maximum limit to the level of the primary balance, which can be motivated by public intolerance to fiscal austerity (Mendoza and Ostry, 2007). This fiscal reaction function is constructed as follows:

$$pb_t = min(\alpha + \beta . d_t, \gamma) + \varepsilon_t^{pb} \quad (2)$$

where the primary balance is the minimum of two values, either - i) a positive relationship between the primary balance and the debt level, with an intercept of α and a slope coefficient, β, and: ii) a maximum primary balance, γ. This function is also subject to shocks, ε_t^{pb}, which can cause the primary balance to temporarily exceed its maximum.

15. As with Ostry and others (2010), the return on a sovereign bond (r_t) is determined as follows:

$$(1 + r_t) = (1 + r^*) . \frac{(1 - p_{t+1} . \theta)}{(1 - p_{t+1})} \quad (3)$$

where p_{t+1} is the probability of default in the next period, r^* is the risk-free interest rate and θ is the recovery value on a bond in the event of default.

16. Finally, the economy is subject to shocks to growth and the nominal exchange rate. Growth is expected to follow a steady-state trend, g^*, but subject to an exogenous shock, ε_t^g. The expected value of the change in the exchange rate is zero, but there are exogenous shocks, ε_t^{er}. The impact on debt of this shock will depend on the share of foreign currency denominated debt, F_t. Combining equations 2 and 3, and the shocks to growth and exchange rates, into equation 1 generates the following debt dynamics equation:

$$\Delta d_t = \left((1 + r^*) . \frac{(1 - p_{t+1} . \theta)}{(1 - p_{t+1})} - 1 - g^* + \varepsilon_t^g \right) . \frac{d_t}{(1 + g^* + \varepsilon_t^g)} + d_t . F_t . (1 + \varepsilon_t^{er}) - (\min(\alpha + \beta . d_t, \gamma) + \varepsilon_t^{pb}) \quad (4)$$

where: i) the first product captures the automatic debt dynamics, determined by the growth-interest rate differential, including the credit spread, and also shocks to growth; ii) the second product shows the impact from exchange rate shocks, which depends on the share of foreign currency denominated debt; and, iii) the third product shows the primary balance, determined by the fiscal reaction function and exogenous shocks.

17. The credit spread in equation 4 is a function of the investors perceived probability of default. In order to construct this probability, the concept of a debt limit, $\bar{d}$, is introduced. The limit is defined as the highest level of debt that a sovereign can sustain at finite interest rates while satisfying its fiscal constraint and the interest rate equilibrium condition. The probability of default is the probability that the current debt will breach this debt limit threshold in the next period:

$$p_{t+1} = pr\left(d_{t+1} > \bar{d}\right) \qquad (5)$$

18. Considering equations 4 and 5, it is clear that the both the credit spread and the debt limit are endogenously determined. A lower debt limit increases the likelihood of default and therefore the credit spread demanded by investors. A higher credit spread worsens debt dynamics by reducing the growth-interest rate differential, which in turn lowers the debt limit. The model is solved numerically by finding the highest level of debt that can sustain a probability of default below 1, and where both $\bar{d}$ and p_{t+1} satisfy the following inequality:

$$p_{t+1} = Pr\left[\left((1+r^*).\frac{(1-p_{t+1}.\theta)}{(1-p_{t+1})} - 1 - g^* + \varepsilon_t^g\right).\frac{\bar{d}}{(1+g^* + \varepsilon_t^g)} + \bar{d}.F_t.(1+\varepsilon_t^{er}) - \left(\min\left(\alpha+\beta.\bar{d},\gamma\right) + \varepsilon_t^{pb}\right) \geq 0\right] \qquad (6)$$

The numerical technique essentially finds the highest level of debt where the probability of default is not certain i.e., is below 1 (and greater or equal to zero, as a negative probability of default does not make economic sense).

19. Given that the debt limit and probability of default are endogenously derived; the following exogenous factors determine a sovereign's debt limit. While there is a non-linear relationship between these variables and the debt limit, the directional relationship is unambiguous.

Parameter impact on Debt Limit

Parameter		**Impact on Debt Limit**
Steady-state real growth	g^*	↑
Default recovery rate	θ	↑
Maximum primary balance	γ	↑
Risk free rate	r^*	↓
Share of foreign currency debt	F_t	↓
Standard deviations of shocks	std$(\varepsilon_t^{pb}, \varepsilon_t^{g}, \varepsilon_t^{er})$	↓
Growth and exchange rate premia	r^{gdp}, r^{er}	↓

20. Once the debt limit of a representative country is estimated, it is possible to consider the impact that different contract designs can have on raising, or in some cases lowering, the debt limit. Two types of instruments are considered—local currency bonds and GDP-linked bonds. Such instruments act to insulate sovereign debt from exchange rate and GDP shocks. But they also come

with a price in the form of a premium required by the creditor to assume this increased volatility in their returns. Both effects impact the debt limit in opposite directions.

21. In the case of GDP-linked bonds, the size of the GDP shock declines as the share of these bonds increase. When all debt is GDP-linked, then GDP shocks will not affect the debt-to-GDP ratio. To clarify this, assume that both the interest rate and primary balance are equal to zero, so that only GDP growth changes the debt-to-GDP ratio. The following identity shows the path of conventional bonds:

$$\frac{D_{t+1}}{GDP_{t+1}} = \frac{D_{t+1}}{GDP_t.(1+g_{t+1})}$$

Here the debt-to-GDP ratio will follow a random walk, which will depend on the past history of growth shocks. Next, assume that the debt level is linked to the level of GDP (using the same contract design as U.K. CPI-linked bonds). A shock to GDP will impact both the numerator (debt) and the denominator (GDP) by the same amount. Therefore, the debt-to-GDP ratio remains constant regardless of the size of growth shocks i.e., the GDP-shocks are eliminated:

$$\frac{D_{t+1}^{gdp}}{GDP_{t+1}} = \frac{D_t^{gdp}.(1+g_{t+1})}{GDP_t.(1+g_{t+1})} = \frac{D_t^{gdp}}{GDP_t}$$

22. The protection provided by local currency debt is easily modelled. The share of foreign currency debt, F_t, simply adjusts in equations 4 and 6, thus changing the share of debt which is effected by shocks to the exchange rate. The premiums that creditors demand in order to bear the sovereign's exchange rate and GDP volatility (r^{er} and r^{gdp}, respectively) are invariant through time, and are unrelated to the debt level. These are simply added to the risk free rate (r^*) in equations 4 and 6.

Calibration

23. The model is calibrated for a representative country from four groups: All Countries (ACs), Advanced Economies (AEs), Emerging Markets (EMs) and Low-Income Countries (LICs). These various country groups have different macroeconomic fundamentals, and these are derived as follows:

a. *Maximum primary balance* (γ)—The 90th percentile of cyclically adjusted primary balances from the sample of fiscal consolidation episodes outlined in Escolano, Jaramillo, Mulas-Granados and Terrier (2014).

b. *Shocks to real GDP growth* (ε_t^g), *the primary balance* (ε_t^{pb}) *and the nominal exchange rate* (ε_t^{er}) – data taken from the IMF WEO, and then demeaned. The shocks are applied to the model using 'bootstrap' simulations, with the same shocks to the three variables coming from the same country and year (histograms displayed in Figures AI.1–12). This means that the contemporaneous correlations (Table AI.1) between the variables are maintained in the model.

c. *Steady-state growth rate (g^*)*—The WEO database includes long-run growth (1960–2015) values for key country groupings. This corrects for countries moving between country classifications through time.

d. *Share of foreign currency debt (F_t)*—The average share by country group taken from the WEO database.

e. *Default recovery rate (θ)*—An 80 percent recovery rate is assumed if a default occurs.

Table AI.1. Country Groups

Country Group	Definition	Number of countries	Number of observations
All countries	All countries in the WEO database	194	3,965
Advanced economies	As defined in the WEO database	37	962
Emerging markets	All countries not designated as AEs or LICs	79	1,566
Low income countries	PRGT-eligible countries as of 2015	73	1,415

Note: Time span of annual data varies by country, with an average of 20 years

24. Table AI.2 summarizes the parameters used in this model, derived from the data explained above. The main stylized facts are as follows. EMs and LICs have a higher steady-state growth rate than AEs, but are subject to larger growth shocks around this trend. The maximum primary balance of the country groups is positively associated with average per capita incomes: AEs have the highest maximum primary balance (7 percent of GDP), while LICs have the lowest (4 percent of GDP). In addition, poorer countries tend to have more volatile primary balance shocks than AEs. Exchange rate shocks are similar across groups. But the share of foreign currency denominated debt also appears broadly inversely proportional to country's income level.

Table AI.2. Model Calibration

Country Group	**Steady state real growth**	**Maximum primary balance**	**Share of foreign currency debt**	**StDev - real growth shock**	**StDev - primary balance shock**	**StDev - exchange rate shock**	**Exchange rate volatility risk premium**	**Real GDP volatility risk premium**
	percentage points	*percent of GDP*	*percent*	*percentage points*	*percentage points of GDP*	*percentage points*	*percentage points*	*percentage points*
All countries	3.3	6.0	55	4.1	3.8	10.3	2.3	2.0
Advanced economies	2.9	7.0	0	3.0	2.3	n/a	n/a	1.5
Emerging markets	5.0	5.5	50	4.4	3.9	9.9	1.9	2.1
Low income countries	5.0	4.0	70	4.2	4.6	10.2	2.3	2.0

25. The GDP and exchange rate volatility premiums is based on a 'certainty-equivalent' framework. This method compensates investors for the variance in returns—the greater the uncertainty of returns, the higher the compensation needed by the investor.[3] The certainty

[3]An alternative approach would be to adopt a CAPM framework whereby the investor is compensated for the correlation of returns with the wider market. However, the correlation between real GDP growth in these country groups and indices such as the S&P500 are very low (see also Bowman and Naylor, 2016 and Kamstra and Shiller, 2009) implying a low risk premium. In order to be conservative, this paper uses the 'certainty equivalent' method instead.

equivalent methodology is based around the simple assumption that investor is risk averse, and have a utility function with constant relative risk aversion (CRRA):

$$U(c) = \frac{1}{1-\delta}c^{1-\delta}$$

where c is consumption, measured by the return on the instrument; and δ measures the degree of relative risk aversion, assumed to be 2, which is standard in the literature. For each of the growth and exchange rate shocks summarized in Figures AI.1–12, the investor's utility associated with this outturn is calculated, and compared to the utility associated with a guaranteed return. The risk premium is calculated as the interest rate needed to ensure that the investor is indifferent between the risky and safe bond. These premia are shown in Table AI.2. As investors prefer certainty in returns, a higher standard deviation of growth and exchange rates implies a higher premium on these instruments.

Results

26. Table AI.3 shows the 'baseline' debt limit, derived by this model, for a representative country from each of the four groups. This debt limit—the maximum sustainable debt level before a default occurs—varies by the fundamentals of each country groups, summarized in Table AI.2. These baseline debt levels make broad intuitive sense[4]. AEs have the highest debt limit, as they can sustain a relatively high maximum primary surplus, which help to stabilize debt in the face of shocks. In contrast, LICs have both a low maximum primary balance and are subject to much larger shocks (although they do have a higher trend growth rate, which helps raise the debt limit). The fact that LICs and EMs have foreign currency denominated debt also exposes them to destabilizing exchange rate shocks, which lowers the debt limit relative to AEs.

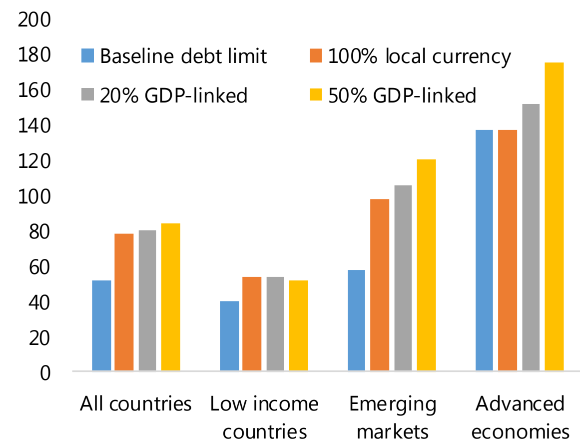
Table AI.3. Debt Limits with Various Instrument Designs

Country Group	Baseline debt limit	Debt limit - 100% local currency	Debt limit - 100% local currency; 20% GDP linked	Debt limit - 100% local currency; 50% GDP linked	Debt limit - 100% local currency; 100% GDP linked
			percent of GDP		
All countries	52	78	80	84	84
Advanced economies	137	137	152	175	238
Emerging markets	58	98	106	120	140
Low income countries	40	54	54	52	50

[4] In some cases, these debt limits may appear on the low side. But it is important to bear in mind that: i) these are averages for country groups; ii) the model does not capture concessional borrowing (especially by LICs); iii) there is no scope in the model for policies such as external emergency liquidity assistance, financial repression or monetary financing. Furthermore, the relative differences between the country group debt limits meets broad priors.

27. Now that the baselines are derived, the impact from increasing local currency or GDP-linked bond issuance can be estimated. Moving towards full local currency denominated debt raises the debt limits of all country groups (AEs are assumed to already have full local currency debt). This is shown in the second column of figures in Table AI.3. The increase is especially pronounced for EMs, where the debt limit increases by 40 percentage points (a 70 percent increase relative to the baseline). This implies that exchange rate shocks are a significant risk to EM solvency. By eliminating this risk (and after taking into account the higher risk premia on local currency debt), the *credit* spread demanded by investors declines, and therefore the debt limit and hence the fiscal space of the country increases. LICs also benefit, with fiscal space increasing by 14 percentage points of GDP. However, the relative impact is less than for EMs. LICs are vulnerable to exchange rate shocks, but the risk of a growth or primary balance shock are also important. Therefore, while the risk of default declines with greater local currency debt issuance, the absolute impact on the debt limit is less (i.e., growth and primary balance shocks remain a major risk).

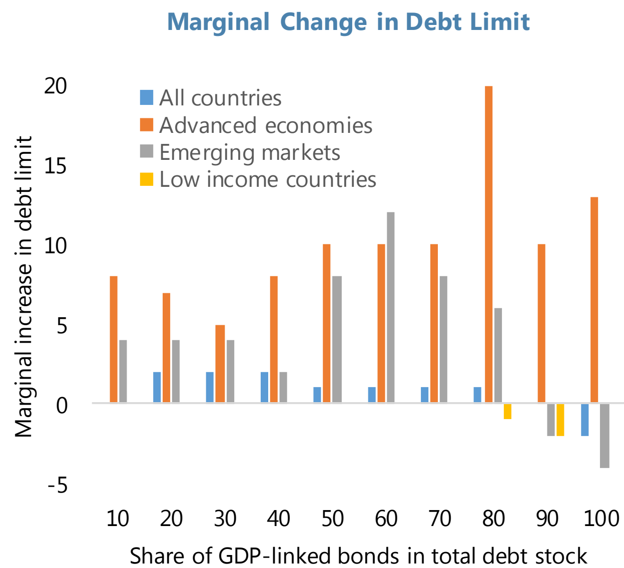
Debt limits
(Percent of GDP)



28. Next, the impact of GDP-linked bonds on the debt limit is considered. It is unlikely that any sovereign would issue all of their debt in GDP-linked bonds. However, even issuing relatively modest amounts—say 20 percent of the total debt stock—can have a significant impact on the debt limit. For AEs, the debt limit would rise by around 15 percentage points of GDP, which would be enough to accommodate the median fiscal costs of a systemic banking crisis.[5] An 8 percentage point increase in fiscal space for EMs is also substantial, enough to accommodate additional borrowing through a typical recession (IMF, 2016). For LICs, however, there is no change in the debt limit (relative to the case where 100 percent of debt is local currency denominated). Here, the higher interest rate costs associated with paying the GDP-volatility premium offset the benefits from smaller GDP shock on debt. For both AEs and EMs, the debt limit continues to rise as the share of GDP-linked bonds increases. If half of debt is GDP-linked, AEs experience an increase in fiscal space of around 40 percentage points, enough to accommodate all but the worst tail-events. EMs also experience a sizable increase, around 20 percentage points of GDP compared to the scenario where all debt is local currency.

[5]Amaglobeli and others (2015) estimate that the direct fiscal cost of a systemic banking crisis (recapitalization and asset purchases) has a median of 6 percent of GDP; while the median increase in public debt associated with these events is around 14 percent of GDP.

29. The results also show that the marginal impact on the debt limit from raising the share of GDP-linked bonds can be diminishing, or even negative. This is illustrated by the marginal impact of moving to full GDP-linked bond issuance. For LICs, there is actually a modest decrease in the debt limit i.e., the marginal impact is negative. This is because the GDP-risk premium lowers the debt level by more than the positive effect from lower GDP volatility. Similarly, EMs have a maximum debt limit which occurs when GDP-linked bonds are *below* 100 percent coverage (Figures AI.13–16 show the debt level for each group as the share of GDP linked bonds rise). For AEs, the debt level continues to increase with the share of GDP-linked bonds, and hence reaches a maximum when all debt is GDP-linked. This does not, however, imply that the share of GDP-linked bonds that maximizes the debt limit is necessarily 'optimal'. A sovereign may have risk tolerance preferences whereby they opt for a lower debt limit in order to reduce debt service costs. This is also consistent with 'myopic' preferences, whereby policymakers don't fully internalize the costs of debt crises. However, this assessment of preferences is beyond the scope of this analysis.



30. The size of the GDP and exchange rate premium is an important determinant in the marginal increase (or decrease) in fiscal space. In order to provide some sensitivity analysis, the impact of a plus or minus 2 percentage point change in the premiums is shown in Tables 4 and 5. The size of the differences in debt limits is striking. For example, a 4 percentage point difference in the GDP risk premium for AEs implies a 170 percentage point difference in the debt limit. Clearly the uncertainty over the risk premium for these instruments is an important limiting factor in assessing their potential benefits. However, the 'break even' risk premium may be more informative. This shows the risk premium that delivers the same debt limit as under the baseline debt level (for the GDP risk premium, this is relative to the full local currency debt scenario). This means that all levels of risk premium below this break-even level cause an increase in the debt limit. The final columns in Tables 4 and 5 show that for all groups and instrument types, this break-even risk premium is higher than most estimates cited in the literature.

Table AI.4. Sensitivity Analysis—Exchange Rate Volatility Risk Premium

Country Group	Risk premium	Debt limit with 100% local currency	Risk premium range (-/+2 %)	Debt limit range	'Break-even' risk premium[1]
	percent	*percent of GDP*	*percent*	*percent of GDP*	*percent*
All countries	2.1	78	0.1-4.1	100-64	5.5
Emerging markets	1.9	98	0.0-3.9	138-78	6.0
Low income countries	3.0	54	1.0-5.0	82-42	5.1

1/ Relative to baseline debt level

Table AI.5. Sensitivity Analysis—GDP Volatility Risk Premium

Country Group	Risk premium	Debt limit with 100% local currency; 100% GDP linked	Risk premium range (-/+2 %)	Debt limit range	'Break-even' risk premium[1]
	percent	*percent of GDP*	*percent*	*percent of GDP*	*percent*
All countries	2.0	84	0.0-4.0	200-54	4.0
Advanced economies	2.2	238	0.2-4.2	280-108	3.5
Emerging markets	2.0	140	0.0-4.0	200-62	4.2
Low income countries	2.0	50	0.0-4.0	134-34	3.0

1/ Relative to baseline debt level

Conclusion

31. By extending the existing set of debt limits models in the literature to incorporate additional shocks, and differentiate between country types, this framework provides a more granular framework to explore the impact that debt contract design can have on sovereign debt sustainability. This is useful for extending this literature beyond academic interest, and towards potential sovereign issuance.

32. The results of this model suggest that there is no one-size-fits-all debt structure that all countries should target. For LICs, with the lowest 'baseline' debt limit, focus may be best directed at reducing exchange rate risk through local currency debt issuance (and building institutions that can raise the maximum sustainable primary balance). For EMs, once they manage to sufficiently reduce exchange rate risk, the benefits from GDP linked bonds are apparent. But AEs experience by far the largest benefit, with debt limits nearly doubling if all bonds are linked to GDP.

33. The analysis also provides interesting analysis on the marginal properties of GDP-linked bond issuance. When considering all economies together, there appears to be a quadratic relationship between the share of GDP-linked bonds and the debt level whereby the debt limit is maximized at 80 percent of the total stock. However, from a cost-benefit approach, sovereigns may choose to target lower levels, given that the 'marginal benefit' (in terms of the change in the debt limit) is declining. While not identifying the 'welfare optimal level', this framework allows these issues to be explored.

34. The results presented here are sensitive to the parameter assumptions. Perhaps the largest uncertainty surrounds the risk premium demanded by investors to hold local currency and GDP-linked bonds. In the absence of large-scale market issuance, further research in this area is important. However, this analysis does show that the benefits—in terms of higher debt limits—are robust to varying the risk premium on GDP-linked bonds across a reasonable range.

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Data Appendix

Figure AI.1 ACs Growth Shock

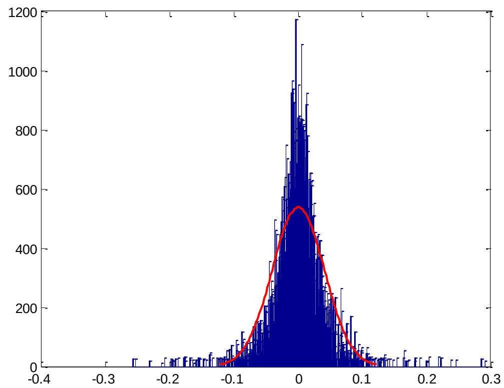


Figure AI.2. ACs Primary Balance Shock

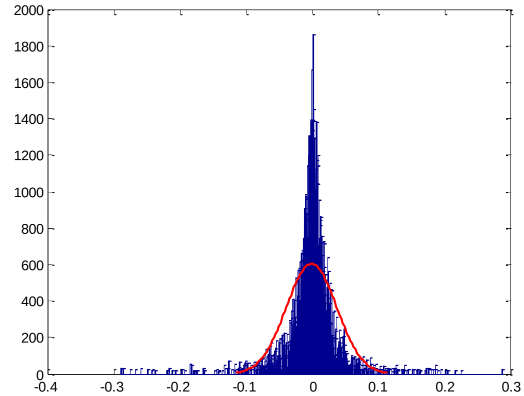


Figure AI.3. ACs Exchange Rate Shock

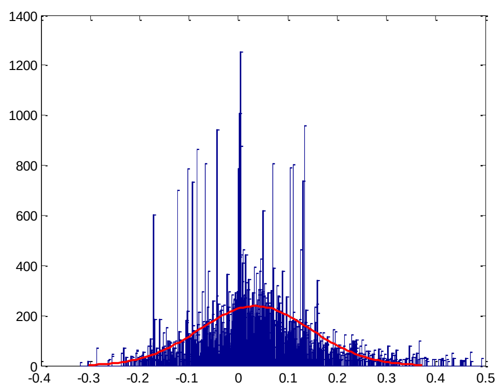


Figure AI.4. AEs Growth Shock

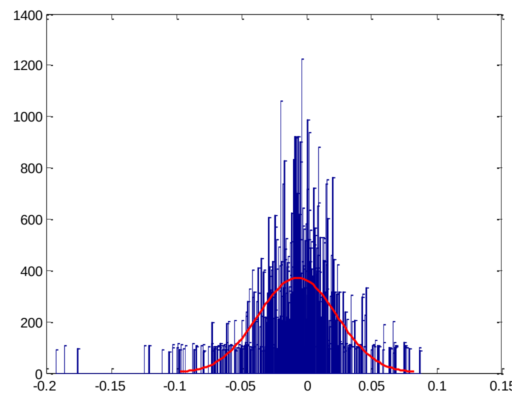


Figure AI.5. AEs Primary Balance Shock

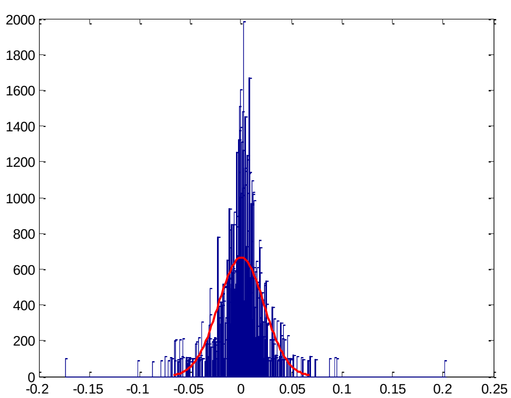


Figure AI.6. AEs Exchange Rate Shock

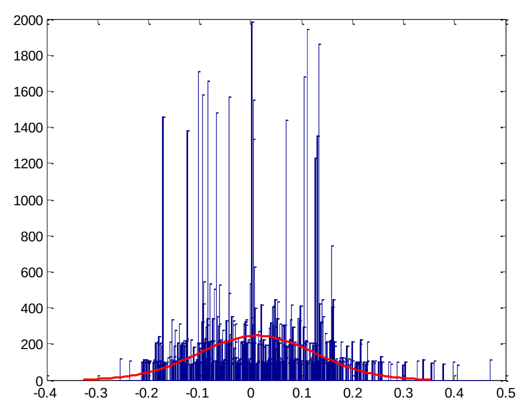


Figure AI.7. EMs Growth Shock

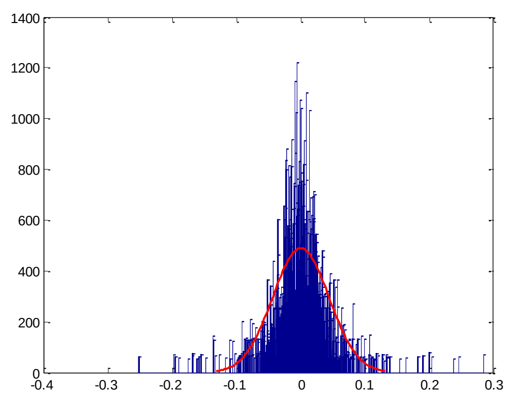


Figure AI.8 EMs Primary Balance Shock

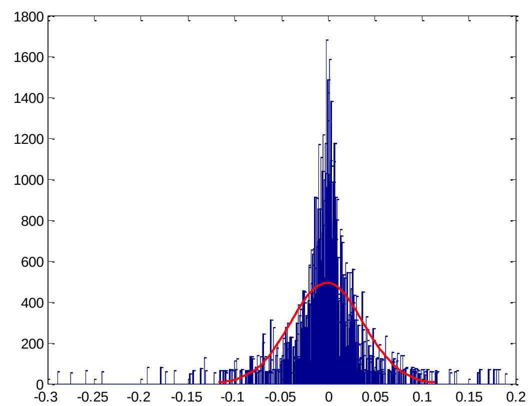


Figure AI.9. EMs Exchange Rate Shock

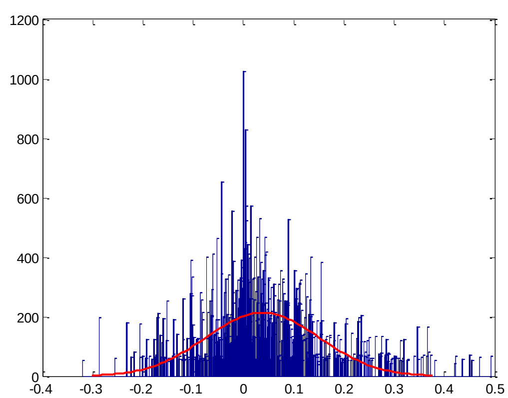


Figure AI.10. LICs Growth Shock

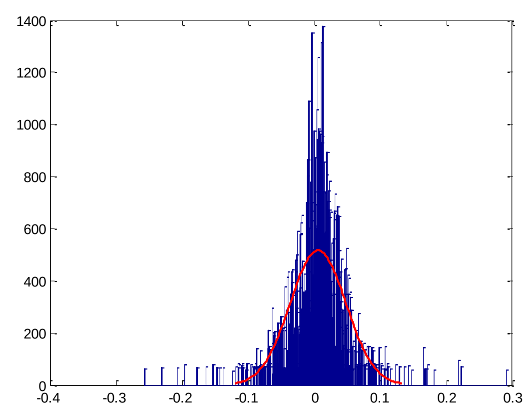


Figure AI.11. LICs Primary Balance Shock

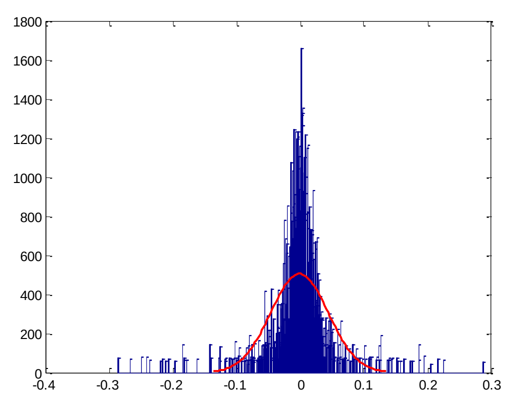


Figure AI.12. LICs Exchange Rate Shock

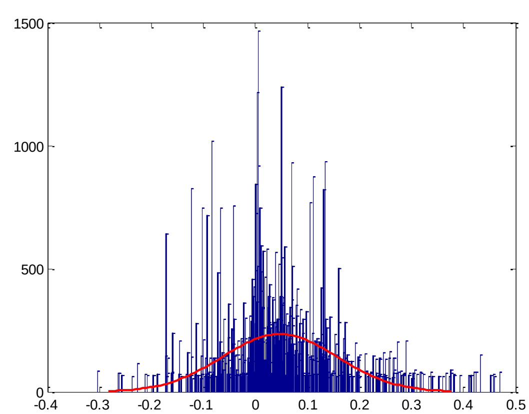


Table AI.6. Shock Correlations

	real GDP (percent change); **primary balance** (change, percent of GDP)	**real GDP** (percent change); **real exchange rate** (percent change)	**primary balance** (change, percent of GDP); **real exchange rate** (percent change)
All countries	0.12	-0.02	0.01
Advanced economies	0.33	-0.07	-0.05
Emerging markets	0.07	0.17	0.10
Low income countries	0.05	0.07	0.10

Figure AI.13. ACs Debt Level

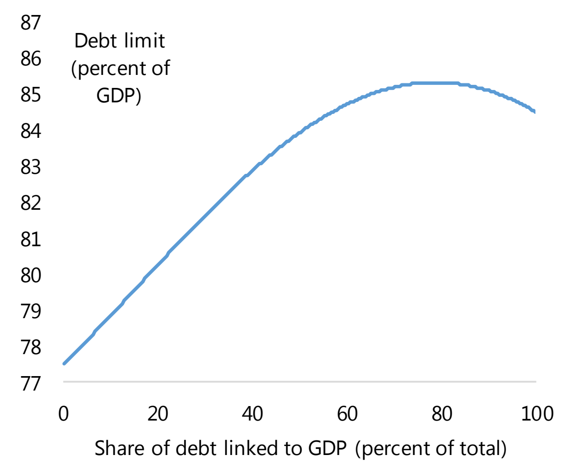


Figure AI.14. AEs Debt Level

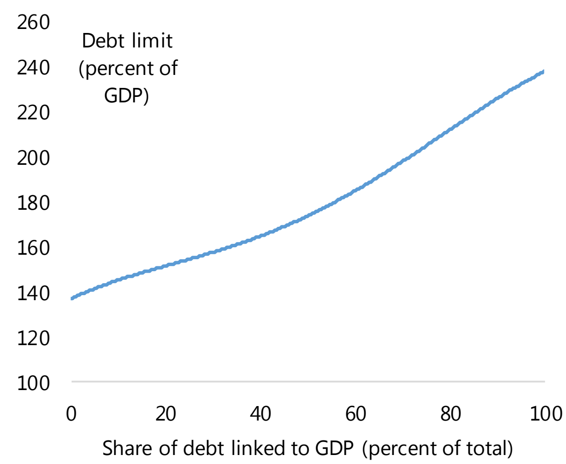


Figure AI.15. EMs Debt Level

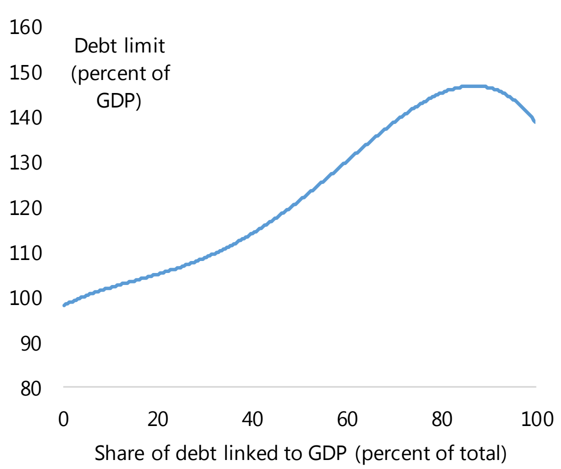
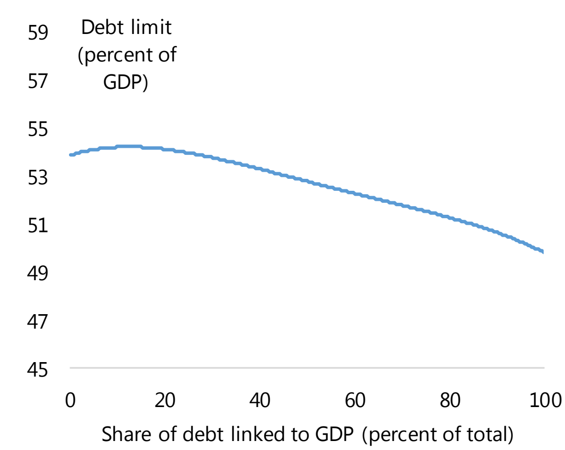


Figure AI.16. LICs Debt Level



Annex II. Conditions for Mutually Beneficial Exchange in SCDIs[1]

This Annex presents the conditions for a mutually beneficial exchange in SCDIs between the sovereign and investors.[2] The first section solves the sovereign's optimization problem from which the maximum premium that the sovereign is willing to pay is derived. The subsequent section solves the investor's optimization problem from which we derive the minimum premium that the investor is willing to accept for holding an SCDI or any other bond. The final section summarizes the joint conditions for the emergence of a mutually beneficial exchange.

A. Sovereign Issuer's Problem

The issuer's problem is to choose a government expenditure level in percent of GDP (c^g) that maximizes the authority's utility function:

$$Max\{E[U(c^g)]\}$$

subject to the following constraints:

1) A budget constraint:

$$B_1 = \sum_i \left[\frac{1+r_i}{1+g} b_{i,0}\right] + c^g - t \quad (1)$$

where B_1 is the total debt stock in percent of GDP at the end of the period, $b_{i,0}$ is the amount of debt instrument i (in percent of GDP) issued at the beginning of the period, r_i is the real interest rate on debt instrument i, g is the real GDP growth rate, and t is the ratio of tax revenues to GDP;

2) The total debt stock in percent of GDP at the end of the period cannot exceed the total debt stock at the beginning of the period (the issuer is already at its debt limit):

$$B_1 = B_0 \quad (2)$$

$$where: \ B_o = \sum_{i-1}^{n} b_{i,0} \quad (3)$$

From (1), (2), and (3):

$$c^g = t - \sum_{i \neq j} \left[\left(\frac{1+r_i}{1+g} - 1\right) b_{i,o}\right] - \left(\frac{1+r_j}{1+g} - 1\right)\left(B_0 - \sum_{i \neq j} b_{i,0}\right) \quad (4)$$

[1]Prepared by Manrique Saenz (SPR).

[2]This model does not account for the additional benefit for the issuer of SCDIs stemming from the increase in the debt ceiling, as explained in Annex II.

Hence, the maximization problem can be rewritten as one where the issuer chooses the amount to issue of each type of debt instrument to maximize its expected utility:

$$Max_{b_{io}} E\left\{U\left\{c^g\left[t_{t+1}-\sum_{i\neq j}\left[\left(\frac{1+r_i}{1+g}-1\right)b_{i,0}\right]-\left(\frac{1+r_j}{1+g}-1\right)\left(B_0-\sum_{i\neq j}b_{i,0}\right)\right]\right\}\right\}$$

The first order conditions with respect to any b_{it} are given by:

$$E\left\{U'(c^g)\cdot\left[-\left(\frac{1+r_i}{1+g}-1\right)+\left(\frac{1+r_j}{1+g}-1\right)\right]\right\}=0$$

$$\rightarrow E\left\{U'(c^g)\cdot\left(\frac{1+r_i}{1+g}\right)\right\}=E\left\{U'(C^g)\cdot\left(\frac{1+r_j}{1+g}\right)\right\}$$

$$\rightarrow E\{U'(c^g)\}\cdot E\left\{\frac{1+r_i}{1+g}\right\}+Cov\left\{U'(c^g),\frac{1+r_i}{1+g}\right\}=E\{U'(c^g)\}\cdot E\left\{\frac{1+r_j}{1+g}\right\}+Cov\left\{U'(c^g),\frac{1+r_j}{1+g}\right\}$$

$$\rightarrow E\left\{\frac{1+r_i}{1+g}\right\}+\frac{Cov\left\{U'(c^g),\frac{1+r_i}{1+g}\right\}}{E\{U'(c^g)\}}=E\left\{\frac{1+r_j}{1+g}\right\}+\frac{Cov\left\{U'(c^g),\frac{1+r_j}{1+g}\right\}}{E\{U'(c^g)\}}$$

Therefore, the maximum premium that the debt manager is willing to pay for bond j over bond i is given by:

$$\rightarrow E\left\{\frac{1+r_j}{1+g}\right\}-E\left\{\frac{1+r_i}{1+g}\right\}=\frac{Cov\left\{U'(c^g),\frac{1+r_i}{1+g}\right\}-Cov\left\{U'(c^g),\frac{1+r_j}{1+g}\right\}}{E\{U'(c^g)\}}\quad (5)$$

Since the marginal utility is a decreasing function of government expenditure ($U''(c^g)<0$), the covariance terms in (5) would generally have the opposite sign of the covariance between c^g and the real interest rate adjusted by growth. Hence the higher the covariance between the return on bond j with c^g, the higher the premium that the issuer would be willing to pay for it. To fix ideas, assume a quadratic utility function:

$$U(c^g)=\alpha_1 c^g-\beta_1 {c^g}^2$$

So that the marginal utility is given by:

$$U'(c^g)=\alpha_1-2\beta_1 c^g \qquad (6)$$

Assume also that $c^g < \frac{\alpha_1}{2\beta_1}$ holds so that the marginal utility is positive but declining in c. Notice that the concavity of the utility function (and therefore the degree of risk aversion) is greater the higher the value of β_1.

Substituting (6) in (5) and given that $E\left\{\frac{1+r_j}{1+g}\right\} - E\left\{\frac{1+r_i}{1+g}\right\} \cong E\{r_j\} - E\{r_i\}$, we obtain:

$$\rightarrow E\{r_j\} - E\{r_i\} = \frac{2\beta_1\left\{Cov\left\{c^g,\frac{1+r_j}{1+g}\right\} - Cov\left\{c^g,\frac{1+r_i}{1+g}\right\}\right\}}{\alpha_1 - 2\beta_1 E\{c^g\}} \quad (7)$$

From (7), the issuer would be willing to pay a premium on bond j over bond i to the extent that the covariance of the government expenditure with the return on bond j (adjusted for GDP growth) is higher than with bond i. The higher the difference in covariances, the higher the premium. Also notice that, given a difference in covariances, the higher the risk aversion of the issuer (which is a function of β_1), the higher the premium that the issuer would be willing to pay.

What determines the value of these co-variances?

Given (4), the covariance between the growth-adjusted return on bond j and the government expenditure is given by:

$$\rightarrow Cov\left\{C^g,\frac{1+r_j}{1+g}\right\} = cov\left\{t,\frac{1+r_j}{1+g}\right\} - \sum_{i\neq j} b_i \cdot cov\left\{\frac{1+r_i}{1+g},\frac{1+r_j}{1+g}\right\} - b_j \cdot var\left\{\frac{1+r_j}{1+g}\right\} \quad (8)$$

Hence, the premium that the issuer is willing to pay for bond j over bond i is higher when: the covariance of return j with the tax ratio is higher, the covariance between the return of bond j and that of other bonds is lower, and the variance of the growth-adjusted return on bond j is lower.

While this covariance term is likely to be negative for bonds with a significant variance in the growth-adjusted interest, this covariance would be zero for a GDP-linked bond a la Bank of England as the growth adjusted real return would be constant.

B. Investor's problem

We assume that the investor maximizes her expected utility by choosing her consumption level c^I subject to a budget constraint and to keeping its wealth level form declining:

$$Max\{E[U(c^I)]\}$$

Subject to:

3) A budget constraint:

$$W_1 = (1 + r_w)b_{w,0} + \sum_i (1 + r_i)b_{i,0} + y - c^I \quad (9)$$

where: W1 is the total stock of wealth at the end of the period, $b_{i,0}$ are bonds issued by the sovereign in the first section and acquired by the investor at the beginning of the period, b_w are other bonds acquired by the investor at the beginning of the period, r_w, and r_i are the respective real returns, and y is investor's income from other sources.

4) The wealth at the beginning of the period (W0) is given by:

$$W_0 = b_{w,0} + \sum_{i-1}^{n} b_{i,0} \quad (10)$$

5) Wealth at the beginning of the period is already at its floor and should therefore not decline by the end of the period:

$$W_1 \geq W_0 = W \qquad (11)$$

From (9)–(11):

$$c^I = (1 + r_w)\left(W - \sum_{i-1}^{n} b_{i,0}\right) + \sum_i (1 + r_i) b_{i,0} + y - W \quad (12)$$

The maximization problem can then be rewritten as follows:

$$Max_{b_{i,0}} \left\{ E\left[U\left((1 + r_w)\left(W - \sum_{i-1}^{n} b_{i,0} \right) + \sum_i (1 + r_i) b_{i,0} + y - W \right) \right] \right\}$$

The first order conditions for the maximization are the following:

With respect to b_i:

$$E\{U'(c^I) \cdot [r_i - r_w]\} = 0 \rightarrow E\{U'(c^I) \cdot r_i\} = E\{U'(c^I) \cdot r_w\} \quad (13)$$

With respect to b_j:

$$E\{U'(c^I) \cdot r_j\} = E\{U'(c^I) \cdot r_w\} \qquad (14)$$

Substituting (13) into (14) we obtain the minimum premium required by the investor to hold bond j instead of bond i:

$$\mathrm{E}\{\mathrm{U}'(\mathrm{c}^{\mathrm{I}}) \cdot \mathrm{r}_{\mathrm{i}}\} = \mathrm{E}\{\mathrm{U}'(\mathrm{c}^{\mathrm{I}}) \cdot \mathrm{r}_{\mathrm{j}}\}$$

$$\rightarrow E\{r_j\} - E\{r_i\} = \frac{Cov\{U'(c^I) \cdot r_i\} - Cov\{U'(c^I) \cdot r_j\}}{E\{U'(c^I)\}} \quad (15)$$

As with the sovereign issuer, we use a quadratic function to obtain a simple expression for the minimum premium required as a function of the co-variances between consumption and bond returns:

Assume $U(c^I) = \alpha_2 c^I - \beta_2 {c^I}^2$, where α_2 and β_2 are the function parameters. The marginal utility from consumption is given by:

$$U'(c^I) = \alpha_2 - 2\beta_2 c^I \qquad (16)$$

Substituting (16) into (15) yields:

$$\rightarrow E\{r_j\} - E\{r_i\} = \frac{2\beta_2\left(Cov\{c^I, r_j\} - Cov\{c^I, r_i\}\right)}{\alpha_2 - 2\beta_2 E\{c^I\}} \quad (17)$$

Using the budget constraint (12), the covariance between consumption and the return on bond j can be expressed as follows:

$$Cov\{C^I, r_j\} = cov\{y, r_j\} + b_w \cdot cov\{r_w, r_j\} + \sum_{i \neq j}\left[b_i \cdot cov\{r_i, r_j\}\right] + b_j \cdot var\{r_j\} \quad (18)$$

Hence, the minimum risk premium required by the investor for holding bond j is lower when the covariance of the return on j with other sources of income for the investor (i.e., y, the return on b_w, and b_j) is low and the variance of the return on bond j is low. In other words, if bond j provides for diversification opportunities in the sense that the covariance terms are low, then the risk premium required by the investor would be low.

The investor could also have liabilities in her portfolio. This can be taken as a particular case where b_w is negative (and therefore is a liability to the investor rather than an asset). If b_w in (18) is taken to be negative, then the covariance with r_j is lower the higher is the covariance between the return on bond j and the return on the liability (r_w).

Finally, the more risk averse the investor is (the higher β_2), the higher the risk premium that she would require given the difference in covariances in (17).

C. Conditions for a market in GDP-linked bonds

A mutually beneficial exchange in bond j between the issuer and the investor requires terms for bond j such that both (7) and (17) hold. Now we restate (7) and (17) to take into account that expectations of the issuer (E^g) and of the investor (E^I) differ, and the fact that equation (7) really establishes a ceiling for the premium that the issuer is willing to pay while (17) establishes a floor for what the investor is willing to receive.

$$E^g\{r_j\} - E^g\{r_i\} \leq \frac{2\beta_1\left\{Cov\left\{c^g, \frac{1+r_j}{1+g}\right\} - Cov\left\{c^g, \frac{1+r_i}{1+g}\right\}\right\}}{\alpha_2 - 2\beta_2 E^g\{c^g\}} \quad (7')$$

$$E^I\{r_j\} - E^I\{r_i\} \geq \frac{2\beta_2\left(Cov\{c^I, r_j\} - Cov\{c^I, r_i\}\right)}{\alpha_2 - 2\beta_2 E^I\{c^I\}} \quad (17')$$

Given the terms of bond j, both issuer and investor generate their own expectation of the return on the bond. In the case of SCDIs, this may be because of differences in the expected path of the state variable that impacts the actual evolution of r_j. The lower the expected value of r_j in the mind of the issuer, the higher the likelihood that condition (7') will be met. The higher the expected value of r_j in the mind of the investor, the higher the likelihood that (17') will be met.[3]

In synthesis, from (7') and (17') and from the covariance terms expanded in (8) and (18), the likelihood that a mutually beneficial exchange will arise in state-contingent bond j increases when:

- The bond provides scope for diversification of risks for sovereign and investor. Specifically, the SCDI provides scope for risk diversification on the side of the investor if the real return on the SCDI should has (i) a high correlation with the investor's liabilities; and/or (ii) a low correlation with the investor's assets (and sources of income); and (iii) low variance (this is relevant to the extent that the SCDI constitutes a significant share of the investor's portfolio. The SCDI provides scope for risk diversification on the side of the sovereign if the (growth-adjusted) real return on the bond has (i) low correlation with the return of other debt instruments issued by the sovereign; (ii) high correlation with the sovereign's tax revenues; and (iii) low variance (low variance in growth-adjusted return implies a high correlation between the real rate on the SCDI and real GDP growth).

- Issuer and investor expectations on the expected return of the SCDI diverge, including because of diverging expectations about the evolution of the state variable. If the sovereign believes that an SCDI will be associated with lower average payouts than investors expect—for example, because the state variable will perform worse—the sovereign will be willing to offer bond characteristics that are more generous to the investor, and a trade would be more likely.

- There is differential tolerance of risk. If the investors are less risk averse than the sovereign (i.e., β_2 is low and β_1 is high), they will be more willing to hold an SCDI that transfer part of the risk from the sovereign to the investor at a price that is acceptable to the sovereign.

[3]If expectations of issuer and investor about bonds j and i coincide, then from (7') and (17') the following condition must hold for a mutually beneficial exchange:

$$\frac{2\beta_2\left(Cov\{c^I, r_j\} - Cov\{c^I, r_i\}\right)}{\alpha_2 - 2\beta_2 E^I\{c^I\}} \leq E\{r_j\} - E\{r_i\} \leq \frac{2\beta_1\left(Cov\left\{c^g, \frac{1+r_j}{1+g}\right\} - Cov\left\{c^g, \frac{1+r_i}{1+g}\right\}\right)}{\alpha - 2\beta E^g\{c^g\}}$$

Annex III. Bank Contingent Convertible Bonds[1]

1. Contingent Convertible bonds (CoCos) are a type of state-contingent debt instrument that automatically adjust so as to absorb losses—possibly through conversion into equity— should the issuing bank's capital fall below a certain level. They have risen to prominence following the global financial crisis, because they were seen as a way of bolstering bank capitalization and buffers against large shocks in an efficient manner.

2. The trigger activating the loss absorption mechanism (LAM) can be mechanical or discretionary. In the former case, activation occurs if the CoCo-issuing bank's capital (CET1) falls below a pre-determined fraction of risk-weighted assets. CoCos with mechanical triggers should provide loss absorption when the bank is a 'going-concern' – i.e., operations are continuing, and the bank is still solvent. CoCos with discretionary or point of non-viability (PONV) triggers, absorb losses if the supervisor judges the bank to be a 'gone concern' —i.e., it faces imminent insolvency. Supervisors can activate the LAM if they believe such action is necessary to prevent insolvency.

3. Issuance of CoCos by banks has been driven primarily by their regulatory treatment, which in turn has implications for their design. Under Basel III, CoCos count towards regulatory capital, assuming certain criteria are met. To qualify as Additional Tier 1 capital (AT1), they must provide loss absorption when the bank is a 'going concern'. Furthermore, AT1 securities must be perpetual. CoCo-issuance is also affected by their tax treatment in different jurisdictions. Given that coupon payments are typically tax-deductible; this reduces significantly the after-tax interest expenses of issuing banks. Between 2009 and end-2015, it is estimated that CoCos amounting to US$446.96b were issued globally.[2]

4. Demand for CoCos has been driven by investors' desire for higher returns (especially in the current low yield environment), while their portfolio diversification benefits appear less compelling. Yields on CoCos are high relative to other debt instruments, given their subordinated position in banks' capital structures, and risks inherent in their state-contingent features. CoCo yields have tended to fall within the range of around 5–7 percent, on average, compared with normal senior bank debt offering around 1 percent, and European high yield bonds offering roughly between 4–5 percent.[3] CoCos can provide diversification benefits only if the issuing bank's tail-risk has low correlation with portfolios of CoCo investors. Unlike natural catastrophes, however, bank failures tend to be correlated with the business cycle, limiting CoCos' diversification capacity in that regard. Investors in CoCos have traditionally been, asset management companies, institutional investors,

[1]Prepared by Sheheryar Malik (MCM).

[2]According to Fitch (2016), issuance for AT1 instruments peaked during 2014, and then saw a steady decline each year thereafter.

[3]Sources: Credit Suisse (2015). In earlier work, Avdjiev and others (2013) documented that yield of newly issued CoCos was on average 2.8 percent higher than that of non-CoCo subordinated debt, and 4.7 percent higher than that of senior unsecured debt of the same issuer.

5. hedge funds and banks.[1] Against the backdrop of heightened economic uncertainty, in part related to weak fundamentals, the CoCo market experienced sharp volatility during 2016 Q1. Some European issuers faced sells-offs of these securities, amid fears that coupons may likely be suspended.

6. In addition to difficulties in understanding pricing complexities of CoCos, initial growth in investor base was hindered by the absence of a complete set of credit ratings. Two main factors explain rating agencies' early reluctance to rate CoCos: (i) the heterogeneity in the regulatory treatment of CoCos across jurisdictions, complicating creation of consistent rating methodologies; and (ii) the existence of discretionary triggers creating valuation uncertainty, further complicating the ratings process. According to S&P's methodology, a CoCo rating should be at least two to three notches below the issuer's credit rating, and cannot exceed BBB+. Further downward notching is applied to instruments with triggers near, or at PONV. On average, ratings are about one notch lower than other subordinated debt, and more than five notches below senior unsecured debt of the same issuer.

7. This experience suggests that successful establishment of a market in sovereign SCDIs needs to take into account all incentives for issuers and investors. Regulatory and tax treatment, the possible market reactions to diverse shocks, and the degree of complexity and heterogeneity within the asset class are some of the factors that need to be addressed.

[1] CoCos cannot be purchased by retail investors directly, as regulators have ruled them too complex for unsophisticated investors.

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Annex IV. Additional Material on Case Studies of the Use of State-Contingent Instruments

A. During Normal Times[1]

Output and revenue-linked instruments

1. Turkey issued revenue-indexed bonds (RIBs) between 2009 and 2012 to diversify its investor base and debt portfolio. Marketed as a "non-interest" debt issue and primarily targeted at domestic participation banks and investors from the Gulf, the bond's coupon payments were indexed to the revenue (budget transfers) of several state-owned companies (Turkish Petroleum Corporation, State Supply Office, State Airport Authority, and Coastal Safety). The RIBs had a maturity of 3 years and coupons were denominated in both Turkish Lira (quarterly coupon) and U.S. dollars (semi-annual coupon). The bonds offered a minimum guaranteed coupon and a maximum coupon limit; the maximum coupon payments were based on the higher of the actual or projected income (transfers from SOEs) in the current year's (e.g., 2009) Budget law for the next three years (i.e., 2009, 2010, 2011). The principal would be paid at maturity with the last coupon payment. Despite initial interest from domestic banks, demand for the bond was less than expected, and the Turkish Treasury discontinued the issuance of these bonds in 2012, and does not plan to issue them further.

2. In response to the 2001 recession, the Government of Singapore launched the New Singapore Shares (NSS), a social transfer program for eligible low-income citizens involving two sets of shares linked to real GDP growth. The shares were not tradable and could only be exchanged for cash with the government. The first set of shares, the NSS, would earn annual dividends in the form of bonus shares, which will be calculated at a rate of 3 percent plus the real GDP growth rate of the preceding calendar year, with a guarantee of at least 3 percent. The second set of shares, Economic Restructuring Shares (ERS), was meant to subsidize Singapore citizens following the increase in the goods and services tax (GST). The bonuses would be calculated in a similar way as the NSS. Dividends on outstanding shares were to be paid every March 1 from 2002 to 2007 for the NSS, and on every March 1 from 2004 to 2008 for the ERS, respectively. The NSS and ERS were discontinued in 2008.

Countercyclical loans

3. More recently, countercyclical official loans have provided state contingent financing terms to debtor countries; these involve adjusting debt service and maturity in line with the economic conditions.

4. ***Multilateral***: Since 2007, the **Agence Française de Développement** (AFD) has offered 16 countercyclical concessional loans amounting to €344m to five low-income countries that have benefitted from debt relief through the HIPC initiative; the loans are directed toward project finance. The Prêt Très Concessionnel Contracyclique (PTCC) is a thirty-year loan facility with a five-year grace period at the beginning of the loan, and a five-year floating grace period for principal payments. The debtor has the right to exercise the floating grace period in the event export earnings fall below a

[1]Prepared by Sanaa Nadeem (SPR).

predefined threshold. A nonconcessional version of the loan is also available, but there is little demand for this product.

5. ***Bilateral:*** **Petrocaribe lending** involves bilateral loans extended by Venezuela to countries to purchase oil produced by PDVSA (Petroleos de Venezuela, S.A.), Venezuela's state-owned oil company, on predetermined flexible financing terms. The loans are designed with a specified amount paid at market prices up front, and the balance paid over 25 or so years. The terms of the loan, i.e., the down payment share, the interest rate, and the grace period, are based on the prevailing price of oil, potentially providing either the creditor (Venezuela) or the debtor protection in the face of an adverse oil price shock. Payment terms are negotiated bilaterally; debtor countries can also offer goods and services in lieu of currency. The loans were first issued in 2005, with Jamaica the first recipient, in a backdrop of unprecedented high oil prices, and efforts to strengthen regional cooperation. Approximately US$28 billion has been extended via Petrocaribe loans as of end-2015. As oil prices began to decline in 2014, many of the threshold prices triggering nonconcessional terms were breached. Some countries (e.g., Jamaica, and the Dominican Republic) bought back their Petrocaribe debt.

6. **Sonatrach**, Algeria's state-owned oil company, contracted a US$100 million oil-linked loan with a syndicate of international banks (led by Chase Investment Bank) in 1989. The instrument comprised a conventional floating rate loan (seven-year maturity, four-year grace period) and oil options. The loan incorporated four call options on oil held by Chase and sold by Sonatrach (with maturities between 6 and 24 months). If the oil price were to rise above a ceiling, Sonatrach would pay Chase a certain amount; this worked in principle for Sonatrach, given that its revenues would rise with oil prices. Yet this arrangement involved a financing cost lower than that without the options (estimated at 1pp above LIBOR relative to 3-4pp above LIBOR).

Commodity-linked instruments

7. In insuring against commodity price risk, commodity price hedging by sovereigns has been more prevalent than bonded instruments. Several papers have already reviewed the use of commodity hedges (IMF 2011). The market for commodity hedges is well-developed, has a sufficient volume of available counterparties, and the cost of acquiring hedges is relatively low. Also, whereas the maturity of currently available hedges is relatively short, under certain conditions, the volatility of commodity markets can be such that sovereigns prefer to acquire shorter term hedges. Some examples of commodity-linked bonds are presented below.

8. Mexico issued local currency oil-backed petrobonds between April 1977 and April 1980. The three-year bonds were issued by the government-owned development bank (NAFINSA, National Financiere S.A.) and targeted at Mexican nationals. The bonds were secured on future oil revenue: each unit of 1,000 pesos was backed by 2.149 barrels of oil. Upon redemption, the holder would receive the principal and a return using the current export price of oil in dollars times the exchange rate (the average of the previous 20 days). The first issue in April 1977 amounted to 2 billion pesos (about US$90 million) at 7 percent; the return on the 1979 bond was 12.658 percent. At the time, Mexico had intended to issue further rounds of commodity bonds (including based on oil and silver). In total, there were five issuances of the bond of about US$50 billion pesos in total. Despite an increase in the price of oil in the period, investors made a loss, due to the difference in the exchange rate used to compute the bond's dividend. Even though the oil price increased from $22.60 to $32.50 during the period, investors were made to use the less favorable Mexdollar official rate of

4,553 pesos for a 1,000-peso bond, which ultimately delivered a net loss for investors. Mexico did not issue a commodity linked bond thereafter.

9. Since November 2015, India has issued four tranches of gold-linked bonds, under the Sovereign (SGB) Gold Bonds Scheme, amounting to about 4.908 tons of physical gold. The bonds were launched to contain India's import of physical gold bullion (of which the country is the world's second largest importer, nearly 1,000 tons in 2015), in a sense providing the sovereign protection against balance of payments risk. The return on the bond is linked to the price of gold: the bonds carry a fixed interest rate of 2.75 percent per annum, paid semiannually, while the principal, payable at maturity is based on the prevailing reference rate of gold. Denominated in Indian rupees, the bond is now issued in multiples of one gram (from 2 grams at launch) of gold (to enlarge the subscriber base). The bonds have a maturity of eight years, with the option to redeem from the fifth year. The bonds are to be issued by the Reserve Bank of India on behalf of the Government of India, and are guaranteed by the government on both the interest and redemption amount. The bonds can be used as collateral for loans, sold, and traded on the National Stock Exchange as of June 2016; for banks, the SGB are eligible for the Statutory Liquidity Ratio. Only residents of India are eligible to hold the bonds. Uptake of the bonds has been muted, in part due to the low rate of return (e.g., cash bank balances offer 8 percent), and that most domestic buyers of gold prefer to hold for long periods for social value, rather than as an investment asset. The SGBs are just one part of a larger program by the government to limit gold imports.

10. An earlier example of commodity-linked bonds is the issuance of Confederate Erlanger bonds (Cotton Loan) by the Confederacy in 1863. Issued in in five European cities (London, Liverpool, Paris, Amsterdam, and Frankfurt), these bonds were backed by and redeemable in bales of Confederate government-owned cotton at the prevailing price. The bonds were linked to cotton due to uncertainty around the Confederacy's ability to pay due to the Civil War. The £100 bonds were redeemable for 8 bales of cotton; the bonds paid a 7 percent interest rate with a maturity of 20 years. The issuance raised about £1.76 million. Nevertheless, there was little overall confidence in the Confederacy, and the price of the bonds declined (notwithstanding attempts by the Confederate government to buy back some of the bonds to support the price).

Catastrophe insurance

11. Catastrophe insurance by sovereigns has generally taken a multilayered, complimentary approach**.** Economic losses under natural disasters can be extremely large, as a result of which insurance through private markets alone can be prohibitively expensive for individual sovereigns. Some developed markets require catastrophe insurance by private markets by law, reducing the need for sovereigns to acquire insurance (e.g., New Zealand, California).

12. Mexico was the first and only sovereign to date to have issued standalone catastrophe-linked bonds. Issued in 2006, the US$160 million 3-year cat bond, CatMex, was designed to provide FONDEN (The Fund for Natural Disasters for Mexico) financing in the event of an earthquake. The coupon was LIBOR-based. The bond had a parametric trigger, defined as an earthquake with a certain magnitude and depth occurring in any of three pre-defined geographical zones in Mexico. The bond was structured in two tranches for different regions; both were rated BB+ by S&P. The launch of the instrument praised by experts and was well-covered by the media. The bond matured without being triggered.

B. During Restructurings[2]

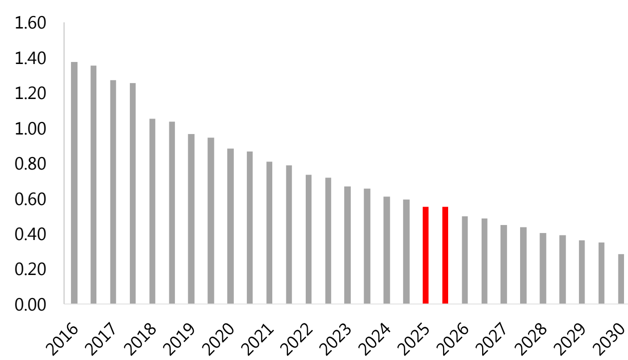
13. Grenada included a hurricane clause in its recent debt restructurings, which allows postponement of scheduled debt service payments upon the realization of an exogenous natural disaster event. The hurricane clause is designed to provide cash flow relief at a critical moment after a natural disaster event when financing needs are greatest and new sources are scarce, thereby enabling Grenada to redirect funds intended for debt service to more immediate needs, reducing the economic impact of the natural disaster. Since the changes to the scheduled debt service payments are pre-defined in a contract, a change does not itself constitute a 'credit event." At the same time, the clause reduces the probability that another ad hoc debt restructuring will be triggered.

14. Key features of the hurricane clause include:

- *Verifiable trigger event measured by an independent entity*: Grenada is a member of the Caribbean Catastrophic Risk Insurance Facility (CCRIF) SPC and has purchased insurance on its 2030 and Exim Bank of Taiwan bonds against the risks of tropical cyclone, earthquake, and excess rainfall. The event is triggered based on parametric measures. If the insurance is triggered, as determined by the CCRIF, the hurricane clause in the bond contract is also triggered.
- *Changes to the cash flow*: The clause provides for deferred payments for up to two payment periods, and there is no nominal principal or interest rate reduction. The deferred interest payment is capitalized and the deferred principal payment is distributed equally on top of the scheduled payments till final maturity.
- *Maximum number of triggers*: The contract allows the trigger to be invoked for up to three times.

Scheduled Debt Service: 2030 Bonds & Taiwan

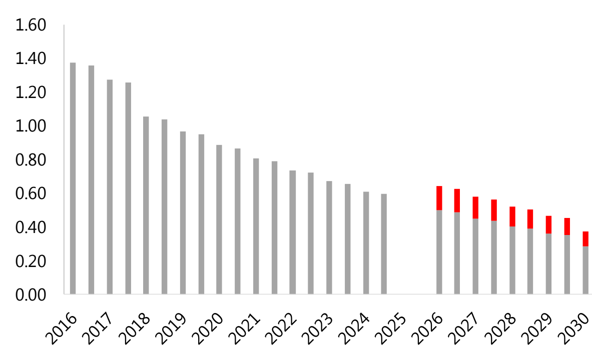
(Percent of GDP)



Source: Fund staff calculations.

Debt Service After a Hypothetical Call on Hurricane Clause in 2024: 2030 bonds & Taiwan

(Percent of GDP)



Source: Fund staff calculations.

15. The cash flow relief that may result from the hurricane clause is equivalent to the probable maximum loss of an event that occurs once in every 25 years in Grenada. Depending on the timing of the event, a one-off trigger of the hurricane clause could provide a cash flow relief of up to 2.6 percent

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[2]Prepared by Eriko Togo (MCM).

16. of GDP. This compares with about 1.5 percent of GDP for the probable maximum loss from an event that occurs once in every 25 years in Grenada, and the average annual loss experienced in Grenada of 9.87 percent of GDP. The charts illustrate the scheduled debt service payments and the payments under a scenario where the hurricane clause is triggered at end-2024.

17. The hurricane clause in a debt contract is a liquidity relief instrument. It does not reduce the stock of debt, let alone generate additional new financing. For a catastrophic event such as Hurricane Ivan that caused damage estimated at 200 percent of GDP, the cash flow relief from the hurricane clause cannot be expected to match the potential financing needs. An instrument such as a catastrophe bond or insurance would be more appropriate.

18. The hurricane clause defines a "Caribbean Tropical Cyclone Event" that is distinct from an "event of default." The clarity of this distinction is important to ensure that the non-payment of the scheduled debt service as a result of a hurricane does not trigger an event of default that could cause the credit rating agency to downgrade the bond to Selected Default.

19. Since the debt with the hurricane clause was issued in the context of a debt restructuring, it is unclear whether such an instrument can be issued under normal circumstances. In the specific case of Grenada, the creditors were already holding the bond, and had a vested interest in the recovery and future growth of Grenada. In the context of a general bond issuance, such consideration may not play a part and investors may demand additional risk premium. Current market valuation suggests that the clause is valued little, but the pricing could be volatile depending on market assessment of the probability of cash flow deferment.

20. The general conditions of the clauses negotiated with various creditors are summarized in the following table:

Details of the Hurricane Clauses

	Private Bondholders	Taiwan	Paris Club[1]
Event	Hurricane insured under CCRIF Parametric Insurance Contract dated June 1, 2015	Hurricane, earthquake, excess rainfall insured under CCRIF Parametric Insurance Contract dated June 1, 2012	Exogenous shocks, including natural catastrophes such as hurricanes and tsunamis
Trigger	CCRIF SPC modelled losses exceeding US$15 million	CCRIF SPC modelled losses exceeding US$15 million	Assessment to be made on a case-by-case basis with no pre-defined set of indicators
Independent Body	CCRIF SPC	CCRIF SPC	Assessment by IFIs, regional institutions or any organization that the PC Creditors, with the help of the Secretariat, will judge relevant, including the IMF, World Bank. CCRIF SPC, the CDB and the National Hurricane Center
Debts Affected	Principal and accrued interest due on the deferral dates	Principal and accrued interest due on the deferral dates	Principal and/or accrued interest. Creditors will have the choice to decide on a bilateral basis whether or not to participate in a debt relief
Deferral Dates	-Up to 6 months or one payment date (if CCRIF SPC payout is greater than US$15 million and less than US$30 million) -Up to 12 months or two payment dates (if CCRIF SPC payout is greater than US$30 million)	12 months (two payment dates)	Unspecified
Repayments Terms	-Principal deferred and accrued interest deferred and capitalized -Both repayable in equal semi-annual installments over the remaining term of the loan	-Principal deferred and accrued interest deferred and capitalized -Both repayable in equal semi-annual installments over the remaining term of the loan	Unspecified
Conditions	Policy Payout by CCRIF SPC and submission of the deferral claim	Policy Payout by CCRIF SPC and submission of the deferral claim	Unspecified, but past cases have typically involved considerable damage and formal request
Maximum Numbers of Triggers	Three	Three	Not stated
Reporting	Progress reports on post-event relief, recover and reconstruction programs	Progress reports on post-event relief, recover and reconstruction programs	Not stated

[1]Exceptional treatment in case of crisis. See www.clubdeparis.org/en/communications/page/exceptional-treatments-in-case-of-crisis.

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Annex V. Evolution of Government Debt Structures in Emerging Markets—Lessons for SCDIs[1]

1. The past three decades have witnessed a seismic shift in the composition of government debt in EM countries. In particular, the share of domestic debt[2] in total debt has risen significantly in most EM countries in the sample.[3] Compared to the 1980s, when many EM sovereigns suffered from the "domestic original sin" (inability to borrow domestically at long-term in own currencies), investors are now more willing to bear the currency and credit risks. Coupled with these sovereigns' increasing ability to borrow domestically, the domestic debt instrument mix in many countries has increasingly shifted toward domestic long-term local currency-denominated fixed-rate debt (DLTF).[4] Yet, such debt remains prohibitively costly in a subset of EM and LIC countries.

2. Countries undertook these efforts because DLTF debt is considered among the safest forms of debt from the standpoint of the debtor. Since it is the creditor who bears the cost of currency depreciation or inflation, DLTF debt protects the sovereign against certain types of shocks. In contrast, countries that suffer from "domestic original sin" cannot issue DLTF debt at a reasonable cost. They are forced to rely on riskier forms debt that have either short-term maturity, or are denominated in foreign currency, or linked to short-term interest rates or inflation. However, to the extent that SCDIs can offer some upside risk to the investors and be priced cheaper than DLTF instruments, they may be an attractive alternative or complement.

3. Since the early 1990s, there has been a shift in the composition of central government debt towards local currency (LC) among EM sovereigns (Figure AV.1). The trend can be mostly attributed to rising reliance on domestically issued debt, among EM sovereigns in Asia, Latin America and the EMEA region.

[1]Prepared by Anastasia Guscina (MCM) and is based heavily on Guscina (2008) and Jeanne and Guscina (2006).

[2]There are three approaches to classifying debt as either domestic or international: (i) currency in which the debt is issued; (ii) residency of the creditor, and (iii) jurisdiction of issuance. The annex uses jurisdiction of issuance criterion.

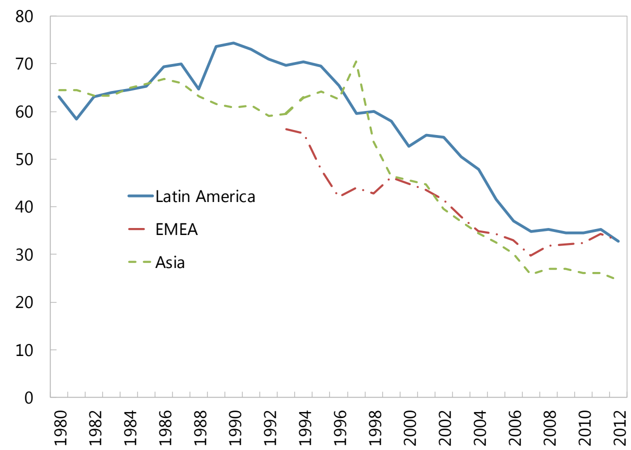
[3]Jeanne-Guscina EM Database covers 19 EM sovereigns.

[4]DLTF is domestic local currency non-indexed fixed-rate debt with original maturity over 1 year.

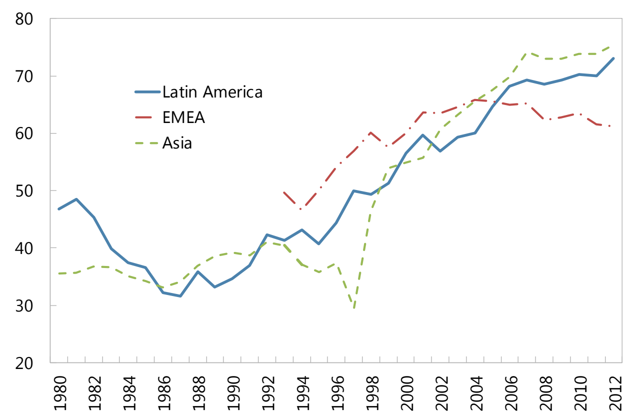
Figure AV.1. Rising Prominence of Local Currency Debt: 1980–2012

(in percent of total government debt outstanding, regional average)[1]

Share of Foreign-Currency Denominated Debt in Selected Regions



Share of Domestically Issued Debt in Selected Regions



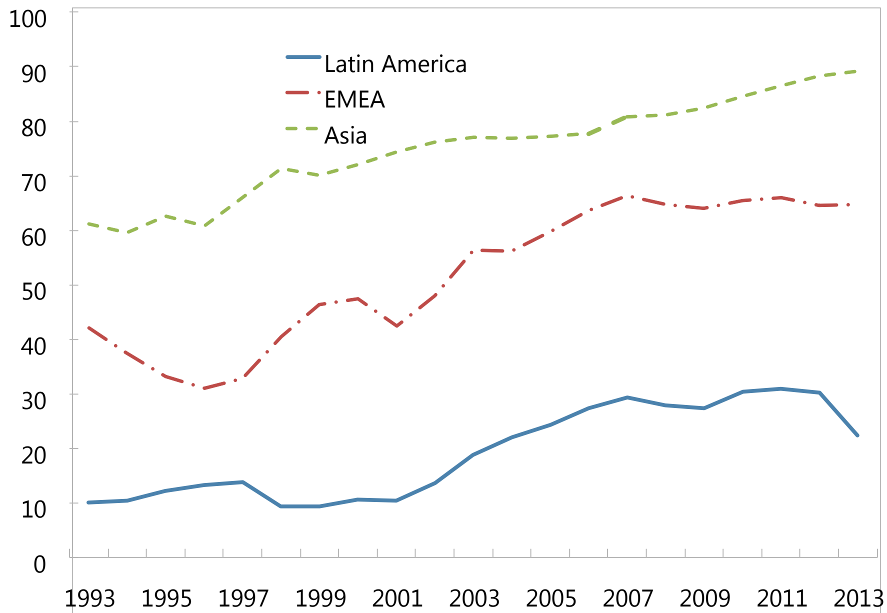
Sources: Jeanne-Guscina EM Debt Database 2014 and staff calculations.

[1]Latin America includes Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela. EMEA includes Czech Republic, Hungary, Poland, Russia, Israel and Turkey. Asia includes China, India, Indonesia, Korea, Malaysia, Philippines, and Thailand.

4. The composition of domestic debt has shifted to local currency long-term debt, as many EMs graduated from the "original sin" (Figure AV.2). This term, coined by Eichengreen and Hausmann (1999) and Hausmann, and Panizza (2003) refers to the phenomenon of EM's inability to borrow internationally in their own currency ("international original sin") or borrow long-term in local currency domestically ("domestic original sin"). While the "international original sin" may be attributed to the very structure of global financial markets, "domestic original sin" may be linked to a history of macroeconomic and political instability, poor quality of institutions, and prioritization of costs over risks.[5]

[5]Guscina (2008), Mehl and Reynaud (2010), Claessens, Klingebiel, and Schmukler (2007).

Figure AV.2. Evolution of DLTF Debt Share: 1993–2013 1/
(percent of domestic debt outstanding)



Sources: Jeanne-Guscina EM Debt Database 2014 and staff calculations.

1/ Latin America includes Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela. EMEA includes Czech Republic, Hungary, Poland, Russia, Israel and Turkey. Asia includes China, India, Indonesia, Korea, Malaysia, Philippines, and Thailand.

5. The experience of EMs in trying to promote DLTF debt may offer valuable lessons relevant to the assessment of SCDIs and approaches to the development of those instruments. The experience outlined here suggests that the composition of the debt portfolio, the level of debt market development, and the structure of the investor base have important implications for the attractiveness of DLTF instruments for sovereigns and investors. Also macroeconomic policies and conditions affect the chances of success in expanding the investor base and the range of available instruments. More specifically, the process of redemption from "domestic original sin" typically involves:

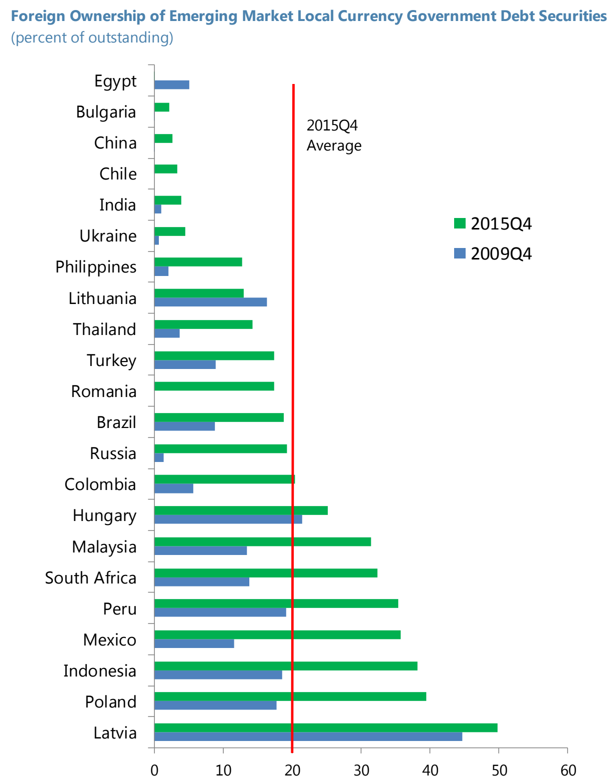
- Better macroeconomic policies which have kept inflation in check. It should be noted that domestic original sin has not been a severe problem for most Asian economies, as these countries have not experienced the sort of hyperinflation episodes and other macroeconomic turbulence that were quite common in Latin America.

- Use of inflation-linked and/or variable rate debt as an intermediary step in the process of transition from FX-denominated debt to DLTF debt. Even after successful disinflation and fiscal adjustment programs, foreign-currency and indexed debt continues to be the dominant form of domestic debt in some countries—reflecting the fact that it often takes a long time for countries to gain anti-inflationary credibility (Jeanne, 2005). Active debt management decision to minimize FX-risk in sovereign debt portfolios;

- Institutional reforms and technical and legal development of local bond markets;

- Opportune external conditions. Many EM sovereigns were able to capitalize on the increased interest of nonresident investors in their domestic bond markets (Figure AV.3), which drove down yields on local currency instruments. Foreign investors' participation in local currency bond market has risen sharply since the Global Financial Crisis. This is due to unconventional monetary policies in advanced economies, search for yield, and greater confidence in EM fundamentals.

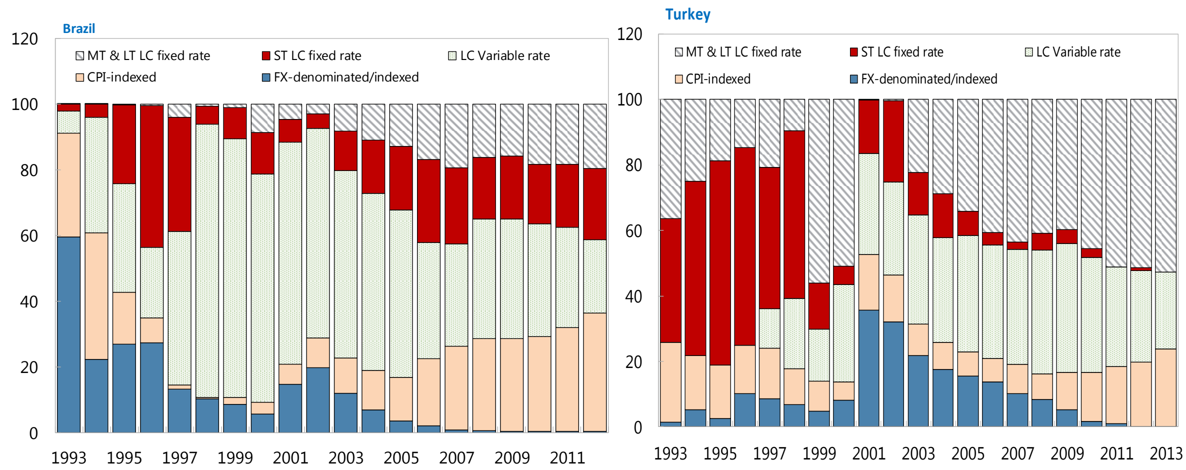
Figure AV.3. Foreign Ownership of Local Currency Debt Securities



Sources: Arslanalp and Tsuda (2014) and staff calculations.
Note: Coverage of debt is central government.

6. Brazil and Turkey provide examples of countries that de-dollarized their sovereign debt portfolio by first shifting toward variable rate instruments and then toward CPI-indexed debt (Figure AV. 4). Over the past two decades Brazil has made important strides towards safer debt structures—the share of FX denominated/indexed debt has been reduced from almost 60 percent in 1993 to less than 1 percent twenty years later. Likewise, Turkey phased out FX-denominated debt altogether, after experiencing the effects of a depreciation shock on government debt, around the 2001 crisis. Both governments first shifted the debt composition toward floating rate local currency debt, or short-term debt, and then toward CPI-indexed debt. In Brazil, CPI-indexed debt now accounts for about a third of the debt portfolio, with the remaining two-thirds split evenly between DLTF, short-term and variable rate instruments. In Turkey, at end-2013, about 55 percent of outstanding debt stock was composed of DLTF instruments, with the rest split evenly between variable rate and CPI-indexed instruments.

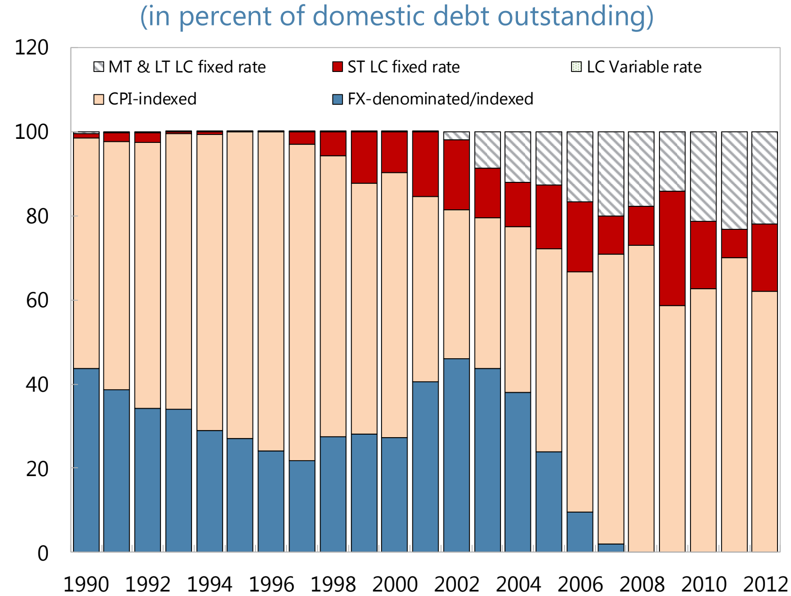
Figure AV.4. Brazil and Turkey: Evolution of Government Domestic Debt Structure
(in percent of domestic debt outstanding)



Sources: Jeanne-Guscina EM Debt Database 2014 and staff calculations.

7. CPI-indexed debt has been a prominent feature of Chile's general government debt portfolio over the past three decades. FX-denominated or indexed debt is no longer a part of the domestic debt structure. Floating-rate debt has never taken off in Chile. The share of DLTF debt has increased over the last decade to about 20 percent of the general government domestic debt outstanding. But CPI-indexed debt remains a prominent feature in the composition of domestic debt, accounting for over 60 percent of domestic debt outstanding (Figure AV.5).

Figure AV.5. Chile: Evolution of Government Domestic Debt Structure
(in percent of domestic debt outstanding)



Source: Jeanne-Guscina EM Debt Database 2014.

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Annex VI. Groupings of Potential Issuers by Characteristics[1]

Introduction

1. **This annex proposes a grouping of countries by their fiscal characteristics and a tentative assessment of the forms of state contingent debt instruments most appropriate for each group.** The characteristics of 194 sovereigns are examined based on a large dataset. A set of country groups are proposed, whose constituents have broadly similar fiscal characteristics. The fiscal characteristics of these different groupings are then examined and compared, which have implications for the most appropriate SCDIs.

Data on fiscal risk characteristics

2. **Sovereigns face a number of sources of risks, many of which can be captured by variables in the debt accumulation identity.** For example, the average growth-interest rate differential will have implications for a sovereign's maximum sustainable level of debt (Annex I and II), while the levels of the debt stock (d_t) and the share of foreign currency debt (δ_t^{fc}) affect the sovereigns' vulnerability to future shocks. The joint distribution of real interest rates (r_t), real growth (g_t), primary balances (pb_t), the nominal exchange rate (ε_t) and the stock flow adjustment (sfa_t) capture the likelihood of a large shock to the sovereign's fiscal position.

$$\Delta \mathrm{d_t} \approx (r_t - g_t)\left(1 + \delta_{t-1}^{fc}\varepsilon_t\right)d_{t-1} - pb_t + sfa_t$$

3. **In addition to this general framework, it is also useful to examine specific risk factors that can affect the probability of large adverse shocks.** For example, some economies may be heavily dependent on a single sector, or highly vulnerable to natural disasters. Similarly, it may be useful to consider factors affecting the degree of domestic policy space, such as the exchange rate and monetary policy regime, and the ability to self-insure. Furthermore, liquidity risks may be captured by the level and volatility of gross financing needs.

4. **In order to assess these fiscal characteristics, a database covering 194 sovereigns and a broad set of measures of fiscal risk factors has been examined.** The joint distribution of the key variables identified above is explored by estimating averages, standard deviations and correlations using annual data for the period 2000–15. For interest rates, measures of both the marginal rate,[2] and the average effective rate are used.[3] Most of the data is drawn from the WEO database, supplemented in places by other sources, including the World Bank WDIs, and the VEE and MAC DSA databases.

[1]Prepared by Tom Best (SPR).

[2]For AEs we use the market yield on long-term government bonds, while for EMDCs we use the average interest rate on new external debts.

[3]Total government expenditure on interest payments divided by the debt stock in the previous year. This will both existing and new debt, and will reflect the average composition of debt.

Country groupings

5. **We organize countries into eight broad groups based on their characteristics.** Three such groups are identified among advanced economies (AEs), and five among emerging markets and developing countries (EMDCs).[4] First there are a small set of advanced economies that issue reserve currencies,[5] that have very liquid domestic debt markets and which tend to experience 'flight to quality' inflows in distressed states of the world. Among the remaining advanced economies, we distinguish between euro-area members, who share a common monetary policy, which somewhat constrains their policy space in the face of idiosyncratic shocks, and a set of small open advanced economies that are exposed to external shocks but generally face fewer constraints on monetary policy. Among EMDCs, commodity exporters and small states face substantial exposure to commodity price shocks and natural disasters, respectively. The remaining Emerging Markets (EMs) and Low Income Countries (LICs) form a fairly large and heterogeneous group, from which we also isolate a set of 'local currency issuers', that have transitioned to issuing debt predominantly in local currency, and whose balance sheets are thus less directly vulnerable to exchange rate fluctuations.[6]

6. **These country groups exhibit somewhat different characteristics.** The 'reserve currency issuers' experience relatively low real GDP and interest rate volatility, although debt levels are quite high. In the euro-area countries, growth is more volatile, and has generally been negatively correlated with real interest rates, reflecting the limited scope for monetary policy to offset country-specific shocks. Small-open advanced economies sit between these groups, with moderate volatility of growth but more stabilizing properties of interest rates. Among the EMDCs, commodity exporters have much higher volatility along most dimensions, while small states tend to face a high probability and vulnerability to natural disasters.[7] The remaining EMDCs look more similar, but the local currency issuers tend to face somewhat lower macro-economic volatility.

[4]See Table AVI.2 for a list of the constituents of each group.

[5]While the euro is also a reserve currency, we consider this group separately given that they share a single euro monetary policy. China is grouped among the EMDCs, and more specifically among the 'local currency issuers'.

[6]The countries in this group issue more than 65% of debt in their own currency. The properties of this group would be similar if this threshold were set at 75% or 50%, although the country composition would change.

[7]See for example 'Small States' Resilience to Natural Disasters and Climate Change - Role for the IMF' (2016).

Figure AVI.1A. Standard Deviations of Key Variables by Group: AEs

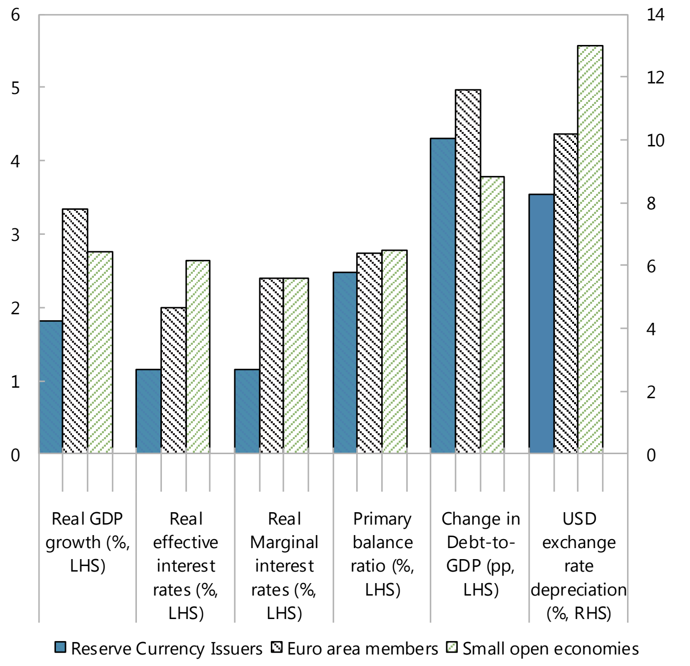

Figure AVI.1B. Standard Deviations of Key Variables by Group: EMDCs

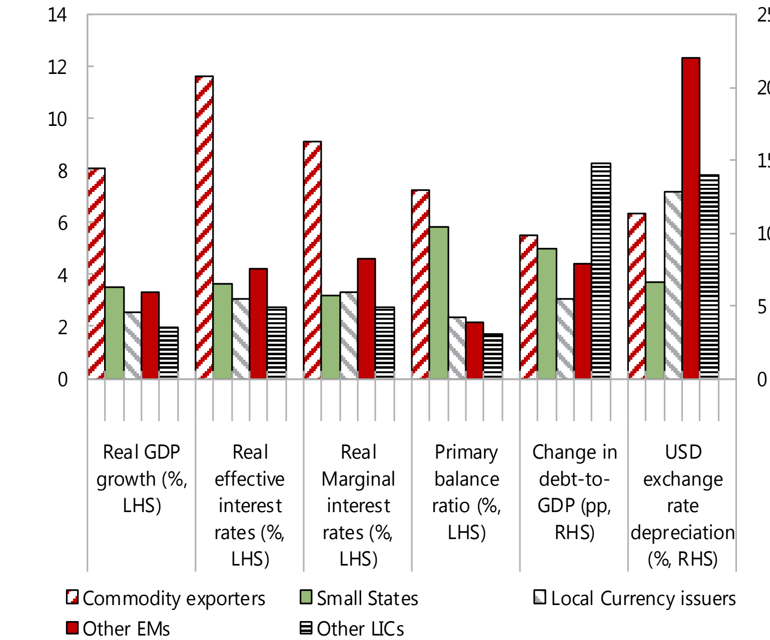

Figure AVI.2A. Correlations of Key Variables by Group: AEs

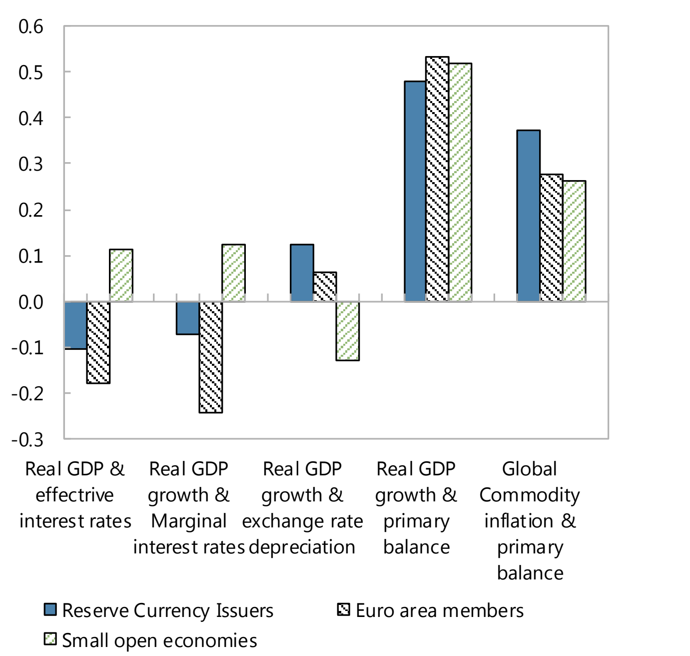

Figure AVI.2B. Correlations of Key Variables by Group: EMDCs

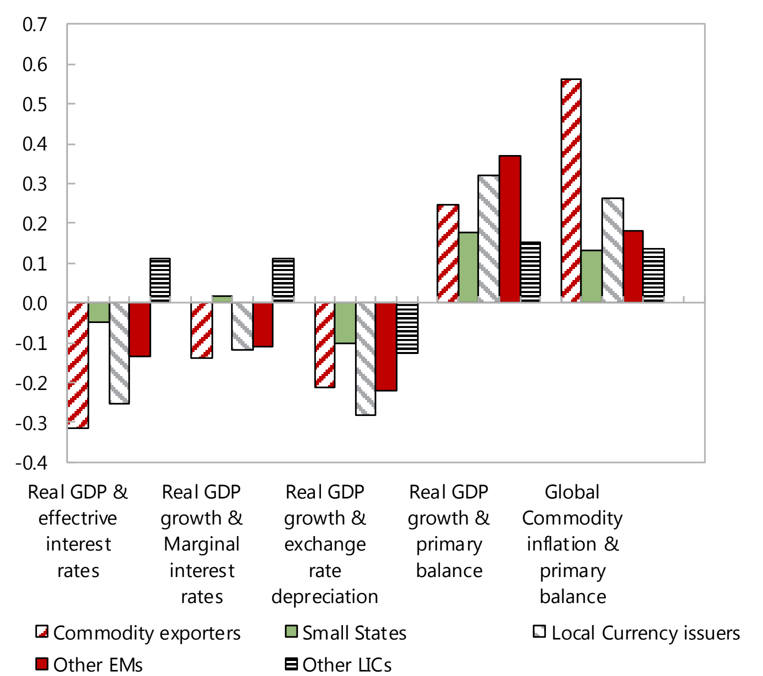

Table AVI.1. Averages by Group for Fiscal Variables

Country groups	Stock variables (latest): Debt-to-GDP ratio (%)	Stock variables (latest): Foreign currency debt share (%)	Averages (2000-2015): Annual real GDP growth	Averages (2000-2015): Effective real interest rate (%)	Averages (2000-2015): Annual exchange rate depreciation (%, vs USD)	Averages (2000-2015): Primary Balance (% of GDP)	Standard deviations (2000-2015): Change in debt-to GDP ratio (pp)	Standard deviations (2000-2015): Real GDP growth (%)	Standard deviations (2000-2015): Effective real interest rate (%)	Standard deviations (2000-2015): Marginal real interest rate (%)	Standard deviations (2000-2015): Annual exchange rate depreciation (%, vs USD)	Standard deviations (2000-2015): Primary Balance (% of GDP)	Correlations (2000-2015): Real GDP growth & effective interest rates	Correlations (2000-2015): Real GDP growth & marginal interest rates	Correlations (2000-2015): Real GDP growth & exchange rate	Correlations (2000-2015): Real GDP growth & primary balance	Correlations (2000-2015): Global Commodity inflation & real GDP growth	Correlations (2000-2015): Global Commodity inflation & primary balance
AEs	72	6	2.3	2.3	0.2	-0.2	4.5	2.9	2.1	2.2	10.7	2.72	-0.07	-0.08	0.01	0.52	0.47	0.28
Reserve Currency Issuers	116	2	1.7	2.3	0.0	-2.2	4.3	1.8	1.2	1.2	8.3	2.48	-0.10	-0.07	0.12	0.48	0.55	0.37
Euro area members	81	5	2.1	2.1	0.0	-0.7	5.0	3.3	2.0	2.4	10.2	2.74	-0.18	-0.24	0.06	0.53	0.45	0.28
Small open economies	42	11	2.8	2.6	0.6	1.5	3.8	2.8	2.6	2.4	13.0	2.77	0.11	0.12	-0.13	0.52	0.47	0.26
EMDCs	50	55	4.4	-2.0	4.7	-0.1	10.2	4.2	5.4	4.9	13.5	4.11	-0.09	-0.01	-0.18	0.23	0.28	0.23
Commodity exporters	35	35	5.5	-1.8	3.6	3.8	9.8	8.1	11.6	9.1	11.3	7.27	-0.31	-0.14	-0.21	0.25	0.35	0.56
Small States	61	63	2.9	-0.1	1.3	-1.0	8.9	3.5	3.6	3.2	6.6	5.84	-0.05	0.02	-0.10	0.18	0.23	0.13
Local Currency issuers	52	16	4.1	0.7	5.0	-0.7	5.5	2.6	3.1	3.3	12.8	2.37	-0.26	-0.12	-0.28	0.32	0.47	0.26
Other EMs	54	60	4.0	-1.4	6.8	-0.4	7.9	3.3	4.2	4.6	22.0	2.15	-0.13	-0.11	-0.22	0.37	0.41	0.18
Other LICs	48	71	5.0	-4.8	6.1	-1.2	14.7	3.6	4.9	4.9	13.9	3.11	0.11	0.11	-0.12	0.15	0.13	0.14

Table AVI.2. Member Countries of Country Groups

Group	Reserve currency issuers	Euro area members	Small open economies	Commodity exporting EMDCs	Small states	Local currency issuing EMs	Other EMs	Other LICs
Member countries	Canada, Japan, Switzerland, United Kingdom, United States	Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Slovak Republic, Slovenia, Spain	Australia, Czech Republic, Denmark, Hong Kong SAR, Iceland, Israel, Korea, New Zealand, Norway, San Marino, Singapore, Sweden, Taiwan Province of China	Algeria, Angola, Azerbaijan, Bahrain, Bolivia, Brunei Darussalam, Chad, Colombia, Congo, Republic of, Ecuador, Equatorial Guinea, Gabon, Iran, Iraq, Kazakhstan, Kuwait, Libya, Nigeria, Oman, Qatar, Russia, Saudi Arabia, South Sudan, Trinidad and Tobago, Turkmenistan, United Arab Emirates, Yemen	Antigua and Barbuda, Bahamas, The, Barbados, Belize, Bhutan, Cabo Verde, Comoros, Djibouti, Dominica, Fiji, Grenada, Guyana, Kiribati, Maldives, Marshall Islands, Mauritius, Micronesia, Montenegro, Rep. of, Palau, Samoa, São Tomé and Príncipe, Seychelles, Solomon Islands, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Swaziland, Timor-Leste, Tonga, Trinidad and Tobago, Tuvalu, Vanuatu	Brazil, Chile, China, Costa Rica, Egypt, El Salvador, Guinea-Bissau, India, Malaysia, Mexico, Morocco, Namibia, Pakistan, Poland, South Africa, Thailand, Turkey, Venezuela	Albania, Argentina, Armenia, Belarus, Bosnia and Herzegovina, Botswana, Bulgaria, Croatia, Dominican Republic, Georgia, Guatemala, Hungary, Indonesia, Jamaica, Jordan, Kosovo, Lebanon, Macedonia, FYR, Panama, Paraguay, Peru, Philippines, Romania, Serbia, Sri Lanka, Syria, Tunisia, Ukraine, Uruguay	Afghanistan, Bangladesh, Benin, Burkina Faso, Burundi, Cambodia, Cameroon, Central African Republic, Congo, Democratic Republic of the, Côte dIvoire, Eritrea, Ethiopia, Gambia, The, Ghana, Guinea, Haiti, Honduras, Kenya, Kyrgyz Republic, Lao P.D.R., Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Moldova, Mongolia, Mozambique, Myanmar, Nepal, Nicaragua, Niger, Papua New Guinea, Rwanda, Senegal, Sierra Leone, Sudan, Tajikistan, Tanzania, Togo, Uganda, Uzbekistan, Vietnam, Zambia, Zimbabwe

Annex VII. State-Contingent Extendible Bonds[1]

A. Rationale and Design Options for State-Contingent Extendible Bonds

Rationale

1. **By pushing out maturities (or imposing debt service standstills), extendible debt instruments can generate "financing" for a country facing a liquidity shock,[2] and thus, prevent liquidity problems from translating into a full-blown/costly debt crisis in times of stress and low confidence.**[3] Through this automatic provision of finance, the risk that temporary liquidity crises propagate (through balance sheet effects, herd behavior, or confidence shocks) into a full-blown loss of confidence should decline. This is of benefit to the creditors, the debtor and the system more widely. Furthermore, to the extent that the maturity extension stabilizes interest payments at pre-crisis levels, these instruments should prevent the solvency of the sovereign deteriorating.

2. **By ensuring automatic private sector involvement, extendible bonds could facilitate and potentially limit the need for official sector support.** Maintaining private exposure makes it politically easier for official creditors to provide financing, as it reduces the amount needed from official creditors, as well as helps provide safeguards on debt sustainability. Furthermore, the resources from the official sector could be used to allow for a more gradual policy adjustment by the sovereign to better support growth and reduce the risk of program failure.

3. **Last but not least, extendible bonds have the potential of enabling markets better internalize sovereign risk, as the implicit anticipation of full official sector bail-out is eliminated.** By reducing the implicit bail-out subsidy from the official sector, sovereign bonds yields would be more in line with their perceived riskiness, as determined by fundamentals. The better differentiation of risk by creditors will incentivize debtors to improve fundamentals and reduce debt through the price mechanism. In addition, these instruments can give time to policymakers to properly assess the debt sustainability situation and, if needed, undertake restructuring negotiations in an orderly way. Finally, by maintaining private sector exposure, they can facilitate access to Fund financing (under its new lending rules), while reducing moral hazard in the system (Brooke and others, 2013).

Potential complications (relative to other benchmarks)

4. **Extendible bonds could be hard to price because of the large one-off adjustment involved.** As they are mainly downside-protection instruments, investors may demand a high risk premia for holding them, while the issuers might not see the benefits in paying such high premia in presence of other available debt instruments. The extension could happen at the issuer's discretion

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[1]This annex was coordinated by Narcissa Balta (SPR), with contributions from Tom Best, Natalia Novikova and Alex Pienkowski (all SPR), and input from Sheheryar Malik and Eriko Togo (both MCM).

[2]This could take the form of an unexpected increase in gross financing needs, rationing of credit and/or rising funding costs.

[3]Buiter, 1999, Consiglio and Zenios, 2015.

(perhaps with a penalty), or could be linked to a trigger (the pricing of such instruments is considered in the subsequent section)

5. **A market in extendible bonds is more likely to emerge insofar as the sovereign attaches particularly high value to debt service relief in times of stress.** In times of stress, the (subjective) discount rate for sovereigns may increase by more than investors' discount rate, and thus, the option to extend may be worth more to the sovereign than the investor. This should help a market to emerge as the sovereign may be more willing to pay a high premium than for continuous SCDIs like GDP-linked bonds. Market participants may also value the extendible option if the alternative is a debt restructuring (with corresponding deadweight costs) rather than an official sector bail-out.

6. **Some of the concerns about data integrity, manipulation, and moral hazard can be addressed through optimal design of the trigger.** Triggers signaling liquidity pressures (such as CDS spreads, or bond yields) could be manipulated by investors; while other triggers, such as request for IMF or ESM assistance could imply delays and get entangled with political economy difficulties associated with Fund programs. Proposals include: a 3-year standstill/extension in the event of request for IMF assistance (Brooke and others, 2013) or ESM program (Andritzky and others, 2016, Deutsche Bundesbank, 2016). Others (Mody, 2014) have argued for large increases in CDS spreads on bond yields. See also Consiglio and Zenios, 2015

Design of extendible bonds with state-contingent triggers

7. **The simplest form, extendible with the option to extend maturity at sovereign's discretion, may be perceived by market participants as opportunistic behavior.**[4] When the cost of refinancing the instrument is greater than the perceived cost (monetary and non-monetary) of extending the maturity, then the option is triggered. Such a maturity extension could be exercised fairly regularly unless there were high non-monetary costs associated with such an action. For example, in a 'repeated game' setting, a sovereign may want to signal that it will only extend maturities in rare events; or if the extension is perceived as a signal of liquidity problems that could trigger panic.

8. **Market acceptability may be greater for an option with a penalty interest rate (i.e., the maturity extension is accompanied by an increase in the coupon).**[5] The step up in coupon payments would increase the cost of exercising the extension relative to refinancing, and so would limit the use to larger interest rate hikes. However, the higher interest rates (relative to the no step-up option) could worsen the financing costs for the sovereign, and its debt sustainability.

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[4]There are several examples of such instruments issued by private debtors, and also from US municipal bonds where repayment day could be moved at the discretion of an issuer by 180–270 days. In addition, Canada has issued a bond with a maturity extension option triggered by the investor; and 30-year U.S. bonds are callable by the issuer any time after 5 years.

[5]Once a maturity extension had been used, a 'penalty' interest rate would reduce the frequency that such clauses are invoked and an opportunistic behavior on the side of the issuer.

9. **An extendible bond with a state-contingent automatic trigger could address concerns about data manipulation, and also about endogeneity to government policy**.[6] Concerns about perverse behavior would likely be less important, as the trigger could be calibrated to anticipate a very large adverse shock (i.e., the government would not have the incentive to engineer such an eventuality). Data manipulation could be alienated if the trigger is externally verifiable by either an international agency that has an incentive to behave credibly (i.e., linked to financial support) or an international statistical agency that has a reputation to preserve. For example, commodity prices or hurricane intensity are reported/determined internationally and beyond the control of a single government, and therefore, such risks would be minimal.

10. **The optimal length of maturity extension will depend on the expected severity of the crisis defined by the trigger, but also on the duration over which the sovereign is likely to need financing relief.** Real life examples range from 6–9 months (municipal extendible bonds) to a 1-year standstill (Grenada hurricane clause) and to a 5-years grace period extension for AFD's countercyclical loans. If the length of the maturity extension is too generous, some investors might be discouraged. Moreover, the longer the extension, the higher the premia demanded by investors.

B. Pricing State-Contingent Extendible Bonds

Pricing an 'Issuer's Discretion' Extendible

11. In examining the pricing of extendible bonds, it is start by considering a bond that extends from 'short' to 'long' maturity at the issuer's discretion. It is helpful to compare the payoff of such a bond with two alternative option-based structures, each of which can be parameterized (with appropriate underlying bonds, strike prices, exercise dates, etc.) so that their potential payoffs, from a sovereign perspective, are identical (Figure AVII.1):[7]

(A) **An 'issuer's discretion' extendible bond**: *selling* a bond with a 'short' initial maturity (m_S), and coupon (c), which includes an *embedded* option to extend to a 'long' maturity ($m_L > m_S$) bond with 'step-up' coupon (c+s), at the issuer's discretion.

(B) **A short bond + (issuer's) put option on long bond**: *selling* a (short) bond with coupon c and maturity m_S, and *buying* a (European) put option,[8] with exercise date m_S and strike price equal to face value, on a bond with maturity m_L and coupon $c + s$.

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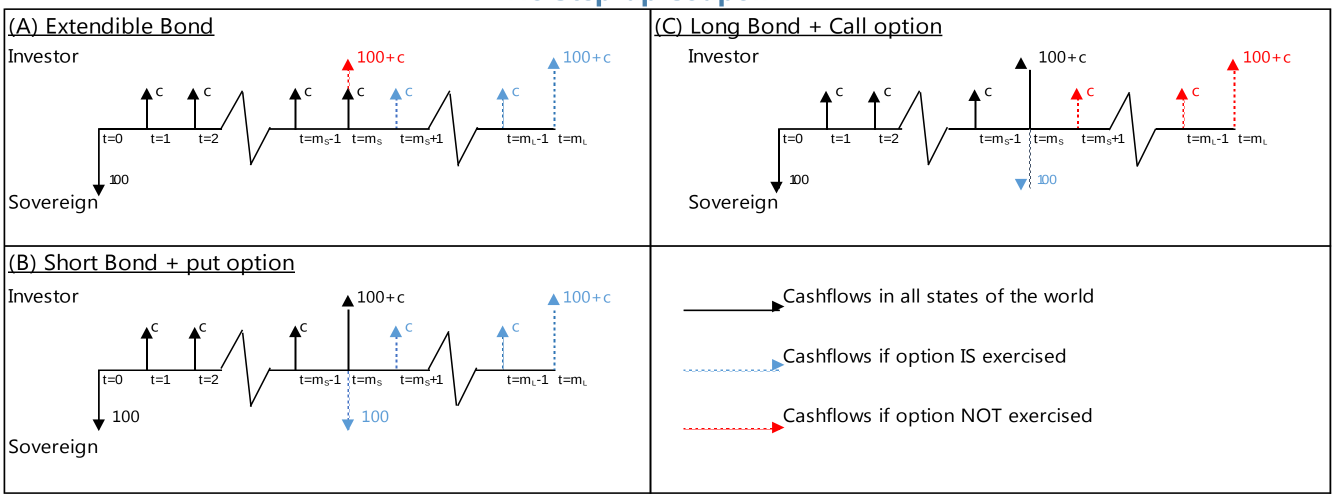
[6]Two real-world examples: Grenada hurricane clause (1-year debt service standstill linked to hurricane of clearly defined intensity) and ADF counter-cyclical loans (5-year 'additional' grace period, when exports are falling below 95 percent of last three years' average). The "Hurricane clause" included in Grenada's 2015 exchange bond allows for a deferral of debt service payments in the event of an externally verified hurricane. Staff's simulations show that this clause may provide a temporary cash flow relief of up to 2.6 percent of GDP over a 1-year period, although this gets reversed in the following year.

[7]Strictly speaking these payouts would only be identical in the absence of counterparty risk, but we ignore that here since the sovereign does not face any counterparty risk in the 'extendible' structure.

[8]An option that provides the purchaser with the right, but not the obligation, to *sell* the underlying bond at the agreed strike price on the option exercise date.

(C) **A long bond + (issuer's) call option on the long bond**: when s = 0,[9] selling a (long) bond with maturity m_L and coupon c, and buying a (European) call option on the same bond with exercise date m_S and price equal to face value.[10]

Figure AVII.1. Cash Flows under Extendible, and 'Bond plus Option' Structures, for the Case with No Step-up Coupon



12. If we assume opportunistic profit-maximizing behavior by the sovereign, then they would choose to trigger the extension at time m_S whenever doing so would reduce their expected interest cost.[11] Since in each case the optionality rests with the sovereign, and the set of potential payoffs is identical, the same conditions would lead the issuer to exercise its put option in structure (B), and *not* to exercise its call option in structure (C). Thus the payoffs of the three portfolios should be identical in all states of the world, and we have the no-arbitrage condition (1):

$$\begin{aligned}(\mathbf{1})\ Price\ of\ extendible\ &=\ Price\ of\ long\ bond - Price\ of\ call\ option\ on\ long\ bond\\ &=\ Price\ of\ short\ bond - Price\ of\ put\ option\ on\ long\ bond^{12}\end{aligned}$$

13. In practice, for an 'issuer discretion' structure of this type, the value of these option could be evaluated using standard approaches, such as the Black-Scholes model or lattice-based methods (e.g., Black-Derman-Toy). This approach could also be used to price extendible with a 'step-up' coupon on extension, which should always have a lower *expected* yield than an extendible without a

[9]For $s > 0$, this replication can be achieved by selling a long bond with maturity m_L, initial coupon c, and a step-up coupon of c+s from date m_S onwards, and buying a call option on this bond with exercise date m_S.

[10]An option that provides the purchaser with the right, but not the obligation, to *buy* the underlying bond at the agreed strike price on the option exercise date.

[11]If we consider a case whether the sovereign's alternative option is to raise financing by issuing a new bond with maturity m_L, they would choose to extend whenever the price of the bond with final maturity $m_L - m_S$ and coupon c+s is greater than its face value.

[12]For the general case where s≠0, the price of the long bond will be higher whenever the forward interest rate between dates m_S and m_L is greater than c+s.

step-up (since the step-up should ensure exercise in fewer states of the world, and because the payoff on extension would be higher).

14. This option-based approach also has implications for pricing dynamics after issuance. As an 'issuer's option' extendible bond nears its initial maturity date, the 'time value' of the embedded option would be expected to fall such that, at unchanged yields, its price would move towards the lower of the long or short bond price. However, the yield of an extendible would likely be more volatile than that of a conventional bond, and increase more under stress, since shifts in the yield curve affect both the value of the underlying bonds and the probability that the option to extend is exercised.

Pricing Extendible Bonds with Trigger Conditions

15. The option premium embedded in 'issuer's discretion' extendible bonds could be quite expensive if they were issued 'near the money'. One way to reduce the cost of the embedded option to extend, would be to include a 'trigger condition', based on a variable linked to the sovereign's 'need' for liquidity relief, which must be breached before the bond extends.[13]

16. The design of such a bond could take two broad forms:

(i) An *'automatic'* extendible, which would always extend in maturity if the trigger condition had been breached;

(ii) A *'knock-in option'* structure, where the sovereign would have the option (but not the obligation) to extend only after the trigger had been breached.

17. To consider the pricing of these trigger-based extendible structures, relative to the 'issuer's discretion' extendible, we can begin by examining the states of the world under which each bond would extend (Figure AVII.2):

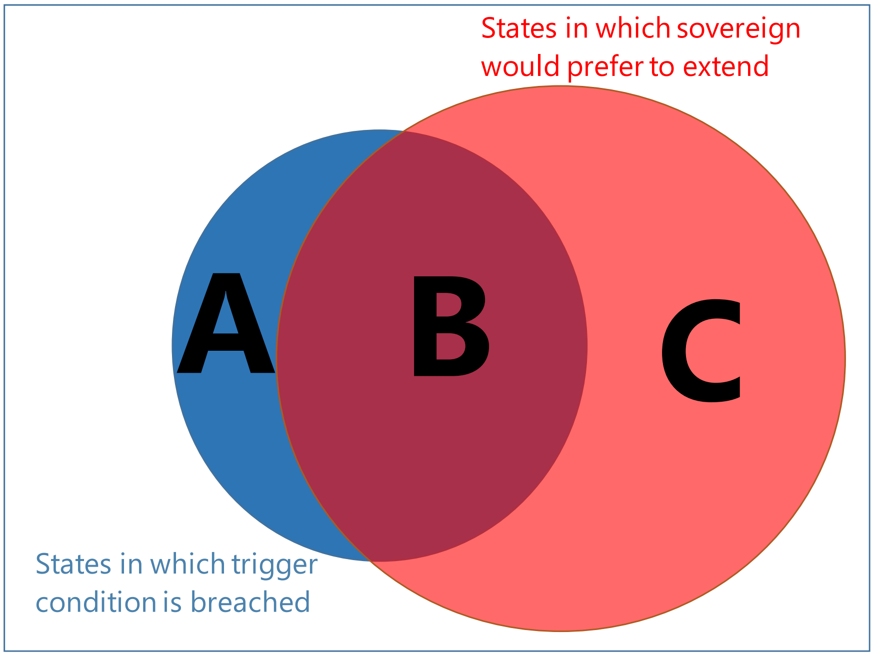
- As discussed in (A), under opportunistic issuer behavior, the '*issuer's discretion'* extendible would extend at time m_S in *all* states of the world in which they could reduce their expected interest cost (Figure AVII.2, areas B and C).

- Under the *'knock-in option'* design, the sovereign would be prevented from extending the bond in circumstances in which the trigger condition was not breached. Such a bond would only extend in circumstances in which the sovereign would prefer to extend *and* the trigger conditions were breached (Figure AVII.2, area B). As such, some opportunistic extensions may be ruled out, and so an option-pricing approach would suggest that the price of this 'knock-in option' extendible should be greater than (or equal to) the price of the issuer's discretion extendible.

[13] Here we focus on the case of extendible bonds offering a one-off maturity extension by a contractually fixed amount, comparable with the 'issuer's option' extendible discussed above.

- For a given trigger, the *'automatic'* extendible would extend in the same states of the world in which the sovereign would exercise its option to extend the 'knock-option' extendible (Figure AVII.2, area B). However, this instrument would also extend in states in which the trigger condition is met, but the issuer would prefer not to extend (Figure AVII.2, area A). As such, since the *investor* should benefit from extensions in some states, the price of the 'automatic' extendible should be greater than or equal to the price of a 'knock-in option' extendible.

Figure AVII.2. Possible States of the World at the Initial Maturity Date of an Extendible Bond



18. As such, and holding all other parameters constant (initial and step-up coupon, trigger condition, initial and final maturity) constant, this results in equation (2) for the relative pricing of the three designs:

$$(\mathbf{2})\ Price\ of\ \text{"}issuer's\ option\text{"}\ extendible \leq Price\ of\ \text{"}knock-in\ option\text{"}\ extendible \\ \leq Price\ of\ \text{"}automatic\text{"}\ extendible$$

19. In the case of the 'knock-in option' extendible, a full pricing exercise would require estimation of the joint distribution of interest rates and the trigger variable. For example, Monte Carlo simulations based on this estimated joint distribution could be used to determine the discounted expected value of the option to extend, and thus the implied price of the extendible bond.

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Annex VIII. Use of Sovereign Guarantee Products[1]

Sovereign credit guarantees, extended both by multilateral development banks and official bilateral creditors, have become more common in recent years. The experience with full credit guarantees has been fairly positive, resulting in significantly reduced sovereign's borrowing costs, and in some cases facilitating market access, although the experience with partial guarantees has been less encouraging. As such, there may be a role for credit guarantees in promoting the development of SCDIs markets, which could offer benefits in terms of providing additional credibility to countries and further reducing sovereign's costs.

1. Providers of guarantees to sovereigns include multilateral development banks and institutions, and official bilateral creditors. Among the multilateral institutions, the World Bank (WB), Multilateral Investment guarantee Agency (MIGA), Inter-American Development Bank (IDB), the African Development Bank (AfDB), the Asian Development Bank (AsDB), and the Caribbean Development Bank (CDB) are the main players. The private sector arm of some of these institutions, such as the International Finance Corporation (IFC) also play a role. Among official bilateral creditors, guarantee facilities are offered by the export credit agencies as well as government aid agencies.

2. Guarantees can cover different types of risks. Among the multilateral institutions, MIGA specializes in non-commercial risks, such as the risk of currency inconvertibility, expropriation, war, terrorism and civil disturbance, non-honoring of financial obligations or breach of contract. All others provide coverage for commercial risks on projects and credit risks on bond and loan offerings by the sovereign. Official bilateral creditors extend export credit guarantees and also credit guarantees to support sovereign loan and bond offerings.

3. Key features in a sovereign guarantee product include:

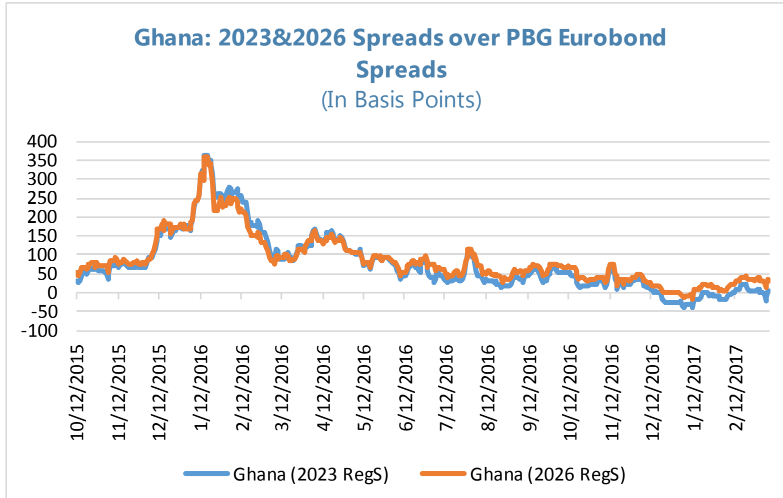
- Target countries: For multilateral institutions, all member countries are eligible, but with different pricing structures conditional on income levels. Official bilateral creditors are politically motivated and may have a list of eligible countries based on geopolitical considerations, or key trading partners.
- Coverage: The coverage ratio should provide incentives for creditors to properly assess and monitor the risks of the borrowers. Most guarantees have partial coverage, but some, for instance those given by the US AID, have 100 percent coverage.
- Fees: Fees are typically charged to ensure that the guarantee program is self-sustaining. However, there are cases where fees are not charged, motivated by socio-political considerations.

4. Credit risk guarantees tend to be issued counter-cyclically. Credit risk guarantees tend to be issued when the sovereign requires external support when its credit standing is deteriorating, or the market environment is not conducive to borrowing due to factors external to the sovereign's credit outlook. Project risk guarantees are less sensitive to business cycles as they tend to be associated

[1]Prepared by Eriko Togo (MCM).

with long term investments in infrastructure or new discoveries of commodities that could lead to future economic growth.

5. The experience of Ghana provides a recent example of a credit risk guarantee provided by a multilateral institution to a sovereign. In October 2015, Ghana issued a US$1 billion Eurobond supported by a World Bank partial credit risk guarantee, with a 15-year final maturity at 10.75 percent. Moody's and Fitch assigned a credit rating that is two notches above the regular sovereign ratings, while Standard & Poor's did not give any ratings uplift, per their policy for partial credit guarantee. The issuance spread compared to Ghana's existing Eurobond suggested that the cost savings achieved by the guarantee was minimal, however, the guarantee may have helped Ghana access the market at a time of heightened risk aversion. Post issuance secondary market spreads provide indication of the time-varying market valuation of the guarantee, whereby its value diminishes in good times, and increases in bad time (see chart). However, the sovereign spreads are not independent of the reaching of agreement with the World Bank, or the authorities' policy actions more generally.



6. U.S. AID offers an example of a bilateral credit risk guarantee. In the most recent years, the US AID extended credit risk guarantees to Jordan, Tunisia and Ukraine. The three countries faced significant financing challenges and faced market access difficulties. The guarantees significantly reduced the borrowing cost of the issuers. The Ukrainian case clearly was issued when market access on their own credit standing was closed and the guarantee not only helped to access the market but at significant cost advantage. In the case of Jordan and Tunisia, the case could be made that they could have issued in the market without a guarantee but at significantly higher costs. All these credit risk guarantees covered 100 percent of the principal and interest payment obligations. The guarantees were issued in support of the governments' commitment to implement macroeconomic adjustments.

Recognised Issuance under Bilateral Credit Guarantees							
		Ukraine	Ukraine	Ukraine	Tunisia	Jordan	Jordan
Date		5/16/2014	5/26/2015	9/29/2016	8/5/2016	6/30/2015	6/30/2015
Issue size		US$ 1 billion	US$ 1 billion	US$ 1 billion	US$ 500 million	US$ 1 billion	US$ 500 million
Maturity		5 year	5 year	5 year	5 year	7 year	10 year
Interest rate		1.844%	1.847%	1.471%	1.416%	2.578%	3.000%
Spread to US Treasury at issuance		28bp	32bp	30bp			
Spread of existing instrument at issuance							
Sovereign Rating at issuance (S&P, Moody's, Fitch)		CCC/Caa3/CCC	CC/Ca/CC	B-/Caaa3/CCC	BB-/Ba3/BB-	BB-/B1/--	BB-/B1/--
Sources: U.S. Government and Fund staff estimates.							

7. Credit risk guarantees have also been extended in the context of a debt restructuring. The AfDB and the CDB issued a guarantee for Seychelles (2010) and St Kitts (2011), respectively, for the new bonds offered in exchange for the restructured debt. The guarantee operations enhanced the value of the final package without significant additional fiscal drain to the debtor, and have been critical in providing comfort to the creditors' Boards and decision-making committees concerned about the impact of a large net present value reduction on their balance sheets. This has facilitated creditors' decision to participate in an exchange offer that involved a significant face value reduction. A CDB guarantee was also considered in the context of Grenada's 2015 debt restructurings of the commercial bond; however, creditors rejected this, preferring to assume the risk themselves.

8. A recent innovation has been to guarantee a currency swap. In November 2015, Cameroon issued its debut Eurobond denominated in US$ for US$750 million. The AfDB provided a EUR500 million partial credit guarantee to cover the payment obligations of Cameroon related to a cross currency swaps that converted Cameroon's payment obligations from US$ to Euro, executed with commercial banks. The transaction also includes a feature with built-in payment moratorium in the event that Cameroon has payment difficulties for up to two years, which will not trigger the guarantee or an event of default.

9. Credit guarantees are also extended by sovereigns to subnational governments, state owned enterprises, and private enterprises, to facilitate their borrowing. The borrowing by the beneficiary entity may be from external sources or from the domestic banking sector. Most sovereigns have a guarantee portfolio to support long-term investment projects implemented by

other public sector borrowers, or private enterprises with critical public interests, such as the Danish-Swedish joint venture company that constructed the bridge across the two countries. Sovereign credit guarantees are also extended to critical economic groups such as small enterprises that find it difficult to obtain credit on their own standing due to asymmetric information and adverse selection and first mover problem. During the recent financial crisis, credit guarantee schemes have been used by sovereigns as a counter-cyclical instrument, softening the effect of private sector credit retrenchment during the recession. They supported companies that already had relationship with banks and who are resorting to guarantees to maintain their indebtedness level in response to the financial crisis. In the years 2010–12, guarantee schemes used in support of SMEs reported a considerable increase in bad debt (KPMG 2011).

References

KPMG, 2011, "Credit Access Guarantees: A Public Asset between State and Market," International Survey on Guarantee Market Players, October.