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WILLINGNESS TO PAY AND THE SOVEREIGN DEBT CONTRACT

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This paper uses a contract theory model to argue that covenants ruling debt renegotiations are important to assure the sovereign willingness to pay. The model includes the following features: first, collective action clauses, exit consents, aggregation provisions and pari passu clauses play an important role in the post default "game" of negotiations and coalitions. These covenants are represented in reduced form by the endogenous probability of refinancing a defaulted sovereign debt. Second, the model has "endogenous bad luck" because the unfavorable state of nature where default occurs depends on the level of indebtedness, which is itself an endogenous variable. Third, "vultures", contrary to conventional wisdom, tend to improve the access of emerging economies to capital markets because they might help to rule out strategic defaults. And fourth, under special assumptions the model is able to analyze the possibility of post default discrimination between domestic and foreign bondholders.

JEL classification codes: H63
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I. Introduction

Several models of corporate finance have evaluated the standard debt contract and derived second best results as a consequence of asymmetric information and verification costs. Incentive constraints have been incorporated to rule out strategic defaults and to assure debtor's willingness to pay. Some of these models could be extended to consider the case of a sovereign debt contract, but with several caveats with respect to the possibility that sovereign debt contracts can have the same effective legal mechanisms than private agents in case of financial distress. The economic literature has analyzed the legal mechanisms of the debt contract

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emphasizing the events where most sovereign debt creditors were large commercial banks. Collective action problems were limited by the relatively small number of large creditors, the relative homogeneity of commercial bank creditors, and the contractual provisions of syndicated loans containing strong pari passu clauses promoting negotiated settlements. Creditors were represented by a steering committee performing a number of functions, among them: resolution of intercreditor problems, assessment of the acceptability of the offers made by the sovereign, and the preservation of confidentiality (Krueger 2002).

The financial crisis of the 1980s induced modifications in bank regulations (Basel Capital Accord Regulations) adjusting minimum capital requirements on risky assets, and requiring higher capital adjustments in lending to sovereigns in emerging economies. The new regulations moved commercial banks away as a source of external finance for emerging economies, and commercial banks' syndicated debt contracts were replaced by the debt contract of sovereign bonds.

There are a number of strands in the literature focusing on country risk and sovereign debt. One strand proposed by Eaton and Gersovitz (1981), Calvo (1989), and Bulow and Rogoff (1989) evaluated sovereign debt contracts with penalties. These could be either the result of a potential loss of future access to capital markets or trade sanctions, especially when affecting short term trade financing. The identification of the form and the real size of the penalty affecting actual or potential output has been reviewed by Eaton, Gersovitz, and Stiglitz (1986). There is no doubt, at the empirical level, that all defaults have been "penalized" by significant output loss in at least one year following default.

Calvo and Kaminsky (1991) proposed an optimal contract model assuming that bank syndicates and debtor countries entered into implicit debt contracts charging a risk premium entertaining the possibility of a borrower's default. Contrary to the strand of literature emphasizing debt overhang, their model assumes full coordination between banks and debtors in designing optimal contracts and debt relief is consistent with full precommitment situations.

Another strand of research involves the role of the IMF. A recent paper by Weinschelbaum and Wynne (2003) addresses some of these issues incorporating the implicit IMF guarantee when acting as a lender of last resort, while Corsetti, Guimares and Roubini (2003) proposed the IMF as a contingent liquidity assistance provider to induce the sovereign to undertake costly reforms.

The model discussed in this paper is an extension of the optimal contract literature, but with an ex ante explicit recognition of ex post bargaining coalitions without IMF intervention. The highly stylized contract theory model developed here will attempt to address these issues following a research line by Diamond (1993)**,** and Bolton and Scharfstein (1996) –among several others in the corporate finance literature– where debt contracts are determined by ex post bargaining considerations. An important difference with respect to the related previous literature on sovereign debt is the introduction of "endogenous bad luck" by incorporating the level of indebtedness as an argument in the probability of an adverse state of nature.

II. Legal provisions for sovereign debt

It has been argued that the absence of a "steering committee" representing bondholders that provides for majority actions among a diverse set of creditors is a primary source of difficulties. A sovereign that obtained the support of a qualified majority of its creditors for a restructuring that could restore sustainability would lack the ability to bind in a minority that may hope to free ride and continue to receive their contracted payments. Individual creditors may consider that their best interests would be served by trying to free ride in the hope of ultimately receiving payments in line with their original contracts. Bratton (2004) illustrates the free ride problem with the case of Elliot vs. Republic of Peru. Elliot, a "vulture fund" specializing in obligations of distressed borrowers purchased US dollars $20.7 million face amount of Peru's 1983 debt at the discounted price of $11.4 from two international banks at the time the restructuring negotiations were ongoing. Elliot brought an action to enforce the debt at face value in the Southern District of New York, a focal point venue in the emerging world of sovereign debt enforcement. Elliot emerged from the Southern District with a judgment of $55.7 million. It was thought that such judgment had value only to the extent the creditor could identify property of the defaulting sovereign in the jurisdiction of the judgment or another jurisdiction willing to levy execution; but that was not the case. Elliot relied on the 1983 debt contract's pari passu clause, which provided as follows:

> The obligations of the Guarantor hereunder do rank and will rank at least pari passu in priority of payment with all other External Indebtedness of the Guarantor, and interest thereon.

When Peru was about to dispatch a large payment on its Brady bonds to European holders via Euroclear, Elliot, in an ex parte proceeding, persuaded the Belgian courts to block the payment on the ground that the pari passu clause gave the holders of the 1983 debt the right to participate pro rata in Peru's payments to other foreign creditors. Peru, not wishing to default on its Brady bonds, paid Elliot in full.

From the 1980s to the 1990s the debate on effective mechanisms to restructure the debt of nations in financial distress did not emphasize the sovereign debt contract and evolved in the direction of involving the official sector in generalized bail-outs, but moral hazard considerations changed the directions of the debate towards market oriented solutions involving the private sector in the open capital markets. This new approach has not been widely acknowledged, and representatives of the official sector in international organizations have permanently complained about the reluctance of private lenders in accepting haircuts as a necessary contribution to complement a package of limited official resources to alleviate the financial conditions of distressed borrowers. Most of the time the private sector would argue that the legal provisions of standard debt contracts are needed to assure international lending to emerging economies

Legal provisions under the law of the state of New York that provide for unanimous action clauses (UACs), requiring approval of a hundred per cent of bondholders before any hair-cut is enacted, makes it difficult for bondholders to provide relief to the sovereign issuer in times of liquidity crisis because just one holdout may cause efforts to modify the payment obligations of a bond to fail. Holdouts reflect both: the existence of agents with different perceptions regarding debtor's willingness to pay, as well as the existence of differences in litigation technology. The case of Elliot in Peru, as well as several other examples of holdouts, illustrates that vultures are significant players in most defaults because they seem to be extremely efficient to contest in legal proceedings. In contrast, bondholders are regular investors seeking stable returns through a diversified portfolio and are not akin to vultures, which target defaulted exposures relying on the efficiency of their own economic analysis as well as in their litigation and holdout ability. Vultures are speculators in financial markets and perform similar functions as speculators in commodities markets. Although severely criticized, vultures are willing to work at the extremes providing liquidity to defaulted assets at the very time when everybody is considering selling the asset.

Also working at the extremes is the International Monetary Fund (IMF) providing liquidity to countries in financial distress, and on the verge of loosing access to capital markets. Curiously enough, many academicians seem more prone to accept vultures as welfare enhancing but not the IMF.

There are two groups of critics of the IMF: on the one hand are those who consider the IMF as not aggressive enough in providing liquidity, thinking that financial distress is the result of weak aggregate demand and should be corrected with more government spending, more borrowing, and fiscal expansion; on the other hand are those considering that the IMF intervention implies a serious moral hazard for the official sector, and in some instances improper liquidity assistance helped to postpone structural reforms financing capital flights aggravating the severity of the crisis. For this last group the IMF seems to act as a natural predator to vultures, on the one hand providing liquidity when nobody would, except vultures, and on the other hand urging sovereign bond issuers to modify their contracts enabling easier restructurings through majority actions, or collective action clauses (CACs), instead of unanimity clauses. Supposedly these modifications would help the extinction of most vultures' holdouts (Krueger 2002).

But sovereigns, investment funds, and some economic research argued that sovereign immunity plus weak CACs could accelerate the extinction of both, vultures and international private lending to emerging markets. The argument is that UACs, and other contractual provisions affecting the probability of successful renegotiation, enforce the debtor's willingness to pay. Allowing partial coalitions of bondholders to relax incentive constraints would weaken the willingness to pay, jeopardizing international capital flows to emerging markets.

To evaluate the coalition possibilities, either in restructuring or in the post default negotiations, it is necessary to understand some of the intricacies of the legal provisions in debt contracts, in particular, it is important to review other provisions denominated "exit consents". These are other contractual clauses covering matters such a negative pledges, governing law, submissions to jurisdiction and listing provisions that can be used to circumvent the unanimity requirement. Changing these clauses requires in some cases simple majority, in other cases, it requires 66.66% of the outstanding bonds.

Choi and Gulati (2003) have evaluated a sample of 50 bond issuances governed under New York law including samples of Ecuador, Uruguay, Argentina and other emerging markets economies and have found that exit consent offers several possibilities of strategic coalitions of players, some of these coalitions have already facilitated the restructuring of Ecuador, and possibly will rule the post default negotiations of most future defaults of sovereigns issuing bonds with UACs.

To illustrate, imagine the case of outstanding bonds having UACs covering just payment dates for principal and interest, and the sovereign in financial distress has managed to work out a coalition with a majority of domestic bondholders to enact a restructuring deal. The government might use implicit side payments, for example, allowing domestic commercial banks some creative accounting registering bonds at nominal values instead of mark to market, which would implicitly reduce the Basel capital requirement. Suppose that external bondholders in coalition with vultures refuse to go along with an exchange bond deal because they have expectations of a better deal. Exit consents could be used by the sovereign in coalition with domestic bondholders prior to their exit from the old bonds. Through exit consents, domestic bondholders exchange their old bonds for the new restructured bonds simultaneously consenting to changes in the terms of the old bonds not covered under UAC provision. Through changes in the governing law, listing provisions and other terms, the exit consent procedure can diminish dramatically the value of the old bonds. Exit consent could change the governing law from New York to that of the home country which could be less sympathetic to holdout behavior and would make it harder for the holdouts to sue. Alternatively, exit consent may be used to rescind the issuer's waiver of sovereign immunity or its consent to jurisdiction in New York[1], both of which would complicate the ability of holdouts to bring suit to enforce their rights under the old bond covenant. Using the exit consent technique in August 2000, Ecuador was able to impose on bondholders a 40% write off on a total debt of $6.5 billion for six different bonds. The bond exchange concluded successfully, even with some vulture's actions, although Ecuador had to assume a market penalty, as it was unable for five years to achieve a B-minus status from Standard & Poor's rating agency.

After Ecuador, collective action clauses became more acceptable for financial actors. Mexico was the first, in a series of other emerging market economies, to

[1] Changing jurisdiction from New York to Argentina , dollar denominated bonds could be converted to pesos, and immediately after conversion the government could devalue the domestic currency. The Argentine Supreme Court judgment of April 5, 2005, declared "constitutional" an Executive Decree during the default crisis of 2002 converting US dollar denominated bonds to pesos, and subsequently the exchange rate was devalued 300%.

introduce in early 2003 collective action clauses in their New York law bonds. Mexico's bonds allowed 75% of holders of the bond to amend its financial terms. Brazil included provisions that required the support of 85% of bondholders to amend the bond's financial terms, and has recently announced it will lower the threshold to 75%. Uruguay went even further. After restructuring its debt (applying the exit consent technique of Ecuador) Uruguay included aggregation clauses in the new bonds. The "aggregation" provision allows, at the discretion of the issuer, the votes of the different bonds issued as part of Uruguay's exchange to be pooled. In the aggregated voting process the pooled votes of 85% of the outstanding principal of all relevant bonds is binding on the holders of each bond, so long as at least 67% of the holders of each individual bond issue also support the restructuring (Roubini and Setser 2004).

UACs, CACs, "exit consents", and "aggregate provisions" work jointly with pari passu clauses. Bratton (2004) has done a penetrating analysis on pari passu clauses and has identified two readings of the clauses: the broad reading and the narrow reading. The broad reading is the Elliot judgment of the Belgian court in the case of Peru, and has been the focus of strong criticism claiming that sovereign debt contracts do not contemplate enforcement actions of the sort applied to Euroclear. These critics also argue that compositions make the majority of cooperative bondholders better off because they help to cure distress. Accordingly, it would not be rational for bondholders to assent to debt contracts that held out encouragements to opportunistic holdouts like Elliot. Contrariwise, the narrow reading does not extend the right of payment asserted by the vultures. An "ultra narrow" reading is the latest (January 2005) Argentinean proposal excluding from any payment regular bondholders that would vote against the proposal. By April 2005 the "ultra narrow" reading excluded 24% of bondholders and the Argentinean officials declared that the excluded bondholder would not be considered during the present administration that is until 2007.[2]

[2] Although this paper has been strongly motivated by the intent of modelling some aspects of Argentina's default (December 2001), we are unable at this stage to include a full evaluation of events because the default is far from concluded. Until late 2005, the IMF (as well as the G7) does not consider "normal" the outstanding Argentina's debt until a solution is arrived with the 24% of bondholders that did not accept the bond exchange. It would seem that the international community would not be willing to accept the "ultra narrow" reading of pari passu covenants as interpreted by the Argentine government.

Modifications recently introduced in the Belgian Law would imply that the pari passu interpretation for Peru will not be available for Argentina where the 76% majority accepted a bond exchange with a hair cut of 65% on defaulted bonds worth $81 billion in December 2001. On historical records this was a giant debt swap involving 152 varieties of paper denominated in six currencies and governed by eight jurisdictions. Although not necessarily through Belgian courts, litigation should be forthcoming in the near future in several jurisdictions that will stress test the language of debt contracts and legislation. And there is some evidence suggesting that the prospect of such litigation will invariably undermine the sovereign's ability to reach a definite agreement with creditors, keeping open the ongoing debate on sovereign debt restructuring.

III. The complete and incomplete debt contract

A simple method for analysing the government's willingness to pay is to imagine that a sovereign asks for a loan to a creditor promising to repay *b*, which represents the nominal value of the sovereign bond at expiration date. The debtor owns *k* liquid assets (with $k<1$) but needs to borrow $1- k$. In addition, assume that the creditor has the option of an alternative investment at a risk free rate *r*.

The sovereign, using its own and borrowed resources, generates an economic and social environment that can produce a fiscal primary surplus, which is used to repay the capital and interests on the amount borrowed. This amount can be produced in two periods in the following way: imagine the debtor's country GDP resulting from two sectors: the first sector is an agricultural sector where the "crop" is collected in the first period, and the other sector is non-agricultural and produces in the second period.[3] Therefore the first period primary surplus is random (because output is random), and the second period primary surplus is deterministic. The idea is to reproduce a typical "external shock" of the sort affecting countries where government revenues are dependent on some commodities like soybeans in the case of Argentina or copper in Chile. In a favorable state, the primary surplus obtained in the first period is enough to pay the outstanding debt. In an unfavorable

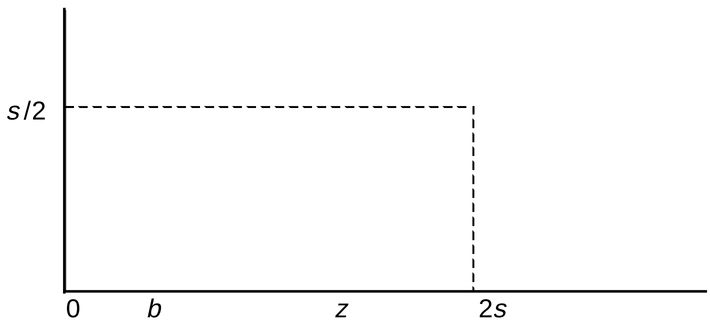
[3] This modeling for output has been developed by Bolton and Scharfstein (1996), and Dooley and Verma (2002).

state, the first period primary surplus is not enough to pay the debt, and the second period primary surplus is used to cancel the outstanding debt.

Suppose that the first period surplus, z, has a uniform distribution in the interval [0; 2s]. Note that z is random with expected value, $E[z]$, equal to s, but in the second period is a predetermined variable of value s.[4] If perfect information exists, and both debtor and creditor are risk neutral, a debt contract is possible where, in good states of nature, the creditor expects to receive an amount b, equal or higher to $(1\text{-}k)(1+r)$.

As z is uniformly distributed, if the realized primary surplus z exceeds the nominal value of the bond b (as shown in Figure 1), a favorable state occurs. Therefore, the probability of a favorable state is: $\theta(b)= (2s\text{-}b)/2s$ and the probability of an unfavorable state is $1\text{-} \theta(b)=b/2s$.[5]

Figure 1. Favorable and unfavorable states for debt service



[4] The uncertainty of the first period output based on uniform distribution was analysed for the case of a private firm by Romer (1996), following the theoretical framework proposed by Gale and Hellwig (1985). Fernández (2003) extended the analysis to the case of a sovereign debt. The fact that the expected primary surplus of the first period and deterministic surplus of the second period are equal is unsubstantial.

[5] In Bolton and Sharfstein (1996), Dooley (2000), and Dooley and Verma (2002) the state probability is exogenous reflecting different kinds of shocks (as weather, or sudden stop of capital inflows as in Calvo, Izquierdo, and Talvi (2002), while in this model the probability is endogenous and depends on the nominal value of the bond. That is, the higher the level of indebtedness, the higher the probability of an unfavorable state. A better assumption in dealing with sovereign indebtedness.

The simple example of a two sector economy –agricultural and non-agricultural– can be taken to illustrate the sequence of events. At the beginning of the first period (covering spring and summer), 1-*k* is borrowed from the creditor. This amount is essential for buying seeds, fertilizers and other expenses for plowing and harvesting. At the end of the first period and beginning of the second period (covering fall and winter), the crop is collected and sold generating a primary surplus *z*. With probability $\theta(b)$, the primary surplus is large enough to service the debt. With probability 1-$\theta(b)$ the surplus is not large enough to service the debt and should be "renegotiated". At the end of the second period a non-random *s* is produced that can be used to service the debt in case that it was not paid at the end of the first period.

Note that a "complete debt contract" could be arranged if it were possible to issue a bond with clauses taking in consideration the different possible states. For example, the contract might say "If the weather is favorable and a large crop can be collected, the bond will be paid at the end of the summer, in any other case, it will be paid at the end of the winter". The problem is that, in many instances, there is "costly state verification" (Townsend 1979), meaning that a state can be observed but not verified in a court settlement. This generates "incomplete contracts", where clauses as described above cannot be found.

Incompleteness admits the possibility of the debtor's unwillingness to pay; even in a favorable state the sovereign could use the primary surplus in his own benefit at the expense of the creditor. This means that if the debt is not paid, it can be attributed to two reasons: liquidity crisis corresponding to an adverse state, or strategic default corresponding to a favorable state and the debtor's unwillingness to pay.

A feasible contract should penalize a default, but it should also consider the possibility of an adverse state. In the context of this model, a default is penalized by creditor's action limiting the possibilities of the sovereign to fully take advantage of the primary surplus at the end of the second period. Given the fact that the default state is of public knowledge, creditors could take some executive actions to jeopardize the primary surplus in the second semester. These actions should not be understood as the confiscation of assets held abroad that usually have wide press coverage and a reputation effect for the sovereign. In our framework the relevant actions are penalties of the type discussed by Eaton, Gersovitz and

Stiglitz (1986) that are relevant only when the future always holds some possibility of transfer in both directions, affecting real economic activity by suspension of short term trade financing, or elimination of long run credit financing of capital goods and intermediate inputs.

Taking in consideration the potential damage on output (or surplus) of such actions, let’s consider that at the end of the first period the sovereign is unable to pay and the contract is renegotiated. If renegotiation fails, with probability 1-*p*, the primary surplus of the second period is zero. If renegotiation succeeds, with probability *p*, the primary surplus is *s*, which is shared in equal parts between debtor and creditor. The following decision tree illustrates the debtor’s expected payoff under the assumption that the risk free interest rate is zero:

$$\begin{cases} \theta=(2s-b)/2s \begin{cases} \text{Willingness to pay}: & E\{z\mid z\ge b\}+s-b \\ \text{Unwillingness to pay: } E\{z\mid z\ge b\}+ & \begin{cases}\text{renegotiation succeeds }(p): s/2\\ \text{renegotiation fails }(1-p): \quad 0\end{cases}\end{cases}\\ (1\text{-}\theta)=\text{b/2s} \begin{cases} E[z\mid z<b]+\text{ renegotiation succeeds }(p): & s/2\\ E[z\mid z<b]+\text{ renegotiation fails }(1-p): & 0\end{cases}\end{cases}$$

The value of *p* is crucial in defining the debtor’s willingness to pay. To accept a debt contract, the creditor needs covenants to rule out a strategic default. It is assumed that the choice variable *p* is a “reduced form” probabilistic representation of explicit or implicit covenants such as UACs, CACs, exit consents, aggregation provisions and pari passu clauses that rule the process of debt renegotiations in a given jurisdiction. A high *p* implies a set of covenants in a contractual framework and a jurisdiction where renegotiation is obtained with high probability, while a low *p* implies a low probability to achieve a successful renegotiation. This choice variable is necessary to enforce an incentive constraint (IC) to motivate the willingness to pay as follows:

$$E[z\mid z\ge b]+s-b\ge E[z\mid z\ge b]+p\left(\frac{s}{2}\right)+\left(1-p\right)\left(0\right). \tag{1}$$

This expression means that the expected payoff when the debtor is willing to pay must be at least equal to the expected payoff of a strategic default.

In addition to a willingness to pay constraint, there is a creditor constraint, given that the creditor will not accept an expected value anything less than the alternative risk free investment. Therefore, the following creditor's constraint (CC) condition must be met:

$$\frac{(2s-b)}{2s}b+\frac{b}{2s}p\frac{s}{2}-(1-k)\geq 0. \tag{2}$$

The first term is the expected payoff if the state is favorable; the second term is the expected payoff when the state is unfavorable and the creditor receives half of the second period surplus when negotiation is successful, and zero otherwise. The last term represents the amount lent by the creditor. The constraint shows that creditors expected payoff must be at least equal to lending the same amount, 1-*k*, at a risk free (zero) interest rate.

The government wishes to maximize its expected revenue from the activity it produces with its own and borrowed resources. The government's objective function (OF) is represented by:

$$OF=\left(\frac{2s-b}{2s}\right)\left[E[z\mid z\geq b]+s-b\right]+\left(\frac{b}{2s}\right)\left[E[z\mid z<b]+p(\frac{s}{2})+(1-p)(0)\right]. \tag{3}$$

When the state is favorable, which occurs with probability (2*s*-*b*)/2*s*, the government receives $E[z|z\geq b]+s$ and pays the bond of value *b*; when the state is unfavorable, which occurs with probability *b*/2*s*, a renegotiation lottery is enacted. If renegotiation is successful, which occurs with probability *p*, the government obtains $E[z|z<b]+ps/2$; if renegotiations fails, which occurs with probability (1-*p*), the government obtains just $E[z|z<b]$. Note that the objective function does not include the possibility of strategic behavior, which is ruled out by imposing the willingness to pay constraint.

IV. Results for complete and incomplete debt contracts

A. The solution for the complete debt contract

The complete debt contract is possible if states are not costly to verify and commitments can be legally enforced. This situation implies that the incentive constraint (reflecting the debtor's willingness to pay) is not required since a favorable or unfavorable state can be verified at no cost; thus, the sovereign has no motivation to deviate the surplus in the first period. The creditor's constraint must be binding at the optimum, that is, the expected pay-off to the creditor cannot be greater than a risk free investment. If this were not the case, the sovereign has the option of searching for another creditor in a competitive market.

A complete debt contract reaches two first best solutions. As debtor and creditor observe all the states, a default is not possible. The creditor collects *b* in a favorable state or *s/2* in an unfavorable state. Renegotiation never occurs, or equivalently, *p* is always equal to one. Since the shape of the creditor's constraint is convex and the objective function is concave, there are three possibilities: a) the curves do not touch each other, meaning that there is no solution, b) the curves are tangent to each other, meaning a unique solution, and c) the curves intersect, meaning that there are two solutions with two values corresponding to the government's bond. Without further considerations these last two solutions are equilibrium solutions. The solution with a lower *b* has a higher probability of a favorable state where the creditor is paid "normally", while the solution with a larger *b* has a higher probability of an unfavorable state where the creditor does not obtain the full value of the nominal bond. This is illustrated in Figure 2 which reproduces the shapes of the curves OF and CC. Solutions for positive values of *b* require $(1\text{-}k)\leq(25/32)s$. If this last expression holds as an strict equality, the creditors constraint curve is tangent to the line $p=1$, and if the expression does not hold at all it means that $(1\text{-}k)$ is too high in relation to the ability to pay of the debtor. When the CC curve does not intersect with $p=1$, it means that creditors are denying market access to the debtor because he is pretending to borrow too much in relation to his ability to pay.

Solutions exist for a range of parameter values. For example, for $s=0.8$ and $k=0.5$, to $p=1$ correspond two solutions for *b*, 0.55 and 1.45, respectively. Both solutions generate the same value of 1.10 for the objective function. As a probability of a favorable state depends on *b,* a low level of indebtedness implies a high probability of favorable state with debt being serviced at the end of the first period. On the contrary, when indebtedness is high, there is a high probability of an unfavorable state ("endogenous bad luck") with debt being serviced in the second period.[6] Though not formally modeled for analytical simplicity, reputation

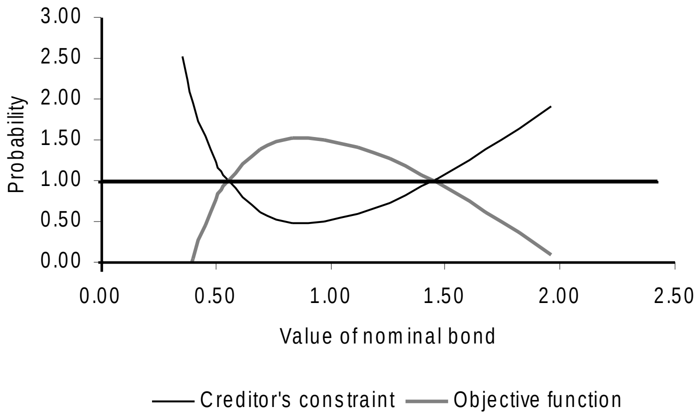
[6] To illustrate a practical application of this conclusion, Argentina entered into default at the end of the 80s and in 2001. In both cases debt to GDP ratio grew in previous years eventually exceeding 40% (a ratio that could be considered fairly low for any country). This would suggest a probability distribution enhancing the possibility of default when close to that ratio. Of course, the uniform distribution for the surplus is not unsubstantial on this issue. A more

considerations should induce the sovereign to obtain the solution with a higher probability of a favorable state. This result resembles some of the analysis in the literature where multiple equilibriums are discussed as a possible feature of emerging economies.[7]

For simplicity this model has considered a single creditor, but in a competitive capital market with several creditors, the highest value of *b* could be discarded since the debtor will always find a creditor willing to receive a bond at the lower nominal value minimizing the potential reputation effect of default.

Figure 2. First best solution

s =0,8 and *k* =0,5



realistic presentation should include the relative size of external shocks (such as sudden stops), possibly in relation to GDP, as well as output loss due to the potential transmission of external shocks to the exchange rate regime and domestic financial system. Although the highly stylized model being used here would not allow to include in a simple way all these elements, there is no doubt that the size of external shocks in relation to the size of the domestic economy should be important in determining the optimal level of indebtedness. Avila (2000), Calvo, Izquierdo, and Talvi (2002), and Ortiz and Rodríguez (2002) analyze the macroeconomic implications of sudden stops and country risk on macroeconomic adjustment.

[7] Calvo (2002) develops the argument that debt service and government expenditures are financed with distortionary output taxes and there is a region where high and low growth equilibria coexist. A “good” equilibrium implies low taxes sustaining high growth, while low growth implies high taxes sustaining low growth. The policy implication is that International Financial Institutions will help to coordinate the high growth equilibrium. In the context of this model a sort of Maastrich restriction limiting the maximum indebtedness could help to achieve the “good” equilibrium with a lower probability of an unfavourable state.

Graphically, the intersection of OF and CC shows the first best result for the nominal value of the government bond *b* and the probability of a successful renegotiation, that in the complete contract case is p=1. A comparative static exercise when p=1 gives $db/ds<0$ for $(1-k)(4/5)<b\leq s(5/4)$. This implies that if the primary surplus is increased, CC moves leftwards, allowing the issue of a lower value government bond. In a context of emerging markets, this would mean that an increase of the primary surplus would reduce the country's risk premium allowing for a bond of lower value for the same amount of money borrowed. A higher primary surplus and a lower nominal bond increase the probability of a favorable state and decrease the probability of default.

B. The solution for the incomplete debt contract

As mentioned in Section III, when state verification is costly or there is no possibility to verify the different states in a court settlement, an incomplete contract has to be analysed giving place to a second best solution. This calls for the inclusion of an incentive constraint (IC) assuring debtor's willingness to pay to avoid a strategic default.

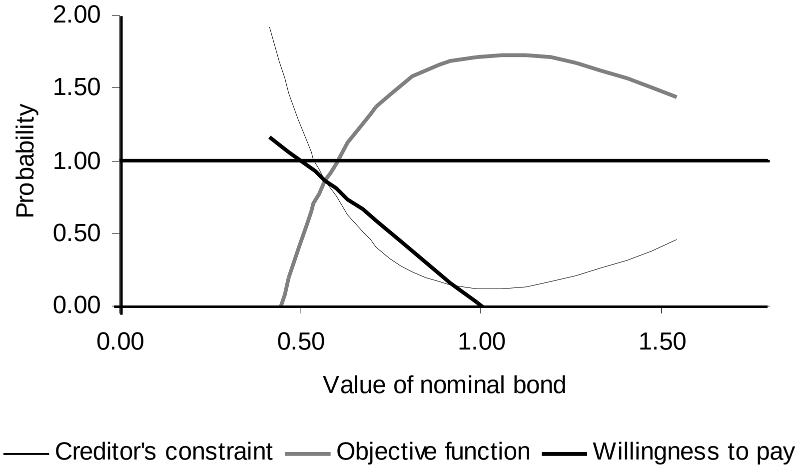
The solution is obtained using restrictions (1), (2), and the objective function (3). Note that, in the incomplete contract, the creditor's constraint (2) is also binding using the same argument as in the complete contract case.

The difference between this problem and the complete case is that now the incentive constraint (1) plays an important role. As shown in Figure 3, when the IC is added, a second best solution is located to the southeast of the first best (p=1) indicating a lower value for the objective function, a higher value of the nominal bond and a lower probability of a successful renegotiation. The added IC intersects the creditor's constraint at two values of *b*, but only the lower value is an optimum as the objective function improves moving upwards.

They key element of the optimal contract is the probability of renegotiation when first period surplus is not enough to repay the loan. The threat of failure in renegotiation induces the sovereign to avoid keeping the first period surplus. If he were to keep it, the sovereign renegotiates with probability of failure (1-p), and in case of failure the second period payoff is 0, generating a lower total payoff to what the debtor would have otherwise received if he had not opted for strategic

Figure 3. Second best solution

s=1 and k=0,47



default. That is, when first period surplus is in fact a value z equal or greater than b, the sovereign will prefer a net payoff of $z - b + s$ rather than $z + ½ s$. If first period surplus were in fact $z < b$, a liquidity default is produced and renegotiation might fail with probability (1-p). It is this last outcome that produces the welfare loss of the incomplete contract.[8]

In Figure 3 we could show the problem of market access of emerging economies imagining a situation where the incentive constraint and the creditors' constraint do not intersect each other. For example, for given values of s, we could draw a creditors constraint with lower values of k (as would be the case of an "undercapitalised" emerging economy) where the incentive constraint remains to the left not crossing the creditors constraint at any point. Tangency of CC and IC requires 1-k=(18/32)s, which is lower than the (25/32)s required in the complete contract, implying that incompleteness reduces market access to sovereigns.

The simple two period dynamics of the model preclude us from deepening the insight of special cases where a defaulted country affected with sudden stop and

[8] This result is frequently observed in the Principal-Agent literature. Normally, optimum contracts are determined by ex-post bargaining considerations, a topic that has received considerable attention in the corporate finance literature, for example, Diamond (1993). An excellent presentation of the same point, but using legal language, can be found in Bratton (2004).

capital flight might end up with a reduced k (as would be the case of Argentina after the 2001 default). The reduced k might imply that the country, after default, needs to access financial and capital markets with an amount of indebtedness the market would not accept. That is, with a reduced k the market expects a future debt overhang and creditors would not lend. Fernandez-Ruiz (2000) developed an interesting strand of research with a dynamic debt overhang model (asymmetric information) where debt buybacks (for example, by privatisation of inefficient state owned companies) might signal future efficiency gains by removal of distortions. In the context of this model, a dynamic extension could use signals of that sort to restore future values of k allowing the emerging economy to regain access to capital markets. Of course a dynamic set up would not be independent of how the emerging economy ends up after debt renegotiation or litigation after default.

V. Renegotiations after default

The previous model used two assumptions: first, a renegotiation game with Nash bargaining, and second, a strong penalty in case of a failed renegotiation. The failure of renegotiations at the end of the first period, which occurred with probability (1-p), implied that the primary surplus of the second period vanished. Now we will introduce a more realistic assumption contemplating the possibility that, even in default, some primary surplus is obtained in the second period. To include this possibility in the design of a debt contract we must consider the possibility of litigation with the expected actions and decisions of sovereign, bondholders, as well as outside buyers, or vultures. The vulture is defined as an agent who has the financial and risk capacity to purchase deeply discounted debt of a defaulted sovereign in the expectation of increasing its value. For the negotiation game we will use the assumption of an n-person negotiation game in coalitional form with side-payments, as originally developed by Lloyd Shapley (1951, 1953), the Appendix giving a detailed presentation of most of the expressions used in the text.

In the previous model we had a negotiation game with just two persons (one debtor and one creditor), and for simplicity the Nash solution was used, but the same results could have also been obtained with a Shapley value function. In what follows the Shapley framework facilitates the interpretation of the value of coalitions that are frequent when contracts include collective action clauses. The Shapley-

Value is an a priori measure of what each player expects to obtain by participating in a game. This value also shows what contribution each player can make when they cooperate in a coalition, and it is expected that each participant will receive its Shapley Value.

As in the previous model we assume that when the state is favorable, which occurs with probability $(2s-b)/2s$, the government either receives $E[z|z\geq b]+s$ and pays the bond of value b; or behaves strategically asking for a renegotiation that will succeed with probability p expecting to receive $E[z|z\geq b]+S_{\theta}(s)$, with the creditor expecting to receive $L_{\theta}(s)$, where $S_{\theta}(s)$ and $L_{\theta}(s)$, are the Shapley values for the government and the creditor respectively. If renegotiation is unsuccessful, with probability $1-p$, the defaulted economy is able to produce a lower primary surplus of $s' < s$ and the government is expected to receive $E[z|z\geq b] + S_{\theta}(s')$, and the creditor $L_{\theta}(s')$. Notice that θ is a sub index representing the state, s and s' are functional arguments also representing the stage of negotiations.

When the state is unfavorable, which occurs with probability $b/2s$, a renegotiation game is enacted. If renegotiation is successful, which occurs with probability p, the government obtains $E[z|z<b]+S_{1-\theta}(s)$, and the creditor $L_{1-\theta}(s)$; if renegotiations fails, which occurs with probability $1-p$, the second period surplus is s', and the government obtains $E[z|z<b]+S_{1-\theta}(s')$, and the creditor $L_{1-\theta}(s')$. The decision tree shows, separated by a semicolon, the expected payoff of sovereign and creditor, respectively.

$$\begin{cases} \theta=(2s-b)/2s \begin{cases} \text{Willingness to pay:} & E[z \mid z\geq b]+s-b\ ;\ b \\ \text{Unwillingness to pay: } E\{z \mid z\geq b\}+ \begin{cases} \text{renegotiation succeeds } (p): S_{\theta}(s)\ ;\ L_{\theta}(s) \\ \text{renegotiation fails } (1-p):\ S_{\theta}(s')\ ;\ L_{\theta}(s') \end{cases} \end{cases} \\ (1\text{-}\theta)=b/2s \begin{cases} E[z \mid z<b]+\text{ renegotiation succeeds } (p): & S_{1-\theta}(s)\ ;\ L_{1-\theta}(s) \\ E[z \mid z<b]+\text{ renegotiation fails } (1-p): & S_{1-\theta}(s')\ ;\ L_{1-\theta}(s') \end{cases} \end{cases}$$

The difference between this decision tree and the one in the basic model is the introduction of the Shapley values for each player in each negotiation game. The new player in the game is the vulture, which, in contrast with the original bondholder, is assumed to have a highly efficient legal technology that allows him to extract a larger part of the second period surplus. Furthermore, it will be assumed that the vulture bears no cost in negotiating and litigating and, in coalition with other players, the maximum amount the vulture can recover from the second period is total surplus *s'*. Next we start analysing the simplest case of a post default negotiation game with the sovereign, one bondholder and one vulture.

A. One creditor and one vulture

Without loosing any substance in the analysis, we will start assuming that the creditor gets no value from keeping a defaulted bond; therefore he may decide to sell it, or to form a coalition with a vulture to recover as much as he can.

Liquidity default: Suppose that the state is unfavourable, the first period primary surplus is not large enough to pay the bond, and the sovereign defaults. If renegotiation is successful, with probability *p*, the second period surplus is available for a very simple Shapley coalition game: either the debtor joins the creditor or the creditor joins the debtor. There are two possible coalitions each having the same probability of 1/2, therefore the Shapley value for the debtor is $S_{1\text{-}\theta}(s)=(1/2)s$ and the Shapley value for the creditor is $L_{1\text{-}\theta}(s)=(1/2)s$. That is, the surplus will be divided equally between debtor and creditor as in Nash bargaining. But if renegotiation fails, the second period surplus is reduced to *s'*, litigation is a possibility, and the vulture enters the game with a Shapley value (see Appendix) of *s'*/6.[9] The Shapley value for the bondholder's expected profit in a liquidity default after failed renegotiation is $L_{1\text{-}\theta}(s')= s'(2/3)$. And the sovereign's payoff when renegotiation fails is $S_{1\text{-}\theta}(s')=s'/6$.

Strategic default: Suppose that the state is favorable and the sovereign defaults. The cash surplus from the first period is enough to cancel the bond, but the sovereign decides to default with the intention to use the available cash in its own benefit, or to compete with the vulture in post-default negotiations. In the renegotiation game there is no litigation, and the vulture does not enter the game. There are two players, debtor and creditor, with Shapley Values $S_{\theta}(s)=s/2$ and $L_{\theta}(s)=s/2$. If renegotiation fails the vulture enters the game, and there are three players with $S_{\theta}(s')= s'/6$, $L_{\theta}(s')=s'(2/3)$, and with the vulture's Shapley Value denoted by $V_{\theta}(s')=s'/6$.

Therefore, on the one hand, the incentive constraint that motivates the sovereign's willingness to pay is:

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[9] Cost of litigating can be incurred by the vulture, and his participation in the game will depend on his Shapley value in relation to expected costs.

$$E[z \mid z \geq b]+s-b \geq E[z \mid z \geq b]+pS_{\theta}(s)+(1-p)\,S_{\theta}(s') \,, \tag{4}$$

$S_{\theta}(s)=s/2$, $S_{\theta}(s')=s'/6$.

On the other hand, the creditor will include the expected liquidation value post-default and will not accept a debt contract with lower expected value than an alternative risk free investment as represented in the following creditor's constraint:

$$\left(\frac{2s-b}{2s}\right)b+\frac{b}{2s}\left[\,pL_{1-\theta}(s)+(1-p)\,L_{1-\theta}(s')\right]-(1-k)\geq 0 \tag{5}$$

$L_{1-\theta}(s)=s/2, L_{1-\theta}(s')=s'(2/3)$

The government's objective function changes to

$$OF=\left(\frac{2s-b}{2s}\right)\left[E[z \mid z \geq b]+s-b\right]+ \left(\frac{b}{2s}\right)\left[E[z \mid z<b]+pS_{1-\theta}(s)+(1-p)S_{1-\theta}(s')\right], \tag{6}$$

$S_{1-\theta}(s)=s/2, S_{1-\theta}(s')=s'/6$.

When the contract takes in consideration expectations of post default negotiations the solution changes, obtaining a lower value for the bond and higher probability of a successful renegotiation.[10] The sovereign also increases his payoff, and all these results are due to the possibility of having a second period surplus. The assumptions in the original model were that if renegotiation failed with probability 1-*p*, the second period surplus was zero. This assumption seems to be too strong when evaluating sovereign defaults. What frequently is observed is a

[10] As the model presents multiple solutions the comparative static should be performed with the economically reasonable solution, which is the solution with a bond with lower nominal value. The existence of the solution is also sensitive to parameters values. Starting with an initial position with parameter values of s = 0.98, and k = 0.5, the model including expected post-default negotiations is equivalent to a comparative static exercise shifting s' from s' = 0 to s'=0.80. With these parameter values, the optimal solution when s' = 0 is b_0 = 0.511 and p_0 =0.957, while the optimal solution when s' = 0.80 is b_1 = 0.503 and p_1 = 0.964 where the value of the bond decreases, the probability of a successful renegotiation increases, and the value of the objective function increases.

short period of output loss (for example, Argentina's rate of GDP growth fell by 12% in the year following default and became positive after that), and some market transactions of defaulted debt with the expectations that debt value can be recovered when the sovereign becomes normal again. Vulture's participation contributes to a positive liquidation value when renegotiation fails after a liquidity default. The main reason is the assumption that the bondholder has no litigation ability. The same result could be obtained with the bondholder hiring the services of a lawyer and sharing the full liquidation value.

In comparing different countries going through the process of debt renegotiation the potential output loss plays a very important role in ruling out strategic default. Then, those countries that are very open in the capital account, providing financial services to other countries (Uruguay, for example, is a net exporter of financial services) might suffer a stronger output loss than countries that are not providing international financial services (Perú, Ecuador, and Argentina) and would tend to define contracts enhancing the probability of successful renegotiation.

In the case of strategic default the vulture's participation is ex-ante, that is, at the time of designing the contract, and not ex-post because the willingness to pay constraint rules out strategic defaults. Perhaps this is the main reason why vultures have such a bad reputation. They contribute to rule out strategic defaults and nobody notices them, but, to be credible, they must prove their existence in liquidity defaults when nobody wants them around, except bondholders out of cash.

B. One governing law, two managers and one vulture

Suppose an emerging economy issuing a bond under New York governing law. Suppose that there is one investor holding 50% of his bonds in the domestic country and the other 50% of the same bond in a foreign country.[11] Therefore, there are two types of claims on the sovereign: domestic and foreign. Suppose that the investor has two independent portfolio managers (working at no cost to the investor), one resident and the other non-resident. In case of default, both managers

[11] This is a simplifying assumption to introduce a difference in jurisdiction during a litigation process. The alternative assumption would be to consider two totally different bondholders, one resident and one non resident. This assumption would require two creditors' constraints, increasing the complexity of the solutions.

are left with a claim with zero value. If the vulture participates in the post-default negotiation in coalition with the managers they extract a surplus, $s'<s$.

There are now four potential players in the negotiation game: two managers, the vulture and the sovereign. In the first stage there is renegotiation without litigation, and the vulture does not intervene. Therefore, possible coalitions include the debtor with the two managers. The debtor with just one manager obtains 50% of voting power, and even with collective action clauses it is not enough to strike a deal requiring a 51% majority, therefore the value of this coalition is zero. The debtor with both managers obtains 100%, and the value of the coalition is the full surplus s. In this first stage of negotiation the coalitional game structure is the same in the favourable state than in the unfavourable state because the vulture does not intervene. The specific Shapley Values are: $L_{\theta}(s)=L_{1-\theta}(s)=s(2/3)$, and $S_{\theta}(s)=S_{1-\theta}(s)=s/3$.

If first stage fails, a second stage negotiation starts where: a) there is litigation, b) there is a surplus loss with $s'<s$, and c), the vulture enters the game affecting the value of coalitions. It will be assumed that the coalition of the vulture or the sovereign with the foreign manager receives $\gamma s'$ ($0<\gamma\leq 1$) from the second period surplus, while the coalition between the vulture and domestic creditor, or between the sovereign and the domestic creditor obtains $\alpha\gamma s'$, $0\leq\alpha\leq 1$. These assumptions can be rationalized on the basis of the following considerations. As mentioned at the outset, if CACs are not available, "exit consents" create the possibility that sovereigns might form a coalition with domestic residents to modify covenants not requiring UACs. There is also the possibility that domestic managers could be "persuaded" by the government not to take an aggressive litigation stance in case of default. In this case domestic managers, either in coalition with the government or with a vulture, might accept a lower recovery value.[12]

The parameter α, can be set equal to 1 when domestic and foreign creditor can

[12] Discrimination between domestic and foreign bondholders could be either way. This can be illustrated in the following quotation from a politician: "Repaying Argentina's debts, he has said, means "paying with the sweat and toil of the people". Foreign bondholders don't vote, and politicians are reluctant to repay them with the sweat and toil of the people who do." Published by *The Economist*, February 19 2004, "The End of the Affair?".

Tirole (2002) (see also Fischer 2004) deals with a similar topic focusing on international capital flows and a dual-agency problem. The dual agents are the emerging-country private borrower and the government of the country. For private capital flows, the lender contracts with one agent, the borrower, whose actions in part determine the outcome of the project extract from the debtor the same amount (in legal terms this corresponds to a broad reading of the pari passu covenant), but α can be less than 1 when there are independent managers acting in different environments and jurisdictions. It is also assumed that the coalition of the two managers with the sovereign receive *s'*.

Two assumptions are analysed: first, the Bolton and Scharfstein (1996) assumption of liquidity default where the sovereign is strongly cash restricted and unable to join a coalition game if renegotiations fails. Second, the sovereign is able to join coalitions after failed renegotiations.

First case: The illiquid sovereign is unable to join post default coalitions

Suppose that the state is unfavourable and the country defaults. If renegotiation fails, the vulture enters the game, and *s'* will be divided according to their Shapley Values. Now, $L_{1-\theta}(s')$ will be the sum of both managers Shapley Values. It can be shown that this equals to:

$$L_{1-\theta}(s')=s'(2/3)-\gamma s'(1+\alpha)/6.$$

The vulture's Shapley Value $V_{1-\theta}$ is

$$V_{1-\theta}=s'/3+\gamma s'(1+\alpha)/6.$$

The Shapley Value of the sovereign is zero, $S_{1-\theta}(s')=0$, because it is assumed that the sovereign does not have enough cash to compete with the vulture and does not enter the game. Notice that the sum of Shapley Values corresponding to each player adds up to *s'*. Also notice that the managers' Shapley Value depends

financed. But the outcome of the project is also affected by the actions of the host-country government. Ex ante, the government promotes capital inflows. But ex post the government promotes the interests of the borrowers at the expense of the lenders.

Another example of discrimination is the case of Argentina mentioned at the outset, where a Supreme Court judgment of April 5, 2005, declared "constitutional" an Executive Decree converting US dollar denominated bonds to pesos. This implied that, immediately after the peso devaluation (300%, beginning of 2002), the dollar value of bonds converted to pesos was reduced to one fourth. In the comparative static exercise it is assumed that the local manager can be discriminated against, but the same result could be obtained if the foreign manager is the one discriminated. What matters is discrimination, not against whom.

negatively on γ and α while the vulture's Shapley Value depends positively on those parameters. Consequently, discrimination against the local managers with a lower α implies that the vulture receives less and the bondholder receives more, the reason is that the foreign manager captures the loss of the local manager plus the loss of the vulture. That is, discrimination against the local manager with a reduced value of α implies that the local manager receives less, but the sum of both managers Shapley Value increases.

Suppose now that the state is favorable but the sovereign defaults. As mentioned above, in the first stage of renegotiation without litigation the vulture does not play the game, and $L_\theta(s)=s(2/3)$, and $S_\theta(s)=s/3$. If renegotiation fails, the vulture enters, and there are four players. Each player receives its Shapley Value, and $S_\theta(s')=s'/12+\gamma s'(\alpha+1)/12$.

Substituting the corresponding Shapley Values we obtain the following system:

Objective function:

$$OF = \left(\frac{2s-b}{2s}\right)\left[E[z \mid z \geq b] + s - b\right] + \left(\frac{b}{2s}\right)\left[E[z \mid z < b] + p(s/3)\right] \tag{7}$$

Willingness to pay constraint:

$$E[z \mid z \geq b] + s - b \geq E[z \mid z \geq b] + p\,\frac{s}{3} + (1-p)[s' + \gamma s'(\alpha+1)]/12 \tag{8}$$

Creditor's constraint:

$$\left(\frac{2s-b}{2s}\right)b + \frac{b}{2s}\left[p\,\frac{s}{3} + (1-p)\left(\frac{2}{3}s' - \frac{1}{6}\gamma s'(\alpha+1)\right)\right] - (1-k) \geq 0 \tag{9}$$

If the government falls into a liquidity default, second period surplus s' is divided between the vulture and both managers according to their Shapley Value, whereas the government receives zero.

Contract design includes a willingness to pay constraint ruling out the possibility of strategic behaviour by the sovereign. This means that the sovereign will always be better off honouring the bond in a favourable state than playing the game of a strategic default. Again, the existence of the vulture is a priori speculation in a strategic default and a sure thing in a liquidity crisis.

Another conclusion is that, if the domestic portfolio manager can be discriminated against in post-default negotiations, the sovereign could issue contracts with lower nominal values for bonds and a higher probability of renegotiation. This seems a controversial result but can be illustrated with a comparative static exercise. Discrimination against the local manager implies a lower value for α: graphically, this could be interpreted as the willingness to pay constraint shifting upwards while the creditor's constraint shifts leftwards.

The explanation is as follows. When the local manager is discriminated (α reduced) the Shapley Value of the bondholder represented by both: the local and the foreign managers, increases, while the Shapley Value of the vulture is reduced. As more of the second period surplus is expected to be received by the bondholder, the nominal value is reduced and the bond has a higher probability of a successful renegotiation. This result depends upon the assumption of one bondholder and two managers. The local manager litigates "inefficiently", either in coalition with the sovereign or in coalition with the vulture, reducing his own payoff and vulture's payoff in benefit of the foreign manager. If instead of two managers we had two bondholders (one local and one foreigner) to produce similar results we would need effective capital controls to allow for discrimination against the local bondholder. That is, the foreign bondholder, ex-ante, would not accept a contract yielding less than the risk free interest rate, while the discriminated local bondholder, under capital controls, might not have access to risk free instruments.

Second case: The illiquid sovereign joins post default coalitions

If the sovereign is able to participate in post default negotiations Shapley Values changes improving the previous solution moving the equilibrium points (graphically) northwest with a lower nominal value for the bond and a higher probability of a successful renegotiation, this, of course at the expense of the vulture. Again, discrimination against the local manager implies a lower value for α: the willingness to pay constraint shifts upward and the creditor's constraint shifts leftwards. The explanation is as above. When one of the managers is discriminated (α reduced) the Shapley Value of the bondholder represented by both the local and the foreign manager increases, while the Shapley Value of the vulture is reduced.

VI. Conclusions

The application of contract theory that we have developed in this paper indicates that several controversial issues of what has been denominated as a new international financial architecture to handle sovereign debt can be analyzed in a framework of standard economic theory. With reasonable assumptions it is possible to address topics that economists have not paid too much attention but are at the heart of day-to-day contract design of bond issues for emerging economies. Governing law, UACs, CACs, exit consents, and litigation procedures are fundamental aspects that are permanently ignored except at the time of restructuring a defaulted sovereign debt.

As the model presented in the preceding sections indicates, post default renegotiations are important elements to be taken in consideration at the time of contract design. The analysis performed so far indicates that the flow of capital funds, badly needed by emerging economies, could be jeopardized if renegotiations are considered to be just a problem of how to handle vultures or how to find a "statutory" reform of financial institutions. Ignoring the fundamental reasons why contracts are the way they are will not help the international capital markets. Paying attention to topics so far exclusively monopolized by professional lawyers specialized in sovereign debt could enrich the understanding of a better financial architecture.

Ignoring the role of incentive constraints assuring the willingness to pay in sovereign's debt contracts might be beneficial at the time of a liquidity crisis but will promote strategic defaults increasing the uncertainty and the long run stability of emerging capital markets.

Governing law is an important element to be considered, as well as the distribution of debt in local and foreign markets, subject to one jurisdiction. The analysis performed so far indicates that post default coalitions to renegotiate debt contracts are important in determining ex-ante the nature of the contract and a fundamental requirement in covenants assuring a transparent and economically efficient access to markets.

All this analysis suggests that a better approach to a new financial architecture is perhaps to deepen the understanding of debt contracts, governing law, and the working of post default coalitions, including vultures. Some of these fundamental issues in debt contract design were taken in consideration in proposals for a statutory approach involving the IMF (for example, Krueger 2002) in crisis resolution. This paper argues that another promising approach would be to define international standards for UACs, CACs, governing law, jurisdiction, and exit consents. A limited role of the IMF as a lender of last resort or connected lending conditioned on improving information and legal imperfections in emerging economies is a possible extension to the present model that would require additional research. A straightforward conjecture is to think the lender of last resort participation as a lump sum transfer moving the distribution of z to the right, decreasing the probability of an unfavorable state. However, when these or other actions are included in the analysis, moral hazard, and the sovereign's strategic behavior should be restated to assure willingness to pay.

Appendix

A. Shapley values

The Shapley Value measures the "value" of each player in an "n-person games in coalitional form with side payments". For our purposes a very simple framework can be presented as follows.

There is a set N of actors and a function v that associates to every subset S of N, where $v(S)$ is a real number and represents the maximum value of the coalition.

The Shapley Value v of player i is exactly the expected marginal contribution of the player i to a random coalition S. For a coalition S not containing i, the marginal contribution of i to S is the change in the worth when i joins S, i.e., $v(S \cup \{i\}) - v(S)$. A random coalition S not containing i is obtained by arranging all n players in line (e.g. 1, 2… n), and then putting in S all those that precede i; it is assumed that all $n!$ orders are equally likely.

The Shapley Value has several desirable properties and the amount the actor i gets if the gain function v is being used is:

$$\phi_i(v) = \sum_{i \notin S \subseteq N} \frac{|S|!\,(n-|S|-1)!}{n!}\left(v(S \cup \{i\}) - v(S)\right),$$

where n is the total number of actors and the sum extends over all subsets S of N not containing actor i. $|S|$ represents the number of elements in S. The applications of Shapley Value in the preceding sections of the paper were developed first for three players and then for four players as follows.

B. Three-person game: Creditor, debtor and vulture

If a represents the creditor (or bondholder), b the vulture and d the sovereign (or debtor country), the possible ($n!=3!=6$) coalitions are: *abd, adb, bad, bda, dab, dba*. Each coalition is equally likely with probability of 1/6.

The Shapley Value for the creditor a, ϕ_a: The random coalitions are formed with all the elements that precede a in the possible coalitions defining elements in S. When there are no elements preceding a there is an empty coalition denoted by ∅. Therefore:

- Possible coalitions: *abd, adb, bad, bda, dab, dba*;
- Elements that precede a: ∅, ∅ , *b* , *bd* , *d* , *db*.

The Shapley Value ϕ_a is computed from the second column of Table A1, where only one empty coalition is reported to save space (the same criterion applies to the following tables), whence $\phi_a=(1/6)[v(ab)-v(b)]+(1/6)[v(ad)-v(d)]+(2/6)[v(abd)-v(bd)]$. The contribution of i to a coalition S is described as $v(S \cup \{i\})–v(S)$, and displayed at the right of each coalition.

For example, the marginal contribution of a to the coalition with elements (bd) is calculated as follows: $v[(bd) \cup \{a\}]–v(bd)=s'–0=s'$, since the vulture and the sovereign do not get anything by themselves, $v(bd)=0$, but when a gets into the

Table A1. Marginal contributions for three-person game

Creditor (a)		Vulture (b)		Sovereign (d)	
Coalition	Marginal contribution	Coalition	Marginal contribution	Coalition	Marginal contribution
∅	0	∅	0	∅	0
b	s'	a	s'	a	s'
d	s'	d	0	b	0
bd	s'	ad	0	ab	0
db	s'	da	0	ba	0

coalition they get *s'*. Notice that empty coalitions have no value and the last term includes coalitions *abd* and *adb* which are weighted (2/6), so ϕ_a=(1/6)[*s*']+(1/6)[*s*'] +(2/6)[*s*']= 1/6 [4*s'*]=*s'*(2/3).

The Shapley Value for the vulture *b*, ϕ_b: all the elements that precede *b* define *S*, representing the possible coalitions. The fourth column of Table A1 shows the marginal contribution of *b*: ϕ_b= (1/6) [*s'*]=*s'*/6.

The Shapley Value for the Sovereign (debtor country) *d*, ϕ_d: all the elements that precede *d* define *S*, representing the possible coalitions. The sixth column shows the marginal contribution of *d*: ϕ_d= 1/6 [*s'*]=*s'*/6.

It can be easily verified that the sum of Shapley Values for all players adds to *s'*.

C. Four-person game: Two managers, debtor, and vulture

First stage: Renegotiation game, the vulture does not play

The parties to the coalition are: the local manager *a*, the foreign manager *c*, and the debtor sovereign *d*. The possible coalitions are: *acd, adc, cad, cda, dac, dca*.

Table A2. Marginal contribution for four-person game, vulture does not play

Manager (*a*)		Manager (*c*)	
Coalition	Marginal contribution	Coalition	Marginal contribution
∅	0	∅	0
c	0	*a*	0
d	0	*d*	0
cd	*s*	*ad*	*s*
dc	*s*	*da*	*s*

Shapley value for manager *a*: ϕ_a=*s*/3.

Shapley value for manager *c*: ϕ_c=*s*/3.

Then, $\phi_a + \phi_c = L_\theta(s)$ =*s*(2/3), given that $s = \phi_a + \phi_c + \phi_d$, $S_\theta(s)$=ϕ_d=*s*/3.

Liquidity default: Sovereign does not play in post default coalitions

The parties to the coalition are: the manager *a* (managing assets in the domestic jurisdiction), the manager *c* (managing assets in the foreign jurisdiction) and the vulture *b*. The possible coalitions are equally likely with probability 1/6: *abc, acb, bac, cab, bca, cba*.

Table A3. Marginal contribution for four-person game, sovereign does not play

Manager (*a*)		Manager (*c*)		Vulture (*b*)	
Coalition	Marginal contribution	Coalition	Marginal contribution	Coalition	Marginal contribution
∅	0	∅	0	∅	0
b	$\alpha\gamma s'$	*a*	0	*a*	$\alpha\gamma s'$
c	*0*	*b*	g*s'*	*c*	$\gamma s'$
bc	$s' - \gamma s'$	*ab*	$s'-\alpha\gamma s'$	*ac*	s'
cb	$s' - \gamma s'$	*ba*	$s'-\alpha\gamma s'$	*ca*	s'

Shapley Value for manager *a*: $\phi_a=[\alpha\gamma s' + 2(s'-\gamma s')]/6 = s'/3 - \gamma s'(2-\alpha)/6$.

Shapley Value for manager *c*: $\phi_c= [2(s'-\alpha\gamma s')+\gamma s')]/6 = s'/3 - \gamma s'(2\alpha -1)/6$.

Shapley Value for the vulture *b*: $\phi_b=[\alpha\gamma s'+\gamma s'+2s')]/6 = s'/3+\gamma s'(\alpha +1)/6$.

The comparative static of Shapley Values indicates that an increase in α increases the Shapley Value of the Vulture and decreases the sum of Shapley Values of managers, that is $\phi_a + \phi_c = L_{1-\theta} = s'(2/3) - \gamma s'(1+\alpha)/6$.

Comparative static of changing α: $d(\phi_a + \phi_c) = dL_{1-\theta} = (-\gamma s'/6)d\alpha$, $d\phi_b = (\gamma s'/6)d\alpha$. Consequently, if the sovereign could discriminate against the local managers reducing α, the vulture receives less and the bondholder receives more, the reason is that the foreign manager captures the loss of the local manager plus the loss of the vulture.

Strategic default

There are now 4 parties to the coalition: the manager *a*, the manager *c*, the sovereign *d*, and the vulture *b*. The following coalitions are equally likely with probability 1/24: *abcd, bacd, cabd, dabc, abdc, badc, cadb, dacb, acbd, bcad, cbad, dbac, acdb, bcda, cbda, dbca, adbc, bdac, cdab, dcab, adcb, bdca, cdba, dcba*.

Table A4 computes the marginal contributions to determine the four-player game Shapley values as follows:

Shapley Value for the manager *a*: $\phi_a = [6\,(\alpha\gamma s') + 10(s' - \gamma s')]\,/24$;

Shapley Value for the manager *c*: $\phi_c = [10\,(s' - \alpha\gamma s') + 6(\gamma s')]\,/24$;

Shapley Value for the vulture *b*: $\phi_b = [2\,(\alpha\gamma s') + 2(\gamma s') + 2s']\,/24$;

Shapley Value for the debtor country *d*: $\phi_d = S_\theta(s') = [2\,(\alpha\gamma s') + 2(\gamma s') + 2s']\,/24$.

Table A4. Marginal contribution for four-person game, strategic default

Manager (*a*)		Manager (*c*)		Vulture		Sovereign	
Coalition	Marginal contribution	Coalition	Marginal contribution	Coalition	Marginal contribution	Coalition	Marginal contribution
∅	0	∅	0	∅	0	∅	0
b	$\alpha\gamma s'$	*a*	0	*a*	$\alpha\gamma s'$	*a*	$\alpha\gamma s'$
b	$\alpha\gamma s'$	*a*	0	*a*	$\alpha\gamma s'$	*a*	$\alpha\gamma s'$
c	*0*	*b*	$\gamma s'$	*c*	$s'\gamma$	*b*	0
c	*0*	*b*	$\gamma s'$	*c*	$s'\gamma$	*b*	0
d	$\alpha\gamma s'$	*d*	$\gamma s'$	*d*	0	*c*	$\gamma' s$
d	$\alpha\gamma s'$	*d*	$\gamma s'$	*d*	0	*c*	$\gamma' s$
bc	$s'-\gamma s'$	*ab*	$s'-\alpha\gamma s'$	*ac*	s'	*ab*	0
bd	$\alpha\gamma s'$	*ad*	$s'-\alpha\gamma s'$	*ad*	0	*ba*	0
cb	$s'-\gamma s'$	*ba*	$s'-\alpha\gamma s'$	*ca*	s'	*ac*	s'
cd	$s'-\gamma s'$	*bd*	$\gamma s'$	*cd*	0	*ca*	s'
db	$\alpha\gamma s'$	*da*	$s'-\alpha\gamma s'$	*da*	0	*bc*	0
dc	$s'-\gamma s'$	*db*	$\gamma s'$	*dc*	0	*cb*	0
bcd	$s'-\gamma s'$	*abd*	$s'-\alpha\gamma s'$	*acd*	0	*abc*	0
bdc	$s'-\gamma s'$	*adb*	$s'-\alpha\gamma s'$	*adc*	0	*acb*	0
cbd	$s'-\gamma s'$	*bad*	$s'-\alpha\gamma s'$	*cad*	0	*bac*	0
cdb	$s'-\gamma s'$	*bda*	$s'-\alpha\gamma s'$	*cda*	0	*bca*	0
dbc	$s'-\gamma s'$	*dab*	$s'-\alpha\gamma s'$	*dac*	0	*cab*	0
dcb	$s'-\gamma s'$	*dba*	$s'-\alpha\gamma s'$	*dca*	0	*cba*	0

Liquidity default: Sovereign plays in post default coalitions

This is similar to the strategic default, there are 4 parties to the coalition: the manager *a*, the manager *c*, the sovereign *d*, and the vulture *b* have the following values*:*

$\phi_d = S_{1\text{-}\theta}(s') = [\gamma s'(1+\alpha) + s']/12;$

$(\phi_a + \phi_c) = L_{1\text{-}\theta}(s') = [5s' - \gamma s'(1+\alpha)]/6;$

$\phi_b = [(\alpha\gamma s') + (\gamma s') + s']/12.$

The solution to the problem of the illiquid sovereign playing post default coalitions consist of the following expressions:

Objective function*:*

$$OF = \left(\frac{2s-b}{2s}\right)\left[E[z \mid z \geq b] + s - b\right] + \left(\frac{b}{2s}\right)\left[E[z \mid z < b] + p(s/3) + (1-p)((\gamma s'(\alpha+1) + s')/12)\right].$$

Willingness to pay constraint:

$$E[z \mid z \geq b] + s - b \geq E[z \mid z \geq b] + p\frac{s}{3} + \left(1-p\right)[s' + \gamma s'(\alpha+1)]/12.$$

Creditor's constraint:

$$\left(\frac{2s-b}{2s}\right)b + \frac{b}{2s}\left[p\frac{s}{3} + \left(1-p\right)[5s' - \gamma s'(1+\alpha)]/6\right] - \left(1-k\right) \geq 0.$$

A comparative static exercise changing α, gives $dS_{1\text{-}\theta}(s')/d\alpha>0$, $dL_{1\text{-}\theta}(s')/d\alpha<0$, and $d\phi_b/d\alpha>0$.

Solving the optimisation problem with parameters values k=0.5, s=0.85, s'=0.5, γ=0.9, and α=0.5 gives a result with OF=1.079, b=0.621 and p=0.706. Reducing the value of α to α=0.4 gives a result with OF=1.080, b=0.620 and p=0.719, which graphically implies that the solution moves to the northwest as mentioned in text.

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