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ABSTRACT

Why do governments default, and why don't they default more often?*

This paper considers the economic and political drivers of sovereign default, focusing on countries rich enough to render sovereign default a 'won't pay' rather than a 'can't pay' phenomenon. Unlike many private contracts, sovereign debt contracts rely almost exclusively on self-enforcement rather than on third-party enforcement.

Among the social costs of sovereign default are contagion and concentration risk, both within and outside the jurisdiction of the sovereign, and 'rule of law externalities'. We consider illiquidity as a separate trigger for sovereign default and emphasize the role of lenders of last resort for the sovereign.

Not only do political economy factors drive sovereign insolvency, they also influence the debt sustainability analyses performed by national and international agencies.

We consider it likely that the absence of sovereign defaults in the advanced economies since the (West) German defaults of 1948 and 1953 until the Greek defaults of 2012 was a historical aberration that is unlikely to be a reliable guide to the future.

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1. Introduction

From an economic perspective, default is any change in the stream of current and future payments on a debt contract that makes it less valuable to the creditor than the execution of the contractually agreed payments stream.¹ Default is probably as old as debt itself, because as with virtually any intertemporal contract, the net present discounted value (NPV) of abiding by the terms of the contract (its continuation value) changes over the life of the contract for the parties involved and may well become negative for one or more of the parties. In the case of debt contracts, the debtor has his fun up-front, when he gains control over the resources he borrows. Servicing the debt, interest and repayment of principal, is the unpleasant part of the debt contract for the borrower. Why would any borrower ever repay his debt once the continuation value of the debt contract turns negative?

In the case of a debt contract involving a private borrower, one obvious answer is that third-party enforcers, including but not limited to the courts, provide the incentives to repay. But in the case of a sovereign borrower, third-party enforcement is the exception rather than the rule – sovereigns choose to service their debt rather than being forced to do so by a third party. That then raises the question why sovereigns don't choose to default more often or indeed – since the lack of third-party enforcement of sovereign debt contracts is rather evident to the (potential) creditors – why *any* sovereign debt should be deemed sustainable and why anyone would willingly be a creditor to a sovereign. The answer of course is that it is often in the sovereign's interest to honour its debt obligations, primarily because the costs of sovereign default – to the sovereign debtor – can be substantial. But these costs are also not infinitely high. So we are squarely in the realm of *choice* – sovereigns on the whole *choose* to service their debt or *choose to default*. The choice aspect of sovereign default tends to be given too little weight in assessments of debt sustainability.

2. The enforcement of private debt contracts

For most contracts between private parties, there are two types of contract enforcement: third-party enforcement by some external entity not a party to the contract, and self-enforcement. Today, in reasonably advanced market economies with a modicum of rule

¹ See Appendix 1 for an attempt to formalize this notion.

of law, third-party enforcement is mainly performed by the state, through the courts, bailiffs and the other servants of law and order. But the coercive power of the state is not the only source of coercive power capable of enforcing contracts. Organised crime, vigilantes and other non-state enforcers can play that role also.

Self-enforcement relies on debt service being in the perceived self-interest of the borrower even after the initial transfer of resources from the creditor to the borrower has taken place and without the benefit of the *deus ex-machina* of an effective third-party or external enforcer. One self-enforcement mechanism could be honour or honesty. In the ancient (and quite possibly mythical) world of 'my word is my bond', people choose to honour their debts because it was the right thing to do. Even if you could get away with defaulting on your debt, and thus be better off from a material point of view in every period and in every state of nature, you would not do so because it would be wrong or immoral to do so. In much of modern economics, short shrift is given to the imperative of 'doing the right thing' as a motive for human action. In most non-cooperative game theory under uncertainty and asymmetric information, honesty is a tactical option, not an intrinsically valued form of behaviour or a compulsion.² You tell the truth if it is advantageous to do so. You lie if lying pays. George Washington and his hatchet would not last long in modern non-cooperative game theory. Truth telling and commitment (which for our purposes can be taken to be the same thing) may, of course, have evolutionary value, if communities with widespread honesty, where most members use honest signalling, can develop and sustain cooperative arrangements based on trust that are not open to communities full of opportunistic liars.³

Self-enforcement of private debt contracts when economic agents are conventional selfish and opportunistic economic automata (i.e. without a capacity for credible commitment based on truth telling and keeping commitments as forms of compulsive behaviour) requires that a sequential (by backward induction) cost-benefit analysis of default vs. continued contractual debt service yield contractual debt service as the rational outcome. The costs of default include reputational costs if the defaulting debtor cannot become anonymous following a default. Debt default, in a world with imperfect and asymmetric information, may be interpreted as a powerful signal of the 'type' of the

² For an extensive treatment, see e.g. Fudenberg and Tirole (1991).

³ See Osizik and Harrington (2012) and Zollman, Bergstrom and Hutteger (2013).

borrower – one with a higher propensity to default, other things being equal, than borrowers who have not (yet) defaulted. A standard consequence of or punishment for default is exclusion from future access to borrowing for at least a while, and a high likelihood of higher borrowing costs even after borrowing becomes possible again. The cost of restricted future market access will be higher to a borrower weighing the pros and cons of default the more likely it is that he may wish to borrow again at some point in the future. More variable and uncertain future income streams and investment opportunities will therefore increase the cost of default.

In addition, the creditor or parties associated with him may inflict damage on the person or property of the defaulting borrower. Clearly, in the case of borrowing from the Mafia or other criminal lenders/loan sharks, the distinction between self-enforcement and third-party enforcement gets blurred: the lender or his agents ensure that the cost-benefit analysis of continued contractual debt service vs. default favours the continued debt service outcome, by threatening the borrower and/or his nearest and dearest with loss of life, limb or property. Indeed, it is possible to see third-party enforcement as simply a special case of self-enforcement, where a very high cost of default motivates choice informed by a rational, selfish cost-benefit analysis. In this view, third-party, external enforcement, even by the state, is shorthand for a bundle of costs of default – the notoriety of a court case, fear of arrest and of debtors' prisons in an earlier age, fines, disqualification from certain activities, occupations or professions, damage to one's credit rating and the wider damage to one's reputation and social standing.

A Special Case: Social or Collective contract enforcement

An interesting form of informal private debt contract enforcement that is neither traditional self-enforcement nor conventional third-party enforcement by the state or the henchmen of your unfriendly loan shark is the collective or group enforcement of debt contracts found e.g. in the micro-lending by the Grameen Bank in Bangladesh. These uncollateralised loans are made to groups of poor, mainly rural borrowers. Peer pressure within the group is used to enforce repayment and maintain or improve the credit

standing of the group.⁴ Peer pressure can, of course, cover a wide range of behaviour, from disapproval and Amish-style shunning to threats to persons or property.

3. Sovereign default

The standard view in the academic economic literature of sovereign debt contract enforcement is that it relies entirely on self-enforcement. Sovereign means “Dieu et Mon Droit”, or, “I’ll do as I Please”. There is no higher authority, no third party, that can enforce sovereign debt contracts against the will of the sovereign, unless the sovereign has voluntarily yielded the substance of sovereignty by agreeing to the adjudication of disagreements over its debt contracts by a foreign court. However, even in the case of sovereign debt contracts under foreign law, the enforcement powers of the foreign courts tend to be limited, even when the sovereign is weak and short of international goodwill. Very few observers believe, for instance, that the Argentine government will pay in full the holdout creditors who rejected the restructuring offers made by Argentina since its default in 2001, regardless of how the U.S. Court of Appeals for the Second Circuit (New York) rules on the judgement of Judge Thomas P. Griesa, a federal judge for the United States District Court for the Southern District of New York, who determined that the Argentine government must pay these holdouts *pari passu* with the creditors that agreed to the debt restructurings (see Bolton (2013)).

Since gun boat diplomacy went out of fashion a while ago (probably after the Venezuelan Debt Crisis of 1902), creditors no longer count on warships to assist in debt collection.⁵ Even trade sanctions – the moderate face of gunboat diplomacy – are rarely used to collect sovereign debt and where they are used that way, as in the case of Cuba, they tend to be ineffective or even counterproductive. Instead sovereign debt contract enforcement relies on a cost-benefit analysis that is in many ways similar to self-enforcement of private contracts – without the sharp edges (knuckledusters and crushed knee caps) sometimes found in the informal enforcement of private contracts.

For modern sovereigns, it is almost exclusively self-enforcement that induces them to service their debt. One aspect of self-interest is common between private and sovereign

⁴ See Bornstein (2005).

⁵ In 1902, the United Kingdom, Germany, and Italy imposed a naval blockade on Venezuela, which was in default on its foreign debt. Soon after this intervention, Venezuela reached an agreement with its foreign bond holders and began meeting its obligations again.

creditors: just like private creditors, sovereign creditors may wish to borrow again in the future. Default will restrict their access to finance in the future, and/or raise the cost of doing so.⁶ For example, Cruces and Trebesch (2011) find that a one-standard-deviation increase in haircuts is associated with a 50 percent lower likelihood of re-accessing international capital markets in any year after the restructuring.⁷ For both sovereign and private creditors, there are also real resource costs (legal, administrative and time costs) that are associated with dealing with default and its aftermath.

There are two key differences between sovereign default and private default that affect the cost of sovereign default and thus the likelihood of strategic sovereign default in perhaps surprising ways. Both relate to systemic externalities from sovereign default. The first type concerns financial stability and macroeconomic externalities *vis à vis* the domestic private sector from sovereign default, caused by contagion or excessive risk concentration. The second type concerns *rule of law externalities* from sovereign default.⁸

3.1. Financial Stability and Macroeconomic Externalities

3.1.1. Contagion and Concentration risk

Much has been made recently in the euro area of non-market links (that is, links through a mechanism other than formal, explicit financial or contractual exposures, one-way or two-ways), between a sovereign and private sector entities, in particular banks, other

Much of the discussion in the previous section dealt with externally held debt. But qualitatively, much the same arguments hold for domestic debt, as long as it is either foreign currency denominated or the domestic sovereign has no control over its central bank, as is the case in the euro area. Reinhart and Rogoff (2009) show that, although externally held debt is more likely to be defaulted upon than domestically held debt, both have been defaulted on with some regularity, and even more frequently if we extend the definition of default to any deliberate NPV reduction in the real value of the public debt, including through higher inflation (unanticipated or anticipated in combination with financial repression). To ignore domestically held debt because we owe it to ourselves is bad economics. Those who own the debt (typically older and richer) are different from those who pay for servicing the debt through taxation or cuts in public spending (typically younger and poorer). Domestic bond owners have more in common with foreign bond owners than with domestic tax payers. Both servicing externally held debt and domestic debt require a dual transfer: For externally held debt, it is the internal transfer from the domestic tax payer/public spending beneficiary to the state and the external transfer from the state to the foreign creditor. For internally held debt, there is one internal transfer from the domestic tax payer/public spending beneficiary to the state and a second internal transfer from the state to the internal bond holder/creditor.

⁷ There is also some evidence that market penalties for default may have fallen somewhat compared to previous decades (Gelos et al, 2011), even though given the relative rarity of defaults and the wide diversity of post-default experiences, we should be careful not to over-interpret these data.

⁸ Of course, there are also externalities to other sovereigns.

systemically important financial institutions and sometimes also private non-financial corporations. Sovereign default in a country can lead to a reassessment of sovereign default risk in other countries. Sovereign default could plausibly lead to a reassessment by actual and potential creditors of the creditworthiness of connected private sector entities or of other sovereigns quite independent of the existence of links through formal, explicit contractual or financial exposures. Not all such 'contagion' would necessarily be blind: sovereign default in a country may lead to reassessments of the value of deposit insurance for banks (often implicitly sovereign-backed although formally backed by the banking industry only), of other explicit or implicit guarantees provided by the government to private sector entities that are deemed too big, too systemically important or too politically connected to fail. It could also lead to different assessments of fiscal risks in other countries.

In addition, there is the *direct* financial exposure of these non-government entities to the sovereign that may cause them to be affected by sovereign default, a problem that is aggravated by the high concentration in the exposure of many euro area banks to their domestic sovereign.

Concentration risk is an important feature of the current European financial crisis. At least until the start of the Greek sovereign phase of the European crisis in 2010, national bank supervisors and regulators in the EU and in the Euro Area in particular had failed singularly to prevent a very high concentration in their banks of exposure to European sovereigns in general, and to Greek risk, and Greek sovereign risk in particular. Ironically, this supervisory and regulatory failure may well have been the result in part of an attempt to correct an earlier widespread supervisory and regulatory error that was highlighted by the North Atlantic Financial Crisis: the low share of liquid assets in the balance sheets of the banks. Under Basel III and assorted national add-ons, national supervisors and regulators have been pressing the banks in their jurisdictions to hold more liquid assets. Eurozone sovereign debt was viewed as liquid and safe by supervisors and regulators and therefore also by the banks. This ignored two fundamental truths: first, that no sovereign is completely safe, and, second, that there are large variations in the default risk associated with different sovereigns, even among the EU and Euro Area sovereigns.

Since 2010, the repatriation of periphery sovereign debt from the rest of the EU to the banks in the periphery has substantially increased the exposure of Euro Area periphery banks to their own sovereigns. The desire by core Euro Area banks to dispose of periphery sovereign debt meshed nicely with financial repression in the periphery, where officials (Ministries of Finance/Treasuries/National Central banks/National Supervisors and Regulators) forced their domestic banks to hold more domestic sovereign debt and at lower yields than they would have voluntarily, all in the name of funding the sovereign at affordable yields. One leg of the so-called sovereign-bank link (the financial repression of domestic banks to fund a domestic sovereign whose solvency was questionable) thus inevitably created another (the excessive exposure of domestic banks to the creditworthiness of the domestic sovereign).

Until the excessive concentration of holdings of high-risk sovereign debt in the balance sheets of Euro Area periphery and soft-core banks is remedied, either by spreading this risk voluntarily by selling the debt to a wider range of private investors, or by socializing the risk, partly or completely, a sovereign default by a Euro Area member state could undermine the viability of Euro Area periphery banks and cause further systemic distress.

However, even with the concentration risk present in the Euro Area, sovereign default is likely to be less systemically damaging from a financial perspective than the failure of a large, complex cross-border financial institution like Lehman Brothers. One reason for this is that, as former Citicorp Chairman Walter Wriston pointed out (in a much misinterpreted statement): *“Countries don’t go out of business...The infrastructure doesn’t go away, the productivity of the people doesn’t go way, the natural resources don’t go away. And so their assets always exceed their liabilities, which is the technical reason for bankruptcy. And that’s very different from a company”*.⁹

Note that Wriston did not say that banks and other private creditors cannot go broke by lending to sovereigns or that sovereigns don’t default. His statement, which is correct, means that when the sovereign defaults, as they have often done historically, the

⁹ Cited by IMF Money Matters: An IMF Exhibit -- The Importance of Global Cooperation; Debt and Transition (1981-1989) http://www.imf.org/external/np/exr/center/mm/eng/mm_dt_01.htm .

country that they are sovereign over does not get wound up, broken up or liquidated, with its physical, human and financial assets sold at fire-sale prices by creditors who fear they may miss out in the rush for the exit. The sovereign default tends to be followed by a form of Chapter 11 lite – very lite - with the debtor firmly in control of the real assets, human and physical, of the nation. The country remains open for business. The assets within its jurisdiction can typically not be attached. As regards doing cross-border business, both the sovereign and likely also the private entities of a state where the sovereign has defaulted recently, will operate on a cash-in-advance basis. But even Argentina has continued to trade internationally following its repeated defaults and its people and government officials have continued to travel freely internationally.

3.1.2. Rule of law externalities

The 'rule of law' externality associated with sovereign default is potentially seriously damaging to the long-run growth and prosperity prospects of a country. A private default on a formal debt contract is (supposed to be) settled under the rule of law by a transparent legal process involving some or all of the following: arbitration, the courts, administrators, conservators, arbitrators, bailiffs and other law enforcement agencies. Private defaults are (supposed to be) resolved under the rule of law and according to the law, and do not therefore undermine the rule of law or the subset of the rule of law that deals with contracts - what, in rather idolatrous terms, is sometimes called the 'sanctity of contracts'. This may well be one of the reasons why the *ad-hoc* bail-outs of systemically important financial institutions during the recent crisis provoked such strong emotions. Another example of a private debt restructuring that violated natural justice was the proposed *de-facto* bail-in (through a tax levy) of insured depositors in both solvent and insolvent banks, in the version of the Cyprus rescue programme originally agreed by the Cypriot government and the troika, but subsequently rejected unanimously by the Cypriot parliament. The fact that the senior unsecured bank bond holders escaped the axe under the ultimately rejected proposal compounded the flaws in the original deal.¹⁰ It was perceived by many as a perversion of the rule of law, the social contract, and the fundamental principles of a market economy, which require the imposition of hard budget constraints on all obligors and respects seniority rankings.

¹⁰ See also <http://in.reuters.com/article/2013/04/03/breakingviews-cyprus-idINDEE93206P20130403>

When the state itself defaults on its obligations, the rule of law inevitably is harmed. Social capital and trust are corrupted, sometimes destroyed. When the state, the very party to the social contract that is supposed to enforce contracts impartially, is itself involved in a breach of contract, respect for all contracts and respect for the rule of law are undermined. The answer to “*Quis custodiet ipsos custodes?*” is, of course, “*Nemo*”. It is therefore essential that the sovereign allows, in his cost-benefit of rational or strategic default, for the damage done by opportunistic sovereign default to respect for the law and thus to the social fabric that differentiates a contract-based market economy under the rule of law from a predation and force-based anarchic economy under the law of the jungle.

Governments, the political elites and sometimes even the polity as a whole tend to be aware of the long-term social cost of this weakening of the rule of law promoted by discretionary sovereign recourse to default. This is why voluntary sovereign default tends to occur mainly in two kinds of countries. The first are countries that have been shocked and traumatized by extraordinary events that have harmed their capacity to service external and/or internal debt and that also are highly unlikely to be repeated. The market’s perception of the sovereign’s creditworthiness is likely, under such conditions, to worsen but little as a result of a sovereign default. The West-German internal sovereign default of 1948 is an example of a sovereign default that probably did not create a precedent that raised citizens’ and other market participants’ subjective likelihood of future defaults by the West-German sovereign.¹¹ The same holds true for the West-German external default of 1953, when the 1953 London Debt Agreement settled Germany’s external debts from the period between the two world wars.¹²

The second kind of country that chooses sovereign default is deeply polarized and internally divided, with little social capital, weak and corrupt political institutions and ineffective political leadership. Greece’s two sovereign defaults in 2012 fit this template. Prior to these recent Greek sovereign debt restructurings, there had been no sovereign

¹¹ Central to the West-German sovereign default of 1948 on the domestic debt was a currency reform. Prices and recurrent liabilities were converted at par from old Reichsmarks to new Deutsche Marks, domestic government debt was written off and other nominal financial claims were converted at an average rate of 6.5 Reichsmarks to one Deutsche Mark.

¹² The Agreement wrote-down the overall external debt by about 50 percent and granted the debtors a significantly longer repayment period. Some debt service payments were even postponed until Germany would be re-unified.

defaults in Western Europe, North America (excluding Mexico), Japan, Australia or New Zealand since the (West) German sovereign defaults of 1948 and 1953.

Figure 1. List of Sovereign Defaults and Rescheduling, 1975-2012

Country	Year
Africa	
Algeria	1991
Angola	1985
Central African Republic	1981, 1983
Côte d'Ivoire	1983, 2000, 2011
Egypt	1984
Kenya	1994, 2000
Morocco	1983, 1986
Nigeria	1982, 1986, 1992, 2001, 2004
South Africa	1985, 1989, 1993
Zambia	1983
Zimbabwe	2000
Asia	
Indonesia	1998, 2000, 2002
Myanmar	2002
The Philippines	1983
Sri Lanka	1980, 1982
Europe	
Greece	2012
Poland	1981
Romania	1981, 1986
Russia	1991, 1998
Turkey	1978, 1982
Latin America	
Argentina	1982, 1989, 2001
Belize	2012
Bolivia	1980, 1986, 1989
Brazil	1983
Chile	1983
Costa Rica	1981, 1983, 1984
Dominican Republic	1982, 2005
Ecuador	1982, 1999, 2008
Guatemala	1986, 1989
Honduras	1981
Jamaica	2010
Mexico	1982
Nicaragua	1979
Panama	1983, 1987
Paraguay	1986, 2003
Peru	1976, 1978, 1980, 1984
St. Kitts and Nevis	2012
Uruguay	1983, 1987, 1990, 2003
Venezuela	1983, 1990, 1995, 2004

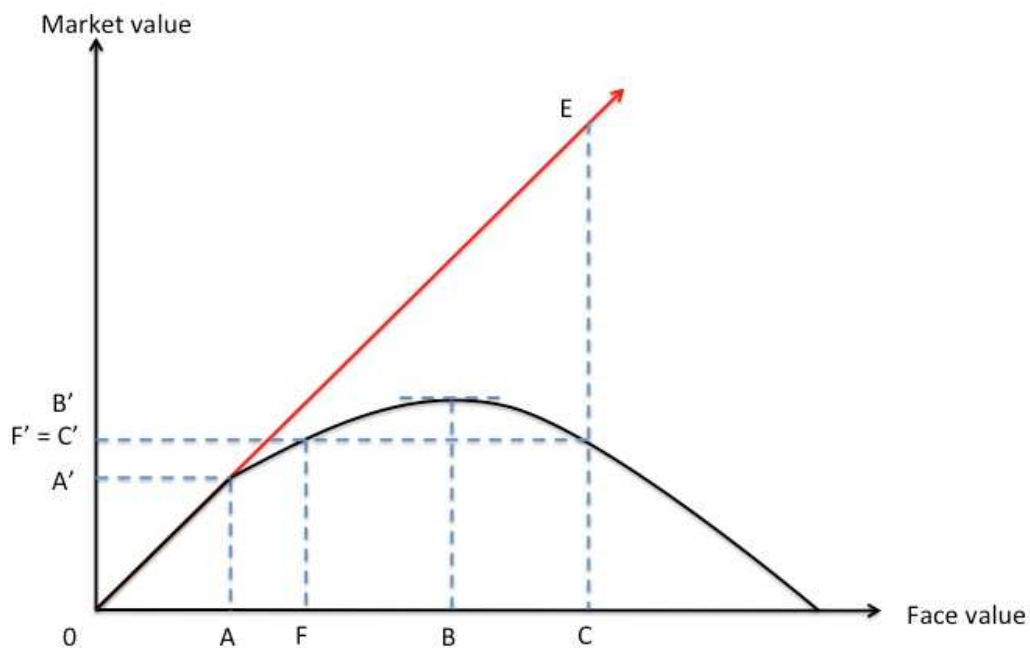
Source: Reinhart CM, Rogoff KS. (2009) 'This Time Is Different: Eight Centuries of Financial Folly', Princeton University Press, Moody's, and Citi Research

3.2 Default and the Sovereign Debt Laffer Curve

In certain circumstances, a default can result in a positive-sum outcome from a social perspective, relative to the alternative where default is avoided. This can happen if the total resources available to creditor and debtor (and to society as a whole) are higher following default than in the absence of default. The case of a sovereign default when the sovereign is on the wrong side of the 'sovereign debt Laffer curve', is an example. If very severe fiscal austerity or very high inflation are the only alternatives to sovereign default, then default may be the lesser evil. If the alternative to bank default is shifting the losses to the tax payers, both fairness and intertemporal incentives (the prevention or mitigation of moral hazard) may call for default, provided this can be implemented in a reasonable orderly manner and does not threaten systemic financial stability. More generally, the social costs of 'debt overhang' can exceed the costs of default in situations where debt is excessive.

Figure 2

Sovereign Debt Laffer Curve



Source: Citi Research

Figure 2 shows the relationship between the market value of the debt and its notional or face value. For simplicity, we choose units such that the market value of one unit of face value debt is 1 if there is no risk of default. The face value or notional value of the debt is denoted D and the market value PD , where P is defined in the Appendix by equation (A5). In Figure 2, $P=1$ if the probability of default is zero. As shown in Figure 2, a larger stock of debt by face value or notional value, D , will, as soon as the probability of default becomes non-zero (at a face value of debt A in Figure 2), increase the market value less than one for one. If the probability of default increases fast enough with the face value of the debt outstanding, the market value of the debt can decline if the face value of the debt rises beyond a certain level (at point B in Figure 2). The 'slippery slope of the debt Laffer curve' is the segment of the curve to the right of point B . Assume a debtor country has landed itself on a point like C . Clearly, a partial default on the debt, reducing it to any amount in face value greater than F but less than C , will make the creditors better off (the market value of their claims on the debtor country is higher than it would have been without the default, although of course less than it would have been if the debtor, somehow, had been able to stick to the terms of the contract, given by point E on the 45 degree line) while the debtors are also better off, if there are costs to them that are increasing with the face value of the debt.

Distortionary taxes required to service the debt could be one mechanism ensuring that sovereign debtors are better off when the face value of their debt is reduced, even if its market value increases. Another example is the adverse effect of a bad sovereign credit rating (associated with a large face value of the sovereign debt) on the credit ratings and access to funding of the private agents in its jurisdiction. Even if a sovereign partial default or debt restructuring does not create a Pareto improvement where both debtor and creditors are better off, it can still be socially efficient in the weaker 'utilitarian' sense that the total resources available to both creditors and debtors (and of the wider society of which they are part) can increase as a result of a (partial) default or sovereign debt restructuring. Note that this illustration leaves out the social cost of rule of law externalities associated with voluntary, strategic or opportunistic sovereign default.

4. So why do governments default?

Unless you are on the wrong side of the sovereign debt Laffer curve, the costs of sovereign default in the form of systemic externalities and impairing future access to capital markets provide powerful incentives to make sovereign creditors whole. But it would be wrong to suggest that sovereigns only default when it is absolutely unavoidable. In fact, it would be more appropriate that governments for the most part default because they *choose to default*. In rich countries at least, sovereign defaults are opportunistic, strategic or 'rational'. This applies to the European Union member states that are, since the eruption of the North Atlantic Financial Crisis in August 2007, struggling to varying degrees with sovereign debt sustainability problems. In these countries, sovereign default is the outcome of a cost-benefit analysis undertaken by an agent incapable of credible commitment. The government, as manager of the state, cannot credibly commit its successor government, nor can it credibly commit itself, during its remaining term in office, to a contingent sequence of future actions unless these happen to be time-consistent (and part of what game theorists call a 'subgame-perfect equilibrium'). The issue is willingness to pay (perhaps *collective* willingness to pay) rather than ability to pay. And since it is willingness to pay rather than ability to pay that matters, political and political economy factors (rather than purely economic factors) are of crucial importance in assessing public debt sustainability.

There are exceptions to the characterisation that sovereign default usually constitutes a choice to default. These include the sovereigns of the very poorest countries such as Haiti following the 2010 earthquake, the countries benefiting from the 2005 Initiative for Heavily Indebted Poor Countries (HIPC), under which the IMF, the International Development Association of the World Bank and the African Development Fund cancel all of their claims on countries that reach the 'completion point' – the stage at which a country qualifies for full and irrevocable debt relief, or countries as poor as the HIPC beneficiaries that have not (yet) benefited from the HIPCs Initiative relief, including Cambodia, Tajikistan, Chad, Eritrea and Sudan.^{13 14}

¹³ As of February 2013, there were 35 'Completion point' HIPCs – countries that have reached the completion point under the Enhanced HIPC Initiative. They were Afghanistan, Burkina Faso, Burundi, Central African Republic, Democratic Republic of Congo, Ethiopia, The Gambia, Ghana, Guinea-Bissau, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, São Tomé and Príncipe, Sierra Leone,

4.1. The Arithmetic of Fiscal Sustainability: ‘Won’t Pay’ and ‘Can’t Pay’ Insolvency

Even though we are in the realm of political economy, a bit of arithmetic can go some way to illustrate the drivers of debt sustainability. The arithmetic of public debt dynamics is simple but inexorable. We refer henceforth to the net non-monetary debt of the augmented general government (the consolidated general government and central bank) as the *public debt*.¹⁵ The evolution of public debt can then be expressed through the following equation (which is in fact an identity):

$$\Delta d \equiv -s + \left(\frac{r - \gamma}{1 + \gamma} \right) d \quad (1)$$

where s is the augmented general government primary (non-interest) surplus as a share of GDP, r the effective real interest rate on the outstanding public debt, γ the growth rate of real GDP, d the public debt to GDP ratio at the beginning of a period, Δd the ‘change in’ the public debt to GDP ratio between the end and the beginning of a period.

To keep the ratio of net public debt to GDP constant, the augmented general government’s primary surplus as a share of GDP has to satisfy:

$$s = \left(\frac{r - \gamma}{1 + \gamma} \right) d \quad (2)$$

If the real interest rate on the outstanding public debt exceeds the real growth rate of GDP (as seems likely in many advanced economies today and as will likely be the

Tanzania, Togo, Uganda, Benin, Bolivia, Cameroon, Comoros, Republic of Congo, Côte d’Ivoire, Guinea, Guyana, Haiti, Honduras, Mauritania, Nicaragua, Senegal, Zambia. Source: IMF
<http://www.imf.org/external/np/exr/facts/mdri.htm>

¹⁴ It is sometimes argued that even in very poor countries, sovereign default is most likely voluntary rather than involuntary, as even in very poor countries the value of a nation’s natural resources, physical capital, net foreign financial assets and human capital (the net present discounted value of its labour income) exceeds the face value of the sovereign debt. This rather distorts the normal meaning of words like ‘voluntary’ and ‘choice’.

¹⁵ Net debt is gross debt minus financial and non-financial assets. By non-monetary debt we mean any liabilities of the government and central bank except the monetary base.

case in the future for an even wider range of advanced economies, when at last we exit the era of extraordinarily low safe real interest rates produced by the global savings glut, excess capacity in the advanced economies, the zero lower bound on nominal interest rates and the provision of near-infinite liquidity at those rates), the government needs to generate adequate primary surpluses (positive values of s of sufficient magnitude) to stop the debt burden from rising.

We can express solvency through a very similar equation as (2). Define variables with an over-bar as the ‘permanent’ equivalent of their equivalent without a bar, i.e. for example $\bar{\gamma}$ would be the permanent growth rate of real GDP. For simplicity, for now think of *permanent* roughly as the ‘expected future long-run average’. Any sustainable fiscal-financial-monetary programme of the sovereign has to satisfy the condition that the outstanding public debt cannot exceed the present discounted value of current and future expected primary surpluses of the augmented general government. Let us express this relationship as:¹⁶

$$\bar{s} \geq \left(\frac{\bar{r} - \bar{\gamma}}{1 + \bar{\gamma}} \right) d \quad (3)$$

The minimum value of the primary surplus (as a share of GDP) that will ensure solvency for the sovereign, \bar{s}^{\min} , can then be defined as:

$$\bar{s}^{\min} = \left(\frac{\bar{r} - \bar{\gamma}}{1 + \bar{\gamma}} \right) d \quad (4)$$

If the long-run effective real interest rate on the public debt exceeds the long-run growth rate of real GDP, \bar{s}^{\min} will be positive in any country with a positive outstanding stock of (net) public debt, i.e. the country would have, on average, to run future primary augmented general government surpluses. For instance, a country with a 100% net public debt to annual GDP ratio, an expected long-run growth rate of real GDP of 2% pa, and an average effective real interest rate on the

¹⁶ Equation (3) strictly only holds if s , r , and γ are both known with perfect foresight, and are constant over time. However, an alternative formulation for (3) can be found at the expense of substantial additional notational complexity.

public debt of 3% would have to run an average 1% of GDP primary surplus in the future.

Figure 3. Selected Countries – General Government Primary Balance (% of GDP), 2012

	Primary Balance (% of GDP)	Cycl. Adj. Primary Balance (% of GDP)
Australia	-2.5	-2.4
Austria	-0.5	-0.3
Belgium	-0.7	-0.5
Canada	-2.7	-2.2
Denmark	-3.9	-2.7
Finland	-1.9	-0.8
France	-2.2	-0.7
Germany	2.4	2.3
Greece	-1.2	2.1
Iceland	1.5	1.0
Ireland	-4.6	-2.9
Italy	2.3	4.0
Japan	-9.3	-8.4
Netherlands	-2.9	-1.5
Norway	11.7	-8.6
Portugal	-0.8	1.0
Spain	-7.9	-2.6
Sweden	-1.3	-1.4
Switzerland	0.7	0.8
U.K.	-6.1	-3.3
U.S.	-6.4	-4.4

Source: IMF and Citi Research

The key question is therefore whether \bar{s}^{\min} is feasible, economically and politically.¹⁷ The primary surplus (as a share of GDP), s , is the difference between revenues, τ (mainly taxes), plus seigniorage, σ (the change in the monetary base), and public spending, g , all expressed as shares of GDP.

$$s = \tau + \sigma - g \quad (5)^{18}$$

Higher taxes are distortionary and costly to extract. Lower public spending can hurt growth when public spending cuts fall on productive infrastructure spending and essential ‘intermediate’ public administration goods and services. Fiscal tightening

¹⁷ We should think of primary surpluses here in a broad sense, incorporating stock-flow adjustments in public debt (such as asset sales and privatizations or bail-outs) even if they are not, according to common accounting conventions, captured by primary surpluses in government financial statements.

¹⁸ If M is the stock of base money, P is the GDP deflator and Q real GDP then $\sigma \equiv \frac{\Delta M}{PQ}$.

will weaken effective demand through the usual Keynesian channels and attempts to raise seigniorage revenue will sooner or later result in higher inflation. Indeed, our estimates of the maximum amount of seigniorage that can be extracted in the major advanced economies when inflation is fully anticipated (and therefore reflected in market nominal interest rates as long as these are not capped by official action) are very low, typically no more than 2 percent of GDP.¹⁹ Unanticipated inflation can, of course be used to reduce the real cost of servicing nominally denominated domestic-currency denominated fixed interest rate public debt, and so can the combination of inflation (anticipated or unanticipated) and financial repression.

Whatever the efficiency costs of higher taxation, lower public spending and wealth levies through (unanticipated) inflation, it is their political costs that are likely to turn out to be the binding constraint on raising the permanent augmented primary surplus (as a share of GDP). The anti-austerity protests in the euro area periphery have made it clear that both raising taxation and reducing public spending can be very unpopular, indeed prohibitively so for any government interested in political survival. We can define, \bar{s}^{\max} , the maximum feasible primary surplus, reflecting economic, technical *and political* limits. This also allows us to define the associated maximum sustainable level of (net) public debt:

$$\bar{d}^{\max} = \left(\frac{\bar{r} - \bar{\gamma}}{1 + \bar{\gamma}} \right)^{-1} \bar{s}^{\max} \quad (6).$$

4.2 A historical digression

Historically, before the 19th century, the norm everywhere (including in the countries that we now characterize as advanced economies) was that sovereign risk tended to be worse than the credit risk of leading merchants or private bankers (see Reinhart and Rogoff (2009)). Prior to the industrial revolution, sovereigns everywhere defaulted regularly. Although many sovereigns in what are now called emerging markets and developing countries continued to default throughout the 19th and 20th centuries, in the

¹⁹See Buiter and Rahbari (2012) and Buiter (2012)

advanced industrial countries, sovereign default has not happened since the (West) German defaults of 1948 and 1953 until the Greek defaults of 2012.

This absence of sovereign defaults in the advanced economies for almost 64 years has come to be viewed as the norm, rather than as something to be explained or possibly even as something rather unusual or even anomalous. Is there a risk that the advanced economies could return to the sovereign default patterns from before the 19th century?

The poor credit rating and performance of sovereigns in Western Europe before the 19th century should not come as a surprise, as prior to the modern age of broad-based income taxes, indirect taxes and taxes on property, the sovereign's revenue sources were limited: seigniorage (revenue from coinage, which was limited in a world with commodity money rather than paper or electronic fiat money), a range of in-kind or corvée (labour supplied without pay) taxes, import and export duties and their local equivalent, tolls, Scutage²⁰, Tallage²¹, Aids²²3, Danegeld²³4, Carucage²⁴5, assorted excises, transactions and transfer taxes, a range of property taxes and poll taxes, including inheritance taxes and death duties, the sale of monopolies, fines, confiscation of wealth and plunder. Although the taxes were many, the revenues were low.

Early examples of income taxes can be found, notably the income tax introduced by Emperor Wang Mang of the Xin Dynasty in the year 10 CE. When he was overthrown in 23 CE, that income tax experiment came to an end. The modern era of income taxes starts with the December 1789 budget of Pitt the Younger, which introduced a temporary income tax to finance the war effort against France. It was indeed abolished in 1802 during the peace of Amiens, reintroduced when hostilities started again in 1803 and abolished again in 1816, a year after the battle of Waterloo. Its reintroduction in 1842 by Sir Robert Peel has not yet been followed by another abolition.

In the US, income tax was first imposed in July 1861 to help pay for the American Civil War. It was abolished in 1872, revived in 1894, and again abolished in 1895, when it

²⁰ a payment in lieu of military service

²¹ a tax on feudal dependents

²² a tax pay by a vassal to his lord in feudal times

²³ a medieval land tax used to fund military expenditures (originally to pay off the raiding and invading Danes).

²⁴ a land tax that replaced Danegeld in England

was declared unconstitutional by the Supreme Court. Since the ratification of the 16th Amendment to the US Constitution in 1913, there has been a Federal income tax in the USA.

Unlike excises or duties on individual commodities, which go back at least to 2000 BCE, broadly based sales taxes, including multi-stage turnover taxes like VAT, date to World War I or more recent times.

Income taxes (personal and corporate), levied on labour income, interest income, dividends and capital gains, and including a range of social security taxes, together with broadly based indirect taxes (sales taxes, turnover taxes, multi-stage turnover taxes like VAT, excises and duties) and broadly-based property taxes permitted the funding of general government spending programmes that now range, in advanced industrial countries, from just above 30% of GDP to just below 60%. The Euro Area average is around 50% of GDP (see Figure 1).

The reasons for the absence of completely (default) risk-free sovereigns among the advanced economies (or anywhere else), despite the massive growth of sovereign tax capacity, are three.

First, demand for public spending in advanced economies has, since the Great Depression and especially since the end of World War II grown even faster than the capacity to tax, and has now outstripped the capacity to raise revenues in a way that: (a) is politically acceptable to the polity and (b) does not materially damage incentives to work, to educate oneself and to take risk as a saver, investor or entrepreneur.

Figure 4. Selected Countries - General Government Expenditure (% of GDP), 1870-1996

	Late Century about 1870	19 th Pre WWI 1913	Post WWI 1920	Pre WWII 1937	Post WWII			21 st Century		
					1960	1980	1990	2000	2010	2012
Australia	18.3	16.5	19.3	14.8	21.2	34.1	34.9	34.7	36.6	36.6
Austria	10.5	17.0	14.7	20.6	35.7	48.1	38.6	51.9	52.6	51.1
Canada	n/a	n/a	16.7	25.0	28.6	38.8	46.0	40.8	43.0	41.0
France	12.6	17.0	27.6	29.0	34.6	46.1	49.8	51.7	56.6	56.6
Germany	10.0	14.8	25.0	34.1	32.4	47.9	45.1	45.1	47.7	45.0
Italy	13.7	17.1	30.1	31.1	30.1	42.1	53.4	45.9	50.4	50.7
Ireland	n/a	n/a	18.8	25.5	28.0	48.9	41.2	30.7	64.9	41.6
Japan	8.8	8.3	14.8	25.4	17.5	32.0	31.3	37.3	38.9	41.3
New Zealand	n/a	n/a	24.6	25.3	26.9	38.1	41.3	34.9	40.1	37.3
Norway	5.9	9.3	16.0	11.8	29.9	43.8	54.9	41.5	44.9	43.4
Sweden	5.7	10.4	10.9	16.4	31.0	60.1	59.1	52.7	50.6	50.1
Switzerland	16.5	14.0	17.0	24.1	17.2	32.8	33.5	34.4	32.7	32.7
UK	9.4	12.7	26.2	30.0	32.2	43.0	39.9	34.3	46.7	43.5
US	7.3	7.5	12.1	19.7	27.0	31.4	32.8	33.7	42.4	40.2
Average	10.8	13.1	19.6	23.8	28.0	41.9	43.0	40.7	46.3	43.6

Note: Data for late 19th century corresponds to 1870 or closest year available for all columns. Data corresponds to the general government except for Austria 1920 and Sweden 1870, for which it refer to the central government.

Sources: For pre-2000 data Tanzi V. and Schuknecht L. (2010), 'Public Spending in the 20th Century: A Global Perspective', Cambridge University Press; for post 2000 data IMF WEO.

Second, in a number of countries with high public debt burdens and large primary structural deficits, political polarisation has increased to the point that even if everyone recognises the unsustainability of the fiscal programme and the need for and desirability of early fiscal tightening, agreement on such a sustainability-restoring programme may be postponed as each interest group tries to minimize its share of the total burden of adjustment. There is a rich non-cooperative game theory literature on 'Wars of Attrition' that rationalises such individually rational but collectively disastrous behaviour.²⁵ Fiscal adjustment could possibly be delayed for long enough to trigger an eventual sovereign debt crisis. Even if the war of attrition between different groups of (potential) tax payers and (potential) claimants on public spending does not postpone fiscal adjustment until a sovereign default is the only option, the delays in adjusting are likely to make the total cost of adjustment larger. Greece and the US would be prime examples of such polarised societies.

²⁵ See Maynard Smith (1974), Bishop and Cannings (1978) and Chatterjee, Reiter and Nowak (2012).

Third, as part of the widespread erosion of social capital (in the sense of trust between government and citizen, between members of rival political parties and between citizens), tax administration has become less effective in many advanced economies, with rapid growth of the underground or grey economy and in tax avoidance and tax evasion (see e.g. Slemrod (2007), Slemrod and Yitzhaki (2002), Slemrod and Feldman (2009) and Slemrod et. al. (2009)).

Globalisation has contributed to this, by providing new avenues for people and corporates to shield their income and wealth from the tax authorities, but the phenomenon is older than that. Tax enforcement is costly. It is effective only if tax compliance is both a social norm and an internalised objective of most citizens, enforced by the law (and informed random auditing), by social disapproval for evasion and avoidance and by the small voice of individual conscience. Such an equilibrium is vulnerable to defection. If a sufficient number of taxpayers default from the 'pay what you owe' equilibrium, others will wonder why they should pay both their own taxes and a share of the taxes of those who avoid and/or evade their fair contributions. If enough defect, there can be a tipping point after which only the foolish and the unlucky pay their taxes in full.

The incidence of tax avoidance and evasion appears to have risen everywhere in Europe and in the US since World War II, and also appears to be higher as one moves further South and East in Europe. Among the worst affected countries are Greece and Italy. Although the size and growth of the informal sector/shadow economy/grey economy is driven not just by taxation but also by regulatory avoidance and evasion, the cross-sectional evidence from Figure 5 in and the time-series evidence for the advanced economies contained in Schneider and Enste (2000, 2002), is also indicative of the extent of tax compliance and the quality of tax administration.

Only in the last few years are there signs that at least some of the more egregious forms of tax evasion and tax avoidance may be on the retreat. Robust exchanges between the US government and the German government on the one hand, and the governments of leading European tax havens like Switzerland and Liechtenstein have resulted in material erosion of bank secrecy – a cornerstone of tax evasion and avoidance. The recent demise of Cyprus as a Euro Area tax haven has accelerated the trend towards ending bank secrecy in the EU, in European nations encircled by the EU and in the UK

Crown Dependencies and overseas territories in the Channel Islands and the Caribbean. This could lead to a step-improvement in tax collection capacity and could create new, less demand-destroying revenue opportunities through wealth levies, including tax amnesties that may prove valuable to such countries as Italy.

Figure 5. Size of the Shadow Economy in 25 High Income OECD Countries in 2006 (% of GDP)

Rank	Country	Shadow Economy
1	United States	8.0
2	Japan	8.9
3	Switzerland	8.3
4	Austria	9.5
5	Luxembourg	9.4
6	United Kingdom	10.9
7	New Zealand	10.9
8	Netherlands	11.2
9	Australia	13.0
10	France	13.2
11	Canada	14.1
12	Iceland	14.1
13	Ireland	14.5
14	Germany	15.4
15	Finland	15.8
16	Sweden	16.3
17	Denmark	16.5
18	Norway	16.6
19	Belgium	19.9
20	Portugal	20.3
21	Spain	20.2
22	Italy	23.1
23	Greece	26.0
24	Korea, Rep.	27.3
25	Mexico	32.1

Sources: Schneider (2009)

4.3 The political feasibility of sustainable fiscal-financial-monetary policy

The previous section highlighted the social and political forces that, together with factor endowments, technology and other economic characteristics of a nation determine the bounds on the values that our public debt and primary balance ratios can assume. These dry algebraic symbols can hide a lot of human drama.

From the analysis of Section 4.1, the relevant solvency criterion is thus whether $d \leq \bar{d}^{\max}$ (or $\bar{s}^{\max} \geq \bar{s}^{\min}$), in which case the sovereign would be solvent, or $d > \bar{d}^{\max}$ ($\bar{s}^{\max} < \bar{s}^{\min}$), which would signify insolvency. Solvency thus requires that the minimum primary surplus necessary to sustain the existing debt is also feasible, in particular politically feasible.

Since our definition of \bar{d}^{\max} and \bar{s}^{\max} explicitly includes political limits to raising primary surpluses, we should think of insolvent here mostly as ‘won’t pay insolvency’ or unwillingness to pay.²⁶ Of course, won’t pay insolvency is what is relevant for a number of advanced economies today, which have high levels of debt, but also high levels of per capita income (far away from subsistence levels) and wealth. The notion that these countries would not be able to eliminate large primary or overall deficits, or to service outstanding levels of debt is for the most part a logical and economic nonsense, even with zero future growth.

Equation (5) expressed the sustainable level of debt as a function of the effective permanent interest rate \bar{r} , the permanent growth rate $\bar{\gamma}$ and the maximum sustainable level of the primary surplus \bar{s}^{\max} . Thus, anything that affects \bar{r} , $\bar{\gamma}$ or \bar{s}^{\max} should affect how much debt a country can sustain – which would be a large number of political, social, cultural, financial as well as economic factors which vary both across countries as well as over time.²⁷

²⁶ We could define a maximum feasible primary surplus excluding political factors, say, \tilde{s}^{\max} , with an associated maximum sustainable level of debt, \tilde{d}^{\max} . By construction, it holds that $\bar{s}^{\max} < \tilde{s}^{\max}$ and $\bar{d}^{\max} < \tilde{d}^{\max}$. Strictly speaking won’t pay insolvency would be given by $\bar{d}^{\max} < d < \tilde{d}^{\max}$ (or $\bar{s}^{\max} < \tilde{s}^{\max}$) and can’t pay insolvency by $\tilde{s}^{\min} < s$ or $d > \tilde{d}^{\max}$.

²⁷ As for the interest rate charged, issuing a major international vehicle and reserve currency, such as the dollar, tends to keep required returns low, as do greater home bias by domestic investors. High private savings can magnify the effect of the home bias on the interest rate, while financial repression may be more effective in such circumstances as well. Of course, attitudes towards risk and risk itself, including economic risk, political risk, inflation risk and other risks would affect required yields, too. Finally, the determinants of growth are a literature of their own. We mostly leave it to the relevant literature to point out the major drivers of economic growth in the medium-and long-term (see also Buiter and Rahbari (2011) and Barro-Sala-i-Martin (2003)). It is, however, important not to misinterpret the arithmetic effect of higher growth on the fiscal debt burden and the level of sustainable debt. It is true that, other things being equal, higher growth reduces the public debt to GDP ratio more rapidly. It also raises revenues, which may appear to provide a painless way of generating larger primary surpluses. However, through human psychology and political entrepreneurship, higher growth also raises the pressures for increased public spending. Other things equal, a large amount of private assets should allow the government to levy higher taxes or to reduce public spending without running material risks of endangering the physical well-being of the population.

Politics and policy can have an effect on all three variables, but political economy considerations are especially pertinent when considering the feasibility of raising primary surpluses. A high level of social capital (the absence of perceptions of corruption, a sense of solidarity, etc) and a well-organised and competent tax administration, perceived as fair and non-partisan by the citizens, should allow more tax revenues to be obtained, other things equal, and at relatively low cost. A high share of foreign-owned debt, on the other hand, may make it more difficult to find the political support necessary to generate and sustain large primary surpluses, mostly for the benefit of making foreign creditors whole. It is somewhat ironic that one of the greatest fiscal consolidations in recent history (Greece in 2012) was attempted in a country which must have scored among the worst according to these three criteria. Of course, intensely political choices are also involved in deciding who or what will be taxed or whose spending will be cut, when trying to raise primary surpluses, i.e. to determine the composition of fiscal tightening. The IMF recently noted that for the median country in the sample it studied, the maximum annual primary surplus achieved was 6 ½ % of GDP for advanced economies since the 1950s, but that that maximum fell to 3 ½-4% of GDP for 5-year moving averages and to 2 ¾-3 ¼% of GDP for 20 year-averages.²⁸

4. 4. What about liquidity?

No discussion of default would be complete without discussing liquidity. To discuss liquidity, let us first distinguish between insolvency and default. Sovereigns (just like companies or households) can be insolvent ($d > \bar{d}^{\max}$ or $\bar{s}^{\max} < \bar{s}^{\min}$), yet avoid default by being bailed out – a hope that undoubtedly exists among a few sovereigns in the euro area currently. On the other hand, countries may default on their obligations because they cannot meet their debt service obligations (interest and/or principal), sometimes despite the fact that they are fundamentally solvent. Put more precisely, even though there exists at least one interest rate \bar{r} that is an equilibrium interest rate (in the sense that the sovereign default risk premium embodied in \bar{r} ex-ante will match the ex-post likelihood of default if \bar{r} is indeed the interest rate paid by the sovereign) and that is consistent with government solvency

²⁸ See IMF (2013)

$d < \bar{d}^{\max}$ or $\bar{s}^{\max} > \bar{s}^{\min}$, there also exists at least one other interest rate $\bar{r} > \bar{r}$ which is also an equilibrium interest rate but for which the sovereign is insolvent, that is $d > \bar{d}^{\max}$ or $\bar{s}^{\max} < \bar{s}^{\min}$.

We call an instance of inability to meet debt service obligations despite being fundamentally solvent ‘illiquidity’. Of course, countries can also fail to meet debt service commitments due when they are fundamentally insolvent. We call failure to meet debt service payments due ‘default’, both when the debtor is solvent and when he is insolvent.

In order to illustrate illiquidity, we return to our discussion of the interest rate \bar{r} . Above, we referred to \bar{r} as the ‘permanent real interest rate on public debt’, to be understood as an expected long-term average. That does not quite pin down \bar{r} . \bar{r} is the interest rate (or more precisely, the ‘average’ or permanent value of a sequence of interest rates over time) that discounts the stream of primary surpluses appropriately (in a self-validating or equilibrium sense, reflecting not just default risk but also all other types of risk, such as liquidity, inflation, and expropriation, that investors would be expected to price in). If more than one self-validating or equilibrium sequence of interest rates exist, \bar{r} corresponds to the lowest permanent or long-run average value of these multiple equilibrium interest rate sequences.

This elaboration of the definition of \bar{r} is not (just) an exercise in pedantism. With a positive level of outstanding (net) public debt, there always exists a value of \bar{r} high enough (potentially infinite) to make any positive level of debt unsustainable - and that interest rate would also be self-validating. To see this, suppose investors assume that the sovereign would default for sure and correspondingly charge a very high interest rate. That very high interest rate then in turn makes the debt unsustainable, validating the expectation of default. Even excluding a self-fulfilling ‘bad equilibrium’, there may be multiple good equilibria (consistent with a low ex-ante and ex-post likelihood of default). We define \bar{r} as the lowest such equilibrium interest rate and henceforth treat the ‘good’ equilibrium as unique.

Now define \bar{r}^{\max} as the highest interest rate at which the sovereign is still solvent, i.e.

$$\bar{r}^{\max} = \bar{\gamma} + (1 + \bar{\gamma}) \left(\frac{\bar{s}^{\max}}{d} \right) \quad (7)$$

Illiquidity is then defined as $r > \bar{r}^{\max} > \bar{r}$, i.e. the interest rate at which the sovereign would be able to borrow exceeds the maximum interest rate at which it would be solvent, *even though the sovereign is solvent* in the sense that its debt would be sustainable, if it were charged the interest rate \bar{r} . This definition does not only capture situations when investors charge an unreasonably high interest rate. It can also encompass a scenario in which when the sovereign is cut off from markets altogether (in which case it would face an infinite immediate interest rate).

Illiquidity clearly happens. ‘Good’ and ‘bad equilibria’ arise typically in models of bank runs where banks have a serious maturity or duration mismatch between their assets and liabilities. Typically, banks have mostly long-maturity, illiquid assets with few liquid reserves. They also have short-maturity liabilities, such as deposits withdrawable on demand and subject to a ‘sequential service constraint’, under which deposits are redeemed on a first-come-first-served basis out of the scarce liquid reserves. Assets that have to be sold prior to maturity can only be sold at a huge loss. Such bank runs models describe well the position of a sovereign whose liabilities are either denominated in foreign currency or that cannot force its central bank to act as lender of last resort should the sovereign be threatened with a sudden market funding stop. Sovereigns too have mostly highly illiquid assets (the net present discounted value of future taxes and the net present discounted value of future spending cuts) and shorter-maturity liabilities.

Illiquidity can be the result of contagion, e.g. a sudden shift, following a sovereign default or restructuring in one country, of the markets’ ‘focal point’ for other countries’ sovereign risk from a virtuous equilibrium to a vicious equilibrium. Historically, there have been many examples of nations with a lot of foreign-currency denominated liabilities, that suffered a ‘bank run-style’ rush for the exit by foreign creditors whose foreign-currency bond exposure or loans to the country mature. This can cause a sovereign default either if the foreign exposure is sovereign exposure or if the foreign exposure is by private institutions deemed, by the sovereign, too systemically important to fail, but that also turn out to be too big to save. A sovereign rescue attempt can then result in sovereign default. This almost happened in Iceland in 2008, where the sovereign at the last

moment decided not to risk its own solvency by guaranteeing the unsecured debt of its cross-border banks. It happened in Ireland, where EFSF loans to the sovereign have been restructured several times since they were first issued. Even at issuance, the interest rates on these loans were likely below the risk-adjusted cost of funding to the creditor nations.

If this depiction sounds all too familiar – and reminds you of the rants of some European policymakers against unreasonable investors or greedy speculators – a word of caution is probably in order: they probably happen less often than you think, at least for advanced economies. For default to result from illiquidity or contagion, two conditions need to be satisfied: First, the sovereign does not have sufficient liquid assets to meet the debt service obligations that are due (otherwise, the sovereign can pay out of her own pocket!). Second, no adequate lender of last resort exists.

The first condition may be met relatively often, as we noted above.

On the other hand, the second condition may not be met very often. In countries where the bulk of the sovereign's liabilities are denominated in domestic currency, the domestic central bank can usually act as a lender of last resort.²⁹ Foreign currency liquidity can be harder to obtain, but international institutions, such as the IMF, ESM or the international development banks, or ad-hoc or systematic arrangements with foreign central banks (say through foreign currency swaps) can provide foreign-currency liquidity, often at no to short notice and on acceptable terms. This is the rule rather than the exception for advanced economies (EMs have long complained that the terms of access to such sources of liquidity had been unduly harsh for them during many crises in the past).

More often than not, what *looks* like illiquidity, is really a reassessment of risks based on learning. An example is the reassessment of sovereign risk for nations other than Greece, based on the observation of Greece's two sovereign debt restructurings with PSI in 2012 which, as noted before, were the first sovereign defaults in the euro area since its creation in 1999 (and in Western Europe since the West German defaults in

²⁹ Legal provisions, such as Art 125 of the Lisbon Treaty in the EU, may complicate a central bank's lender of last resort function for sovereigns, but usually only at the expense of higher legal bills and inefficient financial arrangements.

1948 and 1953). We have been impressed, in most financial crises since the 1980s, including the latest stage of the Eurozone financial crisis that started in 2010, with how little contagion through blind fear and panic there has been. Although there has been jitteriness and nervousness galore, the markets, and creditors in general have on the whole been highly discriminating and selective as regards the sovereigns singled out for special attention. Countries with sound fiscal fundamentals have not been tested in this crisis.

Since the initiation of the LTROs in November 2011 and February 2012, and especially since the announcement of the OMT in September 2012, the risk that blind contagion could drive otherwise solvent sovereigns into default and out of the Eurozone has been lowered materially. The ECB/Eurosystem is now acting as lender of last resort for euro area banks and sovereigns. This does not, of course, eliminate either sovereign default risk for fundamentally insolvent sovereigns or bank failures, recoveries, recapitalizations and resolutions for fundamentally insolvent banks.

4.5. The politics of debt sustainability analysis

Political economy factors matter greatly for sovereign debt sustainability, as we have discussed above. Perhaps less obviously, politics also play a major role in sovereign debt sustainability *assessments*. Such assessments are part of the bread-and-butter business of many international organisations and development banks, including the IMF, the World Bank, the European Commission and related bodies. These organisations are usually picked both because of the financial resources they have at their disposal and for the human resources as well as institutional and organisational knowledge base that should allow them to form an objective assessment of appropriate policy choices as well as debt sustainability.

Given the large number of factors (including social, cultural and political factors, not just economic and financial ones) that affect debt sustainability, such assessments are fiendishly hard. Mistakes tend to be made and, over time – hopefully – some learning occurs. Some of the relatively recent lessons learnt are that it is not only public debt, but also private debt, that matter for sovereign debt sustainability (due e.g. to the latter's tendency to migrate to the sovereign balance sheet when things go bad), and that one

needs to distinguish more carefully between cyclical and structural drivers of government balances. On the whole, the financial, human and organisational resources would seem adequate at these institutions to the task at hand. The guidelines for carrying out these assessments also usually look rather appropriate. For example, the IMF's approach to debt sustainability is summarised by the Fund itself in the following way:³⁰

*“The [IMF] framework consists of two complementary components: the analysis of the sustainability of total public debt and that of total external debt. Each component includes a baseline scenario, based on a set of macroeconomic projections that articulate the government's intended policies, with the main assumptions and parameters clearly laid out; and a series of **sensitivity tests** applied to the baseline scenario, providing a **probabilistic upper bound** for the debt dynamics under various assumptions regarding policy variables, macroeconomic developments, and financing costs. The paths of debt indicators under the baseline scenario and the stress tests allow to assess the vulnerability of the country to a payments crisis.*

*DSAs [debt sustainability analyses] should however not be interpreted in a mechanistic or rigid fashion. Their results must be **assessed against relevant country-specific circumstances**, including the particular features of a given country's debt as well as its policy track record and its policy space.... the frameworks have been regularly refined with a view to—among other elements—bringing a greater discipline to the analysis and responding to the **changing economic and financial environment.**” (bold type added by us)*

The summary suggests that the IMF's experts are aware of the many facets that assessing debt sustainability has, the inherent margins of error, and the differences over time and between countries. Political factors are not explicitly mentioned and thus do not get the special attention they deserve. But that omission still does not explain why the IMF (and the troika) got it so wrong in the case of Greece (at least in its original debt sustainability projections), and in Portugal, too, to name but the two most obvious examples of DSAs that looked wildly over-optimistic even at the time that they were performed.

³⁰ See <http://www.imf.org/external/pubs/ft/dsa/>

Figure 6. Selected Countries – IMF Votes

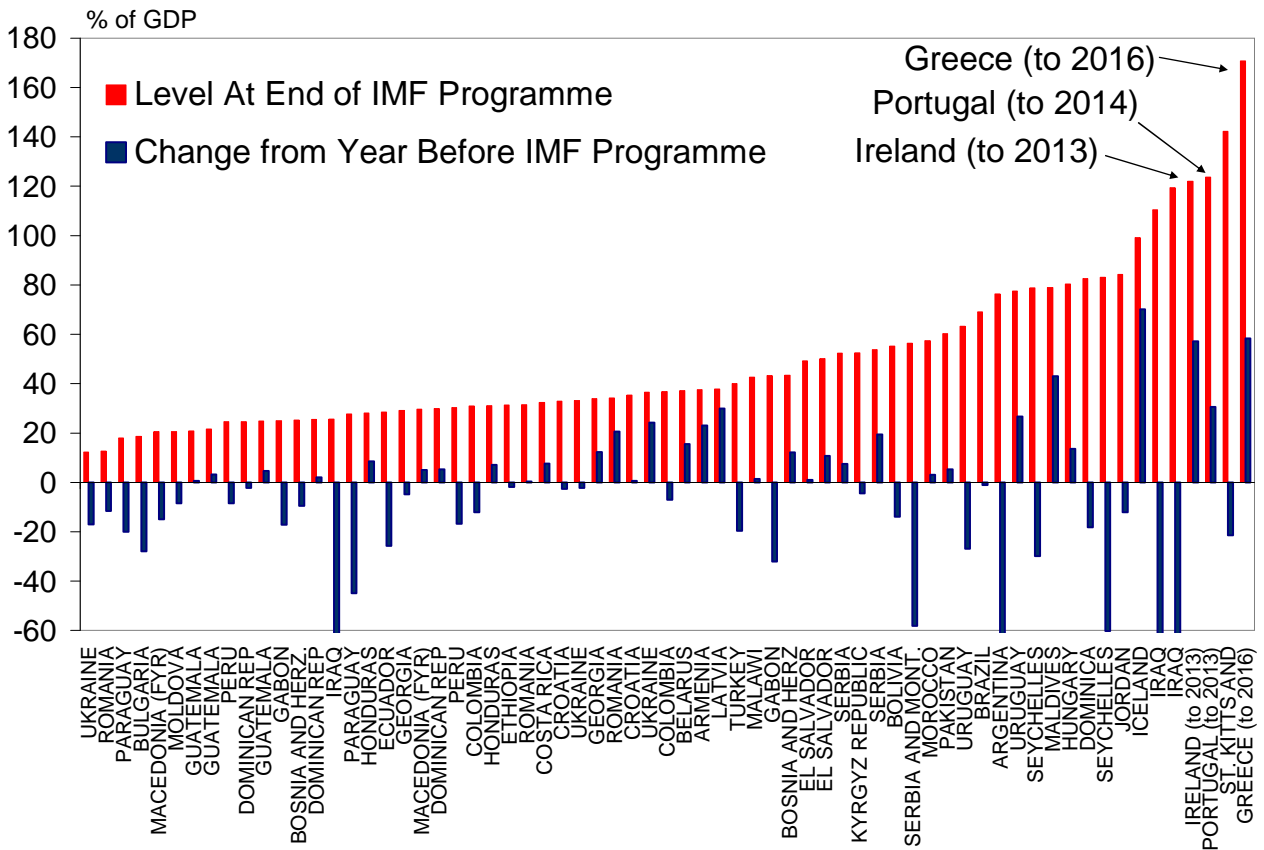
Country / Area	IMF votes number	% of total
Austria	21,876	0.87
Belgium	46,789	1.86
Cyprus	2,319	0.09
Estonia	1,676	0.07
Finland	13,375	0.53
France	108	4.29
Germany	146,392	5.81
Greece	11,755	0.47
Ireland	13,313	0.53
Italy	79,560	3.16
Luxembourg	4,924	0.2
Malta	1,757	0.07
Netherlands	52,361	2.08
Portugal	11,034	0.44
Slovakia	5,012	0.2
Slovenia	3,487	0.14
Spain	40,971	1.63
EA	456,709	22.44
Bulgaria	7,139	0.28
Czech Republic	10,759	0.43
Denmark	19,651	0.78
Hungary	11,121	0.44
Latvia	2,158	0.09
Lithuania	2,576	0.1
Poland	17,621	0.7
Romania	11,039	0.44
Sweden	24,692	0.98
United Kingdom	108,122	4.29
EU	671,587	30.97
China	95,996	3.81
Japan	157,022	6.23

Source: IMF and Citi Research

The answer is, of course that politics are to blame here, too. In May 2010, when the original Memorandum of Understanding (MoU) for the 1st Greek adjustment programme was agreed, the Greek government's euro area sovereign creditors-to-be (which account for 22% of the IMF capital and votes) simply let it be known that they had no appetite for a Greek debt restructuring, as they had no appetite for another round of bail outs of their own insufficiently capitalised and excessively Greece-exposed banks. And the IMF, being the shareholder-friendly organisation that it is, responded to its Board putting pressure on Management to put pressure on the Staff, by coming up with forecasts that not only included wildly optimistic GDP and budget deficit forecasts, but also defined 120% of GDP (in 2020) as the threshold for debt sustainability (see Figures 7 and 8). Based on the IMF's guidelines, one should assume that this was a country-specific threshold, reflecting the special characteristics and fiscal capacities of the Greek economy. But it bore an uncanny resemblance to the level of public debt in Italy at the time (Italy's general government gross debt-to-GDP ratio has since risen to 127% of

GDP in 2012, according to the IMF, and is due to exceed 130% of GDP this year, again according to the IMF.

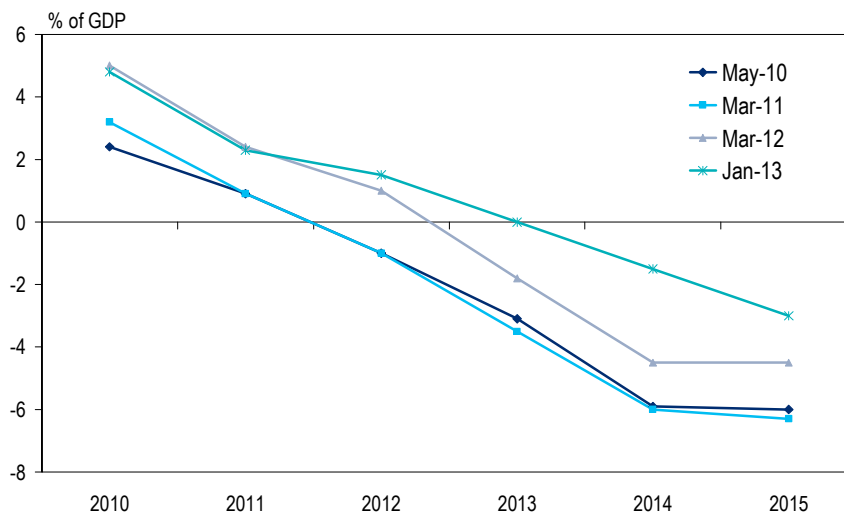
Figure 7. Selected Countries — Government Debt/GDP Ratio Before and After IMF GRA Programmes, 2002-16



Note: Data from IMF MONA database, updated with latest WEO projections for Greece, Ireland and Portugal. Some countries appear more than once if they had more than one programme. We have combined Greece's first program with the current second one. Sources: IMF and Citi Research

The IMF has since regretted that it was so easily convinced to make its forecasts fit the preferences of some of its shareholders, and the issue has reportedly on several occasions raised a few grunts from other parts of its membership, including the non-European advanced economies and some emerging markets. It has since also spoken out much louder on the issue of debt sustainability, and not just in Greece but also, and quite emphatically in the case of Cyprus. In addition, Greece has, since the unfortunate 'all clear' of May 2010, already undergone two formal debt restructurings, with the IMF's blessing. Trust in the objectivity of the troika programmes forecasts has yet to be fully restored, however – and the politicisation of debt sustainability assessments continues.

Figure 8. Greece – IMF Projections of Primary Balance (% of GDP)



Note: Values corresponds to projections on the general government primary balance produced by the Troika on the specified date.

Source: IMF Programme Reviews and Citi Research

It would be wrong, of course, to single out the IMF for the political influences on technical, seemingly objective, assessments. National governments tend to use economic forecasts as mere debating tools. Many other multilateral or international institutions fare or would fare no better. Certainly, not the main European institutions, such as the European Commission or the ECB. Even though the latter may at times have been swayed more by institutional orthodoxy and concern about its own balance sheet size than by political considerations this detail has not benefited its objectivity. We therefore don't regard the recent remarks by European Commissioner Rehn and ECB Executive Board Member Asmussen to end the 'troika' – by which they really mean to kick the IMF out of the troika – as good news.³¹

5. The Political Economy of When and How to Default as a Sovereign

At the outset we defined default as any change in the stream of current and future payments on a debt contract that makes it less valuable to the creditor than the execution of the contractually agreed stream. There are many ways to get there, and still quite a few that do not get stamped as default by the rating agencies or ISDA (which has

³¹ Wall Street Journal: "ECB Official Sees Eventual End to IMF Involvement in Euro Crises .", May 8, 2013, <http://online.wsj.com/article/SB10001424127887323744604578470523613305046.html>

the role of deciding whether a particular transaction constitutes a 'credit event' for credit default swaps). The staple of a 'short back and sides' (a haircut to the face value of the principal) is only one of a dizzying variety of options, including maturity lengthening, coupon reductions or the change of any other of the price or non-price terms of the debt contract.

Both sovereign default (or debt restructuring) and the details of the restructuring of private sector debt are often the outcome of a complex web of legal, accounting and other considerations as well as of financial ones. But there are two major differences: First, political considerations play a much larger role when sovereign debt restructuring is the name of the game. And second, when it comes to sovereign default, the 'rules of the game' can potentially change during the process. If the creditors (as well as the debtor) are public entities, political and popular considerations in the creditor countries seem to suggest almost lexicographic preferences between debt restructurings that do not involve face value haircuts (but with potentially very large NPV losses through lengthening of maturities or coupon reductions and/or deferrals) and debt restructurings with face value haircuts. Political considerations in the debtor countries often also support ways to restructure the debt that may not be designated formal defaults at all. Thus, the idea of dressing up defaults as 'voluntary' debt exchanges (but with 'voluntary' interpreted in the 'army' sense) or, even better, cajoling domestic financial institutions through financial repression into rolling over or expanding their commitments to hold sovereign debt when – at the terms being offered – they would have no interest to.

The 'rules of the game' also often change during sovereign debt restructuring processes. This is particularly true for debt issued under domestic jurisdiction. In those cases, it often only takes an act of parliament to change certain terms of the contract or the seniority of claims. For these reasons, it is more common that in sovereign debt restructurings certain creditors receive preferential treatment relative to others, with the most common beneficiaries being other public sector entities, systemically important private actors and other politically sensitive or powerful entities. The debt manoeuvre through with the ECB and the national central banks of the Eurosystem avoided taking losses on their exposures to the Greek sovereign through the SMP in 2012 is a textbook example of changing the *de-facto* seniority ranking of different classes of creditors. Of course, private debt restructurings are not fully devoid of such political interventions, as governments sometimes find it opportune to involve themselves in private debt

restructuring processes, when their outcome was of some popular interest. Recent examples include mortgage foreclosure processes in many countries, including Ireland, Italy, and Spain, and the bankruptcy of GM in 2009.

The moderately good news for investors is that, partly because a sovereign default allows the country to continue operating as a 'going concern', the recovery rates following sovereign defaults tend to be quite high. There are exceptions, notably defaults that take the form of repudiations, as with Russia's Tsarist debt, West Germany's Nazi-era debt and Cuba's Batista era debt. And of course Argentina's 2001/02 default left at least 70 percent of the creditors with just 30 cents on the dollar. But these were the exceptions, until Greece, in March 2012, defaulted on about euro 200bn worth of sovereign or sovereign-guaranteed bonded debt and imposed an NPV haircut of over 70 percent on the bondholders.

Asonuma (2009) studied 35 sovereign debt renegotiations during the period 1986-2007. He considered only on *ex post-default* and *preemptive renegotiations*, and excluded episodes of delays in payment such as Paraguay in 2003, and Venezuela in 1995, 1998, 2005, and the swap agreement for Peru in 2000. Figure 9 shows the recovery rates for this recent sample of sovereign defaults.

Figure 9 Sovereign Bond Exchanges Since 1997

Initial Default Date	Country	Distressed Details	Exchange Date	Distressed Debt		Loss (%)		Loss as measured by trading prices or by NPV of cash flows
				US\$ bn	% GDP	Nominal haircut*	Loss as measured by trading prices or by NPV of cash flows	
Aug-98	Russia	LC debt (GKO and OFZ)	May-99	8.3	3.1	29	46 res., 62 non-NPV of cash flows	
	Russia	FC debt (MIN FIN III)	Feb-00	1.3	0.7		75	trading prices
	Russia	FC debt (PRIN and IAN)	Aug-00	29.1	16.3	36	90	trading prices
Sep-98	Ukraine	LC T-bills held domestically	Sep-98	4.5	9	34	18	NPV of cash flows
	Ukraine	LC T-bills held by non-residents	Sep-98	0.4	0.8		59	NPV of cash flows
	Ukraine	FC Chase-Manhattan loan	Oct-98	0.1	0.2		31	NPV of cash flows
	Ukraine	FC ING bond and Merrill Lynch bond	Aug-99	0.4	1	45	38	NPV of cash flows
	Ukraine	FC Eurobonds	Mar-00	1.6	5.1	5	31	trading prices
Jul-99	Pakistan	Eurobonds	Dec-99	0.6	0.9		48	trading prices
Aug-99	Ecuador	External debt and domestic bonds	FC Aug-00	7	41.5	40	56 external, 9 domestic	trading external, domestic price NPV
Mar-00	Cote d'Ivoire	Brady bonds	Apr-10	2.8	12.4	20	82	trading prices
Nov-01	Argentina	Domestic debt	Nov-01	64.4	22.6		83	trading prices
	Argentina	External debt	Feb-05	79.7	52	66	71	trading prices
Jun-02	Moldova	Eurobond	Oct-02	0.04	2.7		40	trading prices
Jan-03	Paraguay	Domestic debt due in 2003-06	Jul-04	0.1	2.6		8	NPV of cash flows
May-03	Uruguay	LT FC bonds (external and domestic)	May-03	5.4	39.6		34	trading prices
Jul-03	Nicaragua	CENI bonds payable in LC	FC-denom. Jul-03	0.3	8.2		n/a	n/a
	Nicaragua	CENI bonds payable in LC	FC-denom. Jul-08	0.3	5.4		51	NPV of cash flows
Jul-03	Dominica	LC bonds (domestic and external)	Jun-04	0.1	42.4	30	53	NPV of cash flows
H2-04	Cameroon	Domestic debt	H1-05	1	6.5		n/a	n/a
Dec-04	Grenada	Global bond and domestic debt	Nov-05	0.3	48.9		35	trading prices
Apr-05	Dominica n Rep.	International bonds	May-05	1.1	5.1		5	trading prices
Dec-06	Belize	Private external debt	Feb-07	0.5	45.8		24	trading prices
Jul-08	Seychelles	External debt	Jan-10	0.3	36.8	50	70	trading prices
Dec-08	Ecuador	Global bonds	May-09	3.2	5.9	65	72	trading prices
Feb-10	Jamaica	Domestic debt	Feb-10	7.9	63.7		10	trading prices
Jan-11	Cote d'Ivoire	Treasury bills (short-term)	Dec-11	1.3	5.4		5	NPV of cash flows
	Cote d'Ivoire	Eurobond coupon	In progress	0.1	0.4		25	trading prices
Nov-11	St. Kitts and Nevis	Domestic bonds and external debt	Mar-12	0.1	19.7	50	62	NPV of cash flows
	St. Kitts and Nevis	Domestic loans (debt-land swap)	Apr-12	0.3	46.6		n/a	n/a
Mar-12	Greece	Greek and foreign law bonds	Mar-12	273.4	94.2	54	76	trading prices
Sep-12	Belize	2029 Superbond	In progress	0.5	37.3	In progress	In progress	trading prices

Note: *Largest nominal haircut shown if new instruments had different haircuts.

Source: Moody's, IMF country reports, and Sturzenegger and Zettelmeyer (2005), 'Haircuts: Estimating Investor Losses in Sovereign Debt Restructurings, 1998-2005', IMF Working Paper 05/137, July 2005

There are also differences between sovereign default and private default in the timing of default. Again, for sovereigns, politics can come into play. A new government under high

debt sustainability pressure may want to default as quickly as possible (assuming that it views default as ultimately inevitable), while an incumbent government may have a desire to try to postpone default until after the next election, or simply to delay it in the hope for a better tomorrow – more like what we see with private corporates faced with material default risk.

Sovereign debtors also usually tend to have a greater ability to stave off default for a little while longer, if they are so inclined. This is because they tend to have access to some additional sources of financing, be it through financial repression of domestic banks or other captive entities in the domestic private sector, through the central bank or through the benevolence or naivete of friendly foreign sovereigns, central banks or international institutions.

For private debtors on the other hand, there is of course also an element of choice. However, access to liquidity tends to be much more limited once solvency is in doubt, so delaying the day of reckoning would be harder. In addition, delayed filing of insolvency by corporates is a criminal offence in many countries, and creditors can file for insolvency under some conditions, further limiting the scope for postponing private default.

It is thus that for sovereign creditors more than for private creditors, the timing of default is the result of the bargaining between creditors and debtors. Creditors may be private or public and often enough, these creditors share with the debtor government a preference for postponing default. If the private creditors are banks, they may prefer, for a substantial period of time and for a variety of reasons, to roll over their commitments or evergreen their loans to realising their losses. This type of behaviour was evident both following the Latin American debt crisis and in Europe in 2010 and beyond.

6. Conclusions:

Sovereign defaults have been rare in advanced economies in recent decades, despite the fact that third-party enforcement plays almost no role for sovereign debt. The dearth of defaults is therefore almost exclusively explained by the strength of self-enforcement by sovereigns in averting default and the systemic externalities that come with it, as well as by the fact that revenue-raising capabilities had risen for decades until relatively

recently. Even though sovereign defaults are rare, we should not neglect the element of choice that is involved: Sovereigns mostly choose whether or not to default and political economy rather than 'naked' economics can explain not just the incidence of default, but also often the timing and nature of it.

These considerations make us deeply skeptical that the absence until very recently of defaults in advanced economies will continue in future years. Of course, we already witnessed two formal debt restructurings by Greece in 2012 (involving both PSI and OSI), and a number of additional OSIs (through maturity lengthening and coupon reductions of officially held debt) in Ireland and Portugal. We think that more sovereign defaults, both involving PSI and OSI) are almost certain to follow. Not only are levels of public debt high and growth prospects relatively modest in many advanced economies. More importantly, demands for public spending have also managed to continue to grow, even when the ability of governments to raise revenues efficiently started to decline, as social capital eroded. The political economy in many highly indebted advanced economies also argues for a much higher future risk of debt restructuring, as disaffected voters, both in the periphery (austerity resistance) and in the core (bail-out resistance), resist making sacrifices for the benefit of making sovereign creditors (domestic and foreign) whole. A Santa Claus may sometimes appear, but we doubt that his gift sack will be big enough. We therefore expect that we will see at least a few more sovereign debt restructurings in the euro area in the next few years.

When these occur, they would probably primarily take the form of a lengthening of maturities, with haircuts at most in coupon payments or interest rates and with possible deferral of interest payments, but without face value haircuts. Such restructuring does, of course, involve an NPV loss or NPV haircut, but for reasons that are often hard to fathom (and that mainly seem to reflect poor auditing, accounting, accountability, regulatory and tax standards, rules and practices), many investors prefer between two equal NPV haircuts the one with the lowest face value haircut. The logic of these 'soft' defaults will likely be pushed quite far, with some maturities promising to pay nothing forever, an instrument with full face value and zero NPV.

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Appendix: Defining Default

In its simplest form, a debt contract entered into at time $t = 1$ is a commitment to make a sequence of non-contingent contractual payments $\bar{c}_t \geq 0, t = 1, 2, \dots, T$. Although they do not depend on the state of nature, the contractual (coupon) payments \bar{c}_t can vary over time. For instance, the final contractual payment \bar{c}_T could include the final coupon and the repayment of the principal. A simple but too restrictive definition of default would be that at some time in the life of the debt contract (between periods 1 and T), say in period k , with $1 \leq k \leq T$, the remaining sequence of contractual payments $\{\bar{c}_t; T \geq t \geq k\}$ is changed by the borrower to a another sequence $\{\bar{\bar{c}}_t; T \geq t \geq k\}$ that is dominated by the original sequence, in the sense that

$$\begin{aligned} \bar{\bar{c}}_t &\leq \bar{c}_t \text{ for all } t \geq k \\ \bar{\bar{c}}_t &< \bar{c}_t \text{ for at least one } t \geq k \end{aligned} \quad (\text{A1})$$

We want to extend this definition of default to include the substitution at time i by the borrower of an alternative contractual sequence that has lower net present discounted value (NPV) than the original sequence, if the discount rates used are taken to be the risk-free (that is free of credit risk or default risk) rates.

Let I_{t_1, t_0} is the nominal stochastic discount factor between periods t_1 and t_0 , defined recursively by

$$\begin{aligned} I_{t_1, t_0} &= \prod_{n=t_0+1}^{t_1} I_{n, n-1} \quad \text{for } t_1 > t_0 \\ &= 1 \quad \text{for } t_1 = t_0 \end{aligned} \quad (\text{A2})$$

The interpretation of I_{t_1, t_0} is the price in terms of period t_0 money of one unit of money in period $t_1 \geq t_0$. There will in general be many possible states in period t_1 , and period t_1 money has a period t_0 (forward) price for each state. Formally, therefore, the stochastic discount factor has the state of the world, s , say, as an argument, and should be written as $I_{t_1, t_0}(s)$ but we suppress this as it does not lead to ambiguity. Let E_t be the mathematical expectation operator conditional on information available at the beginning of period t . Provided earlier dated information sets do not contain more information than later dated information sets, these stochastic discount factors satisfy the recursion property

$$E_{t_0} \left(I_{t_1, t_0} E_{t_1} I_{t_2, t_1} \right) = E_{t_0} I_{t_2, t_0} \quad \text{for } t_2 \geq t_1 \geq t_0$$

Finally, the one-period risk-free nominal interest rate in period t , i_t , that is the money price in period t of one unit of money in every state of the world in period $t+1$ is defined by

$$\frac{1}{1+i_{t+1,t}} = E_t I_{t+1,t}$$

Likewise, the risk-free j -period discount factor ($j \geq 1$) in period t is defined by

$$\left(\frac{1}{1+i_{t+j,t}} \right)^j = E_t I_{t+j,t}, \quad j \geq 1 \quad (\text{A3})$$

$$\frac{1}{1+i_{t,t}} = 1$$

So our definition of default amounts to the statement that the offer of the sequence of contractual payments $\{\bar{c}_t; T \geq t \geq k\}$ in lieu of the original sequence of contractual payments $\{c_t; T \geq t \geq k\}$ represents a default if and only if

$$\sum_{t=k}^T \bar{c}_t \left(\frac{1}{1+i_{t,k}} \right)^{t-k} < \sum_{t=k}^T c_t \left(\frac{1}{1+i_{t,k}} \right)^{t-k} \quad (\text{A4})$$

Note that if a contract is in default according to the (A1) criterion it will also be in default according to the (A4) criterion. The converse does not hold.

Of course, the actual stream of payments that will be made to the creditor(s) by the debtor $\{c_t; 1 \leq t \leq T\}$ is uncertain and will depend on the willingness and ability of the debtor to pay. The NPV of the debt contract at time k that is actually priced in the market, P_k , involves the use of the appropriate stochastic discount factors and is given by

$$P_k = E_k \sum_{t=k}^T c_t I_{t,k} \quad (\text{A5})$$

For a debt contract at high risk of default at time k , $\{c_t; T \geq t \geq k\}$, the market valuation of an alternative or revised contract $\{\bar{c}_t; T \geq t \geq k\}$ can be higher than the market valuation of the original contract, that is $E_k \sum_{t=k}^T \bar{c}_t I_{t,k} > E_k \sum_{t=k}^T c_t I_{t,k}$ even though the

repudiation by the borrower of the original contract by the alternative contract constitutes an act of default in the sense that (A4) or even (A1) holds.