Beyond austerity: an SPV to save the Eurozone? *

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Introduction

As is common in financial crises, European problems today contain elements of both insolvency and illiquidity. The former derive in large part from excess risk-taking by banks: in Spain, for example, those that gambled on property and lost, needed bailing out. But issues of fiscal free riding are present too: " In Greece the banks didn't sink the country. The country sank the banks." says Lewis (2010).

Resolving solvency problems may involve debt write-downs and/or quasi-fiscal operations to provide more capital and revenue. Liquidity problems should be much easier to resolve, as temporary asset swaps should do the job. Like a bleeding wound left untreated, however, illiquidity can prove life-threatening. As Calvo (1998) pointed out – and recent events confirm - market panic which raises sovereign spreads can soon render a sovereign borrower technically insolvent.

The creditor coordination problem here is not unlike a bank-run:

> Governments can be subject to the same dynamics of fickle expectations that can destabilize banks. This is particularly so when a government borrows from external lenders over whom it has relatively little influence. Most government investments directly or indirectly involve the long-run growth potential of the country and its tax base, but these are highly illiquid assets. … High debt levels lead, in many mathematical economics models, to "multiple equilibria" in which the debt level might be sustained – or might not be." (Reinhart and Rogoff , 2009, p. xlii)

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Evidence suggestive of such multiple equilibria has been presented by De Grauwe and Yi (2012), who show that the interest rates for Greece, Ireland and Portugal lie way above a regression line fitted to fiscal fundamentals for other Eurozone countries. Similar results are reported by Aizenman and Hutchinson (2012) using CDS spreads.

Given such possible switches of sentiment, what can policy do? Chapter 11 procedures for corporate bankruptcy may be worth considering here, procedures involving an automatic stay with debtor-in-possession finance - followed by debt restructuring. (The latter will typically involve elements of write-down and debt conversion, e.g. a debt for equity swap.) It is a matter of record that Anne Krueger (2001) sought to replicate such corporate procedures for sovereigns in her proposal for an SDRM – Sovereign Debt Restructuring Mechanism. In April 2002 the US Treasury foiled this initiative in promoting instead the insertion of collective action clauses (CACs).into sovereign debt instruments[1]

That is history, and the focus then was on Latin America. What of Europe today? From a legal perspective it seems that, once again, CACs are the instrument of choice[2]. We argue, however, that the ideas promoted by Anne Krueger are still valid and worth pursuing in the European context.

There are two aspects of the current situation to be considered. On the one hand debt restructuring in the form of a switch to GDP bonds or growth bonds could alleviate the fiscal problems of many southern European states. On the other hand, there is evidently a problem of creditor panics in European bond markets as investors fly to safety whenever they think others will! The first problem could be addressed by bond swaps which replace plain vanilla bonds with 'state-contingent' alternatives; but the market may not be ready for such financial innovation. The second problem could be solved by consolidation of national debt in to Eurobonds backed by some supranational agency. Why not solve both problems at once by the creation of an SPV which issues the latter and buys the former?

[1] A description of this confrontation is provided in Miller (2002). Some observers have suggested that talk of SDRM was used simply as scare tactic to persuade bond holders to accept CACs.
[2] Greek debt that lacked such clauses, have indeed, been promptly retro-fitted!

On a political level, Anne Krueger's proposal faced unbrookable opposition. Her plan involved imposing IMF conditionality debtors at a time where confidence in the IMF was at a low ebb; and it involved IMF officials restructuring widely bonds held by American investors represented by the IIF, a powerful lobby for bond-holders. In Europe, today where the Eurozone is threatened with destruction, and countries - other than the UK - are used to surrendering sovereignty, these political roadblocks should be less of a problem - although one does wonder how far Germany will be willing to go (Plickert, 2012).

In the paper that follows, recent empirical evidence of multiple equilibria are briefly presented before turning to a simple model of a sovereign market with good and bad equilibria. We show how, in principle, a bond swap could help to avoid the bad equilibrium; and we go on to outline the creation of an SPV, which issues Eurobonds and holds growth bonds. In the long-run, if and when growth bonds have become acceptable and markets have stabilised, the SPV could sell its assets and pay off its creditors. Job well done.

1: Sovereign bond spreads in Europe: Evidence of Multiple Equilibria?

De Grauwe and Ji (2012) test the hypothesis that government bond markets in the Eurozone are more fragile and more susceptible to self-fulfilling liquidity crises than in stand-alone countries.

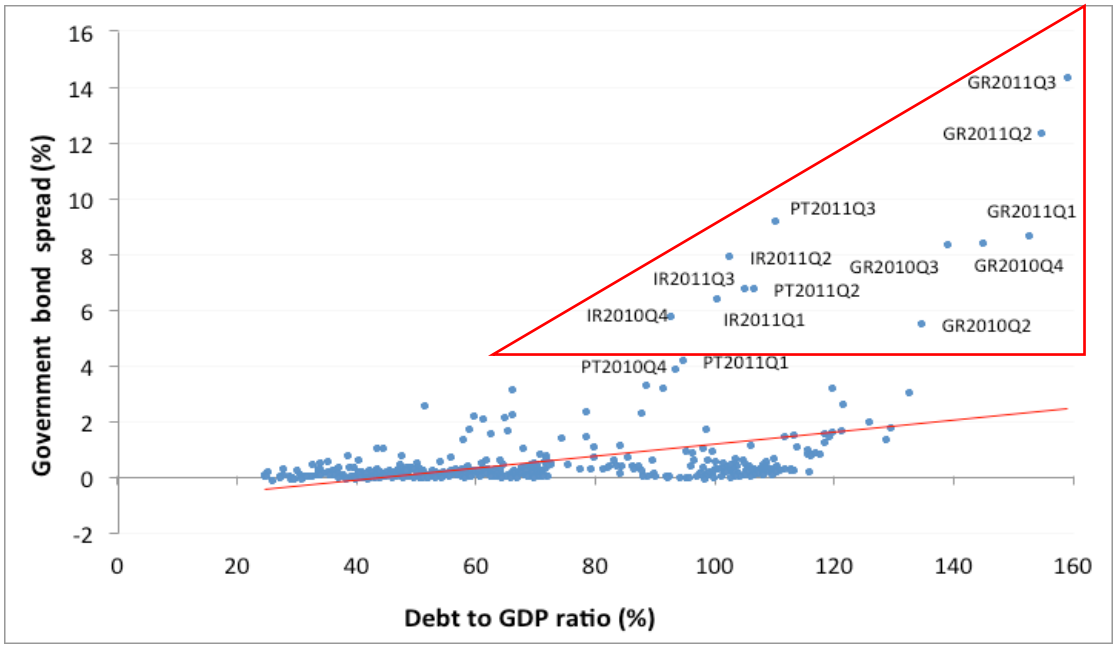


Figure 1: Spreads and debt to GDP ratio in Eurozone (2000Q1-2011Q3) (Source: De Grauwe and Ji, 2012.)

As the data presented in Figure 1 indicates, a significant part of the surge in the spreads of countries in the Eurozone during 2010-22 was disconnected from underlying debt to GDP ratios. This was, it is suggested, "the result of negative self-fulfilling market sentiments that became very strong since the end of 2010.[which] can drive member countries of the Eurozone into bad equilibria". (The spreads for Ireland Greece and Portugal, in particular, are shown as having entered a 'Bermuda triangle'.)

In contrast to evidence that " after years of neglecting high government debt, investors became increasingly worried about this in the Eurozone, and reacted by raising the spreads. No such worries developed in stand-alone countries despite the fact that debt to GDP ratios were equally high and increasing in these countries"(as indicated in Figure 2 from their paper).

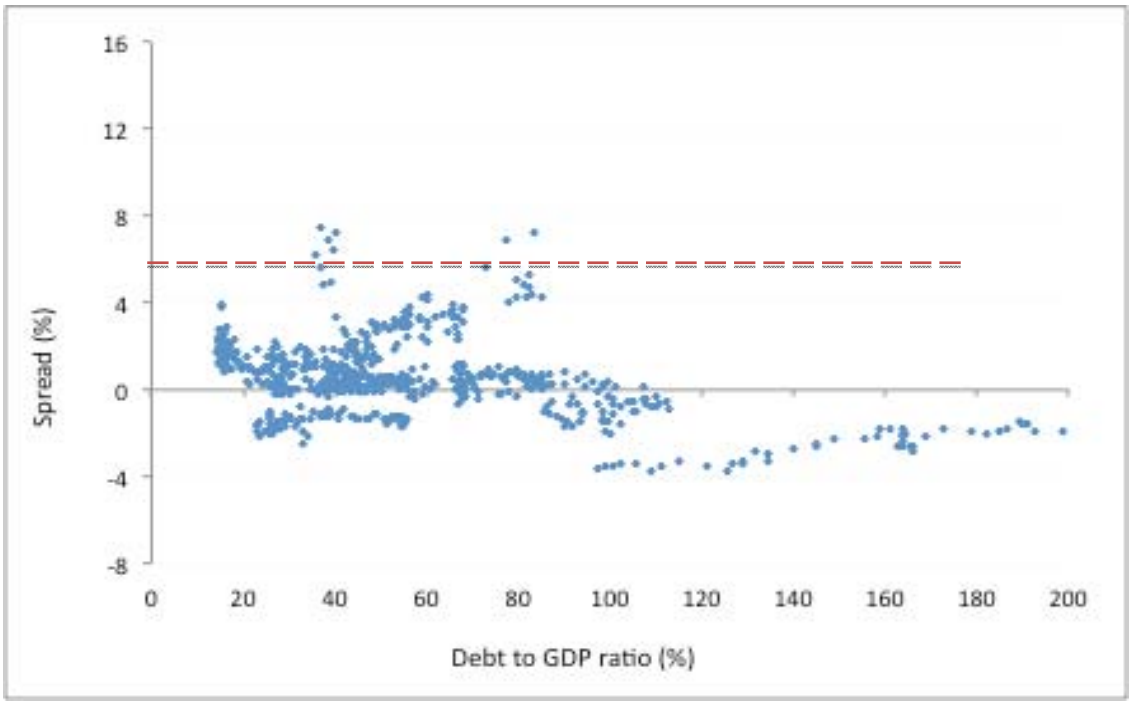


Figure 2: Spreads and debt to GDP ratio in Stand-alone countries (2000Q1-2011Q3). (Source: De Grauwe and Ji, 2012.)

Evidently not all observers are convinced by their evidence and argument, however: see Westerman(2012) , for example, for a critical assessment.

In a related exercise, Aizenman et al. (2012) analyse the pricing of risk in sovereign debt component of the (largely OTC) CDS market[3]. Regression analysis is used to relate sovereign spreads to fundamentals for 50 countries, over the period 2005-2011 for 3, 5 and 10 year CDS focusing in particular on the five countries in the South-West Eurozone Periphery (Greece, Ireland, Italy, Portugal, and Spain).

The empirical evidence used in their investigation is summarized in the Data Appendix. What do they find?

> Dynamic panel estimates of the model suggest that fiscal space and other macroeconomic factors are statistically significant and economically important determinants of market-based sovereign risk. However, risk-pricing of the South-West Eurozone Periphery countries is not predicted accurately by the model either in-sample or out-of-sample: unpredicted high spreads are evident during global crisis period, especially in 2010 when the sovereign debt crisis swept over the periphery area. Aizenman et al. (2012, Abstract)

Like the previous authors cited, they also find that spreads in European widened much more than those of matched countries outside the Eurozone:

> We "match" the periphery group with five middle income countries outside Europe that were closest in terms of fiscal space during the European fiscal crisis. We find that Eurozone periphery default risk is priced much higher than the "matched" countries in 2010, even allowing for differences in fundamentals. One interpretation is that the market has mispriced risk in the Eurozone periphery. An alternative interpretation, consistent with the selective default of Greece in early 2012, is that the market is pricing not on current fundamentals but future fundamentals, expecting the periphery fiscal space to deteriorate markedly and posing a high risk of debt restructuring. Adjustment challenges of the Eurozone periphery may be perceived as economically and politically more difficult than the matched group of middle income countries because of exchange rate and monetary constraints. Aizenman et al. (2012, Abstract).

[3] CDS instruments relating to sovereign debt came to $2.5 trillion in 2010 , which exceeds the total of US government-issued international debt ($2.2 tr) and US GDP ($1.5 tr).

Note, however, that boh the interpretations offered seem to be consistent with the notion of multiple equilibria, The first indicates that things need not necessarily have been so: the second that expectations can be self-fulfilling!

2. Sovereign debt servicing in the Cohen model: solvency and liquidity

To set the scene, consider a case of a sovereign debtor whose debt service capacity is exogenously determined. We characterise how initial debt service ratios can affect solvency and liquidity in a dynamic setup.

Take a country with an initial level of debt, assumed to be short term and contracted in nominal terms, with a nominal interest rate of i. With inflation of π_t, the real (i.e.inflation-adjusted[4]) cost of debt service at t is simply $r_t D_t$ where $r_t = i - \pi_t$ represents real interest rate and D_t denotes the real value of debt at time t.
Assume real output of the country grows at a constant rate of g, i.e.

$$dY_t/dt = g \quad (1)$$

Assume also that taxes are a constant fraction, τ, of output, of which only a fraction θ can be used to service the debt.
The sovereign is solvent if its debt does not exceed the Present Discounted Value (PDV) of taxes available for debt service, i.e.,

$$D_t \leq \int_t^{\infty} \theta\tau Y_s e^{-r_s(s-t)} ds = \theta\tau Y_t/(r-g) \quad (2)$$

where inflation rate is constant and $r - g > 0$.

Equation (2) can be represented by the following dynamics

$$\dot{D}_t = rD_t - X_t \quad (3)$$

where $\dot{D}_t$ is new borrowing, and $X_t = \theta\tau Y_t$ is the ability to pay, and from (1), the dynamics of the ability to pay is

$$\dot{X}_t = gX_t. \quad (4)$$

From (3) and (4) the evolution of debt and capacity, for a given initial debt, is illustrated in Figure 1 where the horizontal axis represents country's ability to pay and the vertical the debt level. On the line $D = X/(r-g)$, labelled Solvency constraint in

[4] Inflation adjustment of deficits is discussed further in Miller(1982)

the Figure, the debt service ratio is stationary and the country is just solvent. Above this, the debt-capacity ratio is growing over time, so the debt becomes eventually unsustainable: the sovereign is playing a Ponzi game, servicing current debt by increasing debt unsustainably. Below the constraint, the debt service ratio is declining: so at some point the sovereign will begin paying down debt.

To help characterise the evolution of debt, the area below the Solvency constraint is divided into illiquid and liquid regions. Note that the debt is contracted in nominal terms, so – on the assumption that the debt is to be rolled over if interst payments are honoured – this servicing imposes a liquidity constraint requires

$$iD_t \leq X_t \qquad (5)$$

With equality, (5) characterises the liquidity constraint drawn in Figure 1.

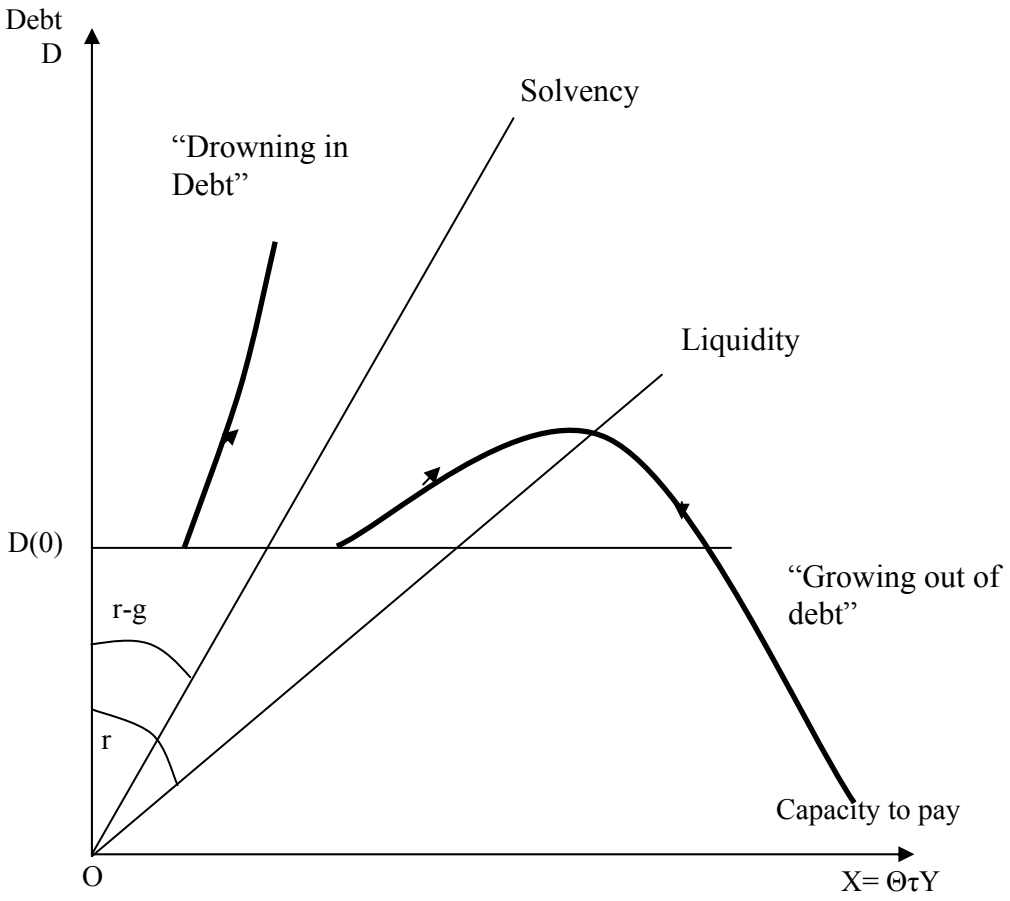


Figure 3: Debt and taxes: Insolvency and illiquidity

If the country is solvent but illiquid, the debt will initially grow, increasing the debt service ratio: but, as the ability to pay increases, the debt service ratio eventually falls. This is represented by the trajectory labelled "Growing out of debt" in the figure. The other trajectory represents the Ponzi game.

Depending on the initial level of debt, therefore, debt may increase unsustainably (as in the Ponzi case); manageably, as in the intermediate case; or it may immediately start to fall in real terms, as shown in Figure 4.

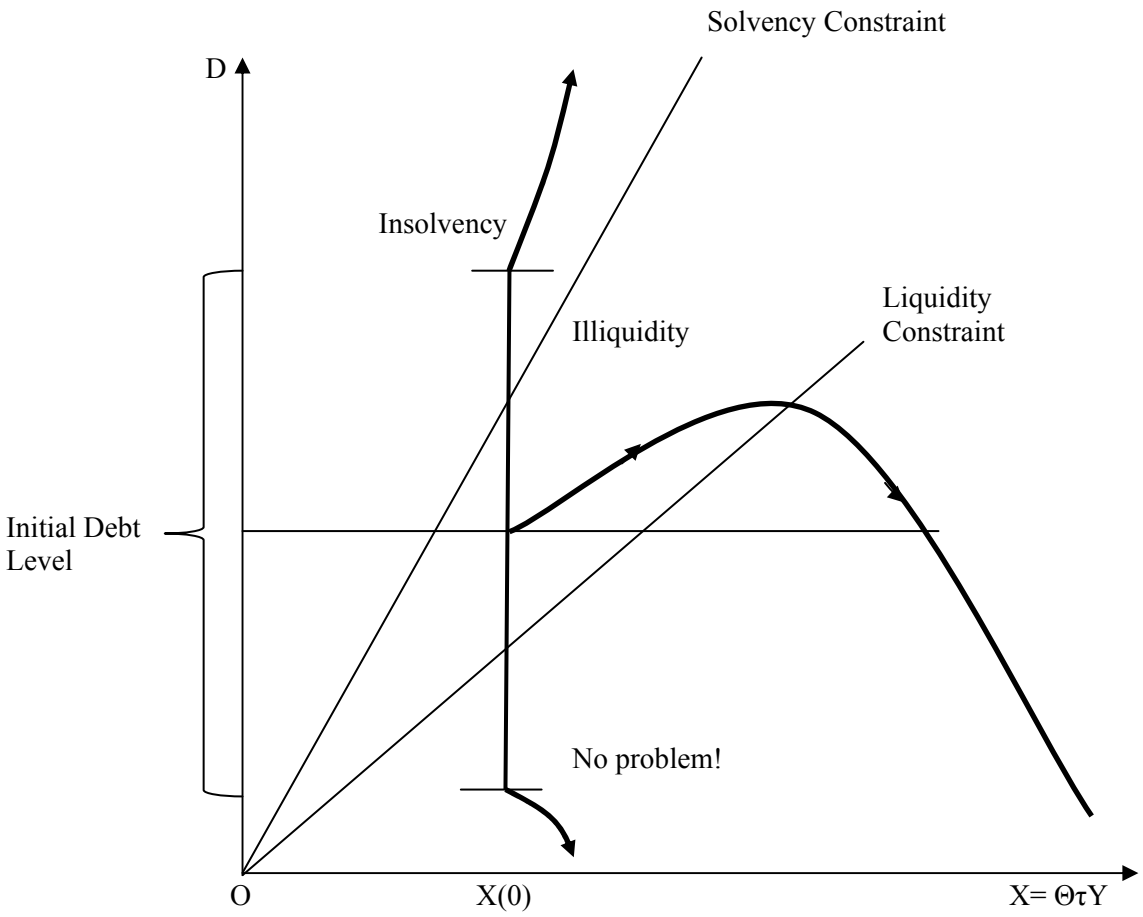


Figure 4: A Ponzi game or debt reduction: initial conditions and debt prospects

3.1 Debt write-downs and multiple equilibria

Now to consider the issue of multiple equilibria. In what follows, we show first that a country that is solvent but illiquid may - even if the debt is rolled over - face a self-fulfilling solvency crisis leading to a partial debt write-down.

Define η the ratio of debt to the present value of debt service capacity, i.e.

$$\eta = D/\left(\frac{\theta\tau Y}{i-\pi-g}\right) \quad (4)$$

The country is solvent but illiquid if

$$\frac{i-\pi-g}{i} \leq \eta \leq 1 \quad (5)$$

If a write-down of δ is expected, the ex ante solvency condition requires

$$(1-\delta)D \leq \frac{\theta\tau Y}{i-\pi+\delta-g} \quad (6)$$

Expecting the write-down, risk-neutral creditors will increase real interest rates to $i-\pi+\delta$ to compensate for the expected losses.

Using definition in (4), (6) becomes

$$(1-\delta)\eta \leq \frac{i-\pi-g}{i-\pi+\delta-g} \quad . \quad (7)$$

Note that (7) ensures solvency for given δ and η. Whether this condition holds depends on the magnitude of η. This is illustrated in Figure 5 where $\eta^* = max\left\{\frac{i-\pi-g}{i}, \frac{4(i-\pi-g)}{(1+i-\pi-g)^2}\right\}$. It is clear that for $\eta < \eta^*$, solvency condition (7) holds as a strict inequality for any debt writedown. When $\eta \geq \eta^*$, the level of debt writedown will affect ex ante solvency condition. The Proposition below summarizes results when solvency is just maintained, i.e., (7) holds as an equality, and for higher values of η.

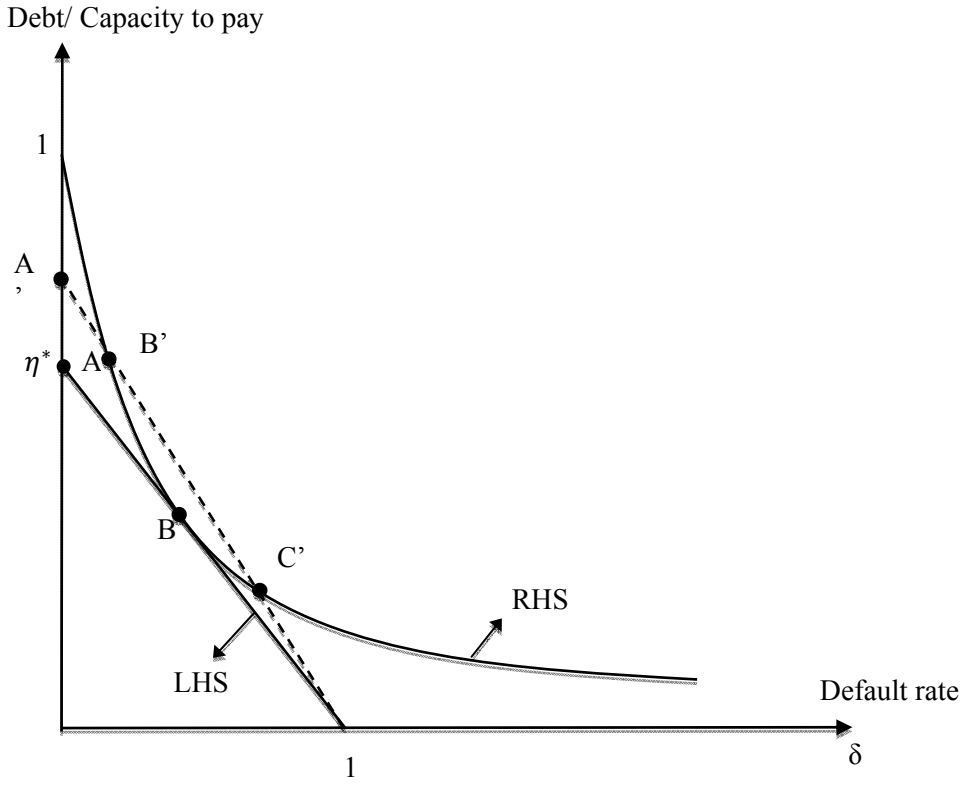


Figure 5: Equilibria with and without default

Proposition 1 Multiple equilibria

For a sovereign which is solvent at going market rates, there are self-fulfilling equilibria which involve default. Specifically, for $\eta \geqq \eta^*$ there are multiple equilibria, two for $\eta = \eta^*$, and three for for $\eta > \eta^*$

For $\eta = \eta^*$ these are shown as A on the vertical axis and B, where LHS=RHS of (7).

For $\eta > \eta^*$ these are shown as A' on the vertical axis and B' and C' corresponding to the two solutions of of (7), say $\delta_s < \delta_L < 1,$ where $\eta^* = max\left\{\frac{i-\pi-g}{i}, \frac{4(i-\pi-g)}{(1+i-\pi-g)^2}\right\}$.

Proof: See Figure 5.

This proposition shows - as Calvo(1998) and Reinhart and Rogoff (2009) have pointed out - that if debt to GDP ratio is high enough, self-fulfilling problems of multiple equilibria can arise. Figure 6 illustrates how creditor panic which raises interest rates unsustainably[5] can shifts the constraints so that a country that facing a liquidity problem may become insolvent.

[5] In the Eurozone, the market appears to treat nominal rates of above 7% on benchmark bonds as unsustainable.

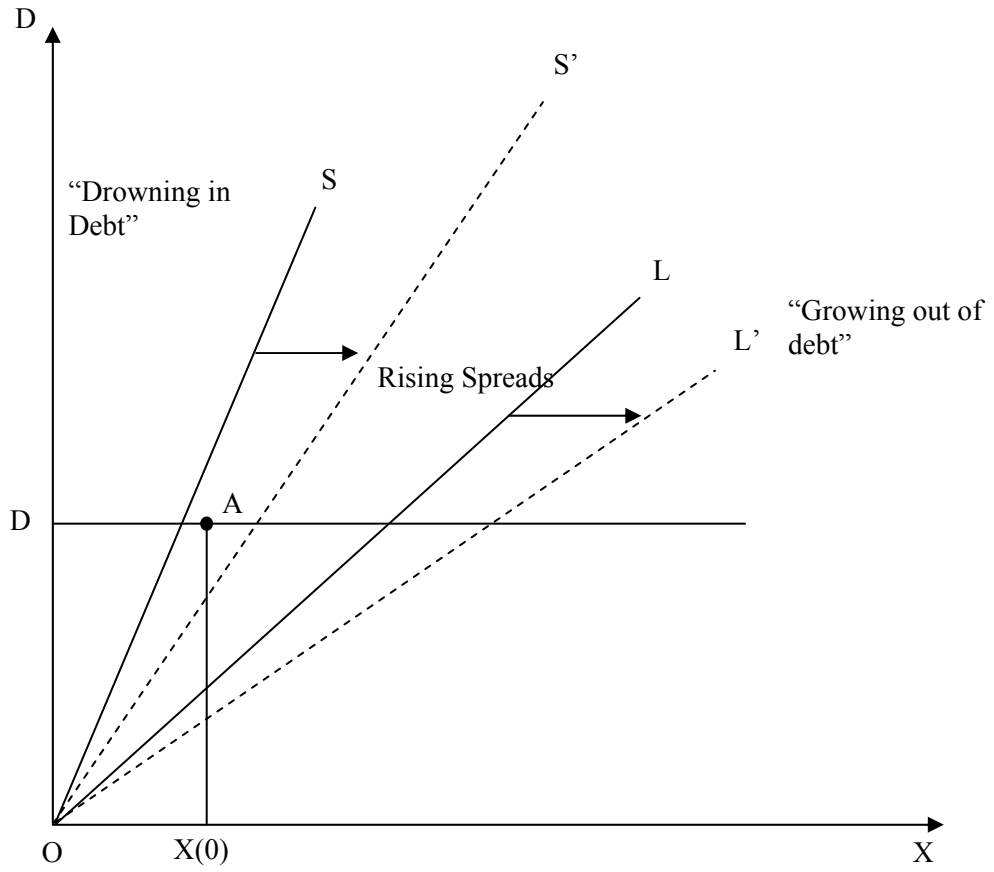


Figure 6 How a self-fulfilling rise in spreads can lead to insolvency.

4. Debt Restructuring: 'state- contingent' debt instruments

What can be done to avoid this? We start from the perspective of Rogoff (1999, p.39-40) who suggested that the current international monetary system is excessively biased towards debt finance[6] : " 'Junk' country debt plays too large a role, given the lack of an effective international bankruptcy systems. In an ideal world, equity lending and direct investment would play a much bigger role".

[6] He proposed a "plan" to address this bias along lines suggested in Bulow and Rogoff (1990).

But we ask, as Anne Krueger did, whether institutions and instruments might be designed to help countries to restructure their debts - as corporations are by the law courts, under the provisions of Chapter 11 of the US bankruptcy code for example. How legal procedures can assist companies in tough times is indicated briefly in Figure 7, constructed along similar lines as the earlier figures. For solvent companies with good growth prospects, for example, a debt equity swap under Chapter 11 may be enough. Even if the corporation is insolvent, a write-down may be in order if it is worth more as a going concern than the scrap value of the assets involved. If not, Chapter 7 procedures for liquidation are there to recycle the resources elsewhere.

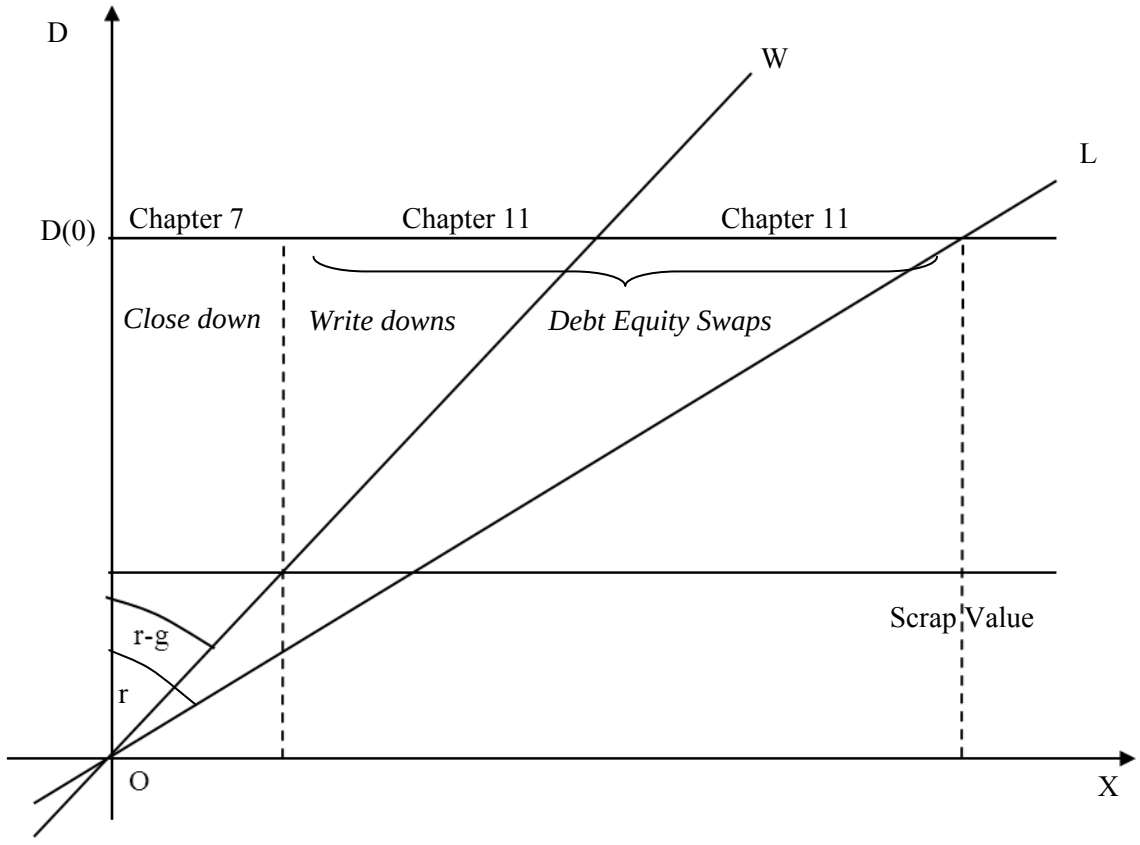


Figure 7: Background: The Corporate Case

What might this imply for sovereign debt restructuring? First of all, of course, debt write-downs may be needed to restore solvency, as for both Argentina in 2005 and Greece in 2012. Second, and more relevant for our present purposes, is the possibility of restructuring debt into state-contingent form (with proposals along these lines involving GDP-indexed bonds and growth bonds in particular discussed below).

Another factor that needs to be considered is how to check moral hazard. For corporations Chapter 7 plays a key role, what is the equivalent for sovereigns?

4.1 GDP-indexed bonds

GDP-indexed bonds, as proposed by Shiller(1993, 2003) for example, can benefit both debtors and creditors. To quote from the paper for the Round-Table by Griffith-Jones and Hertova (2012, p.6-8) :

> First, they stabilize government spending and limit the pro-cyclicality of fiscal pressures [in borrowing countries] by requiring smaller interest payments at times of slower growth—providing space for higher spending or lower taxes—and vice versa…Second, by allowing debt service ratios to fall in times of slow or negative growth[7], GDP-indexed bonds reduce the likelihood of defaults and debt crises. …[Investors, too] would benefit from a lower frequency of defaults and financial crises, which often result in costly litigation and renegotiation and sometimes in outright large losses…[and] the bonds would provide an opportunity for investors to take a position on countries' future growth prospects, offering investors equity like exposure to a country.

These effects may be illustrated with the aid of the model in Section 3. Consider the effects of debt restructuring involving a swap of a fraction, ξ, of the normal debt to GDP bonds and how this might avoid the shift of equilibrium.

In present value terms, let the swap be given by

$$D = D' + E \tag{8}$$

where D is the original debt, D' is the "normal" debt and E is GDP bonds.

Since E is ξ fraction of the original debt, to maintain ex ante solvency

$$E = \xi \frac{\theta \tau \mathrm{Y}}{i-\pi-g} \tag{9}$$

where E has a stream of payoffs $\xi\theta\tau\mathrm{Y}$.

For such a swap to resolve the illiquidity problem,

[7] If half of Mexico's total government debt had consisted of GDP-indexed bonds, it would have saved about 1.6 percent of GDP in interest payments during the financial crisis in 1994/1995 (Borenzstein and Mauro 2004).

$$(i-\pi)D' < (1-\xi)(\theta\tau Y) \qquad (10)$$

Substitute (8) and (9) in to (10), we have

$$D - \xi\frac{\theta\tau Y}{i-\pi-g} < (1-\xi)\frac{\theta\tau Y}{i-\pi}$$

i.e.,

$$\xi > \frac{g-(1-\eta)(i-\pi)}{g} \qquad (11)$$

Thus, if the swap contains a sufficiently large fraction of GDP bonds, current debt service requirements can be reduced so as to satisfy the liquidity constraint.

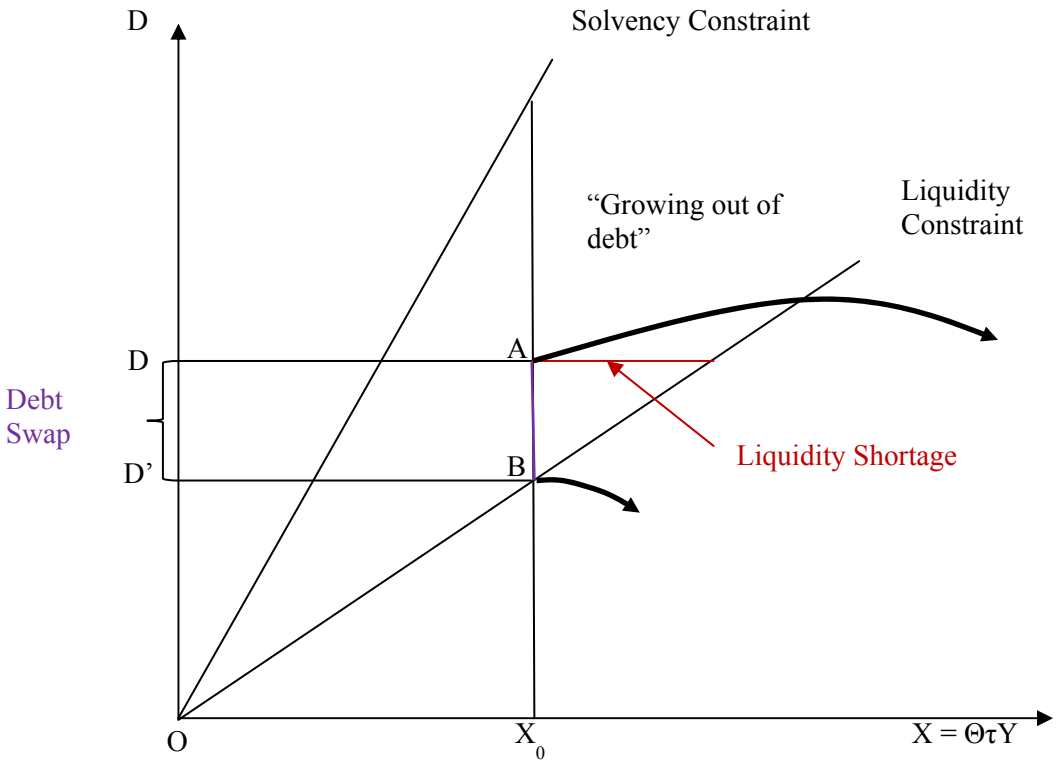


Figure 8: Avoiding a crisis by debt restructuring

How debt restructuring can help a sovereign with high debts but good growth prospects to escape a debt servicing problem that might trigger creditor panic is illustrated in Figure 8. A swap which reduces debt from A to B checks the liquidity problem by reducing current servicing requirements as investors are given an equity-like exposure to the country. With continued economic growth, debt to GDP ratios

immediately start to fall instead of rising (even though the interest rate exceeds the growth rate).

4.2 The Growth-Bond Variant

Growth bonds[8]. provide an alternative to GDP bonds and may be more attractive to bond investors[9]. As Williamson (2006, p. 166) explains:

> The idea of a growth-linked bond is simple enough: Instead of promising to pay *x* percent each year come hell or high water, the borrower would promise to pay *x* percent plus or minus the excess of the country's growth rate over its average growth rate over some proceeding periods (plus, if necessary, a premium that one might expect to be small). Therefore, when the country prospered and grew abnormally fast, it would pay more than the standard *x* percent; but when it hit difficulties and grew unusually slowly, its payment obligations would be lower. Payments would be shifted from times when they would present unusual difficulties to times when they would be relatively easy. Fiscal policy would gain a built-in stabilizer. Investors would have less reason to fear that the borrower would accumulate an unserviceable level of debt, and they would pay them an exceptionally good return if they succeeded in correctly identifying the countries with good prospects.

As shown in Annex A, the price of such bonds moves with the growth rate but is much more stable than the coupons that get paid. This is because in bad times when growth is low, investors get low coupons but expect a capital gain, and in good times the reverse applies.

Figure 8 can also be used to illustrate the potential role for growth bonds. Assume for example that the country's growth rate follows a two- state Markov process, with expected growth at the rate μ, but a low of zero. (For convenience, assume the transition probabilities between high and low growth are symmetric.) Let the

[8] As discussed in Borzenstein and Mauro(2004) , Griffith-Jone and Sharma. (2006) and Williamson (2008), for example.
[9] Moslem investors for example.

economy be in the low growth state stuck at X_0. How could issuing growth bonds help?

As is the case for for GDP-linked bonds , a swap which reduces plain vanilla debt from A to B can reducing servicing costs by offering investors an equity-like exposure. Likewise, given the expected positive rate of growth of debt service capacity, debt to GDP ratios will be expected to fall instead of rising.

The impact of debt restructuring can, of course, be far greater if one treats the evolution of the economy as endogenous, and not as a pre-specified stochastic process. In Europe today, for example, countries are deliberately supressing growth in order to please their creditors in a game of austerity. [Annex B sketches the incentives facing highly indebted sovereigns Europe: it is a prisoner's dilemma game, where each country tries to please creditors by outbidding the others in terms of fiscal austerity.] Engineering an escape from this desperately inefficient situation should offer benefits to creditors, to debtors and – because of the significance for Europe in global trade - to the world at large.

Turning to recent experience, we note that Greek warrants issued as part of the debt restructuring of 2012 will, under appropriate conditions, pay 1.5 times the excess of real growth over a reference rate, Griffith-Jones and Hertova (2012, p. 21-22). As with the Argentine case, however, there are problems with this experiment in financial innovation.. First it is was launched at a time of great social crisis - where contraction not growth is the focus of all eyes. More generally, there is a creditor coordination problem to be solved in getting such innovations accepted[10]. For these reasons a supranational approach may be needed.

The case for multilateral institutions handling exotic new instruments has been made forcefully by Griffith-Jones and Hertova (2012): "Given the existence of positive externalities in issuing these kinds of instruments, as well as coordination problems, there is a clear case for involving multilateral institutions. Concretely, multilateral or

[10] As an analogy, consider the externalities involved in opening a store on 6th Avenue, as discussed by Caplin and Leahy (1998).

regional development banks could play a very active role as "market makers" for GDP-linked bonds."

This was, of course, Anne Kruger's idea before during the Argentine crisis, but it was effectively blocked by the US. Perhaps a European-wide initiative may have a better prospect of success. What form might it take?

5. An SPV for stability and growth

Chapter 11 procedures suggest that financing problems for debtor countries can be eased by bond swaps. There is also the problem of funding instability as creditors switch between countries in a flight for safety. Creditor panic in bond markets with a flight to quality which has taken bond yield in Germany to virtually zero suggests the need for some consolidation.

A number of plans have been proposed, see for example Reis et al. (2012). Some of the variants under discussion are shown in Table 1, drawn from Leineman (2012).

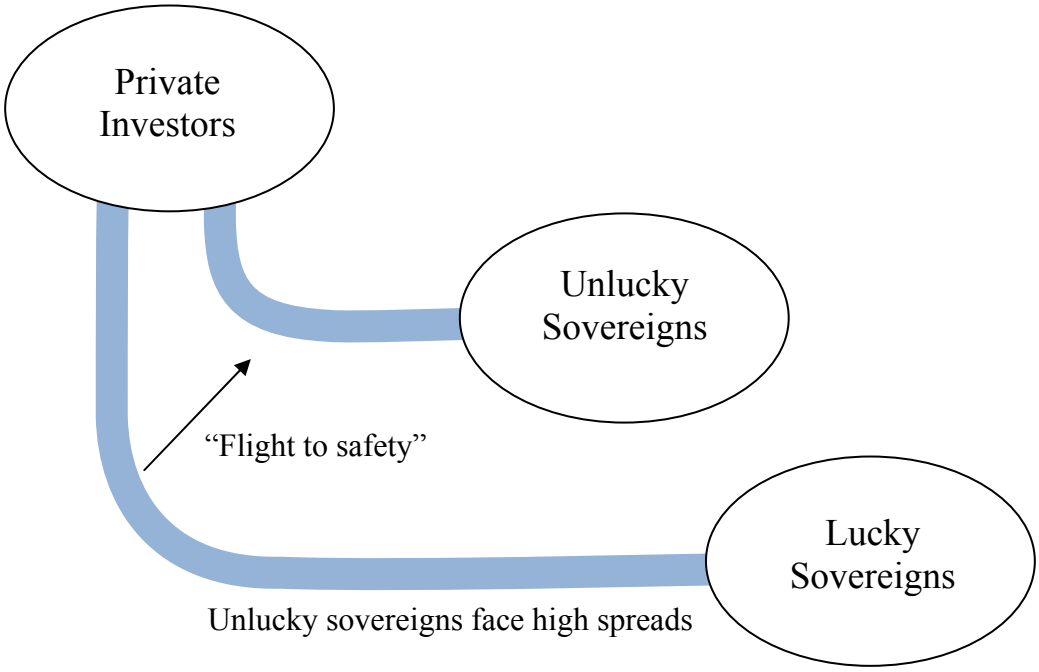
Name	Concept
Euro-bonds	Issue of common bonds to replace all debt
"Blue bonds"	Issue of common bonds up to 60% of GDP
"Elite" bonds	Common bonds only for AAA rated countries
Debt retirement fund	New entity that pools all debts above 60%of GDP, issues its own common bonds. Countries have a credible commitment to amortise the debt in a certain time frame

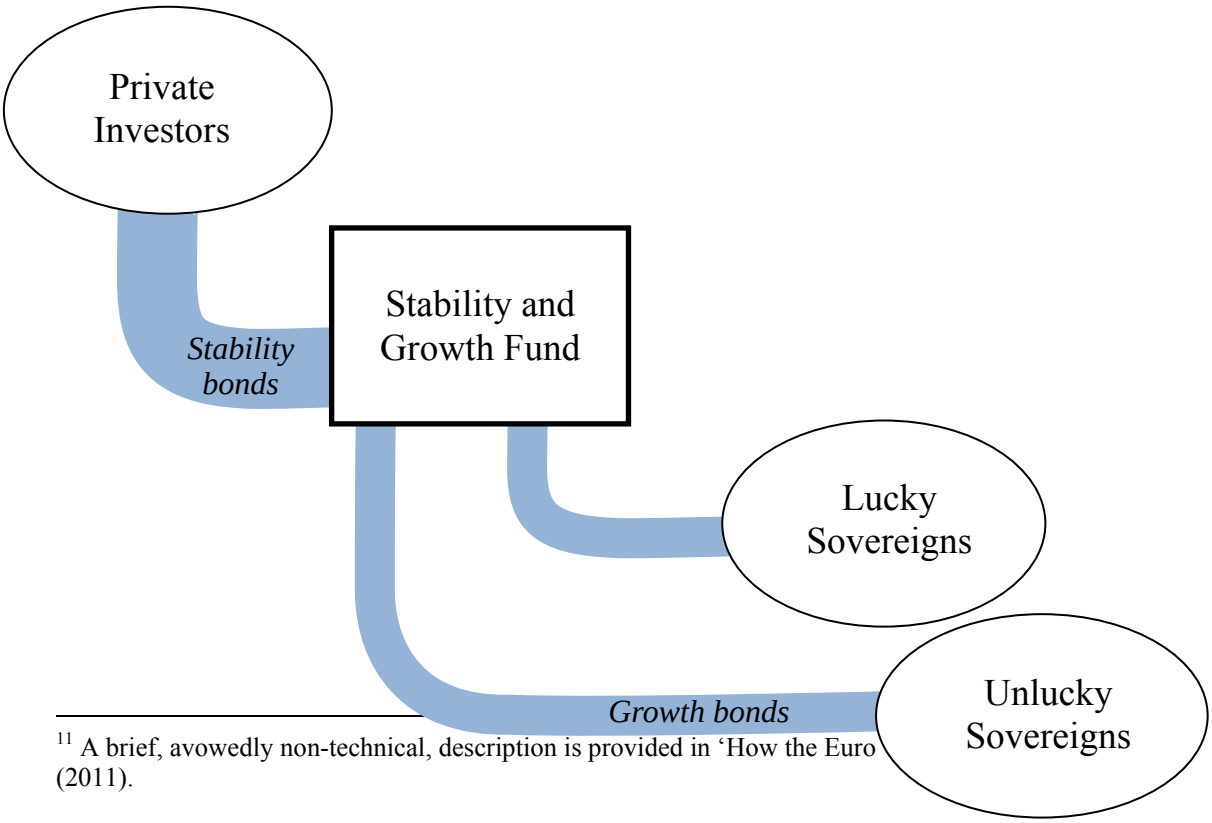
Table 1. Different types of stability bonds.

What we propose therefore is a European SPV to play the role of market-maker (in taking up state-contingent debt issued in swaps) and to act as market-stabiliser (by

offering 'supra-national' Eurobonds to investors)[11]. This is shown graphically as follows.

Figure 9: BEFORE : Investors holds sovereign bonds - but are prone to switch





[11] A brief, avowedly non-technical, description is provided in 'How the Euro (2011).

Figure 10: AFTER: Stability and growth fund pools sovereign debt - and diversifies types of bond

In more detail, consider the balance sheet of the proposed SPV.

Assets	Liabilities
Sovereign bonds: (a) Plain vanilla (b) Growth and GDP-linked	Euro stability bonds Equity base

Table 2. Balance sheet of SPV

On the assets side, holding of regular government debt are complemented by growth and GDP-linked bonds. The market may not give full value for them especially if they are issued in the midst of a crisis. This was the case for Argentina; as reported by Griffith-Jones and Hertova (2012) growth warrants now standing at about $15 were sold for only $2 in 2005: and it appears that the market is attaching little value to Greek warrants. This suggests that such securities might be taken out of the market by an agency with a longer horizon until such time as the country has begun to grow! This would give a breathing space for the debtor country and help it to avoid selling its debt at a deep discount. That is the logic behind the role of a European SPV for the purpose. Its liabilities will be the Eurobonds; and its equity will be guaranteed by Treasuries of Europe.

The issue of debtor moral hazard is flagged up by Reinhart and Rogoff (2009, xli-xlii) as follows: "Suppose a world government agency provided expansive deposit insurance to protect every worthy borrower from panics…The problem is that if one provides insurance to everyone everywhere, with no conditions, some players are going to misbehave." But what is envisaged is not blanket insurance for all European debt: it is tailored restructuring subject to strict conditionality. As GDP is observable and verifiable, the first best contractual solution would be to use GDP in designing contingent instruments. Even if debt service capacity is not monotonically related to GDP, "Eurozone conditionality" can surely be used to link debt service capacity to GDP so as to reduce moral hazard.

6. Conclusion

European countries are currently engaged in a peculiarly masochistic process that is generating austerity. As indicated above, countries are effectively incentivised to reduce their GDP growth rates. The game may be changed, however, by simultaneously restructuring some debts to include growth bonds and by consolidating debt with Euro-bonds. The creation of an SPV that holds one and issues the other seems the obvious institutional innovation.

One might object that the IMF had similar ideas back in 2000 but they led nowhere. There are reasons for believing that the chances for institutional innovativation are greater in the European context. Given the perceived consequences of failure, there is a common desire to find a solution; there are mechanisms in place to impose fiscal conditionality; and there are existing supranational institutions such as the ESM and the EFSF to act as precedents .

References

Aizenman, Joshua and Michael Hutchinson, (2012) "What is the risk of European sovereign debt defaults? Fiscal space, CDS spreads and market pricing of risk", European sovereign debt crisis Conference, Danmarks Nationalbank, April.

Borenzstein, Eduardo, and Paolo Mauro. 2004. "The Case for GDP-indexed Bonds", *Economic Policy*, **19**(38), pp. 166–216.

Bulow, Jeremy and Kenneth Rogoff. (1990) "Cleaning Up Third-World Debt Without Gertting Taken To the Cleaners", *Journal of Economic Perspectives*, **4**(1), pp. 31-42.

Calvo, Guillermo. (1998). "Servicing the Public Debt: The Role of Expectations," *American Economic Review,*78(4), pp.647-61, September.

Caplin, Andrew and John Leahy. (1998) "Miracle on Sixth Avenue: Information Externalities and Search," *Economic Journal*, Royal Economic Society, **108**(446), pp.60-74.

De Grauwe, Paul and Youmei Ji. (2012) "Self-fulfilling crisis in the Eurozone: an empirical test" Conference on the European sovereign debt crisis, Danmarks Nationalbank, April.

Griffith-Jones, Stephany and Krishnan Sharma. (2006) "GDP Bonds – Making it Happen," DESA Working Paper 21.

Griffith-Jones, Stephany and Dagmar Hertova. (2012) "Growth-Linked Securities; Its Role in Counter-Cyclical Policies".

Krueger, Anne. (2001) "International financial architecture for 2002: A New Approach to Sovereign Debt Restructuring." Washington, DC: International Monetary Fund. Photocopy.

Leinemann, Alexander. (2012) **"**Common Stability Bonds for Europe: A Game Theoretical Approach", MSc dissertation University of Warwick.

Lewis, Michael. (2010) "Beware of Greeks Bearing Bonds", *Vanity Fair*, 1st October.

Miller, Marcus. (2012) "How the Euro was saved", available at: http://www2.warwick.ac.uk/fac/soc/economics/staff/academic/miller/events/1129c_euro_bond_swap.pdf

_____. (2002) "Sovereign Debt Restructuring: New Articles, New Contracts – or No Change? ".*International Economics Policy Briefs*, PB02-3, Washington, DC: (Peterson) Institute for International Economics.

_____ (1982) "Inflation-Adjusting the Public Sector Financial Deficit: Measurement and Implications for Policy".Warwick Economics Research Paper Series No. 209. University of Warwick.

Reinhart, Carmen and Kenneth Rogoff. (2009) *This Time is Different: Eight Centuries of Finanical Folly*, Princeton.

Reis, Ricardo et al. (2011) www.euro-nomics.com

Rogoff, Kenneth. (1999) "International institutions for reducing global financial instability", *NBER Working Papers*, 7265.

Shiller, Robert. (2003) *The New Financial Order.* Princeton NJ: Princeton University Press.

_____. (1993) *Macro Markets: Creating Institutions for Managing Society's Largest Economic Risks*. Oxford: Clarendon Press.

Westermann, Frank, (2012) "Self-fulfilling crisis in the Eurozone : discussion" European sovereign debt crisis Conference, Danmarks Nationalbank, April

Williamson, John. (2008)"Is there a role for index-linked securities?" Mimeo (April 15)

_____ (2006)"Revamping the International Monetary System". In E. Truman ed, *Reform the IMF for the 21st Century,* Special Report 19. Washington, DC: Peterson Institute for International Economics.

Annex A: What price growth bonds?

Assume two states for the debtor, zero growth and 2%; and the bond is priced so as to satisfy the arbitrage condition with German bonds, which pay constant 3%. If the mark-off transition probabilities are half, the state-dependent yields on the debt are simply 2% and 4%. With no growth the 2% yield is accompanied by expectations of capital gains, but in the positive growth state a higher yield is offset by expected capital losses.

Let the coupon be c , so In times of distress and stagnation the arbitrage condition will be:

$$rV^l = c + \pi(V^h - V^l)$$

where π is the hazard rate for recovery.

In times of recovery and growth, let the yield be increased by g, so:

$$(r - g)V^h = c + \delta(V^h - V^l)$$

where δ is the hazard rate for stagnation.

Given the opportunity cost r, the coupon rate c , the hazard rates and the growth rate g, the appropriate values will satisfy determined as :

$$\begin{bmatrix} r+\pi & -\pi \\ -\delta & r-g+\delta \end{bmatrix} \begin{bmatrix} V^l \\ V^h \end{bmatrix} = A \begin{bmatrix} V^l \\ V^h \end{bmatrix} = \begin{bmatrix} c \\ c \end{bmatrix}$$

$$\begin{bmatrix} V^l \\ V^h \end{bmatrix} = A^{-1} \begin{bmatrix} c \\ c \end{bmatrix} = \frac{\begin{bmatrix} r-g+\delta & \pi \\ \delta & r+\pi \end{bmatrix}}{\Delta} \begin{bmatrix} c \\ c \end{bmatrix}$$

where $\Delta = (r+\pi)(r-g+\delta)-\pi\delta$.

Hence for c=1, r=0.03, g= 0.02, π=0.5, δ=0.5.

$$\begin{bmatrix} V^l \\ V^h \end{bmatrix} = A^{-1} \begin{bmatrix} 1 \\ 1 \end{bmatrix} = \frac{\begin{bmatrix} 0.03-0.02+0.5+0.5 \\ 0.5+0.03+0.5 \end{bmatrix}}{0.02} \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

where $\Delta = (r+\pi)(r-g+\delta)-\pi\delta$.

Table A 1 Numerical example showing how stable are prices compared to service flows:

c=	1	1	1
r=	0.03	0.03	0.03
π=	0.50	0.50	0.25
g=	0.02	0.02	0.02
δ=	0.50	0.25	0.50
Δ=(r+π)(r-g+δ)-πδ=	0.020	0.013	0.018
V^L	49.754	59.375	42.697
V^H	50.739	60.938	43.820
$1/V^L$	0.020	0.017	0.023
$1/(V^H+g)$	0.040	0.036	0.043

Annex B: Debtors Dilemma: The Engine of Austerity?

Fiscal consolidation may be likened to a “catwalk contest” where the models try to outdo each other in a self-destructive slimming race. Illustrative payoffs in the austerity game - where each player can choose between stabilising output by running a deficit , or stabilising debt via austerity = are shown in the table.

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	Output stabilisation	Fiscal Austerity
Output stabilisation	1,1 →	-1,2
Fiscal Austerity	2,-1 →	0,0

Table B1: The Debtors' Dilemma

The dominant strategy for each payer is fiscal austerity: so budgets are designed not to stabilize the economy on a growth path, but to woo capital markets. Finance Ministers around Europe may be trapped in a costly signalling game. As is common with Prisoners' Dilemmas, institutional mechanisms may be needed to avoid the inefficient Nash equilibrium.

Data Appendix from Aizenmann et al (2012)

Table 1. Summary Statistics of Sovereign CDS Values and Fundamentals.

This table reports mean and standard deviation (in parenthesis) of sovereign CDS spreads (basis points) and macro fundamentals. Tax Base is an average Tax/GDP over a period of previous 5 years. Appendix A provides data sources and Appendix B details the country groups.

	Sovereign CDS 5-yr tenor (basis points)					Fiscal Balance/Tax Base					Public Debt/Tax Base				
Country	05-07	08	09	10	08-10	05-07	08	09	10	08-10	05-07	08	09	10	08-10
Spain	16.7	100.7	113.5	347.7	187.3	0.05	-0.12	-0.31	-0.27	-0.23	1.1	1.1	1.5	1.7	1.4
Greece	15.0	232.1	283.4	1026.5	514.0	-0.18	-0.29	-0.48	-0.33	-0.37	3.2	3.5	4.0	4.5	4.0
Ireland	8.6	181.0	158.0	619.2	319.4	0.05	-0.24	-0.47	-1.08	-0.60	0.9	1.5	2.2	3.2	2.3
Italy	13.4	156.9	109.2	238.0	168.0	-0.07	-0.07	-0.13	-0.11	-0.10	2.5	2.5	2.8	2.8	2.7
Portugal	10.4	96.3	91.7	497.3	228.4	-0.13	-0.11	-0.30	-0.27	-0.22	1.9	1.9	2.2	2.4	2.2
Middle-Income group	124.2	829.9	295.2	233.2	452.8	-0.06	-0.08	-0.22	-0.19	-0.16	2.7	2.2	2.3	2.3	2.3
	(102.8)	(1069.4)	(331.3)	(221.5)	(540.7)	(0.2)	(0.2)	(0.2)	(0.1)	(0.2)	(2.6)	(2.1)	(1.9)	(1.9)	(2.0)
High-Income (non OECD)	32.1	330.7	164.0	172.3	222.3	0.13	0.24	0.10	0.16	0.17	1.2	1.0	1.7	1.4	1.4
	(13.9)	(158.9)	(90.5)	(118.4)	(122.6)	(0.4)	(0.5)	(0.4)	(0.5)	(0.5)	(0.8)	(0.6)	(0.1)	(0.8)	(0.5)
OECD (non Euro)	34.8	260.3	120.3	117.8	166.2	0.04	0.01	-0.12	-0.08	-0.06	1.7	1.7	1.9	1.9	1.8
	(41.5)	(238.8)	(103.5)	(96.4)	(146.2)	(0.2)	(0.2)	(0.1)	(0.1)	(0.1)	(1.7)	(1.7)	(1.8)	(1.8)	(1.8)
Euro (excluding SWEAP)	11.0	95.1	54.2	101.3	83.5	-0.03	-0.02	-0.15	-0.14	-0.10	1.4	1.4	1.6	1.7	1.6
	(13.3)	(40.2)	(24.6)	(55.2)	(40.0)	(0.0)	(0.0)	(0.1)	(0.1)	(0.1)	(0.5)	(0.5)	(0.5)	(0.4)	(0.5)

	Trade/GDP					Inflation (%)					External Debt/GDP				
	05-07	08	09	10	08-10	05-07	08	09	10	08-10	05-07	08	09	10	08-10
Spain	0.6	0.6	0.5	0.5	0.5	3.55	1.40	0.80	2.78	1.66	1.4	1.5	1.7	1.5	1.6
Greece	0.6	0.6	0.5	0.5	0.5	3.32	2.64	2.97	17.34	7.65	1.3	1.4	1.8	1.7	1.7
Ireland	1.5	1.6	1.6	0.9	1.4	3.75	4.05	-4.48	1.30	0.29	7.8	8.9	10.7	11.0	10.2
Italy	0.6	0.6	0.5	0.6	0.5	2.30	2.26	1.02	2.10	1.79	1.1	1.0	1.2	1.1	1.1
Portugal	0.7	0.8	0.6	0.7	0.7	2.60	0.71	0.00	2.52	1.08	1.9	1.9	2.3	2.4	2.2
Middle-Income group	0.9	0.9	0.8	0.9	0.9	6.74	9.73	5.24	6.61	7.19	0.5	0.4	0.4	0.4	0.4
	(0.5)	(0.5)	(0.4)	(0.5)	(0.4)	(4.7)	(6.8)	(5.9)	(5.4)	(6.0)	(0.3)	(0.3)	(0.3)	(0.2)	(0.3)
High-Income (non OECD)	0.9	0.9	0.8	0.8	0.8	8.20	8.02	-0.90	1.37	2.83	0.6	0.7	0.9	0.8	0.8
	(0.0)	(0.1)	(0.0)	(0.0)	(0.0)	(6.2)	(7.3)	(3.9)	(0.7)	(4.0)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)
OECD (non Euro)	0.8	0.9	0.8	0.8	0.8	3.38	4.60	3.02	3.08	3.57	1.0	1.3	1.5	1.5	1.4
	(0.3)	(0.4)	(0.3)	(0.4)	(0.4)	(2.3)	(3.4)	(3.5)	(1.4)	(2.8)	(1.1)	(2.0)	(2.5)	(2.4)	(2.3)
Euro (excluding SWEAP)	1.2	1.3	1.2	1.2	1.2	2.56	2.13	0.94	2.05	1.71	1.8	1.8	2.0	1.9	1.9
	(0.4)	(0.4)	(0.5)	(0.4)	(0.4)	(1.0)	(1.1)	(0.5)	(0.6)	(0.7)	(1.0)	(0.9)	(0.9)	(0.9)	(0.9)