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Daniel A. Dias, Christine Richmond, and Mark L. J. Wright

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Daniel A. Dias*

University of Illinois at Urbana-Champaign, and
CEMAPRE

Christine Richmond*

University of Illinois at Urbana-Champaign, and
International Monetary Fund

Mark L. J. Wright*

Federal Reserve Bank of Chicago, and
National Bureau of Economic Research

ABSTRACT

The stock of sovereign debt is typically measured at face value. Defined as the *undiscounted* sum of future *principal* repayments, face values are misleading when debts are issued with different contractual forms or maturities. In this paper, we construct alternative measures of the stock of external sovereign debt for 100 developing countries from 1979 through 2006 that correct for differences in contractual form and maturity. We show that our alternative measures: (1) paint a very different quantitative, and in some cases also qualitative, picture of the stock of developing country external sovereign debt; (2) often invert rankings of indebtedness across countries, which historically defined eligibility for debt forgiveness; (3) indicate that the empirical performance of the benchmark quantitative model of sovereign debt deteriorates by roughly 50% once model-consistent measures of debt are used; (4) show how the spread of aggregation clauses in debt contracts that award creditors voting power in proportion to the contractual face value may introduce inefficiencies into the process of restructuring sovereign debts; and (5) illustrate how countries have manipulated their debt issuance to meet fiscal targets written in terms of face values.

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1 Introduction

With few exceptions, data on the stock of sovereign debt are presented at *face value*. Defined as the *undiscounted* sum of future *principal* repayments, face values can be a misleading measure of the stock of sovereign debt for two reasons. First, because face values only capture *principal*, two debt contracts that are equivalent—in the sense of having identical future cashflows—will have different face values if the otherwise identical cashflows are divided into principal and interest in different ways. Second, because face values are *undiscounted*, two debt contracts with the same total principal, but amortizing over different time horizons, will be treated as identical.

The emphasis on face values by statisticians and market participants creates at least five practical problems. First, the comparison of debt stocks at face value over time and across countries can generate misleading inferences as a result of significant differences in the contractual structure of debt portfolios over time and across countries. For example, low-income countries often borrow from official sources over a long time horizon and at low subsidized interest rates, while middle-income countries borrow at market interest rates over shorter horizons. Hence, face values may understate the indebtedness of middle-income countries relative to low-income countries. As another example, because international debt markets have shifted away from bank loans issued at par toward bonds issued at a discount, face values will tend to increase over time even in the absence of changes in underlying indebtedness. Second, as a consequence, analyses of debt sustainability based on face values will be misleading, with some relatively low debt countries receiving debt relief at the expense of more highly indebted countries. Third, face values inhibit the empirical assessment of the quantitative macroeconomic literature on sovereign debt, since the literature assumes that all sovereign debts are identical, typically taking the form of zero-coupon bonds, all of whose cashflows are treated as principal. Fourth, as face values are conventionally used to allocate creditor voting power in the event of a restructuring of sovereign debts, the restructuring process may not work efficiently because creditors with identical financial interests have different voting power. Fifth, if debt targets are specified in terms of face values or if budget deficit targets are specified excluding interest payments, the issuing country has both the ability and incentive to manipulate debt issuance to meet these targets. For example, countries can understate

the face value of their debt stocks by issuing par bonds (with a high interest rate and low principal) instead of the equivalent discount bonds (with a lower interest rate and higher principal), or by issuing debts with lower face values amortized over a shorter time horizon.

In this paper we construct a new database of external sovereign debt stocks that sheds light on the extent of these problems. We construct several alternative measures of external indebtedness for a sample of more than 100 developing countries from 1979 through 2006 using previously unpublished data on the cashflows associated with these countries' respective portfolios of external sovereign debts from the World Bank's Debtor Reporting System (DRS). Each of our measures preserves the simplicity and transparency of face values, but corrects for differences in contractual structure that divide cashflows into principal and interest in different ways. Specifically, instead of looking at the face value of a country's actual portfolio of debt contracts—the *contractual face value*—we measure the face value of a synthetic portfolio of debts with a common contractual structure that has been constructed to replicate the cashflows of the country's actual debt portfolio. Our first measure, motivated by the extensive focus on zero-coupon bonds in the quantitative theoretical literature on sovereign debt, defines the face value of a country's portfolio of debts as the face value of a portfolio of zero-coupon bonds that has been constructed to match the actual portfolio of debts owed by the country. We refer to this measure as the *zero-coupon-equivalent (ZCE) face value* of a country's debt. This measure is particularly useful when assessing the empirical success of models in which all debts take a zero-coupon form, and when assessing the incentives of agents to vary contractual structure when creditor voting rights and debt targets are written in terms of face values. Our other measures postulate a positive coupon rate ρ and hence correct for differences in both contractual structure *and* the maturity of debts by discounting *all* future cashflows. Exploiting a known result, these *ρ-coupon-equivalent face values* turn out to be equal to the *present value* of a debt discounted at ρ per-cent. These measures are especially useful in assessing differences in indebtedness across countries and over time, as well as in assessing the incentive to issue short term debt in order to hit debt targets written in terms of contractual face values.

Our findings bring both good news and bad news for users of data on the stock of external sovereign debts. The good news is that much of our *qualitative* understanding of the

market for external sovereign debt is preserved when examined in the light of these new data. The bad news is that much of our *quantitative* understanding of international debt markets needs to be revised. Most dramatically, our new measures of the stock of external sovereign debt reveal that the upper-middle-income countries, and the countries of Latin America and the Caribbean in particular, are more indebted relative to low-income countries. In some cases, such as Mexico, the revised measure shows a dramatic difference in the relative level of indebtedness.

Some of our worst news is reserved for the quantitative theoretical literature on sovereign debt and default. It is by now well known that the benchmark Eaton and Gersovitz (1981) model of sovereign debt and default, as explored quantitatively by Arellano (2008), Aguiar and Gopinath (2006), Hamann (2004), and many others, produces levels of the face value of external sovereign debt that are between 5 and 10 times smaller than the levels reported in traditional sovereign debt statistics. This empirical failure is all the more striking when it is noted that these theoretical models restrict attention to zero-coupon bonds in which all future debt service payments are regarded as principal, thus producing a maximal value for the model generated face value of sovereign debt. We show that when data on the stock of external sovereign debt is constructed using our theoretically consistent zero-coupon equivalent face value measure, it is almost one-and-one-half times as large as traditional estimates, implying that the benchmark model produces levels of the stock of sovereign debt between 7.5 and 15 times smaller than those observed in practice.

We also point to a potential problem associated with the more widespread adoption of aggregation clauses in sovereign debt instruments, as envisaged by the Eurogroup (2010). Since voting rights in the event of a sovereign debt restructuring are proportional to the contractual face value of a bond, creditors whose debts include a high interest rate will have fewer voting rights than creditors holding instruments with identical cashflows but lower interest rates. We show using our data that this would have the largest impact on private sector creditors, indicating that more widespread use of aggregation clauses would lead to the relative subordination of private sector claims. This may explain the reluctance of bondholders to participate in bond issuances including aggregation clauses and, in the event that such clauses become widespread, may give private sector creditors an incentive to adopt con-

tractual forms—such as zero-coupon bonds—that would maximize their voting power in the event of a future sovereign debt restructuring. Finally, we also use our data to document at least one prima facie case of a country varying the contractual form of its debt issuance in order to present its external debt position and budget deficit in a more favorable light.

It is important to stress a number of limitations of our analysis. We have little to contribute to the debate as to the appropriate *rate* at which the cashflows of debts coming due at different dates should be discounted in forming a measure of indebtedness. Any researcher attempting to construct discounted values of debt stocks must confront the fact that the absence of liquid markets for all but a small number of sovereign debts means it is not possible to extract discount rates from market data. Moreover, as established by Dias, Richmond, and Wright (2013), it is not always appropriate to use market discount rates in constructing measures of the cost of servicing a debt to the issuing developing country that likely values debt flows on the margin at a different rate than do creditors. In this paper, which aims to evaluate differences in debt stocks across countries and over time, we follow a long tradition of using a time- and country-independent discount rate (see, for example, International Monetary Fund 2004, 2010; Easterly 2001, 2002; and the discussion in Dikhanov 2006).

Data limitations mean that we focus entirely on *external* sovereign debts, despite the recent surge in interest in the domestic debts of developing countries (for example, Reinhart and Rogoff 2011). Nonetheless, it is important to stress that the exact same measurement problem applies to existing estimates of the stock of domestic sovereign debt. Our study of the contractual structure of developing country sovereign debt, as well as the way it leads to misleading estimates of indebtedness, complements Hall and Sargent's (1997) analysis of the mismeasurement of interest payments by the U.S. Treasury. Our focus on the contractual structure of sovereign debt *per se* leads us to focus on a different set of summary measures of indebtedness than does Hall and Sargent's emphasis on the U.S. government's cost of borrowing.

The rest of this paper is organized as follows. Section 2 presents a simple framework that is useful in accounting for sovereign debts and illustrates, using a series of simple examples, the measurement problems associated with using contractual face values when ag-

gregating debts with different contractual structures. Section 3 describes our data sources. Section 4 presents our quantitative and qualitative findings for the stock of developing country external sovereign debt. Among other things, we show through examples how different measures of indebtedness would have affected past eligibility for debt relief. Section 5 focuses on the policy implications of these data, emphasizing the incentives for countries to manipulate their debt stock data, along with the incentives for creditors to vary the contractual form of their sovereign debts in anticipation of the more widespread use of aggregation clauses in sovereign debt instruments. Section 6 contains some concluding remarks, while a series of appendices describe our methods, data sources, and findings with a greater level of detail than that presented in the paper. Data on the contractual and ZCE face values and on the present values of external debt for all of the countries in our sample are available online.

2 Conceptual Framework

In this section, we introduce some notation that is helpful for talking about country debt portfolios. We also define some measures that we will construct later in the paper and present a series of simple examples to illustrate different debt stock measures, their varying strengths and weaknesses, and their potential quantitative importance.

2.A Notation

Consider a country that has a portfolio of debt contracts. Each debt contract specifies a stream of cashflows denominated in different currencies falling due at future dates. We denote by $C^i_{nj}(t)$ the cash flow associated with contract $n = 1, ..., N$ of country $i = 1, ..., I$ due at time $t = 0, 1, ..., \infty$, denominated in currency $j = 1, ..., J$. We allow for cashflows to be defined at $t = \infty$ to capture the case of perpetuities for which the principal is never repaid. Although not a perfect description of the set of all outstanding sovereign debt contracts, we restrict attention to contracts that pay, as long as there is no default, a non-state-contingent claim in a prespecified set of currencies at a series of prespecified dates.[1]

The cashflows associated with a debt contract are typically divided into principal repayments (or amortization) $A^i_{nj}(t)$ and interest payments (or coupons) $R^i_{nj}(t)$. We will say

[1] For more on state contingent sovereign debt, see, for example, Grossman and van Huyck (1988), Kletzer (2006), Alfaro and Kanczuk (2005), and Sandleris, Sapriza, and Taddei (2008).

that two debt contracts n and n' are *equivalent* if they specify the same cashflows $C_{nj}^{i}(t) = C_{n'j}^{i'}(t)$ for all time periods t and currencies j for any countries i and i', even if they divide these cashflows into amortization and interest in different ways; two equivalent debt contracts that divide cashflows in different ways will be described as having different *contractual forms*.

Most countries owe debts denominated in a variety of different currencies. In addition, some debt contracts are issued in multiple tranches, some of which are denominated in different currencies. If $e_j(t)$ is the number of units of the numéraire currency, the U.S. dollar, that can be purchased with one unit of currency j, then the dollar cashflows of contract n are denoted by dropping the currency subscript j, or

$$C_n^i(t) = \sum_j e_j(t) C_{nj}^i(t).$$

Likewise, the cashflows of country $i's$ entire portfolio of debts are denoted by dropping the contract subscript n, or

$$C^i(t) = \sum_{n,j} e_j(t) C_{nj}^i(t) = \sum_n C_n^i(t).$$

These dollar cashflows are divided into dollar amortization and coupon payments analogously.

2.B Measuring Indebtedness

Almost all of the available data on the stock of outstanding sovereign debt, both domestic and external, is presented at *face value*.[2] The face value in U.S. dollars of an outstanding and disbursed[3] debt contract n at time t is defined to be the undiscounted sum

[2] Strictly speaking, the *External Debt Statistics: Guide For Compilers and Users* (Bank for International Settlements et al. 2003) recommends that countries report what is known as the *nominal value* of the country's debt. The nominal value is computed as the discounted sum of debt service on debt outstanding and disbursed, where the discount rate is set equal to the contractual interest rate of the debt. As we will see later, the nominal value of a debt outstanding and disbursed equals the face value of that debt. In practice, the two terms are often used interchangeably. For example, the European statistical agency Eurostat states that "the nominal value is considered equivalent to the face value of liabilities" (Eurostat 2010, 305). To minimize confusion with measures of the debt stock that are or are not adjusted for inflation, we avoid the term "nominal value."

[3] The *External Debt Statistics: Guide For Compilers and Users (*Bank for International Settlements et al. 2003) defines the *face value* of a debt to be the sum of undiscounted future principal repayments, including those principal payments on debt not yet disbursed, as well as principal that has already been repaid. This is

of any future principal repayments, or

$$B_n^C(t) = \sum_{s=t+1}^{\infty} A_n^i(s) + A_n^i(\infty).$$

Note that, in order to preserve comparability with World Bank data, we measure the debt stock at the end of period t so that the first principal term corresponds to period $t+1$. In what follows, to distinguish this concept from the measure we introduce, we will refer to this as the *contractual face value* of a debt contract, denoted B^C, to capture the notion that it is calculated using the assignment of cashflows to principal as written in the original debt contract.

There are a number of reasons why contractual face values can be a misleading measure of total indebtedness. Perhaps the most obvious is that two equivalent debt contracts can have different contractual face values if they label these cashflows as amortization and interest in different ways. Likewise, identical cashflows due at different points in time are treated equivalently. These potential problems with the use of contractual face values to measure relative indebtedness across countries and over time would be of little concern if the structure of debt contracts (and hence the split of cashflows into amortization and interest, as well as their timing) was roughly constant across countries and over time. This is far from the case in practice. As one example, low-income countries have access to long-term loans at concessional interest rates from creditor country governments and international institutions that result in a greater share of cashflows being recorded as amortization compared with interest payments.[4] As a result, the relative indebtedness of low-income countries may be overstated. As another example, there has been a dramatic shift among middle-income countries over the past quarter century away from bank loans, typically issued at par with a positive coupon, toward bonds, which are often issued at a discount. The use of contractual face values is also problematic when contracted interest rates vary over time. As contracted interest (coupon) rates rise, the

also sometimes referred to as the *initial contractual value*. It is common (for example, World Bank, various) to report the face value of that portion of the debt that is outstanding (that is, the portion that has not been repaid) and disbursed (so that payments associated with undisbursed debt are not included); we follow this practice.

[4] The problematic treatment of concessional lending was behind the World Bank's move to focus on present values of debt service in defining eligibility for debt relief (see Claessens et al. 1996; Easterly 2001).

cashflows associated with a par bond of a given contractual face value will rise relative to those for a discount bond with the same contractual face value. Hence, the relative importance of various lending instruments will vary mechanically with changing interest rates.

To measure indebtedness in a way that is invariant, within the class of equivalent debt contracts, to the split of cashflows into principal and interest, it is necessary to treat all cashflows as though they are divided into amortization and coupons using a common method. Although this can be done in an infinite number of ways, we initially focus on a measure that treats all cashflows as principal, or in other words treats all debt contracts as though they are zero-coupon bonds.[5] Specifically, we define the *zero-coupon equivalent face value* of a bond contract n, denoted B^{ZCE}, as

$$B_n^{ZCE}(t) = \sum_{s=t+1}^{\infty} \left(A_n^i(s) + R_n^i(s)\right) = \sum_{s=t+1}^{\infty} C_n^i(s).$$

This may also be thought of as the face value of the stripped securities. Note that we do not include cashflows that are never paid (or paid at infinity) in this definition.[6]

The zero-coupon equivalent face value measure has several desirable features. First, it is invariant to differences in the contractual form (that is, the split between interest and principal) of two equivalent portfolios of debt (that is, debts that have identical cashflows). Second, it is the correct measure to use when comparing levels of indebtedness in the data

[5] Another alternative would be to treat all bonds as though they are par bonds (as, for example, in the U.S. since 1989 when measuring debt subject to the statutory limit). In 1997, Eurostat introduced new accounting rules for imputing interest payments on a subset of all sovereign bonds outstanding that amounts to measuring the principal of some discount bonds as though they were par bonds (Eurostat 1997a,1997b). Under the new procedures, for both deep-discounted bonds (defined as bonds whose contractual coupon is less than 50% of the corresponding yield to maturity) and zero coupon bonds, the difference between the issue price and the face value is treated as an interest payment due at redemption. Note that discount bonds that do not meet the deep-discount criterion are not treated equivalently. The absence of data on issue prices, as well as our aim of constructing a measure that allows for cross-country comparisons of contractual structure, motivates our preference for the ZCE face value measure. In the nineteenth century, Nash (1883, xiv) reports face values of debt under the assumption that all debts took an identical contractual form and paid a 5% coupon.

[6] Undiscounted measures of debt stocks, such as the ZCE face value, return an infinite value for simple perpetuities, such as United Kingdom consols. We do not view this as a weakness of our measure, since simple perpetuities are typically not treated as debt and are instead grouped with common stock (for example, the Bank for International Settlements (BIS) treats bank issued perpetuities as Tier 1 capital). The only sovereign issued perpetuities in existence today that we are aware of are British consols and the United Kingdom is not in our data set. France, which is also not in our data set, retired the last of its *obligations perpétuelles* in 1987.

with the levels produced by quantitative theoretical models on sovereign debt that focus exclusively on zero coupon bonds. Third, it is conceptually similar to the contractual face value that is conventionally used to assess sovereign indebtedness. Fourth, it is useful when assessing the incentives of agents to vary contractual structure when creditor voting rights and debt targets are, as a matter of convention, defined in terms of face values. Fifth and finally, it is very simple to calculate.

However, both ZCE and contractual face values have the undesirable feature that they do not reflect differences in the *timing* of cashflows. To correct this, we also present estimates of the *ρ-coupon-equivalent (ρCE) face value* of a bond for some positive constant coupon rate ρ. If we let $B_n^{\rho CE}(t)$ be the face value of this synthetic *ρ-coupon* bond at time t, we can construct the sequence of $B_n^{\rho CE}(t)$ by utilizing the fact that the synthetic amortization payments must satisfy $A_n^{\rho CE}(t+1) = B_n^{\rho CE}(t) - B_n^{\rho CE}(t+1)$ while the synthetic coupon payments satisfy $R_n^{\rho CE}(t+1) = \rho B_n^{\rho CE}(t)$. The amortization payment sequence is then chosen to equate these synthetic cashflows to actual cashflows, or

$$A_n^{\rho CE}(t) + R_n^{\rho CE}(t) = C_n(t).$$

Note that we are assuming that all cashflows are made at the end of the year. For a bond with a finite maturity T, so that $C_n(T+1) = 0$ and hence $B_n^{\rho CE}(T+1) = 0$, we can recursively substitute to find that

$$B_n^{\rho CE}(t) = \sum_{s=t+1}^{\infty} \left(\frac{1}{1+\rho}\right)^{s-t} C_n^i(s).$$

This is a statement of a not-widely-known result that the face value of a bond paying a constant coupon rate ρ is equal to the present value of the cashflows of that bond discounted at the same rate ρ. Hence, we will sometimes refer to the *ρ-coupon-equivalent face value* of a bond as its *ρ-percent present value.*

One could, of course, consider a much broader class of *present value* of the cashflows of a portfolio of debts with variable discount rates. If we let the discount rate between periods $t-1$ and t be denoted by some time-varying ρ_t, with implied discount factor $\delta_t = 1/(1+\rho_t)$,

we can calculate the present value of a debt contract n, denoted B^{PV}, as

$$B_n^{PV}(t) = \sum_{s=t+1}^{\infty} \left(\prod_{r=t+1}^{s} \delta_r \right) \left(A_n^i(s) + R_n^i(s) \right) = \sum_{s=t+1}^{\infty} \left(\prod_{r=t+1}^{s} \delta_r \right) C_n^i(s).$$

Note that, as above, we are assuming that all cashflows are made at the end of the year, and that we measure the present value at the end of period t, after period t payments have been made, so that payments scheduled for $t+1$ are discounted by the factor δ_{t+1}.

Present values have the desirable feature of treating cashflows on debts occurring at different times differently. However, like face values, present values may have some undesirable features that relate to the choice of discount rate. The choice of discount rate is quite controversial. One possibility is to infer discount rates from market prices of debts (or equivalently, simply calculate the market value of a portfolio of debts). In practice, there are very few developing countries for which liquid debt markets exist. Even for countries where some liquid debt markets exist, prices only begin to become available in the 1990s, while many debts owed by the country—including official debts, project credits, and most bank loans—are not traded. Moreover, market values may give an incorrect impression of the level of indebtedness of a country and its likely future default risk. For example, if a country is relatively likely to default in the near future, agents will typically discount future cashflows heavily because of the default risk. Calculated using market discount rates, the present value of the debt of the country will be low and, viewed in isolation, may give the impression that the country is not likely to default. Dias, Richmond, and Wright (2013) describe other uses of present values for which the choice of market discount rates would be inappropriate.

In the absence of market prices, there is considerable debate as to the appropriate discount rate to use when calculating indebtedness. Although one could in principle use a different discount rate at each date for each different debt issued by different countries in different currencies and coming due at different maturities, most official organizations and researchers discount at a constant rate. For example, the International Monetary Fund (2004 p.61) used a 7.5% discount rate in its analysis of debt sustainability; the Development Assistance Committee (DAC) uses a constant 10% market rate (Dikhanov 2006); Depetris and Kraay (2005) use a 7.25% rate; and Easterly (2001, 2002) relies on the (constant) time

series average of London Interbank Offered Rates. Likewise, when valuing settlement offers in the context of a debt restructuring, Andritzky (2006) finds that the most frequently applied approach is to use a constant discount factor of around 10%. The International Monetary Fund and World Bank (2012) is an exception in using discount rates that vary over time with maturity and currency of issue (although not across countries). Given the interpretation of present values computed with a constant discount rate ρ as ρ-percent coupon equivalent face values and in the interest of transparency we follow the majority of researchers in applying a discount rate that is constant across contractual forms, currencies, countries, and over time at either 5% or 10%.

Since both ZCE and ρCE face values have their relative strengths and weaknesses, we present estimates for both measures in Section 4. Next, we present a number of examples to illustrate the differences between the contractual face value of a debt, its zero-coupon equivalent value, and its ρ-percent coupon equivalent face value (or ρ-percent present value). We use the examples to make three basic points. First, we illustrate the differences in contractual face values across equivalent bonds (bonds with identical cashflows). Second, we show that, although ZCE face values always exceed both contractual face values and ρCE face values (as long as $\rho_t > 0$ for all t), the contractual face value of a debt may exceed or fall below the ρCE face value of that debt. Third, we show that the differences across measures can be very large for some bond contracts used in the quantitative theoretical literature on sovereign debt.

One Period Discount and Par Bonds

Consider two one-period debt contracts that are both denominated in the same currency issued at time zero and coming due at time one. The first is a par bond (issued at its contractual face value) with a positive coupon, while the second is a zero-coupon bond issued at a discount. In the notation introduced earlier, suppressing currency subscripts and country superscripts, the stream of payments associated with the first bond can be represented as $A_1(1) > 0$ and $R_1(1) > 0$, while that associated with the second can be represented as $A_2(1) > 0$ and $R_2(1) = 0$. We assume that the two bonds are equivalent or that $A_1(1) + R_1(1) = A_2(1)$, and so they are valued identically by both the country

itself and investors. Despite being equivalent, the par bond has a contractual face value of $B^C(0) = A_1(1)$, which is less than the contractual face value of the zero-coupon bond $B^C(0) = A_2(1)$.

Since the two bonds are equivalent, we note that using any common discount rate ρ, the ρCE face values of both bonds are equal and $B_1^{\rho CE}(0) = (A_1(1) + R_1(1)) / (1+\rho) = B_2^{\rho CE}(0) = A_2(1) / (1+\rho)$. In the special case where we discount each bond at its own different contractual interest rate (in order to obtain the "nominal value" of each bond) the ρCE face values of both bonds equal their contractual face values, and the contractual face value is larger for the second bond (which has a zero contractual rate).

Multi-Period Bonds

The one-period examples generalize in a straightforward fashion to debts issued with a maturity of more than one period. Consider a bond that amortizes over time in an arbitrary way given by some $\{A(s)\}_{s=t+1}^{T}$, with its contractual face value at time t given by

$$B^C(t) = \sum_{s=t+1}^{T} A(s).$$

Interest is paid every period at rate r on the outstanding principal, so that $R(s) = rB^C(s-1)$, and hence, the ZCE face value of this debt is given by

$$B^{ZCE}(t) = \sum_{s=t+1}^{T} (1 + r(s-t)) A(s).$$

Obviously, debt contracts with the same amortization profile but different interest rates may have the same contractual face value despite having different future cashflows. Likewise, debt contracts with the same interest rate but that amortize differently may have the same contractual face value but different cashflows.

The ρCE face value (or ρ percent present value of this debt using constant discount

rate ρ) is given by

$$\begin{aligned} B^{\rho CE}(t) &= \sum_{s=t+1}^{T} \delta^{s-t}\left(A(s)+R(s)\right) = \sum_{s=t+1}^{T} \delta^{s-t}\left(B^{C}(s-1)-B^{C}(s)+rB^{C}(s-1)\right) \\ &= \sum_{s=t+1}^{T} \delta^{s-t}\left((1+r)B^{C}(s-1)-B^{C}(s)\right), \end{aligned}$$

where $\delta = 1/(1+\rho)$. In the special case where the interest rate on the debt equals the discount rate, or $\rho = r$, the ρCE face value of a debt is equal to its contractual face value, so that

$$B^{\rho CE}(t) = \sum_{s=t+1}^{T} \left(\delta^{s-1-t}B^{C}(s-1)-\delta^{s-t}B^{C}(s)\right) = B^{C}(t),$$

where the last equality follows from the fact that $B^{C}(T) = 0$. More generally, the contractual face value of a debt will exceed, equal, or fall below its ρCE face value as the contractual face value falls below, equals, or exceeds the discount rate. In contrast, ZCE face values are always an upper bound for contractual face values.

Bonds With Exponentially Declining Cash-flows

In order to keep track of a portfolio of bonds of maturity greater than one period in a computationally tractable way, a number of authors have proposed contractual forms in which cashflows decay exponentially over time. For example, Chatterjee and Eyigungor (2012) examine a class of perpetuities that pay a constant coupon rate z, so that $R(s) = zB^{C}(s-1)$ for all s, and amortize exponentially at rate λ each period, so that $A(s) = \lambda B^{C}(s-1)$. Such debt contracts are "memory-less" so that debt issued at different dates can be aggregated linearly. A portfolio of b such bonds issued at time t is associated with coupon payments of $z(1-\lambda)^{s-(t+1)}b$ and amortization payments of $\lambda(1-\lambda)^{s-(t+1)}b$ in all periods $s > t$. The contractual face value of a portfolio of b such bonds is given by

$$B^{C}_{CE} = b\left(\lambda + \lambda(1-\lambda) + \lambda(1-\lambda)^{2} + ...\right) = b,$$

and the ZCE face value is given by

$$B_{CE}^{ZCE} = b + zb\left(1 + (1-\lambda) + (1-\lambda)^2 + ...\right) = \frac{z+\lambda}{\lambda}b.$$

For the values used by Chatterjee and Eyigungor (2012), $z = 0.03$ and $\lambda = 0.05$, the ratio of ZCE face value to contractual face value for these bonds is 1.6. It is straightforward to show that the ρCE face value of this debt is given by

$$B_{CE}^{\rho CE} = \frac{(z+\lambda)\,\delta}{1-\delta\,(1-\lambda)}b = \frac{z+\lambda}{\rho+\lambda}b,$$

which, if we set the discount rate ρ equal to the contractual rate z, yields $B_{CE}^{\rho CE} = b = B_{CE}^{C}$. As in the previous example, the relationship between contractual face value and ρCE face value depends on the relationship between the contractual interest rate and the discount rate. For $\rho = 0.1$, the ρCE face value of such a bond is roughly half the contractual face value.

By contrast, Hatchondo and Martinez (2009) and Arellano and Ramanarayanan (2012) examine a slightly different exponentially decaying debt contract. These contracts take the form of a perpetuity with a coupon that decays exponentially at rate λ. These debt contracts are also "memory-less". With these contracts, a debt with a contractual face value of one issued at time t pays a one unit coupon at time $t+1$, or $R(t+1) = 1$, and a $(1-\lambda)^{s-t+1}$ coupon, or $R(s) = (1-\lambda)^{s-t+1}$, at all dates $s > t+1$. In our notation, the contractual face value of a portfolio of b such bonds is given by $B_{HM-AR}^{C} = bA(\infty) = b$, and its ZCE face value is given by

$$B_{HM-AR}^{ZCE} = b\left(1 + (1-\lambda) + (1-\lambda)^2 + ...\right) = \frac{b}{\lambda}.$$

Hence, the ratio of ZCE face value to contractual face value is given by $1/\lambda$, which is a 20-fold difference for $\lambda = 0.05$. For any constant coupon rate ρ, the ρCE face value of this debt is

$$B_{HM-AR}^{\rho CE} = \frac{b}{1+\rho}\left(1 + \frac{1-\lambda}{1+\rho} + \left(\frac{1-\lambda}{1+\rho}\right)^2 + ...\right) = \frac{b}{\rho+\lambda}.$$

For this contract, the contractual face value always lies below the ρCE value.

3 Data Sources

The statistics on external sovereign debt are derived from the World Bank's Debtor Reporting System and are compiled in its *Global Development Finance* (GDF) publication.[7] The DRS has been in existence since 1951 and records detailed information at the level of an individual loan for external borrowing. All countries that receive a World Bank loan consent in the loan or credit agreement to provide information on their external debt. The details of the reporting procedures are described in World Bank (2000).

One of the purposes of the DRS is to generate projections of future debt service obligations of a country under various assumptions. Toward this end, the DRS records the number of years to maturity, interest rate, currency of denomination, and grace period of each debt contract at each point in time. Such detailed data are only collected for long-term debts (debts with a maturity at issue in excess of one year); therefore, all the results that follow correspond to long-term debt. Combining these data with forecasts for the paths of future interest rates (for floating rate debt) and exchange rates, we can generate projections of debt service denominated in U.S. dollars. We restrict attention to sovereign debts that are either owed by the public sector of the country or are owed by private sector borrowers but are guaranteed by the public sector of the country (public and publicly guaranteed).

Data on individual loans are confidential, and direct access to the DRS is restricted. The data reported in the subsequent sections are derived from an unpublished data set constructed by World Bank staff at our request. The World Bank ensured the confidentiality of the loan-level data by aggregating data across multiple loans. To preserve comparability with existing publicly available World Bank external debt statistics, we use the same interest rate and exchange rate assumptions that were used in compiling the GDF.

Our data on cashflows begin in 1980 and end in 2007, and for each year we generate projected cashflows over a forty-year time horizon. To preserve comparability with GDF data, we denote the sum of cashflows from year t onward as the stock of debt as of the *end of year* $t-1$, resulting in estimates for debt stocks from 1979 through 2006. We assume that all

[7] Statistics on external debt are also available from the Joint External Debt Hub, which is jointly maintained by the BIS, the International Monetary Fund (IMF), the Organisation for Economic Co-operation and Development (OECD), and the World Bank, and combines data from the DRS with data from creditor and market sources.

cashflows on a debt in period t are paid at the end of the period, but before computing the end of period stock of debt. As a consequence, the present value of a debt at time t discounts payments made in $t+1$.

Data are available for 138 countries, although we focus on a sample of 100 countries with data for the entire time period. An Appendix compares our results for the 100-country sample to those for the entire data set. Data on contractual and ZCE face values, as well as present values, of external debt for all 138 countries are available online.

4 Results

In this section, we examine the evolution of sovereign external debt, using both the zero-coupon equivalent and ρ-coupon equivalent face value measures and then comparing them with contractual face value measures. We begin by examining the behavior of indebtedness—which we define as the ratio of our debt stock measures to the gross national income (GNI) of the debtor country—at an aggregate level for all countries, emphasizing the way in which this new measure alters our understanding of the empirical performance of the benchmark model of sovereign debt and default. We also discuss how using our debt stock measures change our views on the relative level of indebtedness across countries and what the results may imply for analyses of debt sustainability. Finally, we examine how our understanding of the composition and evolution of international debt flows is changed by using our measures.

4.A The Level of Indebtedness

Figure 1 plots the contractual face value, ZCE face value, and ρCE face value of external sovereign debt using both $\rho = 5\%$ and 10%, as a percentage of GNI for our sample of 100 developing countries. By construction, contractual face values never exceed ZCE face values, and strikingly, ZCE face values are *much* larger, always exceeding contractual face values by at least 40% and sometimes by more than 50%. Using a 10% rate, ρCE face values are roughly 20% to 40% smaller than contractual face values, while using a 5% rate they are roughly similar for the first decade of our sample before falling below contractual face values

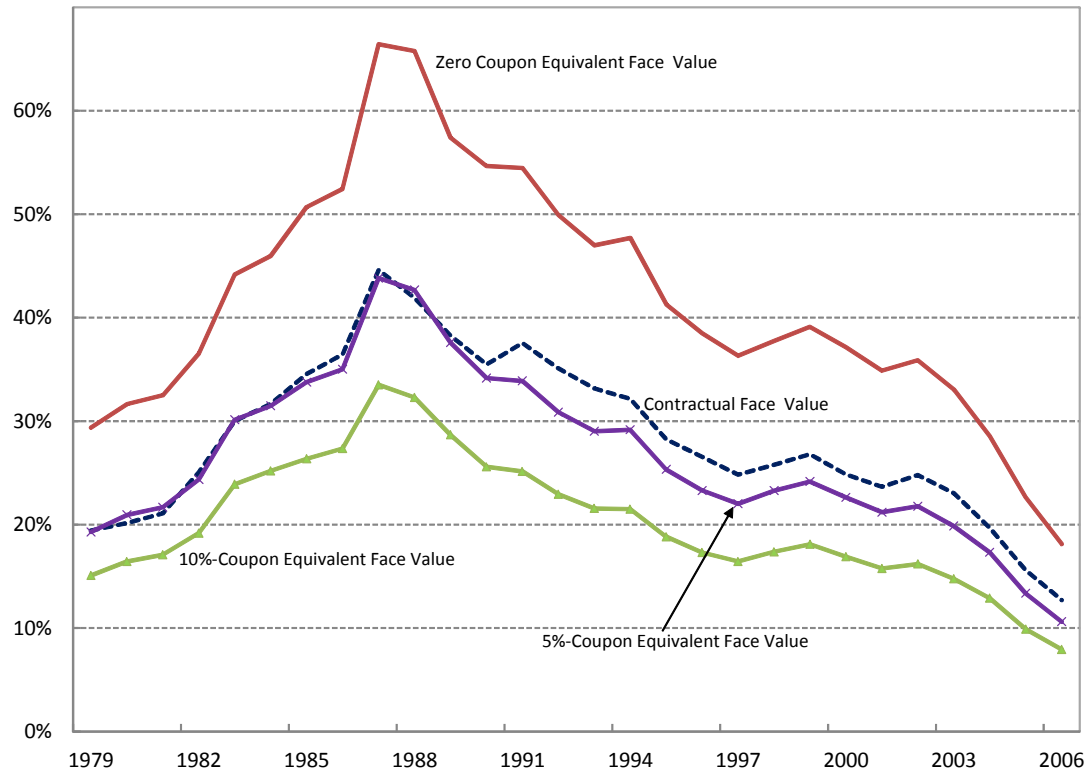

Figure 1: The Stock of External Sovereign Debt, % of GNI

throughout the rest of the period.[8] All three measures peak in 1987, with the contractual face value of external sovereign debt at about 45% of GNI, ZCE face values at 66%, and the 10% ρCE face value at 34%.

Although all four series produce a similar picture of the evolution of developing countries' indebtedness over the sample, the relative size of contractual face values, ZCE face values, and ρCE face values has changed substantially. ZCE face values exceeded contractual face values by more than 50% during the Latin American debt crisis of the late 1980s, which is the same time that indebtedness levels reached their peak. The relative difference in levels declined substantially to just over 40% in the early 1990s, reflecting the lower interest rates incorporated into Brady bonds, before rising back to 45% by the turn of the millennium.

[8] In the data, the contractual face value of an individual country's debt almost always exceeds its present value discounted at 10%. The exceptions occur in the early 1980s (when interest rates were often higher than 10%) for a set of 12 countries including Brazil and Mexico.

Even though overall indebtedness levels declined thereafter, the relative difference between the series did not change much. With respect to ρCE face values, we observe that the extent to which contractual face values exceeded them at both 5% and 10% increased in the 1990s and 2000s as the maturities of sovereign bonds lengthened.

As noted before, the quantitative theoretical literature on sovereign debt has focused almost exclusively on zero-coupon bonds.[9] When assessing the empirical performance of the models presented in this literature, researchers have compared the level of indebtedness measured using the contractual face values implied by the zero-coupon bonds that are featured in the models with the contractual face values of the more complicated portfolio of debts observed in the data. These comparisons have invariably yielded the conclusion that the benchmark model (with one-period debt and zero recovery rates in the event of a default) produces equilibrium levels of indebtedness that are between 5% and 10% of GNI, which are dramatically below the levels of indebtedness observed in the data (for all countries, but only including long-term debt, as shown in Figure 1). The benchmark model's equilibrium levels of indebtedness are even further below the levels observed for middle-income countries, which for long-term debt are typically on the order of 60% of GNI (for example, see Table 1) rising to 80% when short term debt is included. Because these models produce debt levels roughly five to ten times smaller than those observed in the data, many researchers have been motivated to examine modifications of the benchmark model that deliver larger levels of indebtedness.

The importance of researching such modifications is further emphasized once it is understood that the models and the data have not been compared in a theoretically consistent manner. If we compare indebtedness using the theoretically consistent ZCE face values, the empirical performance of the benchmark model of sovereign debt and default deteriorates further. For our sample of countries, the ratio of the ZCE face value of debt to GNI has tended to be almost 50% higher than the contractual face value of debt to GNI. Hence, when data on the stock of external sovereign debt are constructed using our theoretically consistent zero-coupon equivalent face value measure, the benchmark model produces levels of the stock

[9] See, for example, Arellano (2008), Aguiar and Gopinath (2006), Yue (2010), Tomz and Wright (2007), and Benjamin and Wright (2008).

of sovereign debt between 7.5 and 15 times smaller than those observed in practice.

Our data also call into question the success of recent modifications of the benchmark model aimed at matching observed levels of indebtedness. One type of modification keeps one-period debt but allows for nonzero recovery rates for creditors following a default. The resulting debt levels are closer to the data on contractual face values, ranging from 10% of GNI (Yue 2010), to 20% (Bi 2008), 45% (D'Erasmo 2007), and up to 80% (Benjamin and Wright 2008). That is, all but one fall short of the observed 80% levels that result from including short-term debt and measuring the stock of long-term debt using the theoretically consistent ZCE face values. A second modification sets recovery rates to zero but allows for longer maturity debt as discussed in the earlier examples. Measuring with ZCE face values increases the model-generated data on debt stocks. However, this does not unambiguously improve the fit of these models to the data. Hatchondo and Martinez (2009), for example, report levels of the contractual face value of debt from their model as roughly 10% of GNI when their output cost of default parameter is set to 10%. For their model, the relevant ZCE face values, however, are on the order of 200% of GNI. Likewise, whereas Chatterjee and Eyigungor (2012) produce a 70% ratio of contractual face value of debt to GNI, which is quite close to the ZCE face value data, the corresponding model-generated ZCE face values are in excess of 110% of GNI.

4.B Relative Indebtedness and Indicators of Debt Sustainability

Contractual face values have long been used to construct indicators of debt repayment difficulties. For example, until the mid-1990s, the World Bank classified countries as "highly indebted"—and hence potentially eligible for debt relief—if, among other indicators, the ratio of the contractual face value of the country's external debt to gross domestic product[10] (GDP) exceeded 50%. When debt stocks are recomputed using either ZCE or ρCE face values, absolute levels of indebtedness change, rendering the 50% threshold less significant. Importantly, the ranking of countries by levels of indebtedness also changes, suggesting that some deserving countries were denied debt relief despite being more indebted than the

[10] We follow World Bank (various) in reporting debt as a percentage of GNI, rather than GDP. For most countries, the difference between GNI and GDP is small.

	1990 Debt/GNI (%)			
Face Values:	Contractual	ZCE	5CE	10CE
Countries Designated "Highly Indebted"				
Comoros	55.3	66.1	35.8	23.5
Ghana	50.2	61.2	31.2	20.0
Philippines	54.2	81.1	58.3	44.4
Senegal	56.4	71.6	44.3	32.0
Uganda	50.6	60.5	33.3	22.7
Countries Designated "Moderately Indebted"				
Argentina	37.8	61.0	43.6	32.8
Bulgaria	49.6	60.2	52.2	46.0
Cameroon	46.9	62.5	45.7	35.6
Mexico	31.8	67.2	36.8	24.5
Solomon Islands	49.4	58.3	35.2	25.2

Table 1: Relative Indebtedness Levels in 1990

recipients of debt relief.

Table 1 illustrates the changes in rankings by tabulating the debt-to-GNI ratios with our debt stock measures for a subset of those countries that were just above the 50% contractual face value threshold in 1990 (when the threshold was used by the World Bank in awarding the highly indebted designation). The table also does this for another subset of nations whose rankings increase significantly when either ZCE or ρCE face values are used. The most dramatic change in rankings is for Mexico whose contractual face value of debt only just exceeded the 30% threshold of a "moderately indebted" country in 1990, but whose ZCE face value of 67.2% exceeds the ZCE face values of Comoros, Uganda, and Ghana, which were all designated as highly indebted. A similarly large adjustment occurs for Argentina which, like Mexico, borrows at non-subsidized (and hence higher) interest rates. Dramatic changes in rankings also result if ρCE face values are used. For example, Ghana is just above, and Bulgaria just below, the contractual face value threshold for being considered highly indebted, but when we use the 10%-CE measure, we observe that the debt stock of Ghana is less than half that of Bulgaria. Likewise, the Solomon Islands were classified as moderately indebted in 1990 even though its contractual face value of debt, relative to GNI, was slightly less than that of highly indebted Uganda. Although this ranking is preserved using ZCE face values, the Solomon Islands rank as more indebted using either ρCE face value measure.

The World Bank has since moved away from the use of contractual face values toward present discounted values of debt service when designating countries as highly indebted. This was motivated by the issue, discussed earlier, that contractual face values are misleading indicators of relative indebtedness when some countries have access to subsidized concessional financing (see Claessens et al. 1996; Easterly 2001). However, the absence of widely available data on the present value of domestic sovereign debt or on the subcomponents of external sovereign debt has meant that researchers have continued to focus on thresholds defined in terms of contractual face values. For example, Reinhart and Rogoff (2010) study the relationship between economic growth and the contractual face value of both external and internal debt and find that when its ratio to GDP rises above 90%, growth declines by more than 1% per year on average. Moreover, for emerging market countries, when external debt alone exceeds 60% of GDP, the annual growth rate declines by about 2%. This finding has since become the starting point for a number of other studies of the relationship between indebtedness and economic growth (Irons and Bivens 2010; Kumar and Woo 2010) and has since become quite controversial (see Dube 2013, Herndon, et al 2013, Nersisyan and Wray 2010, Panizza and Presbitero 2013, and the response in Reinhart and Rogoff 2013).

Table 2 shows how the ordering of some countries in the neighborhood of the 60% external-debt-to-GNI threshold changes when their external indebtedness is measured using ZCE or ρCE face values for the last year of our data. The table identifies two countries—Panama and Uruguay—whose contractual face values leave them under the threshold, but whose ZCE face values place them in line with other countries that were previously above that threshold. The same is true when countries are ranked by the ρCE face value of their debts; indeed, according to the ρCE face value measure, Panama and Uruguay are more indebted than Guinea and Sierra Leone.

4.C The Evolving Composition of External Sovereign Debt

The extent to which estimates of indebtedness calculated using contractual face values differ from those calculated using ρCE face values depends on the evolving mix of borrowing instruments used in international debt markets, changes in world interest rates, and the

	2006 Debt Face Value/GNI (%)			
Face Value:	Contractual	ZCE	5CE	10CE
Countries Above Threshold				
Dominica	66.9	87.1	60.1	45.3
Guinea	73.3	85.6	50.0	33.8
Jamaica	62.2	103.9	73.5	56.2
Sierra Leone	70.0	79.3	41.4	25.8
Countries Below Threshold				
Panama	48.5	105.4	60.0	40.1
Uruguay	44.7	90.7	53.6	36.4

Table 2: Relative Indebtedness Levels in 2006

changing circumstances of a country as reflected in country risk. As a consequence, relative to measurements using contractual face values, measurements using ρCE face values paint a quantitatively, and in some cases also qualitatively, different picture of the evolving composition of the market for sovereign debt. In this subsection, we explore those differences focusing on the changing performance of different debt instruments, different regions, and different income groups of countries.

Debt Instruments

Figure 2 plots the ratio of contractual face values to ZCE face values for the five sets of borrowing instruments that make up the stock of the world's sovereign external debt. As shown in the Figure, the ratio of the two face values has increased steadily over time for both official lending categories as well as the other private category (which includes, among other things, long-term trade credit). The ratio for commercial banks loans has also increased over time, although there were large decreases in the late 1980s, late 1990s, and early 2000s, reflecting the changes in contractual interest rates on commercial bank loans. The largest changes occur for commercial bond lending, where the ratio fell from around 70% in 1985 to roughly 45% in 1990, before stabilizing at roughly 55% thereafter. Set against the examples in Section 2, this is initially surprising, since bonds issued at a discount should, everything else equal, have higher ratios of contractual face values to ZCE face values than equivalent loan contracts issued at par. However, this is offset by the fact that the increase in bond lending was driven primarily by bonds issued by middle-income countries at higher interest

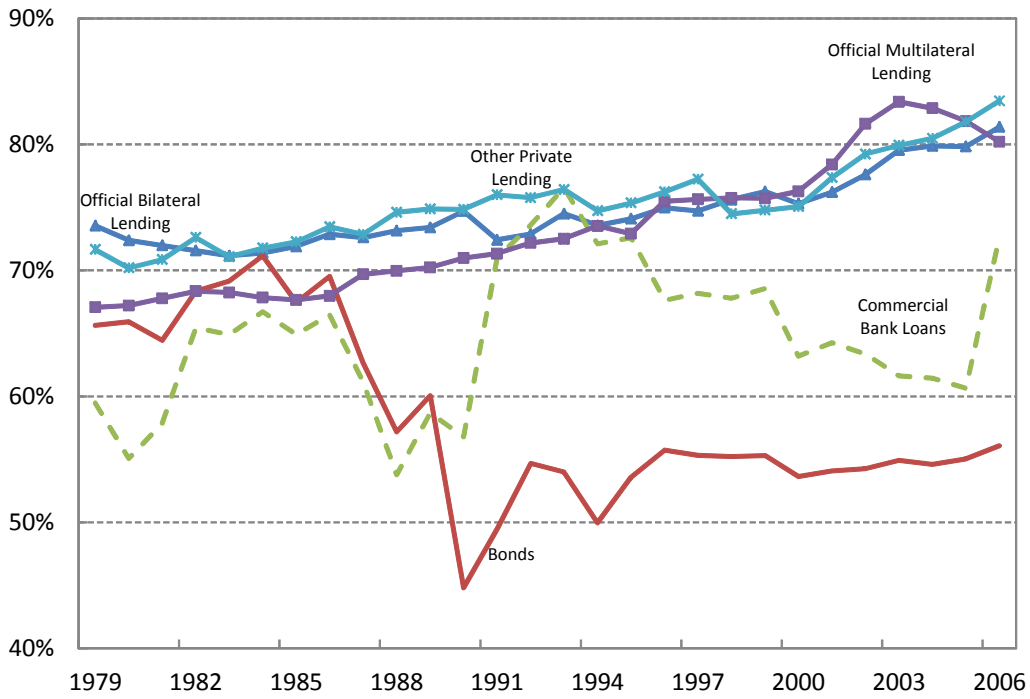

Figure 2: Ratio of Contractual Face Values to ZCE Face Values, by Instrument

rates. Likewise, Figure 3 plots the ratio of contractual face values to 10CE face values for the five sets of borrowing instruments. As shown in the Figure, all ratios are above 100%, except for commercial bank loans during 1980 and 1981 when contractual interest (coupon) rates often exceeded 10%.

Table 3 describes the composition of sovereign debt for our sample of developing countries using all three debt stock measures. The high average interest rates on private lending to sovereign countries results in higher shares for private lending when computed using either

Face Value:	Contractual			ZCE			10CE		
	1980	1990	2000	1980	1990	2000	1980	1990	2000
Official Lending	43.9	57.9	57.6	39.7	51.2	50.4	31.0	50.6	50.6
(i) Bilateral	30.4	33.9	29.6	26.9	29.4	26.1	21.3	29.6	26.4
(ii) Multilateral	13.5	24.0	28.0	12.8	21.7	24.3	9.7	20.9	24.3
Private Lending	56.1	42.1	42.4	60.3	48.8	49.6	69.0	49.4	49.4
(i) Commercial Banks	36.8	20.6	11.8	42.5	23.6	12.7	49.0	26.1	13.1
(ii) Bonds	4.3	11.1	26.1	4.1	16.3	32.9	4.4	11.6	31.2
(iii) Other	15.0	10.4	4.5	13.8	9.0	4.0	15.6	11.8	5.0

Table 3: Shares of Total Debt by Instrument

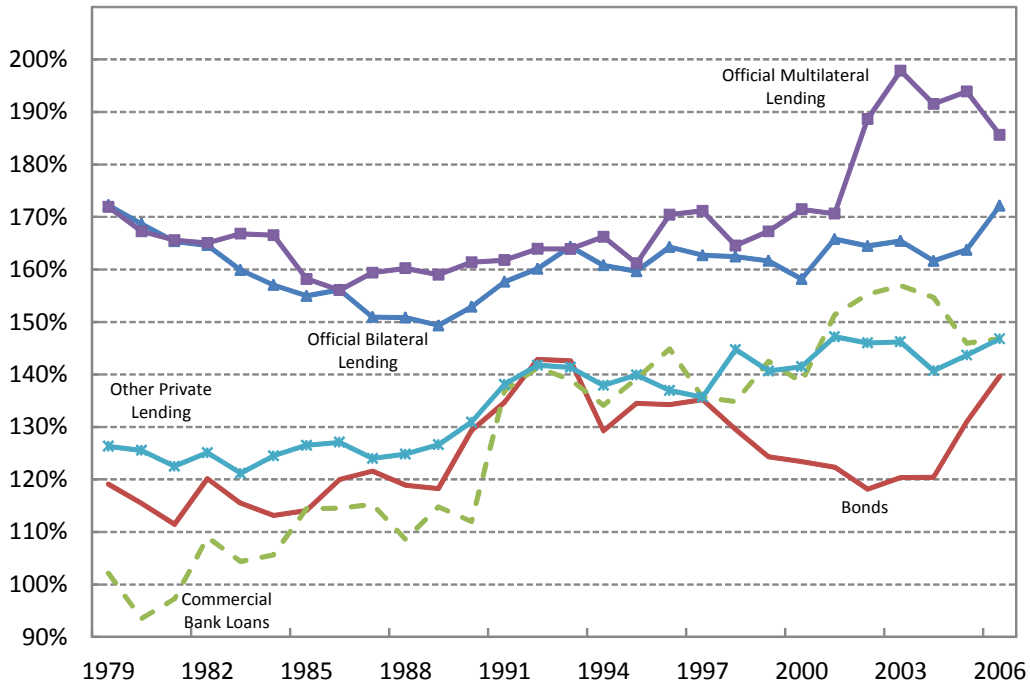

Figure 3: Ratio of Contractual Face Values to 10CE Face Values, by Instrument

ZCE or 10CE face values relative to contractual face values. While private sector lending to sovereign countries had fallen to 42.4% by 2000 as measured using contractual face values, private sector lending still accounted for 49.6% and 49.4% of lending when measured using ZCE or 10CE face values, respectively. These results were driven almost entirely by the growth in sovereign bond lending, whose share of total debt was larger by 6.8 percentage points in 2000 when shifting from using contractual to ZCE face values and by 5.1 percentage points when shifting from using contractual face values to 10CE face values.

Regions

Shifting from using contractual face values to ZCE or ρCE face values also changes the composition of sovereign debt across regions. As shown in Figure 4, Latin America and the Caribbean experiences the largest increase in debt, with the ratio of contractual face values to ZCE face values always below 70% and even dropping below 55% at the beginning of the 1990s. This reflects the greater dependence on credit provided by private sector lenders at higher interest rates to countries in this region (relative to most other nations). The ratio

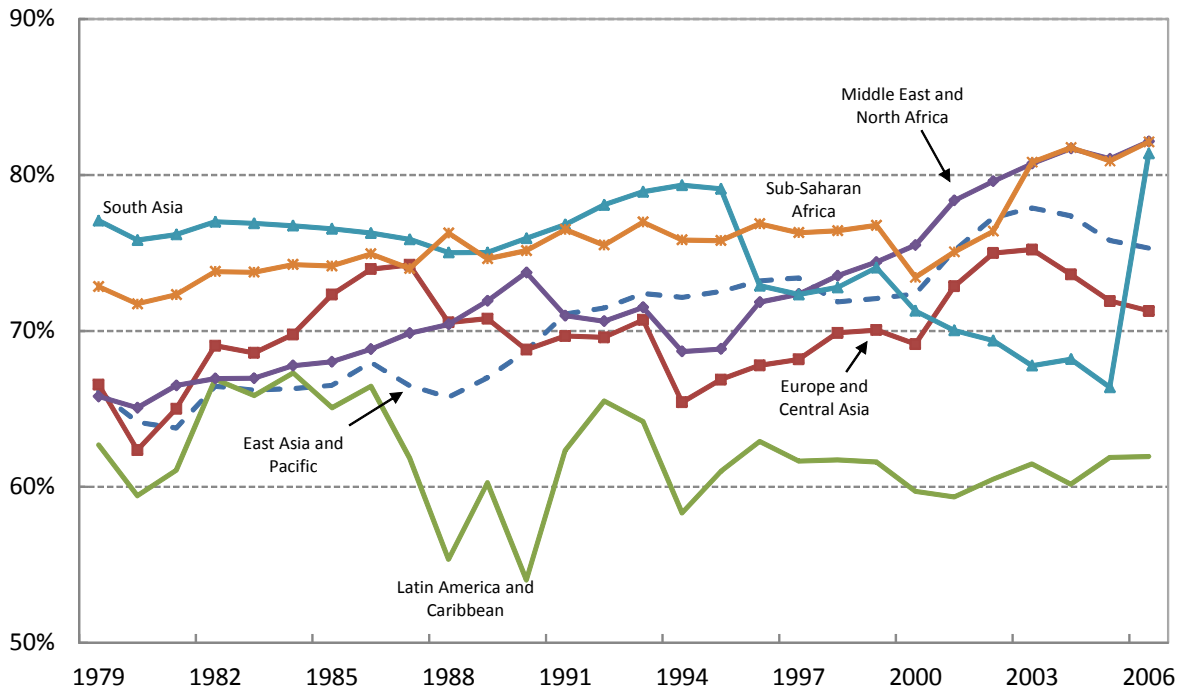

Figure 4: Ratio of Contractual to ZCE Face Values by Region

of ZCE face values to contractual face values is typically low for countries in Sub-Saharan Africa reflecting their tendency to borrow from official creditors, often at concessional rates.

Table 4 presents the share of total outstanding debt owed by each of the World Bank's six regional groupings of developing countries for three of our debt stock measures. Latin America accounts for an additional 5.2% of developing countries' external sovereign debt when measured with ZCE face values and for an additional 5.6% when measured with 10CE face values.

Income Levels

As shown in Table 5, similar patterns emerge when we group countries by national income level. The differences between contractual face values and ZCE or ρCE face values are smallest for high-income countries that are able to borrow at the lowest interest rates. The differences are largest for middle-income countries, with the share owed by upper-middle-income countries higher by roughly 5 to 7 percentage points when ZCE or ρCE face values are used instead of contractual face values to measure shares of total debt. Consequently, the

Face Value:	Contractual			ZCE			10CE		
	1980	1990	2000	1980	1990	2000	1980	1990	2000
Latin America & Caribbean	43.4	33.5	36.7	46.5	40.5	41.9	50.7	38.2	42.3
South Asia	10.6	13.5	11.8	8.9	11.4	11.0	5.4	9.6	9.2
East Asia & Pacific	10.5	17.3	22.3	10.3	16.3	20.4	10.2	17.1	22.3
Europe & Central Asia	8.6	10.7	8.7	9.0	10.1	8.4	9.5	11.9	9.4
Middle East & North Africa	14.9	11.7	7.9	14.6	10.3	6.9	13.6	11.8	7.6
Sub-Saharan Africa	12.1	13.3	12.7	10.7	11.4	11.5	10.6	11.3	9.3

Table 4: Shares of Total Debt by Region

Face Value:	Contractual			ZCE			10CE		
	1980	1990	2000	1980	1990	2000	1980	1990	2000
High-Income	2.6	2.6	1.7	2.7	2.3	1.5	3.1	3.0	2.0
Upper-Middle-Income	53.6	43.5	44.9	56.3	49.9	49.6	61.9	49.7	51.8
Lower-Middle-Income	36.2	45.4	45.9	34.3	40.8	42.9	29.5	41.5	42.0
Low-Income	7.8	8.5	7.4	6.6	7.0	6.0	5.6	5.8	4.2

Table 5: Shares of Total Debt by Income Level

shares of total debt for lower-middle and low-income countries are lower. The low-income countries experience the greatest decline when we move to using ρCE face values because most of their borrowing is at long maturities from official lenders.

5 Contractual Face Values and Public Policy

In this section we point to two areas where the focus on contractual face values gives market participants an incentive to vary the contractual terms of debt issuance and where this may affect the outcomes of changes in international economic policy. We begin with a discussion of the role of face values in determining voting rights in the event of a sovereign debt restructuring; we also examine how this factor may be compounded by recent proposals for expanded use of collection action and aggregation clauses in sovereign debt contracts. We then turn to a discussion of the ways in which countries vary their debt issuance when confronted with fiscal rules that are written in terms of contractual face values, or otherwise treat future interest and principal payments in asymmetric ways.

5.A Face Values and Sovereign Debt Restructuring Negotiations

The distinction between principal and interest can be important when sovereign debts are restructured. Since 2003, emerging market sovereign bonds issued under New York law have included *collective action clauses,* which specify the conditions under which the terms of the bond may be changed. As one example of such a clause, Brazil's 10.25% Global BRL Bonds due in 2028[11] specifies that "the holders of not less than 85% (in the case of Collective Action Securities designated "Type A" or having no designation as to "Type") or 75% (in the case of Collective Action Securities designated "Type B") in *aggregate principal amount* of the outstanding debt securities of that series, voting at a meeting or by written consent, must consent to any amendment, modification, change or waiver with respect to" (emphasis added), among other things, repayment terms. That is, voting rights in the event of a restructuring are allocated in proportion to a debt's contractual face value.

If all debts covered by a collective action clause are identical—and in practice, collective action clauses apply only to a single debt issue—allocating voting rights in proportion to contractual face values will produce the same outcomes as allocating voting rights in proportion to ZCE or ρCE face values. However, if something similar to a collective action clause is applied to different debt contracts that divide future cashflows into interest and principal in different ways or are issued at different maturities, the way voting rights are allocated can change voting outcomes. As one example, allocating voting rights in proportion to ZCE face values instead of contractual face values would increase the voting power of the holders of low-face-value-high coupon debts over those of the holders of equivalent high-face-value-low-coupon debts. Similarly, the holders of short-term debt would have more voting rights than the holders of long-term debt if voting rights were allocated in proportion to ρCE face values rather than contractual face values. As a consequence, if voting rights continue to be awarded on the basis of contractual face values, creditors have an incentive to demand debt securities with a low coupon and a long maturity in order to maximize voting power for a given financial exposure.

Collective voting to restructure a portfolio of sovereign debts is increasing in impor-

[11] See http://www.sec.gov/Archives/edgar/data/205317/000119312510234571/d424b5.htm.

tance over time as *aggregation clauses*—clauses that group together different debt securities in the event of a renegotiation of sovereign debt—become more widespread. A number of nations are now following the example of Uruguay which, in 2003, was the first country to issue bonds containing aggregation clauses[12], and Greece which, in its recent debt restructuring, amended domestic law sovereign bonds by legislation to include aggregation clauses (Zettelmeyer, Trebesch and Gulati 2013). This number is expected to grow. In Europe, for example, the Eurogroup statement of November 28, 2010 (Eurogroup 2010) commits its members to introduce, starting in 2013, "aggregation clauses allowing *all debt securities* issued by a Member State to be considered together in negotiations" (Eurogroup 2010; emphasis added). Proposals to introduce similar aggregation clauses in non-euro-area sovereign bonds have also been discussed in policy circles (International Monetary Fund 2002). Interpreting this policy broadly, we note that future debt restructuring negotiations would then involve negotiations across a very diverse set of debt instruments, such as debts issued by both official and private sector creditors and by both banks and bondholders, as well as debts issued at different maturities and in different currencies under different governing laws. As a result of this diversity, shares of total contractual face value are unlikely to be representative of the relative financial exposure of different creditors.

To obtain a sense of the practical significance of this issue, suppose that all debt securities were modified to contain aggregation clauses and that otherwise the contractual forms of countries' debts remain the same as their level in 2006. If we restrict attention to sovereign debt owed to private sector creditors, one potential source of conflict lies in the competing interests of banks and bondholders. Table 6 collects the countries for which allocating voting rights in proportion to contractual face values would likely have yielded different results in a restructuring where voting rights were allocated in proportion to ZCE or ρCE face values. With a simple majority voting threshold, the holders of Mexico's sovereign bonds would hold a minority share calculated in terms of its contractual face value despite

[12] Uruguay's May 2003 issue of 10.50% bonds due 2006 contained a clause allowing it to modify the payment terms of two or more securities if "the holders of not less than 85% in aggregate principal amount of the outstanding debt securities of all series that would be affected by that modification (taken in aggregate), and ... 66-2/3% in aggregate principal amount of the outstanding debt securities of that series (taken individually)" agree. (See http://www.sec.gov/Archives/edgar/data/102385/000095012303011424/y90432b5e424b5.htm#026).

	Bonds/Total Private			
Face Value:	Contractual	ZCE	5CE	10CE
	75% Threshold			
Barbados	77.3	73.6	71.9	70.9
Chile	73.5	78.3	74.0	71.3
Seychelles	71.8	76.7	75.0	73.3
	50% Threshold			
Mexico	45.2	51.9	48.4	47.0

Table 6: Bondholders vs Other Private Creditors in 2006

being more exposed in the sense of holding a majority of the ZCE face value of the stock of debt. Even with a 75% threshold, bondholders would possess the relevant supermajority by moving to voting rights based on ZCE face values in the cases of Chile and Seychelles. Somewhat surprisingly, a move to allocating voting rights based on ZCE face values would lead bondholders to lose their supermajority in the case of Barbados. The same holds true if voting rights are allocated in proportion to either the 5CE or 10CE face values of Barbados's sovereign debt.

Interpreted literally, the Eurogroup statement may be taken to mean that official creditors will be subject to the same aggregation clauses as private sector creditors in future debt restructuring negotiations. To what extent is there potential for conflict between private sector creditors (who are presumably motivated solely by a concern for profits) and official creditors (who may also be motivated by concerns for equity)? In theory, there should be little conflict: Multilateral official loans have historically been *de facto* senior, and the restructuring of bilateral official loans is in theory predicated on private sector creditors receiving equal or inferior treatment. However, it is not clear that this is true in practice.

To assess the possibility for voting conflict, we collect in Table 7 a number of cases in which a change from allocating voting rights based on contractual face value to either ZCE or ρCE face value would affect the ability of the official sector to obtain a supermajority or, alternatively, prevent the private sector from obtaining a supermajority. Of the 100 countries in our balanced sample, official creditors possess a simple majority by contractual face values in 80 cases, and possess a 75% super-majority in 66 cases. In all eleven cases in Table 7, a move to voting rights based on ZCE face values would lead to the official sector either losing

	Official/Total			
Face Value:	Contractual	ZCE	5CE	10CE
75% Threshold				
Brazil	30.3	21.0	24.7	26.7
Dominica	76.3	71.3	71.0	71.3
Malta	31.3	19.2	25.8	31.0
Turkey	30.7	24.4	27.5	29.6
Uruguay	31.3	21.2	26.6	30.5
66% Threshold				
Grenada	46.3	27.1	31.0	35.8
St. Lucia	68.0	65.5	61.2	58.6
50% Threshold				
Ecuador	57.8	43.6	51.5	56.6
El Salvador	58.3	41.1	49.9	55.4
Philippines	50.7	40.6	42.4	43.8
St. Vincent & Gr.	50.8	49.9	46.8	45.0

Table 7: Official vs Private Creditors in 2006

its majority or supermajority, or losing its ability to prevent private sector creditors from reaching a majority or supermajority. For the same eleven cases, a move to voting rights in proportion to either 5CE or 10CE face values would decrease the voting power of the official sector, although it only changes the ability to reach or block a majority or supermajority in four cases at 10% and seven cases at 5%.

Taken together, these results suggest that more widespread adoption of broad aggregation clauses with voting rights based on contractual face values would lead to the effective subordination of private sector claims. This may, in turn, partly explain the reluctance of private sector creditors to participate in bond issues with aggregation clauses and such bonds' favor with policymakers. However, these calculations also suggest that, should the official sector succeed in encouraging widespread adoption of broadly defined aggregation clauses, private sector creditors will have an incentive to adopt contractual forms (such as zero-coupon bonds) that maximize the contractual face value of their claims and so maximize their voting power in the event of a restructuring.

5.B Manipulation of Fiscal Statistics

Limits on a government's stock of debt or budget deficit are common. Examples include the debt stock limits of the U.S. and Denmark, the budget deficit and debt stock restrictions imposed by the Maastricht Treaty on European Union (EU) countries, and the fiscal targets imposed as part of IMF Stand-By lending arrangements. One of the most common forms of manipulation occurs when principal and interest are treated asymmetrically in the relevant statistical targets, allowing governments to manipulate the contractual form of new debt issuance to meet specific targets and disguise an underlying deterioration in the country's fiscal position (see the discussion in Easterly 1999, Piga 2001, Milesi-Ferretti 2004, and Koen and van den Noord 2005).

The asymmetric treatment of interest and principal in fiscal targets is common. For example, the Excessive Deficits Procedure of the Maastricht Treaty specifies a debt threshold of 60% of GDP where "debt means total gross debt at nominal value outstanding at the end of the year and consolidated between and within the sectors of general government" (Article 2.d) and where "the nominal value is considered equivalent to the face value of liabilities" (Eurostat 2010, 305). Likewise, the U.S. debt ceiling is written in terms of the contractual face value of U.S. sovereign debt, with the relevant law stating as of December 2012 that "the face amount of obligations issued under this chapter and the face amount of obligations whose principal and interest are guaranteed by the United States Government (except guaranteed obligations held by the Secretary of the Treasury) may not be more than $16,394,000,000,000 outstanding at one time" (31 U.S.C. § 3101(b)).

Sometimes, statistics on debt feature imputed face values that limit manipulation. For example, in the U.S. in 1989, following the December 1987 announcement of plans to sell zero-coupon U.S. Treasury securities to Mexico with a contractual face value of $10 billion at a price of $2 billion, the statute governing the debt ceiling was amended so that the face value of U.S. debts issued at a discount or premium are imputed by their issue price.[13] As another example, in the early years of the Maastricht Treaty, changes in the relative issuance of low-face-value, high-coupon debt and high-face-value, low-coupon debt by EU

[13] The adjustment appears in Treasury documents as "unamortized discount" (or "unamortized premium"). See Special Analysis E of the 1989 budget, pages E-30 to E-32, and 31 USC § 3101(c).

governments to hit either debt stock or fiscal deficit targets were common; Koen and van der Noord (2005) document more than twenty cases in which the treatment of interest payments in the fiscal accounts by EU countries was questionable. In response to concerns about the manipulation of debt and budget statistics, Eurostat introduced new rules in 1997 requiring the imputation of interest payments on zero coupon debts and other "deeply discounted" bonds so that measured principal and interest payments for these classes of debt contracts would be treated symmetrically with debts issued at par (Eurostat 1997a,1997b).

The Eurostat imputation, however, is imperfect in that it only applies to deeply discounted bonds and hence only removes the incentive to grossly understate interest expenditures. It does not remove the incentive to understate debt levels (and hence overstate interest) through the issuance of low-face-value, high-coupon debt. In perhaps the best known example, the Italian Treasury reduced the contractual face value of the stock of government debt by 1.9 percentage points of GDP in 2002 by swapping long-term bonds with a low coupon for bonds with a lower face value and higher coupon with the Banca d'Italia (Koen and van Noord 2005, 12–13). In another example, this time from the market for U.S. municipal debt, roughly 200 school districts in California circumvented caps on debt issuance at contractual face value by issuing high-coupon, low-face-value debt at a substantial premium to par.[14]

Another example of the asymmetric treatment of interest and principal in fiscal targets comes from IMF Stand-By Arrangements with Argentina throughout the 1990s.[15] The 1991 Stand-By Arrangement targeted the cash balance of the government (which included interest payments) as well as the face value of the stock of outstanding disbursed external debt (International Monetary Fund 1991). By contrast, the 1996 Stand-By Arrangement targeted fiscal expenditures excluding interest payments on debt (International Monetary Fund 1996; see also Independent Evaluation Office of the International Monetary Fund 2004). As a consequence, starting in 1996 Argentina had an incentive to switch to issuing low-face-value,

[14] See the discussion in "The Poway Deal gets Fishier" by Felix Salmon, *Reuters*, September 26th 2012; "Risky Bonds Tie Schools to Huge Debt" by Dan Weikel, Los Angeles Times, November 29th 2012; and "Poway not Alone in Issuing Capital Bonds: 41 other Borrowings Across California Have More Costly Repayment Ratios" by Matt Clarke, *Union Tribune San Diego*, November 29th 2012.

[15] Other cases no doubt exist. Easterly (1999, 2001) states that Brazil issued zero-coupon debt in 1998 so as to understate current interest expenditures. However, we have been unable to uncover any other sources of information on this episode.

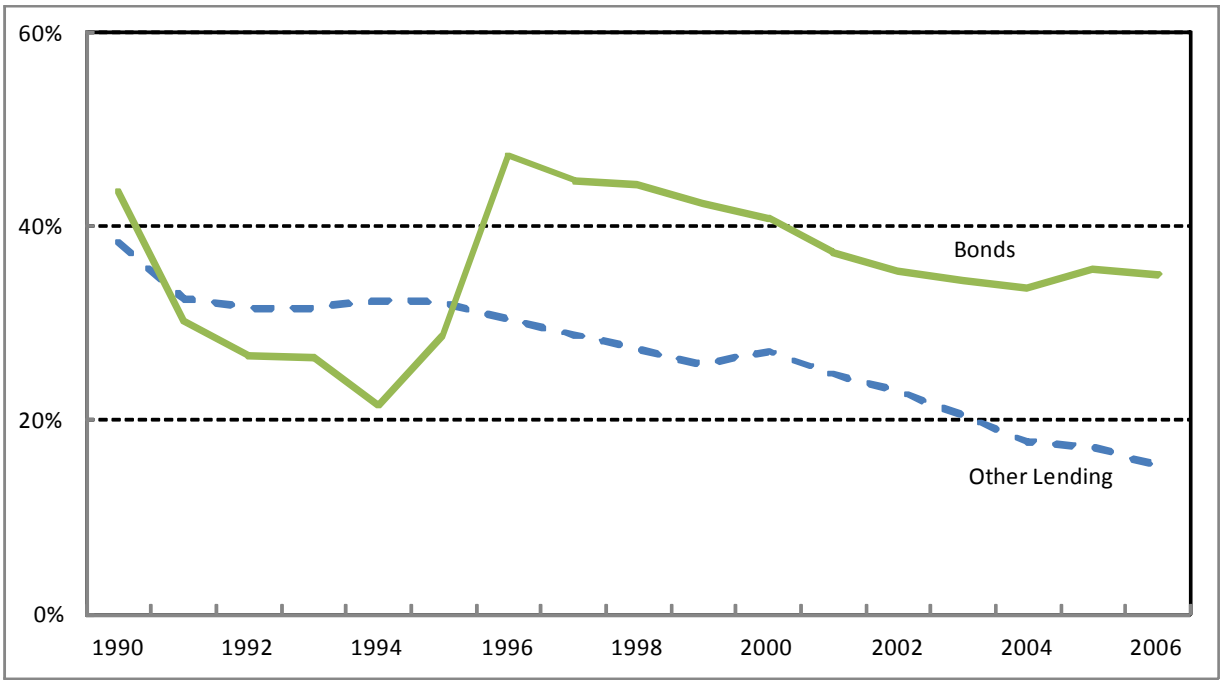

Figure 5: Interest Payments as a Share of ZCE Face Values for Argentine Deutsche Mark-Denominated Debt

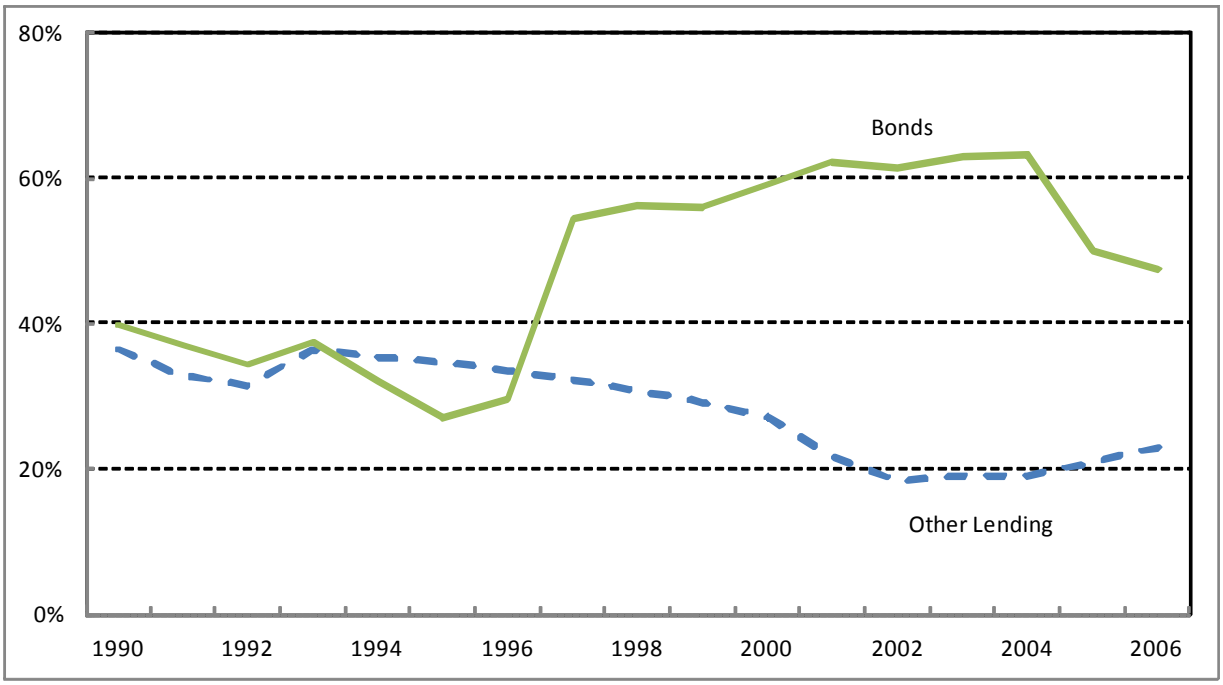

Figure 6: Interest Payments as a Share of ZCE Face Values for Argentine U.S. Dollar-Denominated Debt

high-coupon debt in order to meet the IMF targets for noninterest expenditures.

Our database shows that Argentina responded to this incentive. Figures 5 and 6 plot the ratio of the undiscounted sum of future interest payments to the contractual face value of outstanding debt, by instrument, for both Deutsche mark- and U.S. dollar-denominated Argentine external sovereign debt. Both figures show that, starting in 1996, the share of cashflows labeled interest jumps dramatically. Moreover, this pattern is not repeated for other classes of debt instrument, suggesting that it does not reflect some other change in the environment affecting Argentine borrowing.

It is important to stress that a target written in terms of ZCE face values would only eliminate the incentive to vary contractual form (the split of interest and principal) to meet the target. Sovereign's would still have an incentive to shorten the maturity of their debt issuance—which would raise more revenue from the same face value of debt—to understate the face value of their debt. While a target based on ρCE face values might help partially mitigate this incentive, it would not eliminate possibilities for manipulation as long as the discount rates used to construct the target differ from the discount rates encoded in market prices; if so the country can issue debts at any maturity that is discounted less by the market than the statistical target. Targets constructed using discount rates derived from market prices are also not immune from manipulation; a sovereign can always issue debt to a point where default becomes likely enough that the market value of the debt is small relative to the target. In summary, any statistical target can be manipulated. However, the conventional way of writing targets written in terms of contractual face values is particularly easy to manipulate relative to targets written in terms of either ZCE or ρCE face values.

6 Conclusion

Data on the stock of sovereign debt is typically presented at contractual face value. Defined as the undiscounted sum of future principal repayments, contractual face values can paint a misleading picture of indebtedness because they treat debts with identical total cashflows differently if they have different contractual forms (that is, if the debts have these cashflows divided into principal and interest in different ways) and also treat debts with different cashflows, due to issuance at different maturities, identically. In this paper, we

present new measures of the stock of external sovereign debt for 100 developing countries from 1979 through 2006. The first measure—the zero-coupon equivalent face value—is designed to be invariant to contractual form (the split of cashflows into interest and principal) across equivalent debt contracts (debts with identical cashflows) and is new. The second measure—the ρ-coupon equivalent face value—turns out to be identical to the present value of a debts cashflows discounted at $\rho-$percent, and is designed to correct for differences in the timing over which cashflows are made.

We found that using either ZCE or ρCE face values (instead of contractual face values) paints a very different quantitative picture, and in some cases also a different qualitative picture, of the stock of developing countries' external sovereign debt. For example, according to our measures, the countries of Latin America and the Caribbean are relatively more indebted than countries in other regions because of their access to market sources of funding, which charge higher interest rates relative to official sources. Also, the low-income countries are relatively less indebted because they borrow at subsidized interest rates and at long maturities from official sources. The rankings of individual countries in terms of their indebtedness, which historically was used as a criterion for eligibility for debt relief, can also change significantly when our debt stock measures are applied. For example, Mexico, which was classified as moderately indebted by the World Bank in 1990 based on the total stock of external sovereign debt at contractual face value, is more heavily indebted than some countries that were classified as highly indebted, when indebtedness is measured using either of our measures.

Our zero-coupon equivalent face value measure is particularly useful for comparing the data with the predictions of the growing quantitative theoretical literature on sovereign debt that typically assumes that all debts take the form of zero-coupon bonds. As is well known, models in this literature produce zero-coupon face value of debt levels that are between 5 and 10 times smaller than the contractual face value debt stock data available. When our theoretically consistent zero-coupon equivalent face value measure is used, the empirical performance of these models deteriorates, with model generated debt levels between 7.5 and 15 times smaller than those observed in the data.

Finally, we pointed to the incentives for both creditors and debtors to manipulate the contractual structure of debts given the emphasis on contractual face values. For creditors,

voting power during debt restructuring negotiations is in proportion to contractual face values. As aggregation clauses—which combine different debt instruments for the purpose of one restructuring—in debt instruments become more widespread, creditors holding greater amounts of debt at contractual face values will therefore possess a voting advantage. Using our data, we establish that this has the potential to effectively subordinate private sector bondholders. Similarly, we show that debtors have an incentive to manipulate their debt statistics when they are evaluated on measures that emphasize principal repayments (such as contractual face values) or that emphasize interest payments, and use our data to make a prima facie case for manipulation by one country in our data set.

The paper points to the desirability for further work in at least three directions. First, in the light of a surge of recent interest, it would be desirable to construct similar measures for the stock of domestic sovereign debt. Second, as emphasized earlier, our paper has nothing to say about the desirability or appropriateness of different methods for discounting cashflows to arrive at an appropriate valuation for the stock of external sovereign debt. In a companion paper (Dias, Richmond, and Wright 2013), we show theoretically that the appropriate discount rate will vary according to the purpose for which the resulting measure will be used. We also present several methods for implementing the implications of that theory. Third and relatedly, our paper only briefly touches on the maturity structure of external sovereign debts, which has been a topic of recent academic and policy interest. In future work, we aim to use our data to construct a comprehensive set of estimates of the maturity of external sovereign debts, disaggregated by country, instrument, and currency of issue, which we will then use to discipline the existing models of the maturity structure of external sovereign debt.

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7 Appendix A: Country List

In our calculations we used a subset of the countries that are present in our data set. The reason was that we wanted to use a balanced panel in order to avoid potential attrition problems. In the original data set there are 138 countries, while our sample contains 100 of those countries. Table 8 lists the 100 countries. In Appendix C, we show that our results are qualitatively similar when we use the full set of 138 countries.

Note: The region and income level identifiers are defined as follows. Region: EAP = East Asia and Pacific; ECA = Europe and Central Asia; LAC = Latin America and Caribbean; MENA = Middle East and North Africa; SA = South Asia; SSA = Sub-Saharan Africa. Income: LI = Low-Income; LMI = Lower-Middle-Income; UMI = Upper-Middle-Income; HI = High-Income.

8 Appendix B: Comparison To World Bank Published Data

Earlier we claimed that our data, when aggregated, almost exactly replicates the publicly available data that is published by the World Bank. In this appendix our goal is to

Country	Region	Inc.Group	Country	Region	Inc.Group
Algeria	MENA	UMI	El Salvador	LAC	LMI
Argentina	LAC	UMI	Equatorial Guinea	SSA	HI
Bangladesh	SA	LI	Ethiopia	SSA	LI
Barbados	LAC	HI	Fiji	EAP	UMI
Belize	LAC	LMI	Gabon	SSA	UMI
Benin	SSA	LI	Gambia, The	SSA	LI
Bolivia	LAC	LMI	Ghana	SSA	LI
Botswana	SSA	UMI	Grenada	LAC	UMI
Brazil	LAC	UMI	Guatemala	LAC	LMI
Bulgaria	ECA	UMI	Guinea	SSA	LI
Burkina Faso	SSA	LI	Guinea-Bissau	SSA	LI
Burundi	SSA	LI	Guyana	LAC	LMI
Cameroon	SSA	LMI	Haiti	LAC	LI
Cape Verde	SSA	LMI	Honduras	LAC	LMI
Central Afr. Republic	SSA	LI	Hungary	ECA	HI
Chad	SSA	LI	India	SA	LMI
Chile	LAC	UMI	Indonesia	EAP	LMI
China	EAP	LMI	Jamaica	LAC	UMI
Colombia	LAC	UMI	Jordan	MENA	LMI
Comoros	SSA	LI	Kenya	SSA	LI
Congo, Dem. Republic	SSA	LI	Lesotho	SSA	LMI
Congo, Republic	SSA	LMI	Liberia	SSA	LI
Costa Rica	LAC	UMI	Madagascar	SSA	LI
Cote D'Ivoire	SSA	LMI	Malawi	SSA	LI
Djibouti	MENA	LMI	Malaysia	EAP	UMI
Dominica	LAC	UMI	Maldives	SA	LMI
Dominican Republic	LAC	UMI	Mali	SSA	LI
Ecuador	LAC	LMI	Malta	ECA	HI
Egypt	MENA	LMI	Mauritania	SSA	LI

Table 8: List of countries used in the calculations

Country	Region	Inc.Group	Country	Region	Inc.Group
Mauritius	SSA	UMI	Sierra Leone	SSA	LI
Mexico	LAC	UMI	Solomon Islands	EAP	LMI
Morocco	MENA	LMI	Sri Lanka	SA	LMI
Mozambique	SSA	LI	St. Kittis and Nevis	LAC	UMI
Nepal	SA	LI	St. Lucia	LAC	UMI
Nicaragua	LAC	LMI	St. Vincent and Gre.	LAC	UMI
Niger	SSA	LI	Sudan	SSA	LMI
Nigeria	SSA	LMI	Swaziland	SSA	LMI
Oman	MENA	HI	Syria	MENA	LMI
Pakistan	SA	LMI	Tanzania	SSA	LI
Panama	LAC	UMI	Thailand	EAP	LMI
Papua New Guinea	EAP	LMI	Togo	SSA	LI
Paraguay	LAC	LMI	Tonga	EAP	LMI
Peru	LAC	UMI	Trinidad and Tobago	LAC	HI
Philippines	EAP	LMI	Tunisia	MENA	LMI
Poland	ECA	UMI	Turkey	ECA	UMI
Rwanda	SSA	LI	Uganda	SSA	LI
Samoa	EAP	LMI	Uruguay	LAC	UMI
Sao Tome & Principe	SSA	LMI	Vanuatu	EAP	LMI
Senegal	SSA	LI	Venezuela	LAC	UMI
Seychelles	SSA	UMI	Zambia	SSA	LI

Table 8: List of countries used in the calculations (continued)

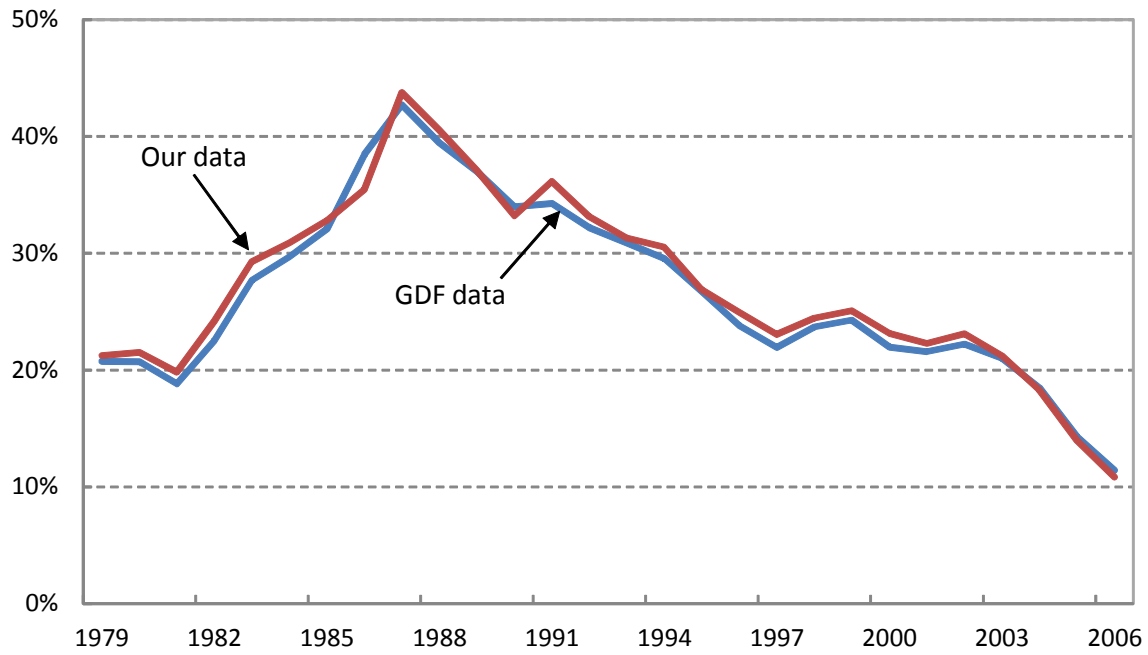

Figure 7: Comparing Publicly Available Data with our Data—Aggregate Values. Units: % of GNI.

provide evidence supporting this claim.

In Figure 7, we compare some of our data with the data that is publicly available in the World Bank's Global Development Finance data set. As it is visible in Figure 7, the differences between the two series are very small, which shows that, at least at the aggregate level, our data is very similar to the data that is publicly available. Our data tend to systematically produce higher values for the debt stocks than those based on publicly available data, but the correlation between the two series is 99.2%. This comparison is only done for those countries that we used in our analyses and for which there are publicly available data.

Because we focus much of our analysis on the composition of debt in terms of instrument and also on the geographical distribution of debt stocks, we also provide some comparisons between our data and the data that is publicly available. Tables 9 and 10 show that there are some differences between our data and the data that is publicly available, but, these differences do not affect our main results.

There are a number of reasons why the published data on contractual face values,

	Publicly available data			Contractual face values		
	1980	1990	2000	1980	1990	2000
Official Lending	8.8	16.3	11.6	9.7	19.2	13.4
(i) Bilateral Loans	6.0	9.7	6.1	6.6	11.3	7.1
(ii) Multilateral Loans	2.8	6.6	5.5	3.1	7.9	6.3
Private Lending	8.4	11.4	8.2	8.9	10.3	8.6
(i) Commercial Banks	7.5	7.7	2.2	7.9	6.6	2.6
(ii) Bonds	0.9	3.7	6.0	1.0	3.7	6.0

Table 9: Comparison Between Reported and Constructed Contractual Face Values, by Debt Instrument (as % of GNI)

	Publicly available data			Contractual face values		
	1980	1990	2000	1980	1990	2000
Latin America and Caribbean	18.5	31.0	20.0	19.9	28.5	21.6
East Asia and Pacific	18.0	22.4	15.3	17.9	23.9	15.5
Europe and Central Asia	22.7	38.8	24.3	22.6	36.6	25.7
South Asia	13.4	26.6	22.3	14.6	30.1	22.4
North Africa and Middle East	47.7	64.5	37.4	47.8	61.2	38.1
Sub-Saharan Africa	27.5	86.9	80.8	26.9	81.9	90.2

Table 10: Comparison Between Reported and Constructed Contractual Face Values, by Region (as % of GNI)

which are based on direct reports of contractual face values by the countries, might differ from our construction of face values by summing principal flows. The first is that some of the countries themselves may have inadvertently reported contractual face values that differ from the sum of future principal repayments specified in their loan agreements. The second concerns the way debt with tranches issued in different currencies are reported. In such cases, the World Bank's *Debtor Reporting System Manual* gives countries the option to combine the amounts from different tranches "at the exchange rates prevailing on the date of the commitment" (World Bank 2000, 12). As future principal repayments are specified using current and forecast future exchange rates, they can be expected to differ from the amounts calculated using the exchange rates at the time of issue.

9 Appendix C: Results From Unbalanced Sample

As explained in Appendix A, the data we obtained from the World Bank has a total of 138 countries, but we only used a subset of 100 countries in our calculations. The main reason for this difference is our desire to have a balanced sample of countries and avoid noise in our results that is caused by changes in the composition of the sample. There are two reasons for the exclusion of 38 countries (listed in Table 11): (1) For 17 countries, the debt data we obtained from the World Bank covers the entire sample period (1979–2006), but we were not able to find reliable estimates of GNI over the whole sample period; (2) for the remaining 21 countries, the data on debt did not cover the entire sample period. This last group of countries is mostly composed of former Soviet Union countries and other Eastern European countries, although there are some exceptions.

The two sets of countries that were excluded are not randomly chosen, and therefore, it is expected that certain results can be different for the two sets of excluded countries in comparison with the set of countries included in the analysis. To give an idea of how different these two sets of countries are from the set of countries included, we plot the ratios of our proposed measures of debt stocks (ZCE face values and present values) to the contractual face value for their debts over time.

From Figures 8 and 9, we can see that there are some differences between the three sets of countries. In particular, countries that were excluded because of missing data tend to have

Country	# Years	Country	# Years
Afghanistan	28	Lithuania	17
Albania	18	Macedonia	28
Angola	28	Moldova	16
Armenia	16	Mongolia	22
Azerbaijan	14	Montenegro	7
Belarus	15	Myanmar	28
Bhutan	27	Romania	28
Bosnia-Herzegovina	28	Russian Federation	28
Cambodia	28	Serbia	28
Croatia	20	Slovak Republic	28
Eritrea	14	Somalia	28
Estonia	15	South Africa	17
Georgia	15	Tajikistan	15
Iran	28	Turkmenistan	15
Kazakhstan	15	Ukraine	15
Kyrgyz Republic	15	Uzbekistan	15
Laos	28	Vietnam	28
Latvia	16	Yemen	28
Lebanon	28	Zimbabwe	28

Table 11: List of Countries in our Data Set that were Excluded from the Analysis

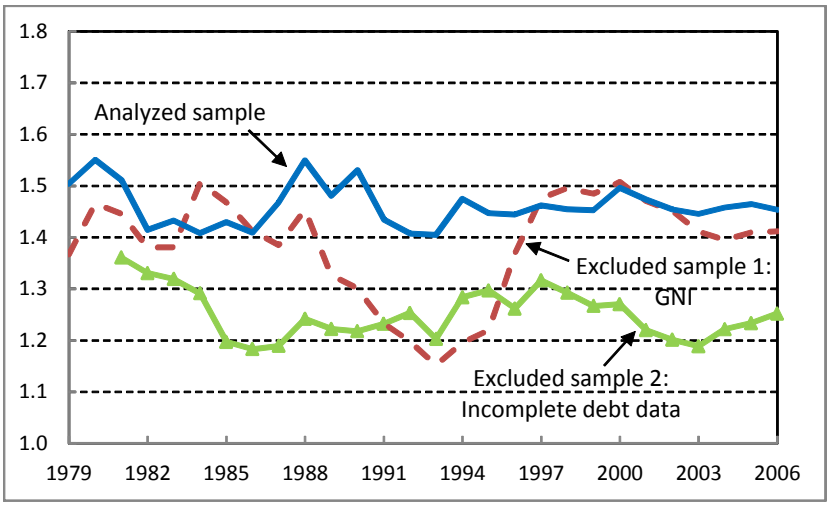

Figure 8: Ratio of ZCE face value to contractual face value: Included vs. excluded countries

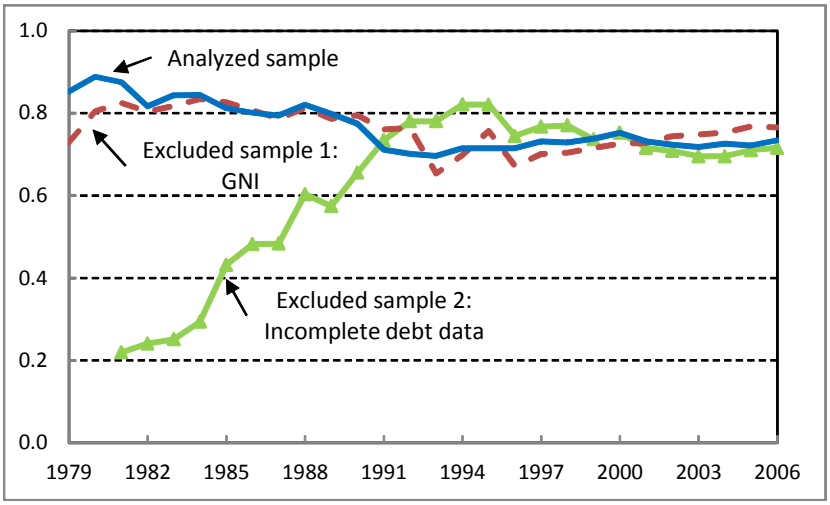

Figure 9: Ratio of 10CE face values to contractual face values: Included vs. excluded countries

a substantially smaller difference between debt stocks based on ZCE face values and those based on contractual face values; and for some of the countries for which we do not have debt data, the ratio of 10CE face values to contractual face values is substantially lower than in the sample we used. This is in part due to the fact that Eastern European and former Soviet Union countries were able to obtain loans at relatively low interest rates. In proportion to the whole debt stock (all 138 countries), the debt stock of the countries that were excluded due to missing data never accounts for more than 4% of the entire debt stock. Regarding the set of countries that were excluded on account of missing GNI data, there are periods where there are no significant differences relative to the sample of countries that was used for analysis. But there is one period, specifically between 1989 and 1996, where the differences between ZCE face values and contractual face values are relatively large. The reasons for these differences are not clear to us. Despite these differences, our main conclusions in the paper are not affected by the sample that we use, and they simply reflect that there is some heterogeneity with respect to some of the issues we raise.

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