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A Dynamic Bargaining Model of Sovereign Debt

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A model of the determinants of negotiated commercial sovereign debt payments in an import-dependent economy subject to foreign exchange and fiscal constraints

This paper — a product of the Debt and International Finance Division, International Economics Department — is part of a larger effort in PRE to understand the economic relationships between developing countries and external creditors in the context of credit rationing and debt negotiations. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Sheilah King-Watson, room S8-040, extension 31047 (64 pages). October 1991.

Eduardo Fernandez-Arias models a dynamic bargaining game between a highly indebted country and its commercial bank consortium, to analyze the determinants of the resulting rescheduling agreements and the net transfer of resources over time.

The bargaining game is based on the simple paradigm that if no agreement is reached for a current (possibly partial) payment, the banks would apply default sanctions. Fernandez-Arias found that under general conditions settlements would be reached and default sanctions would not be applied in equilibrium. But the default sanctions would be a credible threat underlying the negotiations and determining the equilibrium payments. These equilibrium payments in turn would determine the credit ceiling (the present discounted value of expected payments) and the later commercial discounts on the debt market.

Unlike other bargaining games, this one explicitly models the debtor country's economic structure, featuring an import-dependent economy subject to foreign exchange and fiscal constraints. Moreover, the model is truly dynamic in the sense that the future negotiating environment — current investment — is endogenously determined by current bargaining outcomes.

Under plausible refinements and assumptions, Fernandez-Arias obtains a closed-form solution for net transfers, dependent on various structural and policy parameters.

An analysis of comparative static results showed that:

• Fiscal constraints, not foreign exchange constraints, lead to smaller payments.

• Fast-growing countries get less favorable deals because they have less bargaining power.

• Investment disruptions as a result of default sanctions may work in favor of debtor countries, possibly leading to smaller payments, because of the associated cost to banks of future collections.

• Smaller countries, which are generally more open and specialized, can be expected to be stronger negotiators and to make relatively smaller payments.

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by
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1. INTRODUCTION

Since the debt crisis erupted in 1982, many debtor countries and Western commercial banks have been engaged in protracted rescheduling negotiations. The potential impact of these negotiations on the economic development and political stability of the debtor countries and on world financial and trade stability has drawn the attention not only of the primary parties involved, debtor countries and commercial banks, but also of international financial institutions and creditor country governments. In this work, the negotiations are analyzed in order to identify the determinants of commercial bank debt service, credit ceilings and debt market discounts. Closed-form expressions amenable to empirical testing are found[1]. They are functions of the world interest rate, the debtor country government rate of time preference, and some underlying characteristics of the economy (degree of openness, productive capital efficiency, investment and depreciation rates, severity of foreign exchange and fiscal constraints, international trade vulnerability to sanctions, and investment sensitivity to sanctions)[2].

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[1]Empirical work is not reported in this piece.

[2]In a companion paper, "IFIs Financial Support and Commercial Debt Service: a Bargaining Approach," the role of international financial institutions as interested third parties is analyzed.

While there is a fairly large literature about international debt, the negotiation process itself has usually been assumed away[3]. Some exceptions are Sachs [1983], Krugman [1985], Bulow and Rogoff [1988b,1989b], Fernandez and Glazer [1988] and Fernandez-Arias [1989][4].

Some of these papers neglect many relevant aspects of actual negotiations in order to focus on how the parties have organized, providing an economic analysis of why debtor countries bargain independently while banks have been able to cooperate and form a consortium. Sachs and Krugman focus on the importance of the banks' collusion in preventing a default crisis triggered by each bank's free-rider attempt. Fernandez and Glazer, and Fernandez-Arias analyze the failure of the debtor countries' cartel[5].

The rest of the papers employ richer bargaining models, taking as given that banks are able to collude and debtor

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[3]Examples are Eaton, Gersovitz and Stiglitz [1986] and references contained therein.

[4]Fernandez and Rosenthal [1988,1989] present a series of models where, in each period, the debtor country decides about consumption, investment and debt service. These models are particularly interesting because investment is endogenous, but they assume the bargaining away by giving the banks' consortium all the bargaining power regarding debt rescheduling proposals. After a first draft of this paper was completed, it came to our attention an asymmetric information bargaining model in Wells [1990] and an endogenous investment bargaining model in Cohen and Verdier [1989].

[5]Fernandez-Arias has also touched on the stability of the bank consortium.

countries are not. Bulow and Rogoff [19: b] present a seminal bargaining model where players alternate offers and counter offers in the spirit of Rubinstein's perfect information model (Rubinstein [1982]). This model has the important feature that players are treated symmetrically, and therefore no one is given all the bargaining power[6]. They present a multi-stage bargaining model in order to model the fact that in actual negotiations rescheduling agreements are repeatedly recontracted over time. Still, their constant recontracting model of sovereign debt is essentially static, in the sense that investment and growth cannot be endogenously affected by the bargaining process.

This work builds on Bulow and Rogoff's constant recontracting model. It analyzes the debt negotiations in a formal bargaining framework without sacrificing the economic analysis of the debtor's economy. Some key novelties of the additional structure, related to the macroeconomic model and the dynamics of the game, are worth mentioning. It features an import-dependent economy subject to foreign exchange and fiscal constraints. These constraints affect the external transformation needed to service foreign debt and the internal transfer of resources needed to service public debt, respectively. Furthermore, an important dynamic aspect of the negotiations is addressed by relaxing the assumption of investment exogeneity and studying the case where negotiation breakdowns would affect investment and, therefore, future negotiation environments and outcomes.

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[6]This is also true in Fernandez and Glazer and in Fernandez-Arias.

The rest of the paper is organized as follows. Section 2 analyzes the economic factors relevant to the study of sovereign debt negotiations, Section 3 describes the economy and sets up the model, and Section 4 solves the model. Section 5 analyzes the equilibrium solution and Section 6 summarizes the main conclusions.

2. SOVEREIGN DEBT NEGOTIATIONS

An understanding of international debt negotiations starts from recognizing the crucial difference between domestic and international lending regarding the enforcement of the debt contracts. In domestic lending the legal system allows collateral to be attached, which provides a guarantee for the creditor and an incentive to comply for the debtor. Insufficient collateral may lead to debt restructuring and even bargaining, but under normal circumstances the liquidation value of the collateral can be expected to be enough to assure contract compliance[7]. The legal right that creditors have of appropriating the collateral if the debtor does not repay supports domestic lending.

In international lending, by contrast, sovereign immunity makes the provision of effective collateral almost impossible. While sovereign immunity would strictly apply only to public debt, which is the bulk of all international debt, it also limits the

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[7]See Hart and Moore [1989] for an analysis of recontracting in domestic lending.

creditors' legal rights related to private debt, because debtor-country governments retain immense powers such as nationalizing debt or imposing restrictions on international payments. The limitations that sovereign immunity imposes on international law imply that courts can only attach collateral located in the creditor's jurisdiction, which, except in special cases such as airplanes, make the provision of collateral too costly to be included in international debt contracts. In the case of international lending, the question is not about insolvency or the debtor's ability to pay, since debt levels are typically below any measure of the debtor countries' economic possibilities of transferring resources[8]. The interesting question is why the debtor countries might be willing to transfer any amount at all, as they have been doing for a number of years since the debt crisis set in, given that international debt contracts include no collateral[9].

The short answer is that the creditor banks retain the power to hurt the debtor countries in the case of a default[10]. The commercial banking system plays a crucial role in facilitating

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[8]However, an attempt to accommodate a very large internal transfer from the private sector to the public sector in order to repay international debt, either by cutting spending or by increasing revenues, might lead to a government fall. To the extent that the government does not have full command on the country's economic resources, the government's ability to pay might be binding.

[9]It is only because debtor countries have some willingness to pay that international loans have been contracted in the first place.

[10]For a detailed analysis of the costs of default see Kaletsky[1985], Alexander [1987] and Bulow and Rogoff [1989b].

international transactions in world markets, precisely because of the limitations of international law regarding the enforceability of contracts between parties in different countries. Also, although the creditor banks do not have the right to seize assets in the debtor country jurisdiction, where they are located, they do have the legal recourse in their own court system to demand and be granted seizure rights in their own jurisdictions. Since the banking system is highly integrated and international debt contracts include cross-default clauses, if confrontational actions are taken they are likely to be widespread. As a consequence, a drastic reduction in access to capital markets and a cut-off from most international payment mechanisms can be expected. Trade financing would be reduced and goods in transit in the creditors' jurisdiction would be subject to seizure.

The banks can expect to be able to seize a negligible amount of assets, since debtor countries would have ample opportunity to avoid the jurisdictions and instances where assets are seizable and circumvent the obstacles[11]. Debtor countries would be hurt by sanctions, however, despite avoiding seizures. As a consequence of default sanctions, new commercial partners would be required and inefficient commercial practices would need to be used[12]. In

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[11] Iran 1979 is an exception confirming the rule. In this case assets were frozen for political reasons at a time when Iran was not planning to repudiate obligations and therefore not attempting to reduce exposure. Chase Manhattan Bank declared default after assets were frozen.

[12] The argument that the debtor country might also lose some access to international capital markets in the future is discussed later.

summary, default sanctions would essentially translate into deadweight losses because of the trade disruption they would generate, which from the debtor's point of view would be similar to the effect of an abrupt adverse change in terms of trade[13]. These potential penalties are a partial substitute for the missing collateral: they provide some incentives to pay without including the guarantee value of the collateral liquidation. These costs are all deadweight costs due to the inefficiency of the default regime, and for this reason a mutually beneficial negotiation to avoiding default might be expected. Note, however, that these losses accrue only to the debtor.

An additional important cost associated with a default situation, which has not received attention so far, takes the form of reduced output and investment. In fact, the disruption following default is likely to cause major dislocations in the debtor's economy compared to a stable rescheduling regime. One important aspect is that debtor countries' economies are typically rigid economies whose productive structure is strongly dependent on essential imports (both capital and intermediate goods) which

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[13] The available evidence is consistent with this picture. For example Peru in 1986, while preparing for being declared in default, deposited cash reserves in more secure locations (Bank of International Settlements) and transferred gold reserves from Switzerland to Peru. The same contingency plan specified that trade would be redirected through friendly countries in order to avoid hold title when the goods arrived in unfriendly countries. A loss of 10-15% of value of the total commodity trade was estimated (see the Andean Report, March 1986). When Brazil declared a debt moratorium in 1987, the reduction in trade financing was immediate. This, and the fact that international agencies denied financial help, forced Brazil to resume payments (see the New York Times, 2/22/88).

may be virtually impossible to obtain. This would negatively affect investment and the efficiency with which capital is used. The magnitude of the problem may make some firms so unprofitable that plant closings would result, thus reducing productive capacity. Furthermore, the severe dislocation of the relative profitability of different sectors in the economy in the context of an unstable economic environment would not be conducive to investment but rather to a wait-and-see strategy.

The relative importance of direct default sanctions of the kind mentioned above in providing incentives to pay and supporting international lending has been stressed by Bulow and Rogoff [1989a]. In their article, the authors show that under certain conditions of total absence of direct sanctions, the debtor's concern for how his reputation for repayment might affect the availability of future loans cannot sustain any lending[14]. From a more practical point of view, in the current crisis, reputation reasons are not likely to be relatively important because debtor governments cannot expect to receive positive net transfers until very far in the future, and therefore any future gain associated with being a good borrower should be deeply discounted. Consequently, for both theoretical and practical reasons, it appears to be a reasonable approximation to neglect reputation incentives.

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[14]They show that there is no subgame perfect equilibrium of the infinite game exhibiting positive lending. Therefore banks would never lend.

When there is a debt crisis the market value of debt falls below its contractual value (that is, there is a positive discount in the secondary market). In this case, even if banks are perfectly competitive, competition breaks down and the creditor banks acquire monopoly power *vis a vis* the debtor country. This is because creditor banks make a negative expected rate of return *ex post* (reflected in the market discount) and new loans would not obtain a better return by virtue of the seniority structure, which implies that no new bank would step in. In effect, *pari passu* provisions and negative seniority clauses in international debt contracts assure that all banks' claims are equally senior and, in combination with cross-default clauses, have helped the banks to coordinate and form a consortium after the crisis erupted. To simplify, the bank consortium will be taken as a single agent and the internal bargaining will be neglected by assuming that the bank members divide the collections in proportion to exposure. Therefore in a debt crisis the relations between the creditor banks and the debtor country can be characterized as a bilateral monopoly bargaining situation, where the bank consortium attempts to extract the maximum expected present value of net transfers from the debtor.

The maximum present value of net transfers which could be extracted through bargaining can be characterized as the shadow market value of the debt. When this shadow value is less than the contractual value, it becomes the actual market value (positive market discount) and a debt crisis with credit rationing and bargaining is the relevant framework. In this rationing regime

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which characterizes debt crises, any new lending would only be made by existing creditors on an involuntary basis in order to obtain the best negotiation outcome. When the shadow value is not less than the contractual value, then the actual market value is the contractual value (no market discount), and no bargaining takes place. Therefore, from an *ex ante* point of view, the shadow market value equals the debtor's credit ceiling, beyond which credit rationing would occur. The study of the negotiated transfers supporting the shadow value is useful for both the determination of the *ex ante* credit ceiling and for the characterization of a debt crisis, once the credit ceiling has been surpassed *ex post.*

In anticipation of the possibility of a debt crisis and *ex post* negative profits, banks charge a country-risk premium on their loans (obtaining zero expected profits assuming perfect competition). Lacking formal enforcement mechanisms, in the event of a debt crisis, debt obligations are subject to renegotiation depending on the bargaining conditions prevalent when obligations are due. The formal terms of the contract, however, are relevant: since the banks need to abide by the rule of law in order to have legal rights and bargaining power, they cannot possibly extract forced payments above the ones contractually stipulated. It is perhaps not surprising, therefore, that loans are made short term despite the fact that under normal circumstances they are expected to be rescheduled and rolled over[15]. With this short-leash strategy

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[15]The issue of how maturity and risk premia relate is not addressed here. It is simply noted that commercial debt is typically short

eac. bank minimizes the risk of receiving little or no payment at a time when they would like to withdraw as much as possible.

Negotiations between the banks' consortium and each country in the context of a debt crisis can be schematically described as follows The banks abide by the rule of law because otherwise they would lose the possibility of applying legal sanctions. The country, however, does not have this constraint and can renegotiate its obligations in any period. Therefore, without loss of generality, renegotiations seeking a rescheduling agreement can be assumed to take place in every period if the constraint is established that the outcome cannot be detrimental to the country, compared to complying with the original schedule in the current period. This is so because the country can always choose to adhere to the original schedule and comply with the obligation due in the current period[16], in which case there would not be any meaningful rescheduling (formally, the rescheduling agreement would coincide with the original schedule).

If no rescheduling agreement is reached in the current period, no transfer is made and default sanctions are applied in the current period[17]. If a rescheduling agreement is reached in

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maturity debt. Managerial compensation s emes resulting in deep discounting of the future and "herding" are probably important in this respect.

[16]It will be later shown that this option of adhering to the original schedule is irrelevant and not binding under the assumptions.

[17]If direct gains from seizures are larger than the legal costs of imposing sanctions, the incentive for applying sanctions is clear. Otherwise, as we will see, there are many equilibria in this game

the current period, a transfer is made and default sanctions are averted in the current period. In both cases, a new renegotiation starts next period. As revealed by the large discounts at which the international debt is quoted in the secondary market, the marginal value of nominal debt is extremely low. This suggests that countries will not regain access to voluntary lending in the foreseeable future and, therefore, that it is a reasonable approximation to assume that debt renegotiations will go on forever.

It is crucial for the understanding of this analysis to realize that rescheduling agreements need not be explicit to avert the application of default sanctions. If obligations do not fall in arrears, default sanctions would not be applied because the banks would not have the legal right to do it. If obligations do fall in arrears, although the banks would have the legal right to declare the country in default they may choose not to do so. For this to happen the banks simply have to accept the current payment, which is made in exchange for their abstention from applying the default sanctions they are entitled to (in the current period). Protracted negotiations and arrears do not necessarily imply that default sanctions are being applied, neither in this model nor in reality. Typically, debtor countries transfer positive amounts to banks and banks do not apply default sanctions, irrespective of the arrears situation which might have

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depending on the level of sanctions applied. The equilibrium where sanctions are not applied is not interesting because there would not be any collection and, *a fortiori*, any lending in the first place.

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developed. This paper argues that the threat of default sanctions causes the debtor countries to transfer amounts substantial enough so as to make them acceptable to banks, which results in sanctions not being actually applied.

If an explicit rescheduling agreement is reached, that is a new contract is signed, then, typically, current service is paid and a partially offsetting loan is contracted. In this case the current net transfer amounts to the interest payment minus the net capital inflow (fresh money), and future obligations are determined according to the terms of the new contract. If an implicit rescheduling agreement is reached, that is no new contract is signed, some payment is made in the current period and the unmet contractual obligations (if any) fall in arrears. In this case the current net transfer amounts to the payment made and future obligations are determined according to the provisions of the original contract and the associated legal treatment of arrears (if any). In the context of this paper, and arguably in reality, only the actual stream of net transfers that debtor countries make is relevant, as opposed to the legal distinction between signing rescheduling agreements or running arrears. A situation of a partial payment with arrears accumulation is equivalent to a rescheduling agreement specifying a net transfer equal to that partial payment in the current period and a future schedule identical to the one resulting from the accumulation of arrears under the original contract.

In a negotiation attempting to reach a settlement, default

costs have to be weighted against the cost of the agreed net transfer payment. Four dimensions are relevant to the determination of this latter cost. First, there is the present consumption foregone due to the additional savings which have to be generated in order to meet current payments. Second, the transformation of domestic resources into international currency through the corresponding increase in net exports, needed to service external debt, may prove exceedingly costly if larger net export volumes lead to decreasing returns on domestic resources[18]. Third, the internal transfer of resources from the private sector to the government, needed to service public debt, may impose additional costs in terms of political stability (particularly if government spending suffers) and distortions imposed on the economy if an effort to increase revenues is made. Fourth, there is future consumption foregone due to possibly lower current investment.

3. THE MODEL

Bargaining Rules

Negotiations are represented as follows. The bank consortium (the bank) and a debtor country (the debtor) bargain over debt repayments. In each period (of duration h) the parties are assumed to bargain over the current net transfer making alternating offers and counter offers, like in a standard Rubinstein-like

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[18] For example, if export expansion leads to lower international prices or higher domestic costs of production.

bargaining game. Specifically, suppose that at any time t the bank makes a net transfer offer b_t. If the debtor accepts the offer, the payment is instantly made. By yielding to the bank's offer the debtor gives the bank the opportunity to offer again next period, that is at time t+h. If the debtor rejects the offer, default sanctions are applied. By resisting the bank's offer, the debtor earns the opportunity to make a counter offer d_{t+h} at time t+h. This process continues forever.

Similarly, suppose that at any time t the debtor makes a net transfer offer d_t. If the bank accepts the offer, the payment is instantly made. By yielding to the debtor's offer the bank gives the debtor the opportunity to offer again next period, that is at time t+h. If the bank rejects the offer, default sanctions are applied. By resisting the debtor's offer, the bank earns the opportunity to make a counter offer b_{t+h} at time t+h.

This set up is similar to Rubinstein's perfect information game in that it is a model of bilateral negotiation, that is no party is given all the bargaining power, where the parties suffer a loss over time if they do not agree. In contrast, however, this game is a multi-stage game where the debt rescheduled is indefinitely recontracted over time[19]. In this respect the game is in the spirit of the constant recontracting model introduced in Bulow and Rogoff [1989b]. Unlike Bulow and Rogoff's model, this

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[19]In the bargaining theory jargon, there is a potentially infinite number of pies becoming available over time which are to be successively divided: once a pie is divided, another one comes along.

game is inherently dynamic in that the environment in which the players bargain (the productive potential of the economy) is endogenously affected by the negotiation outcomes in a way to be later described.

It is assumed that debt obligations, both interest payments and amortizations, are due in full in each period. This assumption reflects the relatively short maturity of commercial loans when the debt crisis started and some efficiency characteristics of the equilibrium outcome of the bargaining game which will be discussed later. This assumption, however, is not critical. All that is needed is that obligations in any given period are not less than the bargaining solution (and therefore binding for the bank). Under this assumption, any rescheduling agreement would entail a current transfer not exceeding the one specified in the original schedule. If no rescheduling agreement is reached, either implicit or explicit, no transfer is made and default sanctions are applied in the current period. All the resulting outstanding debt, including debt resulting from arrears, is due next period, when it is again renegotiated, etc.

Since the bank abides by the rule of law, the terms at which the debt is rescheduled are binding for the bank. It is assumed that the banks are not in a position to make rescheduling agreements contingent on investment, whose unverifiability may prevent banks from coordinating and committing to such a scheme[20].

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[20]Complex reputation-like strategies could sustain these contracts implicitly, but they do not appear to be relevant in actual

It will be further assumed that the game is not played on the wrong side of a debt Laffer curve (i.e. the incentive effect of future payments on investment is not strong enough to justify unilateral reductions in contractual debt service)[21]. Assuming that the debtor country's rate of time preference exceeds the world interest rate, it will be apparent that, in this model, prepayments (that is larger payments in exchange for smaller scheduled payments in the next periods) would not be efficient and would not be part of the equilibrium. Therefore it can be safely assumed that the bank will make certain that the amount of its contractual claim is not binding. This justifies the assumption that the contractual obligation in each period is large enough that the right to pay in full is not a relevant option for the debtor.

The existence of a debt crisis indicates that outstanding debt is larger than the expected present value of the negotiated payments, still to be determined. Alternatively, this expected present value can be seen as the maximum amount that can be extracted from countries, thus determining a (ex ante) ceiling on international lending. To simplify, it is assumed that there is no

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negotiations. The markovian refinement which will be used for equilibrium selection will imply that bargaining strategies do not depend on historical events except insofar as they have a direct effect on the economy. This forward-looking restriction will imply that promises made by the bank to the effect of abstaining from collecting all they could, depending on investment, will not be honored, and therefore contingent payments will be ruled out on theoretical grounds too.

[21]Once this case is solved and the bargaining solution found, the possibility of mutually beneficial reduced contractual debt service can be explored.

uncertainty[22]. Without uncertainty it makes sense to assume that

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[22]In reality, the effect of sanctions is highly and equally uncertain to both parties. This feature can be easily included as in Fernandez-Arias [1989] without changing the qualitative results (in this model, the unknown sanction should be replaced by its expected value).

the negotiation process will go on forever, because if it were known that at some point the capitalized debt would sell at par, there would not be a debt crisis to begin with. Under these assumptions, the exact terms of rescheduling are irrelevant and will not be addressed.

Economy

The economy will be characterized in terms of a set of parameters in a linear structure. Some of these parameters refer to relations between flow variables and the capital stock and are therefore dependent on the length of the time period used for measuring flows. The period considered is of duration h. Since h will be later considered as a variable, the dependence on h is made explicit by linearly scaling the flow-capital stock parameters. For convenience of language these parameters will be interpreted taking h as unity (i.e. if the parameter relating exports to capital is xh, x will be referred to as the exports-to-capital ratio)

For simplicity, the domestic economy is assumed to produce a single good, which can be absorbed domestically (that is invested or consumed domestically) or exported[23]. Let 0_t be real

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[23]The distinction between tradeable and non-tradeable sectors has been analyzed elsewhere (see for example Aizenman [1987]), where it is shown that the strategic aspects of the debt negotiations may distort the investment allocation across sectors. Here such a distinction would complicate matters without adding much to the aspects this paper focuses on, and therefore all domestic production is assumed to be exportable.

domestically produced output (after some choice of units).

Domestic output is either used for domestic absorption (A_t) or for

exporting (X_t). By definition:

[1] $O_t = A_t + X_t$

Let international dollar prices in constant dollar terms

(that is, deflated by dollar inflation) of imported goods and of

domestically produced goods be p_M and p_X respectively. Let P_t

stand for debt payments in period t, also in constant dollar

terms. The whole analysis can be conducted in terms of dollars

only because it is assumed that real exchange rates among

currencies in which international debt is denominated remain

constant over time.

It is assumed that world conditions are expected to be

stationary. It is also assumed that the debtor country is a small

economy, and therefore it has no effect on the import price p_M.

Then p_M is constant over time and is normalized to $p_M=1$ by a

suitable choice of import units. Therefore real imports in period

t, M_t, are equal to their constant dollar equivalent. In the

exports market the country is not small, however, because products

from different countries are imperfect substitutes[24]. In order to

reflect increasing costs in transforming domestic resources into

foreign currency, which appears to be a characteristic of many

rigid underdeveloped economies, it is assumed that the price of

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[24]Note that this argument does not apply to imports because the
country represents a small share of each exporting country.

exports is also constant but only until a certain point, beyond which it drops sharply making it unprofitable to expand further. This kink is assumed to occur when the exports-to-capital ratio reaches a certain value x^{25}. Units are chosen such that in the relevant range $p_x=1$ as well, and therefore real exports are also equal to their constant dollar equivalent.

In this economy imports are used for domestic absorption[26]. Imported goods (M_t) are absorbed domestically in combination with the domestically produced goods A_t. In order to keep things simple it will be assumed that imported goods can be substituted by domestic goods for absorption purposes at a constant rate e. The substitution rate e is assumed to be such that the country obtains gains from international trade by substituting imports for domestic output, that is e>1. Let C_t be real consumption and I_t be real domestic investment, the two components of domestic absorption, measured in domestic output units. Then:

[2] $C_t + I_t = A_t + eM_t$, e>1

The assumption that e>1 implies that the country makes positive gains from trade at the margin. This means that the country has a foreign exchange constraint, in the sense that the country would like to expand exports at the prevailing prices but will not do it because of the drop in returns. Equivalently, the

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[25]This extreme assumption is made to simplify but is not critical.
[26]Intermediate inputs can be easily included.

expansion of net exports to accommodate debt payments is exceedingly costly in terms of domestic output. Based on this marginal characterization, (e-1) will be interpreted as a measure of the foreign exchange constraint. In this simple linear model this measure also relates to average gains from trade, but the marginal interpretation is the relevant one (similar results can be obtained in a more complicated model with decreasing returns to net exports). In this model, the existence of a foreign exchange constraint implies that exports will reach their maximum. Then:

[3] $X_t = xhK_t$

For simplicity, in this model the capital stock is held fixed during discrete intervals. To simplify notation these intervals are made to coincide with the bargaining rounds, which as described before have length h. Capital depreciates at a rate k. Then:

[4] $K_{t+h} = K_t(1-kh)+I_t$

The technology is linear , that is it exhibits a constant capital-to-output ratio, which reflects technological rigidity and relative abundance of labor inputs. The gross capital efficiency with which output is produced, however, as measured by the capital-to-output ratio, depends on the distortions that the debt crisis introduces in the economy through public policy[27]. It is

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[27]An alternative interpretation could be that debt payments entail political costs, which for the government point of

assumed that when a payment is made, the government is forced to increase revenues through mechanisms which have a distorting effect on output efficiency, such as anti-technical taxes or inflationary financing. This cost is assumed to be a fraction f of the payment made. Since the cost of external payments in terms of domestic output is magnified by the factor e, additional revenues measured in domestic output units are similarly magnified. Let p_t stand for the share of the payment service in installed capital (that is, $P_t = p_t h K_t$). Assuming that in the absence of payments the inverse of the capital-to-output ratio is v and that the adverse output effect is proportional to the additional revenues[28], output can be written as:

[5] $O_t = (v - fep_t)hK_t$, $f \geq 0$, where by definition $P_t = p_t h K_t$.

In the case of sanctions, in principle the country could take a number of defensive measures which could reduce the export volume. To simplify, however, it is assumed that in that event the best course of action for the country is to continue trading internationally by exporting the same amounts and suffering losses from rerouting, as opposed to storing exportable goods to be shipped after sanctions are lifted or consuming them while sanctions are in effect[29]. This assumption is consistent with the

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view are equivalent to reductions in output.

[28]This implies that aside from the payments on foreign debt, public policy has a constant impact on the productive efficiency of the economy as measured by the coefficient v. One justification may be that the relative size of the State in the economy remains constant.

[29]In Bulow and Rogoff's terminology, the punishment-constrained

fact that the economy suffers from a foreign exchange constraint, particularly if critical imported investment goods become not available, as it will be suggested later.

For simplicity, it is assumed that international reserves are held fixed[30], and therefore exports exactly finance imports and (net) payments. It is assumed that the only payments made are those related to commercial debt; in particular zero net capital flight is assumed. In the context of this model, once the investment decision is made and capital accumulated, the export volume next period is determined. The available import volume is then determined by the net payments which have to be financed.

Two scenarios for the balance of payments at time t are considered:

Case 1.   A rescheduling agreement is reached.   In this case a net payment P_t (in constant dollar terms) is made and no default sanction is applied. Then

[6] $X_t = M_t + P_t$

Case 2.   A rescheduling agreement is not reached.   In this case no net payment is made ($P_t = 0$) and default sanctions are applied.

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region, as opposed to the bargaining or the autarky regions, is assumed to be the relevant region

[30]Reserves proportional to trade volume can be easily incorporated.

As explained before, default sanctions have the main effect
of disrupting trade by making international transactions more
costly. In particular, the effect of sanctions is put as an
adverse change in the terms of trade because of the inefficient
trade mechanisms that r ed to be used. Let the terms of trade
shock be measured by the factor q applied to the original terms of
trade, where q≤1. In the extreme case that q=1 the country manages
to circumvent sanctions costlessly; otherwise there is a real
loss. Then:

[6'] $M_t = qX_t$, q≤1

To close this reduced-form model an equation determining
investment is needed. The economy to be modeled is one where
private agents play a crucial role and impose severe constraints
on public policy. For this reason the government will be assumed
to have relatively inefficient instruments at its disposal to
affect the market-determined domestic investment , with the
implication that investment will not be assumed to be optimal from
the point of view of the government. Other bargaining models in
the literature have specified that the investment rate (or the
rate of growth of the economy) is exogenously given, which amounts
to assuming away the dynamic implications of the bargaining
process. There are three interesting sources of investment
endogeneity in the context of this bargaining game: the incentive
effect related to the debt overhang, the liquidity effect related
to current transfer payments, and the disruption effect related to

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the application of default sanctions.

Incentive effects discouraging current investment would arise from the return-reducing future taxation of domestic capital needed to finance future net payments in order to service the debt. Liquidity effects discouraging current investment would arise from the increase in the cost of funds due to the savings needed to cover current net payments and perhaps the increase in the relative price of investment goods if their import component, substituted at a loss (e-1), is sufficiently important. The first effect points to the volume of the outstanding debt (the debt overhang) and the second effect points to the current debt service. There is no consensus about the relevance of these effects, however. Their importance has been forcefully emphasized by Krugman [1988, 1989] and Sachs [1988, 1989] among others. Bulow and Rogoff [1990] however, argue that low investment in Latin America is best seen not as a consequence of the debt crisis but as symptom of the underlying economic shocks which caused the debt crisis.

Debt overhang effects would be reflected in an investment rate dependent on the expectation of future repayments. As long as the debt overhang distortion is not as powerful as to place the parties on the wrong side of the so-called debt Laffer curve, it can be incorporated in this model. Liquidity effects might introduce interesting considerations into the game, because in that case, in contrast to the case where growth is exogenously given or only affected by the debt overhang, the bank might choose

not to extract all it could in the current period in order to improve the future potential of the economy, and therefore future payments[31]. The choice was made not to include these two effects, which would break the linearity of the model, and rather concentrate on a more subtle underlying effect, which will be termed disruption effect.

To maintain linearity, barring liquidity and debt overhang effects, it will be assumed that in the absence of sanctions investment is a constant fraction s of installed capacity. Therefore payments would be absorbed by consumption. Then:

$$[7] \quad I_t = shK_t$$

In the case of default sanctions there are other channels through which the economic environment may be affected, whose effects will be called disruption effects. The disruption due to the sanctions is likely to cause major dislocations in the economy, particularly because of its reliance on essential imports which may be virtually impossible to obtain.

In order to reflect the feature that the degree of substitutability between domestic and imported goods for investment purposes may decrease sharply when core imported capital goods are scarce, which seems to be relevant in many underdeveloped countries, it is assumed that after some point no

[31]This statement assumes that strategies do not depend on past payments.

further perfect substitution at the rate e is possible[32].

Specifically, it is assumed that there are core imports which are needed to support an investment ratio s[33]. If these essential imports are not obtained, the resulting substitution and relocation of investment leads to an investment ratio possibly lower than s. If sanctions are not too severe, critical imports are financeable, s'=s and equation [7] holds under sanctions too. If sanctions are severe enough, however, critical imports are affected and s'<s. Then s'≤s. Let Δ=s-s'≥0 be the reduction in investment due to the disruption effect. Then:

[7'] $I_t = (s-\Delta)hK_t$, $\Delta \geq 0$

No attempt is made here to endogenously derive these particular relationships from a more structural model based on private agents' optimization. They should be seen as a convenient way to parameterize the relationships discussed above. If sanctions are not applied or if they are not effective (x=0, the economy is completely closed; q=1, sanctions are costlessly circumvented) then the economy grows at the exogenous rate s-k. If effective sanctions are applied the reduction in the growth rate is Δ≥0 and the economy grows at the rate s-k-Δ.

To simplify notation, let g=s-k be the growth rate when

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[32]Very imperfect substitution is a key characteristic of two-gap models.

[33]This implicitly assumes that the range of payments to consider is such that they are never so costly as to prevent the financing of core imports.

agreement is reached and $g'=s'-k=g-\Delta$ be the growth rate when sanctions are applied. Let $\gamma=1+gh$ and $\gamma'=1+g'h$ be the corresponding growth factors per period. It will be later justified that in equilibrium default sanctions would not be applied, which implies that two cases can be distinguished at time t:

i) An agreement to pay $P_t=p_t hK_t$ is reached at time t.

Then the system formed by equations [1,2,3,4,5,6,7] prevails. By successive substitution, current consumption and capital accumulation can be obtained:

(I) $\quad C_t/hK_t = (n-g-p_t)+(e-1)x-(e-1)p_t-fep_t$

$\qquad\qquad = c-e(1+f)p_t$

(II) $\quad K_{t+h} = \gamma K_t$

where n=v-k is the net output-to capital ratio, $c=n-g+(e-1)x$ is the consumption-to-capital ratio with no payments, K_t is predetermined and p_t is ₋o be determined.

In this case the consumption-to-capital ratio can be decomposed in four terms. The first term reflects the domestic product identity without adjustments for the presence of foreign exchange and fiscal constraints (that is, taking e=1 and f=0, respectively). It equals net domestic output (n) adjusted by net investment (g) and the trade balance surplus (p_t). The second term

is the gains from trade in terms of current absorption[34]. The third term is the additional cost imposed by the foreign exchange constraint on the external debt payment in terms of consumption, that is the associated loss in gains from trade, at the rate $(e-1)$. The fourth term is the efficiency cost of debt payments due to the fiscal constraint, at the rate fe.

The effect of the external payment can be thought of in three cumulative steps: the direct cost in dollars (p_t), a first indirect cost on top of p_t due to the foreign exchange constraint, which magnifies the direct cost in domestic output units $((e-1)p_t)$, leading to a total cost of ep_t, and a second indirect cost on top of ep_t due to the fiscal constraint, which magnifies the cost in domestic output units because of inefficiencies in the extraction of these additional revenues (fep_t), leading to a total cost $e(1+f)p_t$. Rearranging, the same ratio can be decomposed in two terms: one that would prevail if no external payments were made, c, and another one accounting for the total cost of the external payment, $e(1+f)p_t$. Note that in the absence of both foreign exchange and fiscal constraints, this total cost collapses to the direct cost p_t.

ii) No agreement is reached at time t.

Then no payment is made $(P_t=p_t hK_t=0)$ and the system formed by equations [1,2,3,4,5,6',7'] prevails. By successive substitution current consumption and capital accumulation can be obtained:

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[34]Gains from trade are potentially larger because trade allows to sustain larger investment rates.

(I') $C_t/hK_t = c-(1-q)ex+\Delta$

(II') $K_{t+h} = \gamma'K_t$

where K_t is predetermined.

In the case of sanctions, the consumption-to-capital ratio can be decomposed in three terms. The first term corresponds to the consumption that would prevail if no sanctions were applied or they were completely ineffective (q=1 and, therefore, Δ=0). This term is identical to the analogous decomposition of (I) when no payments are made, which makes sense because both situations would be identical. The second term accounts for the cost of the sanctions in terms of domestic output due to the adverse change in terms of trade. The third term corresponds to the potential increase in current consumption due to the decline in total domestic investment due to the disruption effect. Correspondingly, in the case of sanctions, capital grows at a possibly lower gross rate γ'.

Objective Functions

The internal bargaining within the banks' consortium is assumed away by representing the consortium as a single agent[35]. Similarly, the debtor country's objective function is represented

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[35]The possible relevance for the negotiations of the threat of forming a debtor countries' cartel is also neglected. See Fernandez-Arias [1989] for a treatment of this issue.

by a present discounted expression of domestic consumption. This implies that the debtor government has very simplistic objectives and faces no trade-offs among competing groups, which amounts to assuming away the political complexities of fiscal problems and austerity programs[36].

The banks' consortium objective function at time t, B_t, is the present discounted value of the stream of payments $\{P_t\}$. Since those payments are in constant dollars, the discount rate is the real riskless rate r. Then:

$$B_t = \sum_{j=0}^{\infty} \beta^j P_{t+jh} \quad , \text{ where } \beta = 1/(1+rh)$$

For tractability reasons, in order to obtain a closed-form solution, the debtor country's objective function at time t, D_t, will be approximated as the present value of the stream of real consumption $\{C_t\}$. The discount rate i may reflect not only the government's rate of impatience but also the population growth rate to the extent that the government cares about per-capita consumption. Then:

$$D_t = \sum_{j=0}^{\infty} \delta^j C_{t+jh} \quad , \text{ where } \delta = 1/(1+ih)$$

As will be seen later, if the real riskless rate does not

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[36]Alternatively, the inefficiency cost measured by f can be thought as representing a wedge between the government's evaluation and a desired social evaluation (as seen by an IFI, for example). The implications of distortions in the government's objective function will be analyzed in a separate piece.

exceed the exogenous growth rate of the economy (r≤g) the credit ceiling is unbounded and there would not be a debt crisis. It is assumed therefore that growth is lower than the riskless interest rate (r>g), or equivalently, $\beta\gamma<1$. To sharpen some results it is assumed that the debtor is more impatient than the bank, that is i>r, which is a reasonable assumption since governments are typically very impatient and, furthermore, c includes the population growth rate. In this model i>r also provides a rationale for the debtor's willingness to borrow at the rate r for consumption tilting. Noting that g≥g', it holds true that i>r>g≥g', which implies that in terms of discount factors $\beta\gamma$, $\beta\gamma'$, $\delta\gamma$ and $\delta\gamma'$ are all smaller than 1.

Equilibrium Concept

In this game, each player's pure strategy specifies that player's (deterministic) move at each point in time as a function of the history of the game. The bank offers to agree on an payment $P_t = b_t$ to which the debtor responds with "Yes" or "No", and the debtor offers to agree on a payment $P_t = d_t$ to which the bank responds with "Yes" or "No", where t=0,h,2h,... A party earns the opportunity of making a counter offer next period by rejecting an offer and gives the other party an opportunity to make another offer next period by accepting an offer. A pure strategy specifies which offer or reply should be selected, depending on whose turn it is, as a function of the history of the game.

A Nash equilibrium in pure strategies is a pair of pure

strategies, one for each player, such that neither player can improve its objective function by unilaterally changing its strategy (including stochastic mixtures of pure strategies). As is customary, attention will be restricted to Nash equilibria in pure strategies.

A history-independent strategy is one in which there is no effective dependence on history. A Markov-Nash equilibrium (MNE) is a Nash equilibrium where strategies depend on history only through a set of state variables. In this game it is natural to make replies contingent on the offer received in that same period. Apart from that obvious dependence, it is plausible to consider the capital stock K_t as the state variable, since it summarizes the economic environment in which the game is played[37]. This markovian refinement is the natural generalization of the spirit of the history independence refinement to a game where the physical environment changes over time. The justification of these refinements is simplicity: each continuation equilibrium of the game at the beginning of any period depends only on the game the players have ahead. Therefore pure strategies in an MNE are of the form $b_t \equiv b[K_t]$ and $d_t \equiv d[K_t]$, and similarly for the responses at time t, which depend on the offer received and K_t. It is easy to check that, as a consequence, all subgame equilibrium payoffs at the beginning of each period depend only on the capital stock and whose turn it is to offer.

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[37]Here calendar time per se is irrelevant because of the stationary structure of this infinite game. In a finite game calendar time would be relevant in the remaining part of the game and should also be included as a state variable.

A subgame-perfect Markov-Nash equilibrium in pure strategies in this game is a MNE in pure strategies which is so in any subgame (i.e. in the remaining of the game). Subgame perfection can be interpreted as restricting strategies to those which are *ex post* optimal, and therefore ruling out incredible threats which would not be carried out *ex post*. In this game it means that players attempt to maximize B_t and D_t at every t.

The equilibrium concept in this model will be subgame-perfect Markov-Nash equilibrium in pure strategies, which is a standard refinement in games like this. To sharpen results and ensure uniqueness attention will be restricted to linear offer strategies (i.e. $b[K_t] \equiv bhK_t$ and $d[K_t] \equiv dhK_t$). Another way to characterize this equilibrium concept is by noting that attention is being restricted to strategies where p_t is history-independent (it is either b or d). It is easy to check that because both the economic variables and the payoff functions are linear functions of installed capacity, an equilibrium in linear strategies leads to linear subgame payoffs.

The justification for this constant-return-to-capital assumption is four-fold. First, equilibria of all other related bargaining models in the debt literature exhibit this characteristic, and for this reason it is important to select this equilibrium as a benchmark. Second, it represents a neutral standpoint for the study of how the size of the economy might affect the outcome, which is one of the questions to be addressed.

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Third, the same equilibrium can be obtained by applying other refinements common in the debt literature[38]. In fact, if the game is truncated by assuming that after some final date there will be no more rescheduling, then at that point the players would bargain over a final payment like in a Rubinstein's game. Considering the limiting case where the final date is arbitrarily far in the future leads to the same equilibrium selection[39]. Fourth, linear strategies can be justified on the grounds of simplicity, like the markovian refinement and the exclusion of mixed strategies.

4. EQUILIBRIUM

Let $D_t^A \equiv D^A[K_t, b_t]$ be the debtor's equilibrium expected payoff if it accepts an offer b_t at time t and let $D_t^R \equiv D^R[K_t]$ be the debtor's equilibrium expected payoff if it rejects it, which in this game is independent of b_t. Similarly, let $B_t^A \equiv B^A[K_t, d_t]$ be the bank's equilibrium expected payoff if it accepts an offer d_t at time t and let $B_t^R \equiv B^R[K_t]$ be the bank's equilibrium expected payoff if it rejects it, which is also independent of d_t. Note that these payoff variables are defined only when the corresponding player receives an offer.

A subgame-perfect Markov-Nash equilibrium in pure strategies in this game can be characterized by the equilibrium offer

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[38]As in Bulow-Rogoff's constant recontracting model.

[39]This can be checked by solving for the final payment (which turns out to be linear in capital) and applying backward induction.

functions $b[K_t]$ and $d[K_t]$ and the corresponding reply functions in terms of the offer received and installed capacity K_t. With linear strategies an equilibrium is characterized by the two scalars b and d in the linear offer functions $b[K_t] \equiv bhK_t$ and $d[K_t] \equiv dhK_t$, and the reply functions. The equilibrium $p_t = b^*$ and $p_t = d^*$ satisfy the system:

$$D^A[K_t, b] \equiv D^R[K_t] \text{ and}$$
$$B^A[K_t, d] \equiv B^R[K_t]$$

for all t for which they are defined.

To see this, suppose that in period t it is the bank's turn to make an offer. Because of the markovian assumption and the fact that after a rejection capital grows at the fixed rate γ', the debtor's payoff in case of a rejection, D_t^R, depends only on K_t and not on the offer b_t. Also, D_t^A is monotonically decreasing in b_t because future payments after an acceptance are independent of the accepted offer b_t, since in this case capital grows at the fixed rate γ. This establishes a fixed maximum acceptable proposal b_t^* such that $D_t^A = D_t^R$. Turning to the reply function, subgame perfection implies that offers below b_t^* are accepted and those above are rejected, since, respectively, rejection would be worse and better. In equilibrium the bank should not offer less than this because it could do better by offering slightly more and still having the offer accepted. It should not offer more either. Since in that case the debtor would suffer the default costs and still get the relatively high utility level D_t^R, the bank is bound to be worse off. Similarly, when it is the debtor's turn to make

an offer, d_t^* is determined such that $B_t^A = B_t^R$.[40] Subgame perfection implies that these conditions hold in every period.

The players' equilibrium responses to offers in that equilibrium are such that the points b_t^* and d_t^* are cut-off values dividing the acceptance and rejection regions. At those points there is indifference, but equilibrium strategies have to specify acceptance (otherwise no offer would be a best response because any offer could be improved by offering closer to the cut-off level). Therefore, in equilibrium, offers are accepted immediately and default sanctions are never applied, which appears to be a realistic implication of the model[41]. Notice that even though sanctions are not applied, they represent a credible threat which actually determine the negotiated payment level.

In equilibrium agreement is reached in all future periods, which implies that installed capacity is expected to grow at the exogenous rate γ from the next period onwards. In the current period it grows at the rate γ or γ' depending on whether the current offer is accepted or rejected, respectively. Equilibrium payoffs at time t can be obtained from the systems (I)-(II) and

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[40]This reasoning assumes that both players prefer the resulting solution to never gree. Otherwise the equilibrium corresponds to a corner solution where the player who would prefer not to agree obtains a utility-equivalent settlement. It will be later checked the conditions under which this interior solution holds.

[41]Since agreements may be implicit, the only factual implication is that sanctions are not applied. This is a reflection of the symmetric information assumption in the model. For a model with asymmetric information and agreement delays (and presumably sanctions being applied, although this is not made explicit) see Wells (1990).

(I')-(II'), depending on whether the current offer is accepted or rejected. In the case of the debtor it is the present value of the consumption stream at the debtor's rate of discount; in the case of the bank it is the present value of the stream of payments at the world real interest rate. Recall that in period t the bank makes equilibrium offers bhK_t and the debtor makes equilibrium offers dhK_t. Since in equilibrium offers are accepted, the party who makes the opening offer can be expected to make all the offers. Then:

$$D_t^A \equiv \sum_{j=0}^{\infty}\delta^j (c-e(1+f)b)h\gamma^j K_t$$

$$D_t^R \equiv (c-(1-q)ex+\Delta)hK_t + \delta\sum_{j=0}^{\infty}\delta^j (c-e(1+f)d)h\gamma^j (\gamma'K_t)$$

$$B_t^A \equiv \sum_{j=0}^{\infty}\beta^j dh\gamma^j K_t$$

$$B_t^R \equiv 0 + \beta\sum_{j=0}^{\infty}\beta^j bh\gamma^j (\gamma'K_t)$$

where $j=0,1,2,\ldots$

Applying the equilibrium conditions $D_t^A=D_t^R$ and $B_t^A=B_t^R$, recalling that $\gamma-\gamma'=\Delta h$, and simplifying the common factor hK_t, the equilibrium linear system for b and d is obtained:

[8] $b = \delta\gamma'd + (1-\delta\gamma)(1-q)x/(1+f) + \Delta(c\delta h-(1-\delta\gamma))/e(1+f)$

[9] $d = \beta\gamma'b$

Substituting, the system can be easily solved for the

equilibrium b^* and d^*. Some results are considerably simplified if bargaining rounds are very short. First-mover advantages are also removed, since b^* and d^* have a common limit π. As $h \to 0$, all of $\delta, \beta, \gamma, \gamma'$ converge to 1, $1 - \delta\gamma \approx (i-g)h$, $1 - \beta\gamma \approx (r-g)h$, $1 - \delta\gamma' \approx (i-g')h$, $1 - \beta\gamma' \approx (r-g')h$ and $1 - \delta\beta\gamma'^2 \approx (r+i-2g')h$. In this limiting case the rates i, r, g and g' are instantaneous rates and the flow variables are densities. Then the limit of the payment b^* or d^* is:

[10] $\pi = \dfrac{(i-g)(1-q)x + \Delta(n-i+(e-1)x)/e}{(1+f)((r-g)+(i-g)+2\Delta)}$

The corresponding equilibrium payoff for the bank and the debtor are $\qquad B^* = \lim \sum_{j=0}^{\infty} \beta^j \gamma^j \pi h K$ and
$$D^* = \lim \sum_{j=0}^{\infty} \delta^j \gamma^j (c-e(1+f)\pi) h K$$
respectively, where K is the initial stock of capital. Then:

[11] $B^* = \pi K/(r-g)$

[12] $D^* = (c-e(1+f)\pi))K/(i-g)$, where $c=n-g+(e-1)x$

Note that as $r \to g$ the bank's payoff $\bar{B}^* \to \infty$, which means that $r > g$ is a necessary condition for credit rationing. The above solution for π assumes that it is an interior solution, in the sense that no party would find it more convenient to never agree. In the case of the bank this means that $\pi \geq 0$. In the case of the debtor this means that the debtor does not prefer suffering sanctions forever over paying π each period. In the next section the conditions under which π is the true equilibrium are analyzed.

When the disruption effect is negligible ($\Delta=0$), the exogenous growth case is obtained. In this case, payments (π), payments relative to exports (π/x) and the market value of the debt relative to exports (B^*/hx), are:

$$[13] \quad \pi = \alpha\frac{(1-q)x}{(1+f)} \quad ; \quad \pi/x = \alpha\frac{(1-q)}{(1+f)}; \quad \text{where } \alpha = \frac{(i-g)}{(r-g)+(i-g)}$$

$$[14] \quad B^*/hx = \alpha\frac{(1-q)}{(1+f)(r-g)h}$$

5. ANALYSIS

The reason why one might expect a debtor to pay positive amounts in equilibrium is that sanctions would hurt it and the threat of their application is credible. One way to see this is to consider the case where sanctions are completely ineffective (either they can be costlessly circumvented ($q=1$) or the economy is completely closed ($x=0$)). In this case there is not only no static cost (the one associated with current consumption for a given investment level) but also no dynamic cost (the one associated with reduced investment), because there would be no disruption to affect investment. Then $\Delta=0$ and $\pi=0$ is obtained. Except in this trivial case, if sanctions do have effect one would expect that equilibrium payments would be strictly positive. This is easily checked in the exogenous growth case displayed in [13], where the dynamic effect does not apply. However, it is not true in general.

It is possible that the debtor actually prefers the applicatio of sanctions. It can be checked, by comparing the debtor's utility under permanent sanctions, $(c-(1-q)ex+\Delta)K/(i-g')$, and the one calculated in [12] at the payment level π calculated in [10], that the debtor is indifferent to sanctions when $\pi=0$ and actually likes them if and only if $\pi<0$. Equilibrium payments cannot be negative because before accepting that outcome the bank would prefer to use its option of not agreeing to the rescheduling. This implies that if π is negative, a corner solution with no payment obtains[42]. Therefore this dynamic model, contrary to static or exogenous growth models, is able to generate a non-trivial equilibrium with no payment.

The reason why the debtor government may prefer sanctions is that while the static cost is unambiguously painful, the effect of the dynamic component is ambiguous. If there are low returns to investment and the government is so impatient that it prefers to slow down the investment rate, then the dynamic component is actually beneficial. When the effect on investment is very large there may be a consumption surge in the early periods, despite the static cost of sanctions, which might dominate slower growth. If disruption effects are important and investment opportunities not too profitable, impatient governments, perhaps the least development oriented, might be able to pull out the best deals.

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[42]This neglects the possibility of the banks being able to adjust sanctions and choose a higher q which might hurt country. I later come back to this issue.

Assuming in what follows that sanctions hurt, the debtor prefers the equilibrium solution $\pi>0$ to suffering sanctions. At the same time, banks also prefer to settle at $\pi>0$ rather than to apply sanctions without extracting anything from the debtor. Therefore the negotiations can be seen as a discussion about what fraction of the cost of sanctions, which can be interpreted as the bank's threat point, will be borne by the debtor in the form of payments.

Exogenous growth ($\Delta=0$)

This interpretation about the negotiation is particularly clean in the exogenous growth case, where the sanctions amounts to a trade loss equivalent to $(1-q)X_t$ dollars. In this case, the equilibrium payment in dollars, P_t, can be seen as a fraction $\alpha/(1+f)$ of that trade loss (equation [13]), where $f \geq 0$ by assumption and, under the assumption that $i>r>g$, $0<\alpha<1$.

The coefficient α depends only on the rates i, r and g. As is usual in simple bargaining games with time discounting, the more impatient the player the worse the player does, and when both players are equally impatient they share the pie in halves $(\bar{\alpha}=1/2)$ [43]. In particular, in this model a higher world real

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[43] Bulow and Rogoff obtain a reasonable result similar to this one for what they call the bargaining region. However for the punishment-constrained region, which is the relevant one in this paper, they obtain the unintuitive result that everything would be as if the banks had all the bargaining power ($\alpha=1$ in this model). This calls into question the rules of their bargaining game, which are responsible for this disturbing result.

interest rate r is to the debtor's advantage because it makes the bank more impatient (in order to do business elsewhere), without any additional effect. The market value of the debt, measured by B^*, and therefore the secondary market price, would also decline not only because payments are lower but also because of heavier discounting (see [14]). Impatient governments with a large discount rate i, which to some extent can be interpreted as the ones less development oriented, would end up striking worse deals and therefore achieving a lower welfare level (as measured with any arbitrary welfare function based on aggregate consumption).

In this model the rate of growth g also affects α, but its effect is not obvious. Contrary to the analysis of the players' impatience, to our knowledge this effect has not been studied before[44]. It can be checked that $\partial\alpha/\partial g > 0$, which means that the faster the growth of the economy the larger the fraction the debtor pays. The reason seems to be that what matters is the rate of impatience relative to the rate of growth g. When g increases, the relative impatience of the bank, which is smaller, decreases in a larger proportion. Here the causality runs from investment to debt payments. In an empirical investigation of the effect of debt payments on investment, this positive feedback relation may mask the presumably negative causal relation due to liquidity and debt overhang effects.

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[44]Bulow and Rogoff touch on the issue but provide no specific analysis. The way in which they modify their solution in the case of economic growth implies that growth has no effect on payments as a share of the size of the economy. I conjecture that this is wrong.

Apart from the parameters included in α, the other parameters relevant for the determination of π are the fiscal constraint parameter f, the sanction parameter q and the degree of openness of the economy measured by x. The role of the parameters q and x is straightforward, since the direct cost of sanctions is $(1-q)X_t$, which amounts to $(1-q)x$ in relation to capital. It is useful to interpret payment as fractions of exports (π/x), where the fractions are determined by α, and its underlying parameters, q and f. Similarly, the credit ceiling as measured by B_t^* can be written as a multiple of current exports X_t, where the multiple is $\alpha(1-q)/(1+f)h(r-g)$ as shown in [14]. This implies the well-known results that the credit ceiling can be increased by opening the economy and, for a given degree of openness, by being more vulnerable to sanctions. The credit ceiling as a multiple of exports, that is for a given degree of openness, would also expand if world real interest rates were smaller and if the economy grew faster.

It might not be surprising that the investment efficiency parameter n does not appear in the solution, because in this model the negotiations are driven by the threat of sanctions, which are not related to the productive efficiency of the economy given the export level. It might be somewhat surprising, however, that the foreign exchange constraint parameter e does not play a role either. The reason for this is that this constraint, the high marginal value of foreign exchange in terms of domestic output, is an indirect cost magnifying the cost of both the debt payments and

the default sanctions, since both affect the balance of payments[45].
If debt payments correspond to a constant fraction of the
sanctions in utility space, which one would expect given the
bargaining strength of the parties as measured by α, then they
correspond to the same constant fraction in dollars space
irrespective of the parameter e. The conclusion is that the
foreign exchange constraint is irrelevant for the determination of
debt payments.

The case of the fiscal constraint parameter f, which is an
indirect loss on top of the indirect loss due to the foreign
exchange constraint, is different. This indirect cost is borne
only when payments are made, but not when sanctions are suffered.
A larger fiscal constraint f, that is a more inefficient revenue
extraction mechanism to cover payments, tilts the balance against
agreeing to pay and leads to lower payments. This asymmetry leads
to the result that the lower the ability to pay, as reflected by
fiscal tightness, the lower the willingness to pay and therefore
the lower the equilibrium payment. For a given debtor this does
not translate into a welfare improvement, however, because the
lower payment exactly compensates for the magnified cost of
payments, as can be seen in [12]. A Government in worse shape
regarding fiscal accounts gets better deals. This has implications
for the incentives to adjust which are parallel to the debt

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[45]In this linear model e plays a non-marginal role too. This is
inconsequential because in the exogenous growth case the sunk
gains from trade are not affected by sanctions or debt payments.

overhang disincentives[46].

To summarize, comparative statics results are presented. The parameters considered are the government rate of impatience (i), the world real interest rate (r), the rate of growth of the economy (g), the degree of openness (x), the degree of foreign exchange constraint (e), the net productive investment efficiency of the economy (n), the degree of fiscal constraint (f), and the terms of trade under sanctions (q) . The variable analyzed is the payment relative to exports (π/x), referred to as the payment fraction. Similar qualitative results obtain for the credit ceiling, or equivalently the market value of the debt, relative to exports (B^*/hx), referred to as the credit ceiling multiplier, as can be checked in [14]. The variables under study are independent of the capital base. This comparative exercise can be seen as what would happen if a permanent unexpected change occured in the underlying parameters, perhaps as a result of policy, or, alternatively, as a comparison across debtor countries.

	i	g	x	n	e	r	f	q
π/x	+	+	0	0	0	-	-	-

Endogenous growth ($\Delta>0$)

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[46]These implications will be explored in a separate piece. It should be noted that the parameter f can be also interpreted as the political cost of servicing the debt, as seen by the government. In this case the result would be that the more politically sensitive the debt crisis, the better the deal and the higher social welfare.

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In this case many of the results in relation to the payment fraction π/x and the credit ceiling multiplier B^*/hx turn ambiguous. As mentioned before, if the disruption effect Δ is large enough there is the possibility of no interior solution, and therefore null equilibrium payments. In this case all parameters are irrelevant. Assuming that such an extreme does not hold, the corresponding comparative statics exercises involve the differentiation of the general equation for π (equation [10]). The smoothness of this function π assures that the comparative statics results of the exogenous growth case which are definite (that is, non-zero) continue to hold if disruption effects are small enough (and Δ is considered as an independent parameter). Since this expression for π in [10] is bilinear with respect to each parameter, the sign of the partial derivative with respect to any parameter depends only on the rest of the parameters, and is therefore constant over the entire range. With large enough disruption effects, ambiguity may arise; unless more assumptions are made, the sign of these constants is sometimes undetermined.

Some results are unambiguous. The negative relation between the real world interest rate and payments still holds for the same reason: a larger interest rate diminishes the present value of future collections and makes the bank more eager to settle. Similarly, it still holds true that faster growth increases payments and that a higher fiscal constraint leads to lower payments, which are still divided by $(1+f)$. In contrast, now the net investment efficiency of the economy n matters because it is important for the determination of the cost of slower growth due

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to disruption. Higher productivity, as measured by n, leads to higher payments.

The role of the debtor's impatience is ambiguous, in contrast to the exogenous growth model where more impatience always leads to worse outcomes. Here a more impatient debtor (that is, one with a larger i) may get a better deal because it also discounts more heavily the cost of lower economic growth. The impact of the parameters x and e, which in the exogenous case were irrelevant, are now ambiguous too.

Unless the debtor is very impatient and investment efficiency low , it can be expected that a higher x would lead to a lower payment fraction π/x. As can be easily checked by inspecting π/x, the effect of x depends on the sign of n-i: it is negative (positive) when i<n (i>n). The reason is that the cost the debtor incurs as a consequence of slower growth due to sanctions has a domestic component independent of x whose sign depends on n-i, as can be seen in [7]. Assuming that the government finds the observed actual investment rate to be too low, that is i<n[47], the result is obtained that more open countries manage to pay lower payment fractions π/x. Since smaller countries are generally more specialized and therefore more open, this result implies that smaller countries can be expected to pay lower payment fractions.

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[47]The parameter n measures the net marginal productivity of capital (neglecting external effects related to gains from trade).

If the debtor's welfare in case of a rejection, D^R, increases with the disruption Δ for given future payments d, which, for example, is obtained if the government is very impatient compared to investment net return and increases in current consumption more than compensate slower growth, then more disruption leads to lower equilibrium payments. This makes sense because in this case more disruption diminishes the expected cost of sanctions. This is the case when the dynamic cost of sanctions is negative. If, alternatively, D^R decreases with the disruption Δ for given future payments d, which can be seen as the normal case where sanctions are painful also in their dynamic component, the effect on payments is ambiguous.

The reason for the ambiguity is that the bank's future collections after a rejection (B^R), for given future payments b, also decrease with disruption because the economy grows more slowly. In other words, the dynamic effect of sanctions is also painful for the banks. This cost calls into question the credibility of the threat of applying default sanctions. The net effect on equilibrium payments depends on the relative weight of these two opposing forces. In particular, as can be checked by differentiating [10] with respect to Δ, if the debtor is sufficiently impatient and capital inefficient, even if disruption hurts him , the second force dominates and the debtor makes better deals with more powerful disruption effects. In that case, growth weakness is a safeguard against being attacked, and vulnerable countries end up transferring smaller fractions of their international trade.

The analysis for the parameter q could be formally done following the same method. In this case, it still holds true that q has a negative effect on payments. However, it makes more sense to consider that the disruption effect Δ is endogenous and decreases with the parameter q. To the extent that q negatively relates to Δ, its effect on payments depend on how disruption affects payments. If more disruption leads to larger payments, then it still holds true that the more resilient the economy (the larger q), the lower the payment fraction. If more disruption leads to lower payments, then the effect of q on payments become **ambiguous**. This suggests that the banks might prefer to use less sanctions than the ones they could use in order to achieve a better outcome.

If x defines a normal level of import financing , and therefore specialization and dependence on international markets, it makes sense to assume that the core imported capital goods which are difficult to substitute domestically are a fraction m of the total. If $q \geq m$ (sanctions are not very severe), critical imports are not affected, $\Delta=0$ and the exogenous growth case obtains. If $q<m$, $(m-q)x$ critical imports cannot be financed. In relative terms this corresponds to a fraction $(1-q/m)$, which is presumably the relevant measure of the impact on Δ. Note that since Δ does not depend on the rest of the parameters analyzed, the previous results for those parameters still hold.

If a linear specification is assumed, $\Delta=a(1-q/m)$, where $a \geq 0$

is a sensitivity parameter[48]. Then the above discussion about the effect of Δ applies to the sensitivity parameter a and the threshold parameter m. In this case, the payment π is bilinear in q. Therefore the harshness of the sanctions, as measured by q, monotonically increase or diminish payments. If higher potential sanctions lead to more payments, then the banks would set q at its minimum value, as expected. If, however, more potential sanctions lead to less payments, then banks would like to adjust sanctions and lower them in order not to affect the debtor's growth (that is, q=m). This requires a high enough investment sensitivity a. In this case, Δ=0 and the exogenous case obtains.

It is not clear whether banks would be able to commit to such a restraint once the legal procedures are followed and gains from seizure become available. If they cannot commit and the only option is not to apply sanctions at all, this option (q=1) may dominate and an equilibrium with no payments may emerge. Even if there is a continuous choice over the sanctions severity, if the debtor is extremely dependent on imported investment goods and m=1, then q=1 is an equilibrium with no payment. In both cases this zero-payment equilibrium obtains because the banks would choose not to apply sanctions (q=1), which makes them not credible.

To summarize, comparative statics results are presented. The sensitivity of investment to critical imports , a, is added to the

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[48]In a two-gap model formulation where domestic investment is a multiple of (core) imported investment goods, a=s.

parameters studied in the exogenous growth case[49]. It is assumed that sanctions hurt the debtor, that is $\pi > 0$, because otherwise zero payments obtain. It is further assumed that there is a positive disruption effect, that is $\Delta > 0$, because otherwise the exogenous growth case obtains and the previous results apply. This is equivalent to assuming that $a > 0$ and that sanctions are sufficiently severe ($q < m$). The results reported are valid for arbitrary positive disruption effects. In the special case where they are small ($\Delta \cong 0$, or equivalently, $a \cong 0$), the definite results of the exogenous growth case apply. In this case the effect of i and q can be signed unambiguously.

	i	g	x	n	e	r	f	q	a
π/x	?	+	(*)	+	?	-	-	(**)	?

(*) Sign of $i-n$

(**) Negative if $\partial(\pi/x)/\partial a$ positive.

Debt service and market discounts

Let F_t be the face value of the debt at time t. Since credit rationing is assumed, its market value is, by definition, B_t^*. Let the secondary market discount at time t be ρ_t. Then:

[15] $B_t^* = (1-\rho_t)F_t$, $\rho_t \geq 0$

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[49] Similar results can be obtained for the critical imports share m.

Let λ_t be the fraction of total interest service computed at the market rate r which is not covered by the payment P_t. In other words, total interest service rhF_t is partially financed by new money in the amount $\lambda_t rhF_t$. Then:

[16] $P_t = (1-\lambda_t)rhF_t$

Using [11] and substituting $P_t = \pi hK_t$, [15] and [16] yield a linear relation between the market discount ρ and the fraction of unpaid interest service λ at any point in time:

[17] $\rho_t = (r\lambda_t - g)/(r-g)$

As stated above, for credit rationing, r>g, which is assumed. Since $\rho_t \leq 1$ because the market value of the debt cannot be negative, then the fraction $\lambda_t \leq 1$. In other words, as expected, payments cannot be negative in equilibrium; when they are null, $\lambda_t = 1$ and the debt market discount reaches its maximum ($\rho_t = 1$). On the other extreme, the market discount would vanish ($\rho_t = 0$) when the unserviced portion of total interest payments is not larger than g/r<1. When the face value of the debt equals the credit ceiling, that is $F_t = B_t^*$, in which case there is a zero market discount, the borderline case $\lambda_t = g/r$ is obtained. Service payments beyond this minimum rate of new money financing are inconsistent with credit rationing. Note that to the extent that there is positive economic growth (g>0), only relatively large amounts of

new money are consistent with credit rationing[50].

The dynamic evolution of the market discount ρ_t (or equivalently, of the the unserviced portion λ_t making use of [16]), depends on expected payments, which have already been determined, and debt accumulation. Debt accumulation depends on the interest rate charged on new loans in the case of explicit rescheduling agreements or imputed to service arrears in the absence of explicit agreements. In a non-rationing regime, the rate charged for roll-overs should be the competitive rate r. As long as there is credit rationing, competition breaks down and the rate charged is a matter of negotiation. In the context of this model this rate is irrelevant as long as the face value of the debt does not fall below the credit ceiling. Assuming that in this case the applicable rate is also r, which as will be shown is consistent with this model, a description of the dynamics of debt accumulation can be provided for the case of credit rationing and compared to the case of a non-rationing regime. This assumption is the standard one[51] and appears to reasonably resemble reality.

Let the face value of the debt in terms of capital at time t, F_t/K_t, be f_t. Let the initial credit ceiling in terms of capital, B_0^*/K_0, be m. As can be checked in [11], this ratio remains constant over time, that is to say both the credit ceiling and

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[50]Allowing for uncertainty, the relationship between market discounts and current payments would be true in some average sense.

[51]This includes models where this rate is not irrelevant and therefore potentially inconsistent.

capital grow at the rate g. Since credit rationing is assumed at time 0, the credit ceiling corresponds to the market value of the debt and therefore $m \leq f_0$. The dynamic evolution of the ratio f_t follows the difference equation[52]:

$$[18] \quad f_{t+h} = f_t / (\beta \gamma) - bh/\gamma$$

Solving [18] and letting $h \to 0$, it is found that debt accumulates according to:

$$[19] \quad f_t = f_0 + (f_0 - m)(e^{(r-g)t} - 1)$$

It is being assumed that $r > g$, which is a necessary condition for credit rationing. If at time 0 the face value of the debt exceeded the credit ceiling, that is if there was credit rationing and a positive market discount, then $f_0 > m$ and f_t is monotonically increasing and unbounded. In this case, the debt grows faster than the economy and the country is forever credit rationed, which is consistent with the assumption in the model. If at time 0 the face value of the debt was below the credit ceiling, that is if there was not credit rationing, $f_0 < m$ and the model does not apply. If, hypothetically, the same payment fractions π were made, then f_t would be monotonically decreasing and unbounded (the country would end up being a creditor). In the borderline case where the original face value coincided with the credit ceiling, $f_0 = m$ and f_t remains always equal to the credit ceiling, which implies that

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[52]This assumes that the bank makes the opening offer, but this asymmetry vanishes when limits are taken.

debt grows at the same rate as the economy.

From [15] it is apparent that $\rho_t = 1 - m/f_t$. Therefore, starting from a positive market discount $\rho_0 > 0$, the market discount ρ_t would be monotonically increasing and would approach 1. It can be checked in [17] that in this case the unserviced portion of interest payments, λ_t, would also be monotonically increasing and approach 1.

6. CONCLUDING REMARKS

This paper models a dynamic bilateral bargaining game between a credit-rationed debtor country and its commercial bank creditors based on the simple paradigm that if no agreement is reached for a current (possibly partial) payment, either implicit by the acceptance of the corresponding transfer or explicit in the form of a rescheduling agreement subject to renegotiation once the current payment is made, the banks would apply default sanctions (to the extent they can hurt the debtor by doing so). Under general conditions it is found that settlements will be reached and default sanctions will not be applied in equilibrium. However, their application is a credible threat which underlies the negotiations and determines the equilibrium payments. In turn, these equilibrium payments determine the *ex ante* credit ceiling, which is the present discounted value of expected payments, and the *ex post* commercial debt market discount.

Default sanctions are assumed to disrupt international trade.

On the one hand, they have a static component which affects
current consumption for an exogenously given investment level. On
the other hand, they have a dynamic component which may affect the
investment level. This last dimension, which has been neglected so
far in the literature, is able to generate qualitatively different
results. The static component entails a reduction in domestic
absorption which falls entirely on current consumption and is
therefore unambiguously costly for the debtor. The dynamic
component would also be costly to the extent that the debtor
government prefers to increase the investment rate. If the
government is sufficiently impatient and investment returns
sufficiently low, however, the debtor government may prefer to
lower the investment rate that would prevail otherwise, in which
case the dynamic component of the sanctions may be actually
beneficial to the debtor.

In the case of exogenous growth, where disruption effects on
investment due to sanctions are negligible, only the static cost
is relevant. Then sanctions are unambiguously costly and payments
are positive. Payments turn out to be a constant fraction of
exports (the payment fraction). The payment fraction is
proportional to the cost of trade disruption (the loss in gains
from trade) as a share of exports, decreasing with the world real
interest rate and increasing with the debtor's rate of time
preference, as expected. Also not surprisingly in this
willingness-to-pay framework, and in contrast to an ability-to-pay
approach, both the productive efficiency of the economy and its
degree of openness are irrelevant for determining the payment

fraction.

An interesting and new result is that the payment fraction increases with the economic growth rate of the economy. The reason is that what matters in a dynamic context is each party's rate of impatience relative to the growth rate of the economy. Here fast growing countries obtain less favorable deals because they have relatively less bargaining power, which would induce a positive relationship between growth and debt service possibly masking the existence of debt overhang effects on growth.

Another interesting finding has to do with the role played by foreign exchange and fiscal constraints. Payments entail a direct cost in terms of exports and two indirect costs in terms of domestic resources: the cost involved in the transformation of domestic resources into foreign currency, due to a foreign exchange constraint associated with decreasing export returns, and the cost involved in the extraction of resources from the private sector in order to service public debt, due to a fiscal constraint associated with tax inefficiencies. The foreign exchange constraint turns out to be irrelevant because it affects both the cost of sanctions and the cost of settlement. One implication of this is that an unanticipated permanent change in terms of trade should not have an effect on the payment fraction.

The fiscal constraint, in contrast, affects only the cost of settlement and is therefore relevant. The more costly it is to raise additional public revenue, that is the tighter the fiscal

framework, the better the deal for the debtor (the additional cost is compensated by smaller payments). To the extent that fiscal adjustment is costly, this positive linkage between adjustment and payments, like in the debt overhang argument, negatively affects the incentives for adjustment. A different interpretation of the fiscal cost in political terms suggests that political costs and instability associated with the service of the debt would also lead to better deals. Differences in the fiscal constraints among debtor countries may explain variations in payment fractions.

In the general case of endogenous growth, where default sanctions have a non-negligible dynamic component in terms of diminished investment, qualitatively different results can be generated. If the economy has poor investment opportunities, that is investment returns are relatively low, and the government is very impatient, the dynamic component of sanctions may be beneficial to the government. The extreme case where this benefit dominates the static cost of sanctions is possible, in which case a non-trivial equilibrium with no payments is obtained.

Assuming that sanctions hurt overall, payments are positive. If investment disruption is beneficial to the government, then this dynamic effect leads to payments smaller than otherwise. Economies with poor investment opportunities and myopic governments obtain better deals. Perhaps surprisingly, investment disruption caused by sanctions may also lead to smaller payment fractions when investment disruption is costly. The reason is that slower growth is also costly for the banks in terms of future

collections. This dynamic consideration, in contrast to the traditional static approach, points to the fact that what matters is not only the threat at the disposal of the banks, in terms of the cost that the debtor may be inflicted upon, but also the credibility of its realization to the extent that it may hurt the banks. Growth weakness may be a safeguard against being attacked and lead to better deals. Banks may actually choose to unilaterally limit the intensity of their sanctions in order to diminish or even eliminate the investment disruption, in which case the exogenous growth case would obtain as an equilibrium result by virtue of this dynamic dimension.

The dynamic dimension of sanctions leads to other amendments to the static analysis of payment fractions. Now the debtor's rate of time preference has an ambiguous effect. A more impatient debtor is more eager to settle (the usual static factor) but is also less sensitive to slower growth (the new dynamic factor). This dynamic dimension also leads to larger payments for countries with better investment opportunities, an element which was irrelevant in the static case. The degree of openness of the economy is also relevant now for the payment fraction because the dynamic costs of sanctions also depend on the domestic potential of the economy. Unless investment opportunities are poor and the government is very impatient, more open economies obtain better deals in terms of payment fractions. This implies that smaller countries, which are generally more specialized and open, can be expected to be stronger negotiators and pay smaller payment fractions.

There is a linear relation between the debt market discount at a point in time and the portion of total interest payments (at the market rate) which is currently financed with new money. In the context of a growing economy, new money can be expected to be significant. Positive but relatively small amounts on average are inconsistent with market discounts. Assuming that unserviced debt is charged the competitive world interest rate, which is consistent with this model, debt grows faster than the economy and the debt market discount approaches 1.

There are two directions for future research which we plan to pursue building on this model. From an analytical point of view, third parties, such as creditor country governments and international financial institutions, may play a significant role in the bargaining game between debtor countries and commercial banks and should be considered. From an empirical point of view, the model should be estimated and tested. To do this it will be necessary to distinguish those parameters which are observable, even if imperfectly, from those which are not. In the context of this model there is a perfect equivalence between payment fractions, related to current transfers, and payment multipliers, related to the market value of the debt and therefore secondary market discounts. In the empirical application the two approaches will need to be evaluated.

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