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Sovereign Debt: Indexation and Maturity

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Abstract[*]*

In this paper we review the literature on sovereign debt with particular emphasis on indexation and maturity and the main policy proposals related to these topics. We also advance some implications derived from our work. In Alfaro and Kanczuk (2005a, b, c), we modeled sovereign debt as a contingent claim following the framework developed by Grossman and Van Huyck (1988). Our framework, however, recognizes that contingent debt might be associated with incentive problems. Applying this framework to the study of the sustainability of sovereign debt, the tradeoff between nominal and indexed debt, and the optimal debt maturity, we find some of the proposals advanced in the literature regarding lengthening debt maturity and issuing nominal debt to be unsustainable in emerging (volatile) economies.

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Key words: Sovereign debt, default, nominal debt, indexed debt, maturity, short-term debt, long-term debt, default, tax smoothing, contingent service.

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1. Introduction

The structure of sovereign debt in emerging markets has been blamed for recent crises in Mexico (1994-1995), Russia (1998), Brazil (1999), Turkey (2001), and Argentina (2001-2003). As illustrated in Table 1, developing countries rely on external debt far more than do rich countries.[1] Relative to rich countries, developing countries also find it difficult to issue large amounts of long-term local currency debt even in their domestic markets.[2] Several studies have argued that debt structures dominated by debt in foreign currencies (indexed debt) and short-term liabilities render an economy vulnerable to changes in market sentiment, sudden stops, and rollover risk.[3] Many proposals have been advanced to reform the international financial architecture,[4] and a consensus has evolved in favor of policies aimed at lengthening debt maturity and indexed debt. Nonetheless, without a better understanding of the determinants of and incentives that drive debt structures it is difficult to evaluate proposals designed to reduce instability in the international financial markets and mitigate the effects of crises.

In this paper, we review the literature on sovereign debt with particular emphasis on indexation and maturity issues. We then review the main policy proposals related to these topics and advance some implications derived from our work. In Alfaro and Kanczuk (2005 a, b, c), we modeled sovereign debt as a contingent claim following the framework proposed by Grossman and Van Huyck (1988). Consistent with the stylized facts of sovereign borrowing, these authors developed a model in which sovereign defaults occur as bad outcomes of debt-servicing obligations that are implicitly contingent on the realized state of the world. In their view, lenders sharply differentiate excusable defaults, which are justifiable when associated with implicitly understood contingencies, from debt repudiation, which would be inexcusable. Our framework, however, recognizes that contingent debt might be associated with incentive problems as the government may be motivated, ex post, to overspend.[5] To capture this trade-off, we use an adverse-selection-like information structure whereby lenders signal-extract the type of

[1] See Borensztein et al. (2005) for the main stylized facts related to the composition and structure of sovereign debt. Section 2 presents an overview of the main stylized facts.

[2] Eichengreen, Hausmann and Panizza (2003) observe that only few countries issue debt in their own currencies. Reinhart, Rogoff and Savastano (2003) link dollarization, indexation to inflation or short-term interests to what they labeled "debt intolerance." A country's record of meeting debt obligations and managing its macroeconomy is relevant to forecasting its ability to sustain moderate to high levels of indebtedness.

[3] See, for example, Alesina, Prati and Tabellini (1990), Chang and Velasco (2000), Cole and Kehoe (1995, 2000), Giaviazzi and Pagano (1990), and Rodrik and Velasco (1999).

[4] Section 5 of this paper presents an overview of the main proposals.

government. That is, they attempt to understand if there were reasons to justify the default. As a consequence of their doubt, the interest rates in the following period tend to be higher, and the government's financing problems may get worse.

We evaluate some of the proposals advanced in the literature by applying this framework to study the sustainability of sovereign debt, the tradeoffs between nominal and indexed debt, and the optimal debt maturity. Overall, our results cast doubt on the efficacy of lengthening the maturity of debt and reducing the indexation of sovereign debt in emerging markets without addressing the host nations' inherent lack of credibility.

The rest of the paper is organized as follows. Section 2 presents the main stylized facts related to sovereign debt structure with particular emphasis on emerging markets. Section 3 discusses debt structure and maturity. Section 4 presents the main results of our theoretical work. Section 5 reviews and evaluates the different policy proposals. Section 6 concludes.

2. Stylized Facts

There are number of stylized facts regarding differences between sovereign debt issued by developed nations versus that issued by emerging markets and developing countries. These differences are related to the structure of sovereign debt, including maturity (long term or short term); currency composition; indexation (real or nominal), and source of debt (external or internal), all of which vary widely between advanced countries and emerging/developing economies. Tables 1-5 present a series of stylized facts on debt composition and maturity.

Table 1 presents the composition of debt issued in international markets. As of 2001, most debt issues represented bonds and notes, although high-income countries have issued money market instruments. In terms of the composition of debt, Tables 2 and 3 show that few emerging markets issue large amounts of long-term local currency debt, even in their domestic markets.[6] As seen in Table 2, in advanced economies 65 percent of total debt is issued in local currency; for emerging markets, this percentage is only 1.2 percent. There is some variation within emerging economies. East Asia issues 18 percent of debt in local currency, while in Latin

[5] See Barro (1997) for a similar argument.

[6] Most international sovereign debt of emerging market countries has been issued at medium-term (5-10 years) or longer-term maturity, but the average maturity for emerging market debt has declined in recent years and is now lower than for advanced countries. See Borensztein et al. (2005).

America that percentage is almost nil. Table 3 presents further details on the currency composition of long-term debt for emerging markets.

Table 4 shows external debt to be higher in emerging markets. The percentage of short-term debt is also higher, although there are variations within emerging markets. Reliance on external debt has been far greater in emerging markets than in advanced countries, and maturity, currency composition, and the prevalence of indexed debt varies considerably across developing countries.[7] As seen in Table 5, adapted from Borensztein et al. (2005), emerging markets rely less than advanced markets on long-term local currency debt, but there is substantial variation. Such debt is virtually absent in Latin American countries, but accounts for fully half the debt of a number of emerging Asian and European countries. The composition of debt also varies significantly between developed and developing countries. In East Asia, domestic debt amounts to 10 percent and external debt to only 3 percent of GDP. In the emerging markets of Europe, domestic debt accounts for 10 to 15 percent of external debt, for 10 percent of GDP. In Latin America, the figures are approximately equal at 20 percent for domestic and 20 percent for external debt. In South Asia, domestic debt is fairly insignificant, whereas external debt can be as high as 20 percent.

3. Why Does Debt Structure Matter?[8]

> *Were the expense of war to be defrayed always by revenue raised within the year…wars would in general be more speedily concluded and less wantonly undertaken.*
>
> *Adam Smith, 1791*

> *Suppose a country to be free from debt, and a war to take place, which should involve it in an annual additional expenditure of twenty millions, there are three modes by which this expenditure may be provided; first, taxes may be raised to the amount of twenty million per annum [….]; or secondly, the money might be annually borrowed and funded, in which case, if the interest agreed upon was 5 per cent., a perpetual charge of one million per annum taxes would be incurred for the first year's experience, […], and so on for every year that the war might last. […] The third mode of providing for the expenses of war would be to borrow annually the twenty million required as before, but to provide, by taxes, a fund, in addition to the interest, which, accumulating at compound interest, should*

[7] Domestic and external refer to the jurisdiction in which debt is issued. Foreign and domestic debt, however, are not entirely separable as pointed out by Reinhart, Rogoff and Savastano (2003). With international financial integration, foreigners are able to hold larger amounts of domestically issued debt and residents of developing countries to hold instruments issued by governments abroad.

[8] Lucas and Stokey (1983), Bohn (1988, 1990), Calvo and Guidotti (1990, 1993), and Barro (1974, 1979, 1989, 1995, 1997), among others, have studied aspects of debt management decisions.

finally be equal to the debt. … In point of economy, there is no real difference in either of the modes.

David Ricardo,1820

War-taxes, then are more economical, for when they are paid, an effort is made to save to the amount of the whole expenditure of the war, leaving the national capital undiminished.

David Ricardo, 1820

Fiscal policy involves choices about expenditures, taxes, and debt. Choices related to debt obligations include maturity structure, whether to issue nominal or indexed bonds, and whether debt payments should be contingent on other variables such as output.

In broad terms, these choices are irrelevant if governments faced little uncertainty in terms of their expenditures and tax receipts and had access to taxes that do not distort consumers' or firms' behavior (lump-sum taxes). In this not-very-realistic world, governments may either finance their spending by taxing current taxpayers, or they may borrow by issuing bond and raising taxes in the future to repay this borrowing. These choices, however, have no effect on total demand in the economy, as consumers anticipating future increase in taxes would save and thus offset any extra government spending.[9] In this case, the division of government financing between debt and taxes does not matter: both the quantity and composition of the public debt are irrelevant, and the problem of optimal debt management becomes uninteresting.

The choice between debt and taxes becomes relevant when one allows for the realistic assumption of taxes that affect consumers' and firms' choices (distortionary taxes). In this case, variations in the timing of taxes will alter the agent's decision to work, and consumption is now versus later. For example, in anticipation of higher labor taxes, consumers may decide to increase labor today when taxes are relatively lower and work less when taxes are relatively higher. Optimal debt management will attempt to reduce variations in tax rates, which have negative effects on consumer welfare.

The maturity of the debt, however, matters only when one considers uncertainties to government outlays, real interest rates, and receipts (output). In this instance, optimal taxation calls for the smoothing of taxes over different states of nature. The government will

[9]This result is usually referred to as Ricardian Equivalence. See Barro (1989) for the implication and objections to Ricardian Equivalence (finiteness of life; imperfections of private capital markets; uncertainty about the incidence of future taxes and about other variables; and the distortionary nature of taxation). See also Sargent (1987).

consequently want to issue claims contingent on the relevant risks, which might dictate the optimal structure (nominal versus indexed, short- versus long-term) of public debt.

Governments, however, may have incentives to change their behavior when they issue contingent claims. For example, the government may be motivated, ex post, to overspend. Equivalently, when the method of financing is too convenient, a government is likely to abuse it—an intuition expressed in the quotations by Adam Smith and David Ricardo above. More generally, in the presence of incentive problems, the irrelevance of debt term and composition breaks down. In this case, the government may try to use its own capital structure to reduce the "incentives to misbehave."[10] And, as a consequence, choices related to the maturity structure of debt and whether to issue nominal or indexed bonds will affect a country's economic performance.

Nominal versus Indexed Debt

Nominal debt might increase a government's incentive to default through inflation; indexation eliminates a government's incentive to inflate in order to reduce the real cost of nominal liabilities.[11] That most governments in the world do not index government debt has long puzzled economists.[12] Proponents of indexed bonds include Jevons, Marshall, Keynes, Fisher, Musgrave, Friedman, and Tobin.[13] Reviewing the main arguments in favor of indexed debt, Fischer (1983) notes that in addition to reducing the incentive to inflate and encourage savings,

[10] This result is analogous to that of corporate finance: the firm's capital structure can serve a useful role as an incentive device. See Diamond (1991).

[11] Fischer (1983) reviews the main arguments in favor of indexed debt. See also Calvo (1978, 1988), Lucas and Stokey (1983), and Missale and Blanchard (1994).

[12] According to Shiller (2003), the Commonwealth of Massachusetts issued the world's first known inflation-indexed bonds in 1790. Barro (1997) notes that Britain issued indexed perpetuities to finance deficits in the eighteenth and nineteenth centuries. Finland introduced indexed bonds in 1945. Inflation-indexed debt was introduced by Israel and Iceland in 1955, Brazil in 1964, Chile in 1966, Colombia in 1967, and Argentina in 1972. The United Kingdom, which had experimented with inflation-linked debt in 1975, had been offering inflation-linked gilts since 1982. Inflation-indexed bonds based largely on the U.K. design were offered by Australia in 1985, Canada in 1991, New Zealand in 1977 and 1995, Mexico in 1989, Sweden in 1994, and the United States in 1997. France began to issue inflation-indexed government debt in 2001 and Greece and Italy in 2003. See Price (1997), Shiller (2003).

[13] Shiller (2003) notes in an overview of the literature that historians of the theory of indexation start with William Stanley Jevons who wrote extensively in favor of indexed bonds and other indexed contracts in 1875. Joseph Lowe's much earlier (1822) if less eloquent reference is apparently the first clear treatment of the concept of indexation. The usual history of the creation of indexed bonds begins in the twentieth century; Professor Irving Fisher made advocacy of inflation-indexed bonds a life-long campaign, and the company he co-founded issued its first such bonds in 1925.

indexed bonds can provide a safe, real asset that can substitute more closely than other government liabilities for physical capital.

Nominal debt is not, however, without advantages. It can enable a government, for example, to hedge against unexpected shocks that affect the fiscal budget and thereby reduce tax distortions. Bohn (1988) makes a case for nominal debt as valuable insurance against the budgetary effects of economic fluctuations. Because nominal bonds pay poorly in real terms when inflation is unexpectedly high, nominal debt has some of the characteristics of government contingent debt—specifically, it enables a government to partially default via inflation. More recently, Goldstein (2003) argued with reference to several emerging market crises that the inflexibility of indexed debt makes an economy more vulnerable to external shocks.

Maturity

Maturity is usually understood to be related to the date on which a debt becomes due for payment. Correspondingly, Cole and Kehoe (1995, 2000) and Alesina, Prati and Tabellini (1990) define maturity as the amount of debt that matures every period. Other definitions appear in the literature as well. Missale and Blanchard's (1994) definition of effective maturity, for example, is related to the effect of a change in inflation on the value of the debt. By this definition, extremely short-term maturity is analogous to indexed debt. Conversely, Barro (1997) argues that the relevant concept of short-term debt is not the stated maturity of debt but rather the degree of sensitivity of debt payments to fluctuations in short-term market real interest rates. In the context of corporate finance, Diamond (1991) measures maturity relative to the timing of the arrival of cash flows rather than in calendar time.[14]

The literature also shows differentiation among distinct channels through which shorter- or longer-term maturity might affect an economy. These include *maturity premium, sustainability, service smoothing,* and *incentive issues.*

Maturity premium denotes the observation that longer maturity debt tends to be more expensive than shorter maturity debt. This argument, however, is not so easily rationalized because governments also can default on short-term bonds (Barro, 1997). It is thus unclear, ex-ante, why default risk is greater for long-term obligations.

[14] Rodrik and Velasco (1999) and Broner, Lorenzoni and Schmukler (2004) use a related definition.

Sustainability refers to how maturity structure makes a sovereign more or less prone to default. Alesina, Prati and Tabellini (1990) and Cole and Kehoe (2000) maintain that longer maturity debt is less vulnerable to crisis. Alesina, Prati and Tabellini (1990) concluded from their analysis of Italy's debt management policies during the 1980s that the maturity structure of public debt might influence the likelihood of a confidence crisis; the shorter and more concentrated the maturity, the more likely a confidence crisis. Shifting debt into longer maturities positions a government to better weather crises and thereby renders a run less likely. Similar conclusions are reached by Cole and Kehoe (1995) when studying the Mexico 1994-95 Tequila Crisis and further formalized in Cole and Kehoe (2000).[15] Other authors share their conclusions.[16]

A third channel is *service smoothing*. This motive is associated with the desire by the government to smooth taxes over different states of nature in order to maximize welfare. A debt structure that implies the same amount of service every period regardless of external shocks also implies fewer tax distortions (Barro, 1997). Implicit in different maturity structures is greater or lesser sensitiveness to these oscillations and thus greater or lesser tax distortion. Short-term debt, because it needs to be rolled over every period, is subject to current shocks. An abundance of short-term (indexed) debt can leave a government vulnerable to fluctuations in refinancing costs. A large share of long-term (indexed) debt with long average maturity can reduce fiscal budget sensitivity to fluctuations in interest and, in particular, to a steep rise in interest rates.

Incentives issues also warrant attention. In general, short-term maturity might be a response to deeper problems associated with uncertainty and the enforcement of contracts (incompleteness of contracts).[17] According to this view, existing debt contracts are optimal, as the threat of

[15] Implicit in longer maturity is that smaller quantities of debt are rolled over every period. Hence, gains from defaulting depend on the size of the debt to be rolled: if the amount is smaller the gains from defaulting are smaller. Consequently, long-term debt is more sustainable (or less vulnerable). Note that these papers model default as a once and for all phenomenon; a government that defaults is not able to borrow again.

[16] For example, Rodrik and Velasco (1999) argue that excessive build up was a proximate cause of recent crises and that countries should lengthen the average maturity of debt to reduce vulnerability to crises. The authors, however, caution against wholesale restraints on short-term borrowing because government and private borrowers alike might have good reason to assume some short-term debt. Chang and Velasco (2000) developed a model whereby banks' level of reserves and term structure of interest rates and the maturity of their external debt, are jointly determined. Banks consider the possibility of self-fulfilling runs when choosing the structure of assets and liabilities. If the probability is small banks will chose illiquid positions and expose themselves to a run, in which case short-term debt will be cheaper than long-term debt.

[17] Sachs (1984), Krugman (1985), and Calvo and Guidotti (1990) consider the emergence of short-term debt to possibly be symptomatic of commitment problems. Sachs and Cohen (1982) discuss the ex-ante benefits of making sovereign debt more difficult to restructure ex-post. In Chari and Kehoe (2003), "bad times" are crucial for

crisis will discipline borrowing governments. As Boreinsztein et al. (2005) argue, "risky and seemingly inefficient debt structures heavily weighted towards foreign-currency denominated debt or short-term debt are rationalized as necessary evils to reduce moral hazard on the part of policy makers. Thus, crisis-prone debt structures can be a symptom rather than the root cause of countries' inability to commit to good policies, which may in turn result from weak domestic institutions."

4. Understanding Sovereign Debt, Maturity, and Indexation as a Contingent Claim

The history of sovereign borrowing suggests the following stylized facts about defaults: defaults are usually partial and associated with identifiable bad states of nature; sovereign states often are able to borrow soon after defaulting; and countries with histories of defaults are charged higher interest rates than countries with no repayment difficulties.[18] Grossman and Van Huyck (1988) developed a model whereby, consistent with the first two "facts," sovereign defaults occur as bad outcomes of debt-servicing obligations that are implicitly contingent on the realized state of the world.[19] They maintain that lenders sharply differentiate excusable defaults that are justifiable when associated with implicitly understood contingencies from debt repudiation, which is deemed inexcusable.

Obstfeld and Rogoff (1996) observe that, although much lending takes the form of non-contingent loans, the evidence from debt crises is that in the event a borrower's economy falters

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identifying resilient governments since governments that repay their debt during bad times, "pass a test of fire" and thus enhance their reputation. Hence, bailing out bad governments in difficult times has an additional cost: signal-jamming. Rodrik and Velasco (1999), Tirole (2002, 2003) and Jeanne (2004) have similar arguments. In Jeanne (2004), for example, foreign investors cannot know what policies borrowing countries will implement after they secure loans. A dangerous external liability structure enhances a country's incentives to implement creditor-friendly policies, but makes the country vulnerable to crises caused by shocks. One proposed solution is to lengthen the maturity of debt ex-ante and find better ways to coordinate exports. In the model, coordination failures are not the basic source of inefficiency but rather reflect the incompleteness of sovereign debt contracts. Albeit inefficient, this might be the only means available given the legal infrastructure of international sovereign debt finance to enforce creditors' rights. Consequently, solving coordination problems might not necessarily be optimal.

[18] Overviews of major debt crises and stylized facts can be found in Eichengreen and Portes (1986), Cohen (1992), Dooley (1994) and Sturzenegger (2003). Eichengreen and Portes (1989) and Ozler (1993) present evidence that lenders base country risk assessments on past debt-servicing behavior. See Rose (2002) for an alternative view.

[19] Two alternative assumptions are prevalent in the literature that studies sovereign debt as way to smooth consumption. In Eaton and Gersovitz's (1981) and others' *contingent debt* models, consumption smoothing is achieved by making debt issuance contingent on the realization of income: a sovereign that realizes low (high) income issues (retires) new debt. In *contingent service* models, such as that of Grossman and Van Huyck (1988), consumption smoothing is achieved by making debt servicing contingent on the realization of income: the sovereign

payments can be rescheduled, renegotiated, or changed unilaterally; lenders have the options of making new loans or cutting off existing lines of credit. That lenders as well as borrowers anticipate states of nature in which scheduled payments are not made in full is evidenced by the compensatory premium included in loans. It is then equivalent to model loan contracts as explicitly state contingent or implicitly, as they become so only as a result of an ex-post but perfectly predictable state contingent renegotiation process. As Eaton, Gersovitz and Stiglitz (1986, p. 482) conclude: "[T]hough indeed the borrower is required to service a debt, there is no way that, in general, the borrower can be forced to do so under all contingencies. Debt and equity are both contingent claims, although they clearly differ in the nature of the contingencies involved."

During the last 20 years, the importance of the recurring phenomenon of debt default has prompted an enormous volume of theoretical and empirical literature on sovereign debt.[20] Initial research focused mainly on why countries ever chose to pay their debts (or why private creditors ever expected repayment). Recognizing that few direct legal sanctions can be invoked against sovereign borrowers, Eaton and Gersovitz (1981) argued that sovereign countries repay in order to avoid developing a reputation for defaulting and consequently losing access to international capital markets. Bulow and Rogoff (1989) challenge this explanation, pointing out that for reputation to enforce contracts, a sovereign would have to be excluded from international markets that permit, for example, insurance policies to be bought against low realizations of income.[21] But as Grossman and Han (1999) show, an appealing property of a contingent service model of sovereign debt is that it can support positive amounts of debt even for a sovereign that can save after defaulting. Thus, in this sense, a contingent service model is also appealing from a theoretical point of view.

General Framework

To quantitatively study debt sustainability, in Alfaro and Kanczuk (2005 a), we construct and calibrate a dynamic equilibrium model recognizing sovereign debts to behave much as

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services its debt full only when it realizes high income and defaults either partially or fully when it realizes low income. See Grossman and Han (1999) for a taxonomy of debt models.

[20] For surveys of the literature, see Kletzer (1994) and Eaton and Fernandez (1995).

[21] Subsequently, Cole and Kehoe (1995, 1998) showed the ability of reputation to support debt to depend on the alternatives open to a country, the country's relationships in the international arena, and assumptions made about institutions.

contingent claims. In order to recognize that contingent debt can be associated with incentive problems, the model employs an adverse-selection-like information structure that assumes two types of sovereigns. "Bad" sovereigns are extremely impatient and always default, independent of the state of the economy; "good" sovereigns default optimally (excusably) in order to smooth tax distortions. Experience shows that lenders face considerable uncertainty about borrowers' characteristics and preferences.[22] The equilibrium interest rate is determined by lenders who signal-extract the type of government. Because lenders become uncertain about the type of sovereign and tend to charge higher interest rates after a default, the benefits of defaulting are tempered by higher future interest rates that worsen a government's financing problem.

The quantitative analysis reveals that for a wide range of parameters, the only equilibrium of the model is one in which the sovereign defaults in all states. That is, for the model's *calibrated* economy, the currently observed value of debt is not sustainable, unless we build other costs from defaulting, in addition to those already considered. When we assume that default implies additional output costs, however, the economy displays equilibria that very much resemble the data.

In point of fact, these additional output costs are an important stylized fact of debt crises. The 1980s experience with sovereign debt as well as previous debt crises, such as those in the 1870s, 1890s, and 1930s, showed managing a debt crisis to be a difficult process, so difficult as to have led to economic uncertainty and stagnation in much of the developing world. Although these additional output losses are well documented (see, for example, Cohen, 1992, and Barro (2001), their micro-foundation remains to be understood.[23]

We also find that the equilibrium in which there is no default for all states implies greater welfare even as it provides less consumption smoothing. This result is due to the additional

[22] Brazil's January 2003 election of Luis Ignacio "Lula" Da Silva is just one example of the difficulty of assessing a sovereign's type.

[23] We do not further this quest, but suggest that the existence of these costs is an important determinant of the sustainability of sovereign debt. Calvo (2000) advances some explanations in the context of self-fulfilling prophecies whereby changes in relative prices can either cause a generalized financial crash under flexible prices or lead to a contraction of aggregate demand in the context of sticky prices. Dooley (2000) argues that output loss is caused by the inability of debtors and creditors to quickly renegotiate contracts and the inability to condition the loss of output ex-ante by reasons of nonpayment. This creates a time interval during which residents of a country in default are unable to borrow from locals or foreigners due, for example, to the inability of new credits to be credible senior to existing credits. Dooley (2000) theoretically explores the possibility that the threat of such substantial and protracted output losses as typically follow debt defaults is the dominant incentive for international debt repayment. Cline (2000) argues that international debt is possible because such output losses substitute for the lack of collateral

output costs of defaulting, which are magnified by the adverse selection problem. A natural question is why do we then observe defaults so often? Our experiments suggest that countries with high debt levels and/or high GDP volatilities cannot support the equilibrium with no default, and must therefore resort to equilibria with state-contingent default.

Nominal versus Indexed Debt

Alfaro and Kanczuk (2005b) pose a quantitative horse race between the arguments in favor of and against nominal versus indexed debt. Summing up the arguments discussed earlier, defaulting on nominal liabilities can generate a welfare loss that must be quantitatively weighed against the gains from tax smoothing.

This paper quantitatively applies the basic framework discussed to the problem of determining the optimal amount of nominal (contingent) debt. For this purpose, we construct and calibrate a dynamic equilibrium model in which (i) government expenditure is stochastic and (ii) the only source of regular taxation available to the government is distortionary labor taxes, but (iii) the government has nominal non-state-contingent liabilities outstanding.

In this environment, government faces a trade-off in choosing the path of inflation. On the one hand, the government would like to use unexpected inflation as a non-distortionary tax on nominal wealth. In this way, the fiscal authority could minimize the need to vary distortionary income taxes over the business cycle. On the other hand, unexpected inflation comes at a cost. Lenders become more uncertain about the type of the sovereign and tend to charge higher interest rates, which tend to worsen the government's financing problem. Moreover, as lenders anticipate part of the unexpected inflation, defaults are also associated with the traditional inflation cost, an analysis which goes back to Bailey's calculation of the area under the inverse demand function for real money (see Lucas, 2000)). A rise in interest rates post default begets a drop in real money balances, implying lower welfare levels.

We calibrate our artificial economy to match both the United States as an example of a mature economy and Brazil as an example of an emerging market. We chose the Brazilian case for various reasons. The country introduced indexation relatively early (1964) and, as mentioned before, is attempting to reduce the levels of indexed debt. Due to the high inflation experience, public debt in Brazil is virtually all linked to short-term interest rates (overnight). To match the

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enforcement. Rogoff (2003) argues that in the absence of better institutions, default costs provide a punishment that

Brazilian economy stylized facts, we calibrate the model with government outlays 10 times more volatile than in the United States.

Long-Term versus Short-Term Debt

To quantitatively study optimal debt structure for a government, Alfaro and Kanczuk (2005c) run a quantitative horse race between the different rationales for long- versus short-term debt. To do so, we employ the same methodology, and assume that the sovereign at some moment in time may decide to default on, or renegotiate, the terms of certain bonds but not others (in our specific case, certain maturities and not others) or that the default rate may be higher for some types of bonds (maturities) than others.[24]

We first calibrate our artificial economy to match that of a developing country. Again, we choose Brazil, where virtually all public debt in that country is linked to short-term (overnight) interest rates. We also study the case of the United States as an example of a mature economy, obtaining results that are very similar, though quantitatively less expressive. In particular, we find that although the long maturity currently observed in the United States is not optimal, the potential gains from shortening the debt maturity seem almost irrelevant in terms of welfare.

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in some sense substitutes for effective property rights at the international level.

[24] In fact, as Duffie, Pedersen and Singleton (2003), note, there are several reasons that justify this assumption. (i) Bond covenants may not include cross-default clauses that would force the default of one bond, the simultaneous default of other bonds of the same type, but of a different maturity. (ii) Even when bonds include cross-default clauses (the failure to make payments on one bond allows the owners of other bonds to accelerate their bonds, requiring immediate repayment of the principal) creditors to sovereign bonds may have little or no incentives to exercise their rights. The incentives of sovereign bonds holders to invoke such clauses differ from those holding bonds to firms because there are no legal procedures whereby government assets can be compulsory reposed and distributed among the creditors. (iii) Sovereigns issue bonds under different legal systems (domestic versus foreign such as those of the United States, United Kingdom, other European countries) that have different rules such as collective-action clauses or "rights to accelerate." This strategy gives "legally" governments more discretion over which bonds to default. Finally, although the last three decades have seen a change in the laws as well as the development of new legal strategies, in a recent survey of the literature, Sturzenegger and Zettelmeyer (2005b) conclude that the effect of legal mechanisms in enforcing sovereign debts remains limited not so much due to "sovereign immunity"—a legal doctrine that limits the extent to which sovereign assets located in foreign jurisdictions can be attached by creditors—but due to the fact that few sovereign assets (including future income streams) are in fact located outside its national borders, and that a sovereign cannot credibly commit to hand over assets within its borders in the event of a default. The authors conclude that in spite of the legal changes that have made litigation more feasible against defaulting countries, recent experiences indicate that creditors have in general been relatively unsuccessful in devising legal strategies that allow them to obtain payments from defaulting nations. See also Rogof and Zettelmeyer (2002).

5. Policy Proposals and Implications

The crises of the last decade, specifically, Tequila (1994-1995), East Asia and Russia (1997-1998), Turkey (2000-2001), and Argentina (2001-2002), have revived debate over the merits of international financial integration and sovereign borrowing. Over the years, a number of policymakers and academics have advanced proposals and frameworks aimed at improving the international financial architecture and the structure of sovereign debt. These proposals are wide ranging, from grand schemes to create an international lender of last resort, to rethinking the use of capital controls, to lowering debt levels and lengthening debt maturity.[25]

At a basic level, these proposals can be divided into two sets: one that suggests altering the "international financial architecture,'' another that suggests re-engineering components of the debt structure per se. A well-known candidate in the first set is the IMF's Sovereign Debt Restructuring Mechanism (SDRM), which is essentially an attempt to come up with a set of "best practices" that can provide "better incentives for debtors and creditors to agree on prompt, orderly and predictable restructuring of unsustainable debt."[26] Other proposals in the first set suggest establishing an international lender of last resort and an international bankruptcy court for sovereigns. Proposals in the second set, which put responsibility for restructuring their debt as well as the institutions and policies that govern debt issuance on the sovereign, include monitoring a country's debt level to prevent it from become unsustainable, building a higher level of foreign reserves, focusing on enhancing local bond markets, and improving transparency of the local banking systems. To make public debt structures less crisis-prone, a consensus has emerged on the need to develop a deep domestic market for government debt, especially long-term local currency instruments.

For purposes of this paper, and in order to compare the literature with our work, we shall concentrate on proposals related to debt structure. In terms of debt levels and debt maturity, the emerging consensus is to focus on crisis prevention. In order to do so, countries should reduce debt to sustainable levels and sell local currency denominated bonds with long maturity. However, that approach does not seem to be a consensus regarding debt indexation. As long as the debt is denominated in local currency, it is not clear if it should be indexed or not.

[25] See Rogoff (1999), Eichengreen (1999), Jeanne (2004), Borensztein et al. (2005), Roubini and Seltser (2004) and Sturzenegger and Zettelmeyer (2005a) for overviews of some of the proposals.

[26] For details of the main features of SDRM, see "Proposals for a Sovereign Debt Restructuring Mechanism (SDRM)" http://www.imf.org/external/np/exr/facts/sdrm.htm#b1.

Sturzenegger and Zettelmeyer (2005a) maintain that in terms of debt levels and debt structures, a "good" country is one that has low debt levels, a smooth repayment profile, a low share of short-term debt on a residual maturity basis, a currency structure that matches the currency denomination of receipts (low share of foreign currency debt), ample reserves, and equity-linked indexed liabilities or other forms of insurance to buffer against shocks. Reinhart, Rogoff and Savastano (2003) find "safe" thresholds for highly debt-intolerant emerging markets to be quite low, as low as 15 to 20 percent of GDP in many cases. They find that these threshold levels depend on a country's history of default and inflation. Manasse and Roubini (2005), for example, identify "safe zones" in which safe debt levels depend on a host of macroeconomic indicators.[27] As the authors of these studies argue, however, there are costs related to implementing these policies (for example, maintaining ample reserves), and some objectives might not be easily realized.

Another set of issues relates to how countries can move to safer public debt structures, longer maturities that reduce roll over risk, and domestic currency debt that reduces the risk of currency crisis. Writing on the subject of debt maturity, Rodrik and Velasco (1999) observe that restraining short-term borrowing "involves no free lunch, since in some circumstances both government and private borrowers may have perfectly sound reasons for wanting to take on some short-term liabilities." "[P]olicies that make [borrowing] short-term prohibitive, regardless of circumstances," add Chang and Velasco (2000), "need not enhance social welfare."

Borensztein et al. (2005) maintain that the absence of monetary and fiscal credibility impedes many emerging market countries from issuing long-term domestic debt in local currencies. Reinhart, Rogoff and Savastano (2003), for example, have found indexed debt to be associated with debt intolerance and histories of serial default and inflation. Based on a comparison of Australia and Chile, however, Caballero, Cowan and Kearns (2004) have argued

[27] An objection to issuing inflation-indexed debt is that it might lead to an economy-wide culture of CPI indexation, which would reduce real wage flexibility and the effectiveness of stabilization policies. An alternative form is indexation to a market determined domestic interest rate (floating debt rate). This policy, however, implies that in bad times debt repayments increase, which can exacerbate a crisis. Other proposals include making available new financial instruments that facilitate governments' management of debt and provide a cushion against economic shocks and creating loan instruments that tie debt to other leading economic indicators, for example, GDP-linked bonds for which the repayment schedule is determined by overall economic performance. Debt frameworks that call for real indexation of debt, which involves making higher payments when economic performance is strong and lower payments when economic performance slows, suggest indexing debt to GDP and other economic indicators that reflect the strength and weakness of the economy and, by association, the ability of a country to repay its debts. See Borensztein et al. (2005) for an overview.

that establishing sufficient credibility to issue such debt through stabilization and institutional reform might take years or even decades. According to Sturzenegger and Zettelmeyer (2005a), however, recent policy experiences suggest that countries can overcome this stigma relatively quickly after stabilizing their currencies and reforming their monetary policy framework. In the past 10 years, several countries that have embraced reforms (among them, Chile, Mexico, Poland, and Israel) have managed to increase their shares of local currency debt by issuing indexed debt as an intermediate step and lengthening maturities gradually.

Policy Implications of Our Work

Our findings suggest that some of the proposals for debt restructuring be approached with caution. In particular, we believe that further theoretical and empirical work is needed to understand the causes of the output losses following debt defaults with respect to certain of these proposals. Indeed, as Dooley (2000) and Rogoff (2003) observe, understanding the nature of the default costs is a crucial requirement to pin down the most adequate proposals. If private financial arrangements depend on the threat of costly defaults and output losses, mechanisms that facilitate swifter resolution might reduce international lending by weakening both the confidence of international investors and the incentives that make international debt possible. On the other hand, the costs of reduced international lending need to be weighed against any potential reduction in output losses achieved through such mechanisms. The question of whether these costs are an efficient market response to the lack of collateral enforcement remains to be answered.

Nominal versus Indexed Debt

In terms of the choice between nominal and indexed debt, our results cast doubt not only on the possibility that volatile developing countries such as Brazil may successfully reduce their indexed debt levels, but also on the optimality of doing so from a welfare point of view. Indeed, our results suggest that the optimal amount of nominal debt is zero for both the United States and Brazil. That is, for any amount of nominal debt, the anticipated inflation costs more than offset the benefits from tax smoothing

We also study a situation in which the government must use some amount of non-indexed debt. In this case, the optimal structure is to have no indexed debt at all or, if possible, to have

negative amounts of indexed debt (i.e., indexed assets). This perhaps surprising result has a simple explanation. Given certain government expenditure volatility, the required inflation rate, in order to smooth taxes in bad periods, is smaller the greater the nominal debt. Therefore, the cost associated with anticipated inflation, which is quantitatively the most important one, is smaller the greater the non-indexed debt proportion.

Furthermore, for each economy, we obtain a boundary on the maximum amount of sustainable nominal debt for a given degree of agency costs. Whereas for the U.S. economy this boundary is well beyond the observed values, for our Brazilian artificial economy the debt sustainability problem seems to be quantitatively important. That is, given the existing volatility of government outlays, an attempt to issue contingent debt in Brazil, as is sometimes proposed, may not be feasible.

Interestingly, our results are also related to the debate about the flexibility of monetary policy addressed in two distinct branches of the literature. A first branch (Calvo and Guidotti, 1993, and Chari and Kehoe, 1999) characterizes the "Ramsey" optimal fiscal and monetary policy in flexible-price environments. This work focuses on economies with nominal non-state-contingent government liabilities and assumes that the government effectively has access to a commitment technology, thus abstracting from time- inconsistency problems. The key result that emerges is that it is optimal for the government to make the inflation rate highly volatile, as price changes play the role of shocks absorber of unexpected innovations in the fiscal deficit.

In contrast, a second strand of the literature focuses on characterizing optimal monetary policy in environments with nominal rigidities, also assuming that the government has a commitment technology (see, for example, Erceg, Henderson and Levin, 2000; Kahn, King and Wolman, 2000; and Rotemberg and Woodford, 1999). The key result of this branch of the literature is that optimal monetary policy implies an almost constant inflation rate for all dates and states. In some papers, this result is driven by the assumption that the government has access to (endogenous) lump-sum taxes to finance its budget. Thus, there is no need to use unanticipated inflation as a lump-sum tax. In other papers (especially Schmitt-Grohé and Uribe, 2004), this result comes from the fact that the price adjustment costs are quantitatively more important than the benefits from tax smoothing.

Our results thus indicate that even if prices were totally flexible, it would still be better to have constant inflation. This is so because the costs associated with the incentive problems

surpass the benefits from tax smoothing. In other words, according to our results, when governments do not have access to a commitment technology, the introduction of incentive problems associated with the use of contingent debt is enough to overturn the results of the first branch of literature: the optimal policy is one which displays little variation in inflation.

Long-Term versus Short Term Debt

In terms of debt maturity, our results caution against policies aimed at lengthening debt maturity without taking into consideration local conditions. According to our results, debt sustainability decreases with debt maturity. Or, equivalently, for some given economic fundamentals, it is not possible to lengthen debt maturity structure. Interestingly, this is in line with the stylized facts. Borensztein et al. (2005), for example, report that most emerging markets find it difficult to issue long-term debt even in their domestic markets.

We also obtain that even when long-debt maturity is sustainable, it seems to be associated with equilibria in which default happens more often and welfare levels are lower. That is, we find that the optimal structure is to have exclusively short-term debt. In a sense, this is just a corollary of the previous results. But it tends to be very controversial. It is contrary to the findings obtained by Cole and Kehoe (2000), among others, as well as the emerging conventional wisdom among scholars and policy makers alike.

To understand what is driving this difference in results, one must analyze how the costs and benefits from defaulting are affected by the debt maturity. Note that both in Cole and Kehoe (2000) and in our model, the gains from defaulting depend on the size of the debt that needs to be rolled-over: the smaller the amount to be rolled-over, the smaller the gains from defaulting. Notice also that in Cole and Kehoe (2000), but not in our model, default is a once-and-for-all-time phenomenon. After defaulting, a government is not able to borrow again, and thus the costs of default do not depend on the debt structure. Consequently, long-term debt is more sustainable.

In contrast, in a framework of repeated defaults such as ours, and consistent with stylized facts, defaulting does not imply permanent exclusion from the financial markets. Rather than assuming that default is a once-and-for-all-time phenomenon, we consider that countries can borrow soon after defaulting. This is in fact the crucial distinction between the two models, and what drives the contrasting results. Instead of being punished with perpetual market exclusion, defaulting countries are penalized with higher future interest rates. And because of this, it is not

true anymore that longer maturity debt is more sustainable. Longer maturity and smaller amounts of debt to roll over imply lower gains from defaulting, but the costs associated with defaulting are also lower. As a consequence, long-maturity debt is less sustainable. It is associated with equilibria in which default happens more often, and, as it turns out, with lower welfare levels.

Given that our results contrast with those of Alesina, Prati and Tabellini (1990) and Cole and Kehoe (2000), it becomes important to study which of them is more supportive of the stylized facts. Unfortunately, this is a non-trivial task because it involves counterfactual experiments. We limit ourselves to two casual anecdotes, one supportive of each result.

The first anecdote, which supports the view of Cole and Kehoe, is to imagine a country hit by an international confidence crisis. A country with debt with very short maturity (say, the debt that has to be rolled over in its entirety every month) is much more vulnerable to such a shock. In this case, one can say that longer maturity should make the debt less vulnerable or more sustainable. The second anecdote, supportive of our view, is to imagine a country with a very short maturity structure, say, one month, that attempts to (slowly) lengthen the maturity of its debt to, say, 20 years. As a response, investors would likely react by not buying the debt and thus triggering a default. In this case, one can say that in this country only short-maturity debt is sustainable or, equivalently, that longer maturity makes debt less sustainable in this country. This was certainly the case of Brazil in many instances when the country attempted, unsuccessfully, to sell longer-maturity debt.

To better compare these two views, consider a country in crisis. According to Cole and Kehoe's (2000) model, the crisis would not have occurred if the country's debt had been of longer maturity. According to our model, given its fundamentals, it was impossible for the country to have had longer maturity debt. In other words, long-term debt simply was not sustainable from the outset.

6. Conclusion

This paper presents an overview of the literature on sovereign debt, with particular emphasis on indexation and maturity. We review the main policy proposals related to these topics and advance some implications derived from our work. In a series of papers, Alfaro and Kanczuk (2005 a, b, c) show sovereign debt to be a contingent claim, following the framework of Grossman and Van Huyck (1998), but also recognize associated incentive issues. We find some

of the proposals advanced in the literature regarding lengthening debt maturity and issuing nominal debt to be unsustainable in emerging (volatile) economies due to credibility issues.

To obtain these results, we resorted to many simplifications needed to keep the computational analysis manageable. In particular, among the various assumptions, we considered that debt levels were constant, that defaults imply (additional) output costs, that preferences were linear on consumption, that the government expenditure process was exogenous, that long-term debt duration was only two years. We believe that relaxing these assumptions could improve the analysis by making the results quantitatively more precise. But we do not expect that doing so would change the results qualitatively. In particular, our finding that relative to long-term debt short-term debt is more sustainable and associated with higher welfare levels should be robust to these simplifications.

That said, our results are nevertheless a consequence of the model we chose. Our model (i) recognized debt to be a contingent claim implicitly understood by investors, (ii) treated default as a repeated phenomenon, (iii) considered the punishment from defaulting to be associated not with market exclusion but with higher interest rates and the effect thereof on government budget (higher tax distortions), output (productivity drop), or higher inflation rates. Other types of models, specifically those that emphasize liquidity problems (e.g., Cole and Kehoe, 2000), yield entirely different conclusions and policy implications. Understanding which are the best assumptions and most crucial features of the sovereign debt process remains the most important avenue for future research.

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Table 1: Composition of Debt issued in international markets.
Data as December 2001

Group of countries	Bonds and Notes	Money Market Instruments
By Income		
High Income	94.2%	5.8%
High Income OECD	94.2%	5.8%
European Monetary Union	92.0%	8.0%
High Income Non OECD	94.4%	5.6%
Upper Middle Income	99.5%	0.5%
Middle Income	99.1%	0.9%
Lower and Middle Income	98.5%	1.5%
Other Categories		
Advanced	94.9%	5.1%
Emerging Economies	99.0%	1.0%
By Region		
Latin America and Caribbean	95.5%	4.5%
East Asia and Pacific	89.2%	10.8%
Europe and Central Asia	91.5%	8.5%
Middle East and North Africa	99.4%	0.6%
South Asia	100.0%	0.0%
Sub-Saharan Africa	100.0%	0.0%

Source: Bank of International Settlements

Emerging countries include: Argentina, Brazil, Chile, Mexico, Venezuela, China, India, Indonesia, Malaysia, Philippines, Thailand, Poland, Russia, South Africa, Hungary, Turkey

South Asia economies include India, Pakistan and Sri lanka

Table 2: Composition of Debt issued in international markets.
Data as December 2001

Group of countries	Local currency-denoiminated Debt	Foreign currency-denoiminated Debt
By Income		
High Income	58.0%	42.0%
High Income OECD	63.1%	36.9%
European Monetary Union	61.2%	38.8%
High Income Non OECD	0.3%	99.7%
Upper Middle Income	1.2%	98.8%
Middle Income	1.1%	98.9%
Lower and Middle Income	1.0%	99.0%
Other Categories		
Advanced	64.0%	36.0%
Emerging Economies	1.2%	98.8%
By Region		
Latin America and Caribbean	0.4%	99.6%
East Asia and Pacific	17.7%	82.3%
Europe and Central Asia	51.1%	48.9%
Middle East and North Africa	0.3%	99.7%
South Asia	0.0%	100.0%
Sub-Saharan Africa	0.0%	100.0%

Source: Bank of International Settlements
Emerging countries include: Argentina, Brazil, Chile, Mexico, Venezuela, China, India, Indonesia, Malaysia, Philippines, Thailand, Poland, Russia, South Africa, Hungary, Turkey
South Asia economies include India, Pakistan and Sri lanka

Table 3: Currency Composition of Long-Term Debt, 2003

Country groups	Currency composition of Long-Term debt			
	US Dollars	Euro	Japanese	Pound
All developing countries	60.7	18.1	10.9	1.2
Latin America & Caribbean	76.9	12.2	5.2	0.4
Europe & Central Asia	54.0	35.0	4.5	0.7
East Asia & Pacific	55.8	7.2	27.8	0.3
South Asia	63.7	6.2	15.4	2.0
Middle East & North Africa	45.8	28.6	10.4	1.4
Sub-Saharan Africa	49.0	23.0	5.9	4.3
Upper middle income	61.8	16.9	13.0	0.5
Middle income	62.4	19.6	10.7	0.6
Low income	55.4	13.7	11.3	3.0
Lower middle income	63.6	25.2	6.0	0.8

Source: Global Development Finance, 2003

Table 4: Domestic Credit and External Debt, 2003

	Domestic credit provided by banking sector (% of GDP)	Domestic credit to private sector (% of GDP)	External debt, total (as % GDP)	Long-term debt (as % GDP)	Short-term debt (% of total external debt)
By Income					
High Income	181.9	158.3	n.a.	n.a.	n.a.
High Income OECD	183.0	159.0	n.a.	n.a.	n.a.
European Monetary Union	125.1	105.0	n.a.	n.a.	n.a.
Upper Middle Income	53.5	36.6	39.7	31.7	17.7
Middle Income	85.3	64.2	35.4	27.6	17.3
Lower and Middle Income	79.3	58.6	35.8	28.7	15.7
By Region [1]					
Latin America and Caribbean	45.0	25.7	44.8	37.3	10.7
East Asia and Pacific	150.9	123.6	25.9	19.1	23.9
Europe and Central Asia	37.7	24.2	48.2	36.1	19.9
Middle East and North Africa	69.9	46.4	21.3	18.4	12.8
South Asia	53.2	31.0	23.9	22.6	3.9
Sub-Saharan Africa	74.6	63.7	52.7	43.9	13.4

Source: World Development Indicators, 2003

[1]: Developing countries only