On the contribution of game theory to the study of sovereign debt and default

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Abstract This paper reviews the lessons learned from the application of the tools of game theory to the theoretical study of sovereign debt and default. We focus on two main questions. First, we review answers to the most fundamental question in the theory of sovereign debt: given that there is no supranational institution for enforcing the repayment of debts, why do countries ever repay their debts? Second, we review theories of the process by which sovereign debts are restructured with a view to answering the following question: why does the process of sovereign debt restructuring appear so inefficient? The first question raises issues in the design of self-enforcing contracts and on the credibility of threats to punish a country in default. The second question involves applications of the theory of bargaining in environments where the parties to a bargain cannot commit to honour the terms of the bargain or even commit to enter into negotiations in the first place.

Keywords: sovereign debt, sovereign default, game theory, bargaining theory

JEL classification: C72, C78, F34, F55

I. Introduction

Sovereign countries have been borrowing money for thousands of years.¹ For much of this time, sovereign debt appears to have been the most widely traded financial asset, accounting for 76 per cent of the assets listed in the mid-nineteenth century on the London Stock Exchange, the largest financial market of the time (Tomz and Wright, 2013). Today, sovereign debt constitutes about 20 per cent of the world’s total financial assets (Roxburgh et al., 2011).

¹ The first recorded sovereign debts were loans made by temple authorities to Greek city states to fund military campaigns in the Peloponnesian War in the fifth century BC. The first recorded sovereign default occurred in 377 BC when 10 of the 13 Greek city states in the Attic Maritime Association defaulted on loans made by the Temple of Delos (Winkler, 1933).
The prominence of sovereign debt as a financial asset is remarkable in light of the doctrine of sovereign immunity, which makes repayment of these debts particularly difficult to enforce. Indeed, as a consequence of the doctrine, the market for sovereign debt can be viewed as the archetypal contract-enforcement problem. To understand why sovereigns ever repay their debts, as well as the nature of the interactions between a sovereign and its creditors in the event of a sovereign default, international economists have turned to the tools of game theory. In this paper, we review what international economists have learned about sovereign debt and default by using these tools.

We emphasize two main strands of the literature. In the first strand, international economists have drawn lessons from the game theoretic literature on the design of self-enforcing agreements in order to understand why sovereign countries ever repay their debts and, hence, why creditors ever lend to them. These tools have also found application in a diverse number of areas in which legal enforcement mechanisms are limited, such as developing country financial markets and the (illegal) collusive behaviour of firms. One key question arising from this literature is the extent to which the threat to impose a punishment, and in particular the threat to stop lending to a country, are truly credible. In light of this question, we review the literature on repeated and dynamic games of sovereign lending, with a particular focus on the design of renegotiation-proof sovereign debt contracts.

A criticism of the literature on renegotiation-proofness is that it appeals to the idea that the parties to a contract might desire to renegotiate, without placing any explicit structure on the renegotiation process itself. After all, if renegotiation is important to the question being asked, why is it not modelled explicitly? In response to this objection, the second strand of the literature that we review concerns the process of bargaining to restructure sovereign debts in the event of a default, which in turn draws on the substantial game theoretic literature on bargaining.

We argue that in the same way that international economists have learned a great deal from game theorists, game theorists can learn a lot from the study of sovereign debt. The market for sovereign debt has existed for a long time. This fact, combined with sovereign debt’s prominence as a financial asset, means that there is a wealth of data available on the terms of contracts that are agreed on by sovereigns and their creditors, the prices at which these contracts trade, breaches of these contracts, and the outcomes of negotiations to restructure sovereign debts. These data, combined with the ability of researchers to use archival research to probe the thought processes underlying the decisions made by participants in the market for sovereign debt, form one of the richest sets of observations with which to test the predictions of game theory.

II. Enforcement of sovereign debt obligations

In this section, we review the source of the enforcement problem for sovereign debt, as well as various theories as to how self-enforcing contracts can arise. We pay particular attention to the credibility of the strategies used to enforce repayment of debt, as well as the empirical evidence in support of these theories.
(i) **Sovereign immunity**

The doctrine of sovereign immunity is derived from the intuitive notion that a sovereign cannot be bound by laws that it makes itself. Traditionally, a sovereign could appeal to the doctrine to make itself immune from suit (and its assets immune from attachment) within its own jurisdiction. As a matter of convention, sovereigns grant this immunity to those foreign sovereigns with which they have friendly diplomatic relations.

Over time and as a result of the increasing involvement of governments in commercial transactions, this absolute version of the doctrine of sovereign immunity has been weakened into a more restrictive doctrine of sovereign immunity. Codified in the United States with the passage of the Foreign Sovereign Immunity Act of 1976, codified in the United Kingdom by the State Immunity Act of 1978, and accepted by the general assembly of the United Nations in the Convention on Jurisdictional Immunities of States and Their Property, the restrictive doctrine limits the immunity of a sovereign to acts of state, excluding its commercial activities. As debt issuance is recognized as a commercial act, foreign creditors now have the ability to bring suit against a sovereign in default on its debts at least in their own and other foreign jurisdictions. However, this ability is of value only to the extent to which the assets of the sovereign can be attached, and a number of recent court cases have suggested that it is difficult to seize the small stocks of assets held abroad by the average debtor nation. In one well-known example, the Swiss company Noga unsuccessfully attempted to enforce contracts with Russia by seizing embassy bank accounts, Russian properties in France, naval ships, fighter jets, uranium shipments, and fine art (Wright, 2001a; Dömeland et al., 2008; Kolb, 2011; Pitchford and Wright, 2012).

Why then do sovereign countries ever repay their debts? International economists have theorized that sovereigns repay in order to retain access to capital markets in the future or to avoid direct sanctions that can be imposed upon by them by members of the international community acting either in concert or individually. We next review the different versions of these theories.

(ii) **Sanctions and domestic economic costs**

In this sub-section, we review punishments that can be imposed upon a defaulting sovereign by the direct action of creditor country governments, or by the direct actions of creditors themselves. We refer to such direct actions as *sanctions* and note that they come in many forms.

One type of sanction affects the ability of a sovereign government and its citizens to access international capital markets. As noted earlier, market participants commonly refer to the loss of normal financial market access as one of the primary consequences of a country’s decision to default. Later, we review theories as to how this might arise in the equilibrium of a game between the sovereign and its creditors. However, here we consider the alternative possibility that the loss of credit market access may be the result of direct actions of creditor country governments. In the past, creditor country governments have imposed financial sanctions in the form of restrictions on the ability of their citizens to engage in financial transactions with the government or residents of a foreign country. One of the best-known examples concerns the U.S. restrictions on financial transactions with Iran. Following the hostage crisis in 1979, President Carter issued executive order 12170 freezing Iranian assets. Some of these assets remain frozen.
to this day. Likewise, Iranian financial institutions have been barred from directly accessing the US financial system. And although they may access US financial markets by using banks in other countries as intermediaries, in recent years the US government has worked to discourage this either directly through sanctions (for example, on Bank Saderat Iran; see Lawder (2008) for details), or indirectly.

While it is certainly possible that countries may repay their debts out of fear of financial sanctions, such sanctions remain rare and there is little evidence that sanctions of this type have been imposed directly in response to a default. An alternative possibility is that—the doctrine of sovereign immunity notwithstanding—creditors may use their own country’s courts to limit access of a sovereign to international capital markets. Although in general the ability to seize sovereign assets is limited by the fact that most of these assets are not held in creditor country jurisdictions, one asset that inevitably flows through creditor country jurisdictions is the funds associated with servicing new loans to the country. This approach has been adopted in two prominent recent court cases, both involving the hedge fund Elliott Associates. In the first case, which occurred in the late 1990s and involved Peru (for details, see Alfaro, 2006; Pitchford and Wright, 2012), Elliott Associates obtained a judgment in New York and convinced a Belgian court to halt the flow of debt service payments on Brady bonds, issued as part of Peru’s debt restructuring, through Euroclear. Peru—with its funds frozen and faced with the prospect of defaulting on its Brady bonds—agreed to settle out of court. In the second case, which is ongoing at the time of writing this article, Elliott Associates convinced a New York court to rule that Argentina could not pay debt service on bonds issued as part of its debt restructuring in 2004 (following its 2001 default) unless it paid the original defaulted bonds held by Elliott Associates in full (for more on this case, and the *pari passu* bond clause at the heart of the legal arguments, see Gulati and Scott, 2011; Wright, 2011). The outcome of this case is uncertain, and the legal mechanism underlying these two claims may be neutered by rewriting future sovereign debt contracts; however, it is possible that fears of such legal tactics may work to discourage default in the future. It is certain, however, that such concerns played no role in encouraging sovereign countries to repay their debts prior to the modern period.

Other sanctions may be imposed directly on a country and its economy without affecting a country’s ability to issue sovereign bonds. One possibility is that default may lead to restrictions on international trade (Bulow and Rogoff, 1989b). There is some empirical evidence that countries in default experience a significant decline in foreign trade (Rose, 2005; Borensztein and Panizza, 2010). However, it is not clear whether these declines reflect the imposition of trade sanctions, either explicitly or *sub rosa*, or whether they reflect the state of the economy at the time of default. Martinez and Sandleris (2011) find that default disproportionately depressed trade with non-creditors, suggesting that trade sanctions were not at work. Likewise, Agronovsky and Trebesch (2009) show that exports to creditors rose after debt restructuring. Similarly ambiguous evidence exists for earlier time periods (English, 1996; Tomz, 2007). Alternatively, declines in trade may be the result of lost access to trade credit facilities (Kaletsky, 1985; Kohlscheen and O’Connell, 2007). While it has been documented that commercial credit shrinks in the aftermath of default and that exports of sectors that depend on external credit tend to suffer the most (Zymek, 2012), other authors have concluded that the impact on commercial credit is brief and not sufficient to explain the total drop in trade (Borensztein and Panizza, 2009).
Alternatively, sanctions may affect other aspects of a sovereign’s international relations. For example, Cole and Kehoe (1998) model a mechanism in which default leads to the disruption of other kinds of international cooperation, echoing findings from the industrial organization literature on multImarket contact (Bernheim and Whinston, 1990). The concept of reputational spillovers seems plausible, and there is some evidence in favour of this hypothesis in the arena of environmental treaties (Rose and Spiegel, 2009); however, there is little indication that such spillovers exist in the closely related topic of foreign direct investment (Fuentes and Saravia, 2010; Tomz and Wright, 2010; Eden et al., 2012).

Finally, other possible sanctions could be more direct and dramatic. For instance, a country in default could become a target of military intervention. Many scholars have argued that this was common until the early twentieth century. For example, Oosterlinck (2013) writes that ‘military interventions to force repayment . . . were common up till the First World War’. Additionally, Finnemore (2003) writes that militarized debt collection was accepted practice until the Second Hague Peace Conference in 1907, while Mitchener and Weidenmier (2010) add that gunboat diplomacy was ‘effective and commonly used’ before 1913. Others have argued that creditor country governments did not use, or threaten to use, military force on behalf of bondholders. For example, Tomz (2007) maintains that even the most commonly cited example of military intervention to enforce a debt—the 1902 intervention against Venezuela—occurred because of tort claims, rather than debt default. Moreover, investors often lent to countries they had no chance of coercing, and debtors repaid militarily strong and weak creditors equally. We find the evidence presented by Tomz (2007) more convincing. However, regardless of the position one takes on these historical debates, all agree that countries do not use military intervention to enforce debt contracts today.

Besides the threat of various forms of sanctions, sovereigns may repay their debts to avoid costly consequences for their own citizens. There are numerous mechanisms through which this might occur. A default may impose direct costs on the economy of the defaulting country if it damages the domestic financial system by inducing a domestic banking crisis. More subtly, if a sovereign default leads to a cessation of issuance of domestic sovereign debts, and if these debts play an important role as collateral or as a hedging instrument, a sovereign default can lead to less intermediation and risk sharing by domestic residents (for a model of this phenomenon, see D’Erasmo and Mendoza, 2012).

Even absent a domestic financial crisis, if a country cannot discriminate among the holders of its debts, a default can result in large redistributions between domestic residents (see relatedly, Broner and Ventura, 2011). Guembel and Sussman (2009) capture this idea in a model wherein the sovereign is disciplined by the political process through the preferences of the median voter. Debt repayments to foreigners are enforced because the (domestic) median voter is a creditor who wants the sovereign to repay through a tax system that transfers funds from voters who do not hold sovereign debt.

Broner et al. (2010) construct a related model in which secondary markets may serve to reallocate bond holdings in such a way as to deter default by making the costs of default fall primarily on domestic residents. Thus far, evidence on this mechanism is mixed. For example, Waldenström (2010) studies bond markets during the Second World War, when capital controls segmented international markets, and finds that yields on Danish bonds were lower in Denmark than in Sweden. This is consistent with a model in which sovereigns can favour domestic over foreign investors. Likewise, sovereigns sometimes transform their debt stocks in ways that permit discrimination, as in
Argentina in 2000–1, which induced domestic residents to shift into new instruments, which received better treatment than the bonds foreigners continued to hold. In both cases, the ease with which the sovereign discriminated in favour of domestic residents is inconsistent with a model in which sovereigns repay all debts to avoid hurting domestic residents. In addition, some authors have argued that sovereigns frequently discriminate in favour of foreigners. For example, Erce and Díaz-Cassou (2010) analyse 10 recent defaulters and find that four discriminated against foreign creditors, three adopted a neutral approach, and three afforded preferential treatment to foreign creditors.

In light of the mixed empirical evidence in favour of each of these hypotheses, researchers have tended to focus on enforcement mechanisms driven by the desire of a country to retain future capital market access. We next turn to a study of such theories.

(iii) Retaliatory loss of capital market access

As noted previously, market participants frequently refer to the loss of normal credit market access as the primary cost borne by a sovereign that defaults on its debts. There are two main theories as to why credit market access may be lost, in addition to the adoption of legal tactics by creditors discussed earlier. Somewhat confusingly, both mechanisms are said to represent the loss of a country’s ‘reputation’.

In the first approach, emphasized in early work on sovereign debt by Eaton and Gersovitz (1981), creditors threaten to retaliate against a country in default by denying it access to financial markets in the future. As the response of creditors is conditioned on the past behaviour of the sovereign, this does capture one notion of reputation, although we refer to it as a retaliatory mechanism to avoid confusion with the other usage of the term reputation later (namely, reputational loss modelled as a sovereign being revealed as a ‘bad’ type). The retaliatory mechanism for supporting repayment has been analysed in a number of contexts, most notably by Kocherlakota (1996) who builds on earlier work by Coate and Ravallion (1993). Kocherlakota studies an environment in which two risk-averse agents face a random endowment and seek to trade with each other to smooth their consumption. Neither agent can commit to honouring promises, so that any trade needs to be self-enforcing for both agents (in the language of the literature, this is a ‘two sided limited commitment model’). Kocherlakota showed that in this two-agent world, out-of-equilibrium threats to retaliate by denying future capital market access could support positive amounts of trade and that these threats were credible in the sense of being part of a sub-game perfect equilibrium strategy. Kletzer and Wright (2000) studied a similar model, with one risk-averse sovereign and one risk-neutral international creditor.

Although threatened denials of future trade are credible in the sense of being sub-game perfect, such threats may not be credible in a deeper sense. The problem is that exclusion from financial markets leaves unexploited potential gains from trade in financial assets. As a result, the parties to the original agreement have a mutual incentive to depart from such an outcome. If it is anticipated that they will do so, this renders the initial threat not credible. Such a concern underlies the literature on renegotiation-proofness in repeated and dynamic games, and multiple formulations of the notion of renegotiation-proofness have been advanced in the game theory literature (compare Pearce, 1987; Bernheim and Ray, 1989; Farrell and Maskin, 1989; Ray, 1994).

In the case of sovereign borrowing and lending, concerns about the credibility of threats to deny access to international credit market turn out not to be a problem.
Kletzer and Wright (2000), for example, show that the same amount of trade that can be supported by the threatened denial of future trading opportunities can also be supported by strategies satisfying alternative definitions of renegotiation-proofness. Essentially, the problem with threats to deny capital market access is that they leave potential gains from trade unexploited. Kletzer and Wright show, however, that the same incentive for repayment can be generated by strategies that do not waste potential gains from trade. Specifically, if the sovereign defaults (that is, if it deviates from the equilibrium strategy), the creditor can refuse to trade with the sovereign unless the sovereign makes an up-front payment large enough to leave the sovereign with the same level of utility that it would have received if it were excluded from capital markets (an analogous argument works for the case in which a creditor deviates from the equilibrium strategy). As the utility of the country is the same as if it were excluded from future access to capital markets, the same incentive to repay exists. However, these retaliatory threats are credible in the sense of being proof to renegotiation by the players of the sovereign debt game because no gains from trade are being wasted.

A related and more problematic concern arises when there are other creditors that could trade with the sovereign if it is in default. Bulow and Rogoff (1989a) demonstrate a particularly strong version of this argument by establishing conditions under which a country could default, take the payments it would have made to foreign creditors, and invest them with foreign financial institutions to generate a higher level of welfare than they could obtain from future borrowing. Specifically, they show that to avoid the costs of default a country need only be able to save abroad using a rich enough menu of assets to be able to replicate the state-contingent cashflows implied by the original debt contract; it need not have future access to borrowing in international capital markets (it needs only future access to saving in international capital markets). They conclude that the threat of exclusion from future borrowing (as opposed to all future credit market access) is not sufficient to enforce repayment of debts.

A large literature has established the limits of the Bulow–Rogoff critique of retaliatory punishments. Much of the literature focused on whether or not a sufficiently rich set of assets is available. Pesendorfer (1992), for example, argues that it may be necessary to go short in one or more assets in order to obtain a rich enough set of savings opportunities for the Bulow–Rogoff critique to work, so that the threatened denial of access to borrowing (going short) would be sufficient to allow some borrowing in equilibrium. Likewise, Amador (2003, 2006) explores a variety of mechanisms under which a country is unable to commit to save for political economy considerations. In the absence of assets that permit a long-term savings commitment, such a country would not optimally exploit savings opportunities in the event of a default, thus invalidating the critique. Finally, in a version of Kletzer and Wright’s (2000) model with multiple risk neutral creditors that can all trade with the sovereign, the authors show that retaliatory threats survive because of the assumption of two-sided limited commitment, which means that creditors cannot commit to honour contracts and hence cannot offer the appropriate savings contracts (see also Cole and Kehoe, 1994).

Other research argues that whether or not sufficiently rich savings opportunities required for the Bulow–Rogoff results are readily observed in markets is irrelevant, because if there is demand, market participants are capable of constructing the appropriate asset. Specifically, because the required richness in assets means that the assets can replicate the cashflows under the original debt contract, and because market
participants were able to offer the original debt contract, they should be able to construct the required assets. The question then becomes whether creditors can coordinate to keep these contracts from being available, in equilibrium, to the defaulting sovereign.

To study this question, Wright (2001a) develops a model with a risk-averse sovereign that is unable to commit to honouring contracts and with many risk-neutral creditors that can commit to honouring contracts. In this one-sided limited commitment framework, creditors are able to commit to honouring a full set of savings contracts, making the kind of assets envisaged by Bulow and Rogoff feasible. Wright (2001a) shows that, even if there is intense competition among creditors (so that they all expect to earn zero profits), they can coordinate to credibly exclude a defaulting sovereign from access to credit markets. Coordination is facilitated by the fact that, even in a competitive market in which creditors expect to earn zero profits, lending contracts are associated with streams of payment in the future that have a positive value to creditors. That is, at some point in the future in some state of the world, the sovereign must be expected to repay. Hence, creditors can threaten to disrupt each other’s shares of these repayments (by offering the appropriate assets to the sovereign) if other creditors do not cooperate to punish a sovereign in default. For this to work, the creditors must appropriately divide up the cashflows associated with any single loan among all creditors (as in syndicated bank loans), or appropriately divide up the total cashflows associated with the borrowing of other sovereigns in which these creditors are engaged.

In all of the models discussed in this sub-section, default in the sense of a deviation from the equilibrium strategy does not occur in equilibrium. This is a reflection of the fact that sovereigns and their creditors in these models are assumed to be able to design contracts of arbitrary complexity under conditions of perfect information so that payoffs can be tailored to ensure default never occurs in any state of nature. If contracting flexibility is limited, events such as default can emerge in equilibrium (as in the discussion of price wars in the repeated oligopoly model of Rotemberg and Saloner (1986, 395–6)). Specifically, if the cashflows associated with borrowing and lending are limited in the extent to which they can vary across states of the world, default provides a partial (and costly) form of insurance that occurs in equilibrium (see Eaton and Gersovitz (1981) as well as its modern variants such as Aguiar and Gopinath (2006); Tomz and Wright (2007); Arellano (2008)). Likewise, modifications of these models to include asymmetric information may result in periods of limited or no capital flows occurring on the equilibrium path (see Hopenhayn and Werning, 2008; Dovis, 2013; Miller et al., 2013).

Moreover, since the theories primarily differ with respect to the sort of behaviour that can happen out of equilibrium, it is not obvious what empirical evidence can be brought to bear on these models. One approach, in the spirit of Greif et al.’s (1994) analysis of cooperation by members of merchants’ guilds, is to undertake archival research of the records of market participants at times when defaults were being contemplated, with a view to isolating the thought processes undertaken and, hence, potentially also the range of strategies considered by these market participants. Wright (2001b) provides one such analysis for the case of Spanish loans in London in the 1860s and argues that institutions that lent to Spain in violation of a market-wide embargo found that their other financial dealings were disrupted by creditors that respected the embargo. Similar evidence about the interactions of private creditors with a sovereign in default is presented by Drelichman and Voth (2011a). Further research exploring other cases of this type would be very valuable.
An alternative reason for the loss of credit market access following a default is that the decision to default reveals something negative about the country’s creditworthiness, thus leading creditors to reduce or cut off lending to them. We refer to this cost of default as the loss of a country’s reputation. For example, if there is incomplete information about the gains from sovereign borrowing—perhaps because the country’s value of future lending or the costs of default are unknown to the creditor—a default will lead creditors to infer that the country is a ‘bad type’.

Cole and Kehoe (1998) examine a model where there are two types of sovereign and where only the sovereign can observe its type. The ‘bad’ type will default whenever the discounted value of doing so exceeds the cost due to the loss of future loans. The ‘honest’ type suffers a large disutility from breaking contracts in general. This framework views the loss of reputation due to a default as being revealed not to be the honest type. Cole and Kehoe first show that, without the ability to save abroad, the loss of reputation and the consequent lack of access to future borrowing are enough to support borrowing in equilibrium as the borrowing horizon becomes infinite and even as the prior probability of an honest sovereign approaches zero. However, they show that the Bulow–Rogoff result of zero sovereign borrowing in the presence of saving with international institutions extends to this environment provided the loss of reputation is limited to the sovereign borrowing arena, which Cole and Kehoe refer to as partial loss of reputation.

If being revealed to be a bad type in one arena reveals the same information in other arenas, such as foreign direct investment or international political cooperation, a general loss of reputation occurs. As noted before when we discussed reputational spillovers, the empirical evidence for this is mixed, with some authors finding support from the arena of environmental treaties, while other authors have found little evidence in the context of foreign direct investment.

Richer versions of these models have also been produced. Tomz (2007) describes an environment in which some countries are ‘stalwarts’ and always repay their debt, some countries are ‘lemons’ that never repay, and others repay in an attempt to earn a reputation for repayment. He finds evidence for this pattern in a study of the history of sovereign borrowing over the past three centuries. Cole et al. (1995) study a variant of this type of model in which the surplus the sovereign obtains from access to financial markets fluctuates over time with changes in the country’s demand for borrowing that are unobservable to creditors. Their model produces a rich set of equilibrium dynamics, with defaults occurring on the equilibrium path and with improvements in the sovereign’s position being signalled to creditors via a payment that may be thought of as a debt restructuring settlement.

In all of the models discussed in this sub-section, the country’s reputation is understood as referring to beliefs about a fundamental characteristic of that country’s government that is related to the benefits and costs in the event of a default. However, a similar mechanism can work if the private information relates to some other aspect of the country. For example, suppose that the government has information on the true level of productivity of the country (perhaps because it is in charge of compiling economic statistics for the country). Such a government may repay debts in order to signal a country’s high level of productivity to creditors so that domestic firms retain access to capital markets, as in the model of Sandleris (2008).
III. Bargaining to restructure sovereign debt

Much of the literature reviewed thus far postulates a particular source of punishments for countries that default on their debts, and studies the extent to which these punishments support borrowing in equilibrium. An alternative literature takes the existence of borrowing as given, generates default in equilibrium by placing restrictions on the types of strategies that can be played by agents (as in Eaton and Gersovitz, 1981), and studies the process by which debts in default are restructured through negotiations between the sovereign and its creditors.

Before studying theories of sovereign debt restructuring, it is useful to summarize the empirical evidence on debt restructuring outcomes that has guided this literature. One of the most striking features of the process of restructuring of sovereign debts is that it is very time consuming. Using a standard definition of default (the one produced by the ratings agency Standard & Poor’s), Pitchford and Wright (2007) find that defaults commonly take around 6–8 years to be resolved, with a mean of more than 7 years and a median of a little over 6 years (see also Benjamin and Wright, 2008). Although other studies using different definitions of defaults have found a larger number of defaults of shorter duration, they also find that these defaults are closely correlated in time so that, even if individual defaults have short durations, the period during which access to capital markets is disrupted is far longer (see the review in Tomz and Wright, 2013).

The long periods taken to resolve defaults, along with the associated costly disruptions to capital market access and the domestic economy of the defaulting sovereign, seem very inefficient. This inefficiency appears all the more severe given that both creditors and debtors apparently gain little from debt restructuring. Benjamin and Wright (2008), for example, find that sovereign debtors that restructure their debts tend to exit default with a level of indebtedness at least as high as when they entered default (in terms of ratios of debt to gross domestic product (GDP)). Similarly, Sturzenegger and Zettelmeyer (2006), using a different measure of indebtedness, find that the form of the restructured debts typically implied relatively small gains, and in some cases losses, for the countries that defaulted.

At the same time, a number of researchers have found that creditors lose a substantial amount of the value of their claim following a debt restructuring. In the most careful study to date, Cruces and Trebesch (2013) estimate that creditors lose roughly 40 per cent of the value of their investment as a consequence of debt restructuring. This rises to roughly 50 per cent when losses are compounded across neighbouring default events (Benjamin and Wright, 2008).

Given these findings, researchers have sought to understand why these outcomes are so inefficient. In this section, we review alternative game theoretic formulations of the debt-restructuring process that seek to answer this question.

(i) Asymmetric information

Game theorists have long tried to understand why agents—in contexts as varied as labour disputes, political impasses, and debt restructuring—seem to find it difficult to reach agreements that appear to be mutually beneficial. Indeed, this is one of the greatest puzzles addressed by bargaining theory. Perhaps the most commonly cited
explanation is that there is an asymmetry of information between the parties to bar-
gaining. In the case of negotiations to restructure sovereign debt, a debtor country is
likely to have more precise information about the political and economic costs it would
face by agreeing to a settlement than do the creditors. Likewise, creditors are likely to
have more information about the state of their balance sheets and the set of alternative
investment opportunities they face. In such a world, neither party knows the value the
other party places on agreeing to a settlement.

A number of formulations of bargaining in the presence of so-called two-sided asym-
metric information have been presented. Cramton (1992) studies a two-sided asymmetric
information version of Admati and Perry’s (1987) bargaining model in which the
time between offers is chosen endogenously by the bargaining parties. In such a world,
delay serves to reveal information about the value each player places on a settlement,
with each party becoming more pessimistic about the other party’s valuation as time
goes on. Delay is informative because the more the player values agreement, the more
costly is delay. When offers are eventually made and accepted in such a world, the valu-
ations of both creditor and debtor are revealed.

Delay in these games is socially inefficient, which begs the question of whether there
may be less costly alternative means of revealing a player’s private information. In a
related context, Hörner and Sahuguet (2011) show that the ability to signal one’s type
by committing resources (other than through the time cost of delay) acts to essen-
tially eliminate delay. One implication for policy-makers is that they should investigate
mechanisms that allow for faster, less socially costly means of revealing information.

There has been relatively little empirical research assessing whether information
asymmetries appear to be relevant in explaining the observed delays in sovereign debt
restructuring. One finding, which is suggestive rather than being definitive, is that delays
and creditor losses are partially predictable using information on GDP that is readily
available at the beginning of negotiations (Benjamin and Wright, 2008). Although this
does not rule out a role for asymmetric information as a cause of delay in bargaining,
it does suggest that alternative models that are consistent with this predictability are of
value. We now turn to such models.

(ii) Symmetric information models of delays in bargaining

Symmetrically informed parties clearly do not learn anything from their rival by adopt-
ing a strategy of delay. Removal of this motive might lead one to think that immediate
agreement will ensure. However, Merlo and Wilson (1995) found that it might be efficient
to delay reaching agreement if the size of the surplus to be split can grow in the future.
The idea that this model might be used to explain delays in sovereign debt restructuring
was first postulated by Merlo and Wilson (1998) themselves. However, there was no
attempt to connect the (somewhat abstract) bargaining model with the details of the
sovereign debt restructuring case. Importantly, in both of these papers, the surplus over
which the parties bargain varies exogenously according to a stochastic process. It is the
fact that this surplus may grow at a rate faster than the discount rate of the parties to the
bargain that generates socially efficient delay in Merlo and Wilson’s model.

Efforts to analyse sovereign debt restructuring within a Merlo–Wilson framework
were made in a series of papers by Marcus Miller and his co-authors. Miller and
García-Fronti (2005) take the exact Merlo and Wilson (1998) model and calibrate parameter values to match Argentina’s 2004 restructuring. This argument is further developed in Dhillon et al. (2006). In both papers, the size of the surplus is calibrated to match public statements by the parties on their bargaining positions as to the size of the recovery rate (the resulting surplus amounts to 2.64 per cent of Argentina’s GDP). Importantly, the analysis assumes that an early settlement locks in a permanently lower level of output, whereas delay generates a permanently higher level of output. That is, delay is not just privately optimal for the debtor and creditors, it is also socially optimal.

In all of the papers discussed in this sub-section, fluctuations in the surplus from bargaining occurred exogenously, and led to socially efficient delay. This efficiency seems in stark contrast to the data on sovereign debt restructuring outcomes discussed earlier. Several recent papers exploit elements of the Merlo–Wilson framework to produce socially inefficient delays, even though delay is privately optimal for the creditor and sovereign debtor, and we describe them next.

(iii) Limited commitment to honour debt-restructuring agreements

An alternative explanation for delays in bargaining over debt restructuring is based on the limited enforceability of contracts. In particular, if agreement to a debt restructuring produces benefits for the country, both at the time of settlement and in the future (possibly as the result of better future capital market access), creditors will bargain in order to obtain a share of these future benefits. If agents are patient, these future gains are likely to far exceed current gains. However, for the very same reasons that the sovereign is in default in the first place, the sovereign is unable to credibly promise to share these future benefits with creditors. Instead, the debtor can only promise to share these gains with the creditor by issuing debt as part of the settlement. However, such debt may not be very valuable if the creditor perceives that the debtor will likely default on it. Thus it may be privately optimal for creditors to wait until future default risk is low before agreeing to a debt restructuring.

Benjamin and Wright (2008) formalize this intuition. They show that the mechanism is further strengthened by the fact that reaccess to international credit markets is more valuable to the country when future default risk is low (because the country can borrow on better terms), giving the parties another reason to delay. The determinants of future default risk include the evolution of the sovereign’s economy, the evolving political trade-offs within the economy, and the evolving institutions governing debt restructuring that affect the relative bargaining powers of the parties. For example, Benjamin and Wright (2008) argue that the development of official lending into private arrears reduced creditor bargaining power and prolonged the 1980s debt crisis. Benjamin and Wright (2008) show that a calibrated version of their model can explain long delays and large haircuts, as well as the fact that the level of indebtedness to private creditors typically does not decline following a settlement.

Relative to the Merlo–Wilson framework, in the Benjamin and Wright (2008) model, the surplus over which the sovereign and its creditors bargain is determined endogenously. In Benjamin and Wright’s model, fluctuations in the likelihood of future default risk drive fluctuations in the size of the surplus and, specifically the possibility that future default risk may decline, which in turn drives delay. In a related paper, written...
contemporaneously, Bi (2008) also modifies the Merlo–Wilson framework with a surplus that endogenously fluctuates with the level of current resources in the economy (in her model, debt is not issued as part of a restructuring, and hence future default risk has no direct impact on the value of the settlement to creditors, although it may indirectly matter by increasing the value of capital market access to the sovereign). Both of these approaches show promise in terms of matching the data on debt restructuring outcomes. Neither speaks to the concerns of policy-makers that it is the inability to coordinate groups of creditors that results in delays. We next turn to a model that does address these concerns.

(iv) **Limited commitment to enter bargaining**

In the models discussed in the previous sub-section, creditors were assumed to be able to perfectly coordinate when negotiating with a sovereign debtor in default (so that the sovereign bargained with a representative creditor). In practice, creditors often find it difficult to coordinate; some creditors accept a debt restructuring offer, others reject it and wait for a better offer, and still others resort to litigation to encourage full repayment. Direct evidence for the importance of this issue can be found in the large number of recent policy proposals suggesting changes to sovereign bond contracts designed to make the coordination of groups of creditors easier (see, for example, IMF, 2013). Indirect evidence comes from studies of corporate debt restructuring that find that when a large investor such as a private equity fund is involved, debt restructuring proceeds more quickly, with less litigation, and is more likely to result in the survival of the firm than when no large investor is involved (Hotchkiss et al., 2012).

There are at least three reasons why creditors may have an incentive not to coordinate when negotiating with a sovereign, even though collectively all would be better off by coordinating. We refer to this incentive problem as the inability of creditors to commit to entering bargaining.

The first reason why creditors may not coordinate is the possibility of free-riding in the provision of debt relief. This was a major concern during the debt crisis of the 1980s, where it was believed that sovereigns faced a debt overhang problem. Debt overhang refers to a situation in which a country’s debt level is too large to be repaid in full, leading to suboptimal decisions by both the country and its creditors. From the perspective of the country, if creditors are able to extract the bulk of any future increase in revenues, the country will have no incentive to make investments that increase its future income and, hence, the value of the creditors’ claims. This problem can be removed if creditors write down their debt to the level where the country retains enough of the extra income to be persuaded to make the investment, but still leaves creditors with a more valuable settlement. However, if creditors cannot coordinate in writing down their debts, then individual creditors have an incentive to free ride on the write-downs of other creditors. Models of this phenomenon were provided by Krugman (1988), among others.

A variety of informal mechanisms between creditors arose to deal with this problem, albeit imperfectly. Bank advisory committees were set up in which representatives of the major bank creditors were responsible for convincing smaller banks to participate in the restructuring process, among other things. A number of different methods were
used. Devlin (1989), for example, argues that large banks used their contact with these smaller banks in other markets as an inducement to participate. Milivojević (1985) refers to such incentives as working through the ‘network of influence’ large banks have on small banks which includes threats to exclude free riders from future syndicates, terminate correspondent banking facilities, or cut interbank lines of credit. In addition, although it is difficult in general to discriminate explicitly, in some cases debtors appear also to have discriminated against free-riding banks during a restructuring (Cline, 1983; more generally, see the discussion in Lipson, 1981, 1985). All of these informal methods are imperfect, and a challenge for any future debt-restructuring process is to ensure full participation in order to remove this incentive to free ride.

More recently, a second reason for lack of coordination has arisen in the aftermath of successful litigation by minority creditors against sovereigns in default, such as the Elliott Associates cases discussed earlier. Recent research has focused on the incentive of some creditors to engage in what has been termed ‘strategic holdout’, in which a subset of creditors does not participate in a restructuring agreement in order to engage in later litigation. If such litigation is able to hold up the restructuring, these creditors might be able to extract more generous terms from the sovereign, which is likely to slow down the restructuring process more generally.

The result of successful early legal actions against sovereigns has been a substantial increase in such litigation, with more than 50 cases filed by commercial creditors over the past decade against highly indebted poor countries (IMF and World Bank, 2005). Given holdout creditors have earned very high returns (see Singh, 2003) their successes have led to a greater incentive to holdout from the regular restructuring process. A number of policy proposals have been advanced to deal with this problem; the most notable among them is the introduction of collective action clauses that allow a supermajority of creditors to impose common restructuring terms on minority holdouts. These clauses have now become standard in bonds issued under New York law.

Game theoretic models of the strategic holdout incentive have been developed by Pitchford and Wright (2007, 2012). They also use the models to study the effect of changes in the contractual form of sovereign debts, including the introduction of collective action clauses in international bonds designed to bind holdout creditors to accept majority settlements. They find that these models are able to explain the amount of delay observed in the data. Moreover, they find that the implementation of such clauses will, in most cases, reduce the cost of default ex post by reducing the socially wasteful costs of default. They also find that the implementation of such clauses may nonetheless raise the welfare of borrowing countries ex ante despite adverse effects on the incentive of a country to default.

Pitchford and Wright (2012) also find that, in some cases, collective action clauses will increase delay. This comes about because of a third collective action problem—the potential for free riding on negotiation costs. In particular, when collective action clauses are used to impose common settlement terms on creditors, they also reduce the latitude for discriminatory settlements to be used for compensating creditors that take the lead in negotiations and, by consequence, bear the brunt of the costs for negotiations. Pitchford and Wright (2012) provide evidence that these costs are large—in excess of 3 per cent of the value of a restructuring in some complicated restructuring cases—and are in many cases hard to verify and thus difficult to compensate directly.
through reimbursement of expenses. Thus collective action clauses may work to remove
the ability of creditors to hold out for full repayment, but they may also exacerbate the
incentive for creditors to free ride on negotiation costs.

IV. Conclusions and policy implications

As a result of the legal doctrine of sovereign immunity, sovereign debt faces the archetypal enforcement problem. The environment in which trade between sovereigns and their creditors takes place is relatively unstructured, and the issues that arise in thinking about sovereign borrowing and sovereign default are particularly amenable to treatment using the tools of game theory. In this paper, we have reviewed the progress made by theorists on two basic questions from the field of sovereign debt that are amenable to analysis using the tools of game theory, and attempted to assess the empirical evidence relevant to these issues.

Approaches to answering the first question—why do countries repay their debts?—typically take the form of the incentive to repay debts as given and study the strength of that incentive in terms of its ability to support sovereign borrowing. Different theories have been postulated as to why sovereigns repay their debts: trade sanctions, military intervention, and disruption of other forms of international cooperation, as well as threatened denials of future capital market access. Although empirical research into the relevance of each of these mechanisms has not yet been proven conclusively, there is an emerging consensus that the threat of losing future capital market access is the primary incentive for sovereigns to repay, although there remains considerable disagreement as to the mechanism by which this denial of credit is supported.

Approaches to answering the second question—why are the outcomes of sovereign debt restructuring negotiations so inefficient?—typically take the existence of borrowing and default as given and study the effect of different bargaining environments on restructuring outcomes. The leading theories have postulated the following as the primary determinants of delay: asymmetric information, the inability of sovereigns to commit to honouring the outcomes of debt restructuring negotiations, and the inability of creditors to commit to enter into such negotiations in the first place. There has been a significant amount of quantitative theoretical research aimed at assessing the ability of these mechanisms to explain observed restructuring outcomes. At the moment, we have several theories that are consistent with a number of facts, and future work will need to derive and test alternative predictions of these models with a view to discriminating among them.

Game theoretic research into these questions has also generated recommendations for policy-makers. As noted before, game theoretic analyses of sovereign debt restructuring have indicated the potential for collective action clauses to actually worsen delays in reaching agreement on a restructuring, although they have been a central component of recent policies to reduce delays in sovereign debt restructuring (for example, Eurogroup, 2010). Quantitative applications of this theory have also allowed policymakers to evaluate the trade-off between policies that reduce the cost of default ex post, and the effect they have on the incentive to borrow appropriately and avoid default ex ante. These evaluations may help determine the conditions under which collective action clauses may reduce delay and increase welfare.
Moreover, the analysis of incentives using game theory has also pointed to problems with the implementation of some recent policy proposals. For example, recent debt restructurings involving aggregation clauses—which allow a supermajority of creditors holding different debt instruments to form an agreement that binds holders of all debt instruments—have allocated voting rights in proportion to the face value of the outstanding debt securities. But Wright (2012) and Dias et al. (2012) have illustrated how creditors and the sovereign may manipulate their debt issuance to maximize voting rights in the face of such clauses, and have proposed alternative allocations of voting rights to correct for this problem. Similarly, Wright (2012) points to the problem of pre-default restructuring in the presence of credit default swaps, which can result in a situation in which some creditors in debt restructuring negotiations are indifferent to the outcome.

Finally, in the same way that researchers in the field of sovereign debt have benefitted from the insights of game theory, we argue that there is much that game theorists can learn from the study of sovereign debt. Most obviously, the importance of sovereign debt as a financial asset has ensured that there is a substantial amount of information available as to the prices and quantities of sovereign debt in existence over a long time period. In addition, the long history of borrowing and default means that we are able to study the effect of slow-moving international institutions on the nature of interactions between sovereign debtors and their creditors. Perhaps more subtly, a study of sovereign debt allows researchers to probe more deeply the underlying strategic rationale for observed actions by the sovereign and its creditors. One of the great challenges to an empirical study of game theory is the fact that much of the theory depends on out-of-equilibrium behaviour by players, and yet by its very definition such behaviour is not observed. The fact that both sovereigns and their creditors have traditionally kept substantial records of their borrowing and lending processes means that careful archival work may be able to inform researchers of the kind of out-of-equilibrium behaviour that players were contemplating when arriving at their equilibrium strategies. Some progress along these lines has already been made (see Drelichman and Voth (2011a,b); much of the work of Flandreau and his co-authors, such as Flandreau and Flores (2009) and Flandreau et al. (2009); and Wright (2001b)).

References


\[2\] The recent Greek debt restructuring is an example where an aggregation clause was used.


On the contribution of game theory to the study of sovereign debt and default


On the contribution of game theory to the study of sovereign debt and default