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ABSTRACT

The stock of sovereign debt is typically measured at face value. This is a misleading indicator when debts are issued with different contractual forms. In this paper we construct a new measure of the stock of external sovereign debt for 100 developing countries from 1979 to 2006 that is invariant to contractual form, and illustrate five problems with debt stocks measured at face value. First, we show that correcting for differences in the contractual form of debt paints a very different quantitative, and in some cases also qualitative, picture of the stock of developing country external sovereign debt. Second, rankings of indebtedness across countries, which were historically used to define eligibility for debt forgiveness, are sometimes inverted once we correct for differences in contractual form. Third, the empirical performance of the benchmark quantitative model of sovereign debt deteriorates by between 40 to 70 percent once model-consistent measures of debt are used. Fourth, we show how the spread of aggregation clauses in debt contracts which award creditors voting power in proportion to the contractual face value may introduce inefficiencies into the process of restructuring sovereign debts. Fifth, we show how the use of contractual face values gives issuing countries the ability to manipulate their debt stock data, and illustrate the use of these techniques in practice.

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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 indicator of sovereign indebtedness because two debt contracts that possess identical future cash flows, but divide those cashflows into principal and interest in different ways, will have different face values.

The emphasis on face values by statisticians and market participants creates at least five important practical problems. First, the comparison of debt stocks at face value over time and across countries is misleading in the light of significant differences in the contractual structure of debt portfolios across countries and over time. For example, low income countries often borrow from official sources at low interest rates while middle income countries borrow at market interest rates, while international debt markets have shifted away from bank loans issued at par towards bonds which are often issued at a discount. Second, as a consequence, analyses of debt sustainability based on face values will be misleading, with some relatively highly indebted countries being ineligible for debt relief. Third, it inhibits the assessment of the empirical relevance of quantitative macroeconomic literature sovereign debt which typically assumes that all sovereign debt takes the form of zero-coupon bonds. Fourth, it may introduce inefficiencies into the process of restructuring sovereign debts where creditor voting power is allocated on the basis of face values. Fifth, the emphasis on face values gives the issuing country the ability, and sometimes an incentive, to manipulate their debt stock data. For example, countries can understate the 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).

In this paper, we construct a new database of external sovereign debt stocks that sheds light on the extent of these problems. Motivated by the extensive focus on zero-coupon bonds in the theoretical literature on sovereign debt, we propose a new measure – the *zero-coupon-equivalent face value* – of a country's external sovereign debt, that is invariant to the division of the cash flows of a debt contract into principal and interest. We then construct estimates of our measure of developing country indebtedness using unpublished data on the cash flows associated with a countries portfolio of external sovereign debts from the World

Bank's Debtor Reporting System for a sample of 100 developing countries for the period 1979 to 2006.

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 relatively more indebted than other developing countries. In some cases, the revised measure leads to dramatic changes in the measured relative level of indebtedness, as in the case of Mexico where the debt stock measure more than doubles in some years.

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) and many others, produces levels of the face value of external sovereign debt that are between five and ten 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). As 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 issues including aggregation clauses and, in the event that such clauses become widespread, may give private sector creditors an incentive to adopt contractual forms – like 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 presents its external debt position in a more favorable light.

It is important to stress a number of limitations of our analysis. We have nothing to say about other limitations associated with the use of face values as a measure of indebtedness. This includes, but is not limited to, concerns about the fact that face values are *undiscounted* sums of future cash flows and thus treat debts with different maturity structures as equivalent. This is closely related to concerns that face values are not accurate measures of the value of a debt to investors, nor of the cost of servicing the debt to the sovereign country itself. All of these issues may be summarized as concerns about the rate in which the cash flows of a debt occurring at different dates should be *discounted* in forming a measure of indebtedness. Any attempt 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, it is not always appropriate to use market discount rates in constructing measures of the cost of servicing a debt to the issuing country. We discuss these issues, as well as alternative approaches for estimating appropriate discount rates, in a companion paper (Dias, Richmond, and Wright 2011).

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 2008). 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 and the way it leads to misleading estimates of indebtedness complements Hall and Sargent's (1997) analysis of the mismeasurement of interest payments by the US Treasury. Our focus on 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 US 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 aggregating 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 and show by example how changing levels of relative indebtedness could have affected past eligibility for debt relief. Section 5 focuses on the policy implications of these data, emphasizing the incentive of countries to manipulate their debt stock data, and 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 in a greater level of detail than that presented in the paper.

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 cash flows denominated in different currencies falling due at future dates. We denote by $C_{nj}^{i}(t)$ 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[1], we restrict attention to contracts that pay, as long as there is no default, a non-state contingent

[1] On state contingent sovereign debt, see, for example (Grossman and Huyck 1988, Kletzer 2005, and Alfaro and Kanczuk 2005).

claim in a pre-specified set of currencies at a series of pre-specified dates.

The cash flows 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 that two debt contracts n, n' are *equivalent* if they specify the same cashflows $C^i_{nj}(t) = C^{i'}_{n'j}(t)$ 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 numeraire currency, the US 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

$$C^i_n(t) = \sum_j e_j(t) C^i_{nj}(t).$$

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

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

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 US Dollars, of debt contract

[2]The face value of a debt is also sometimes referred to as the *nominal value* of a debt. For example, the European statistical agency Eurostat states that "the nominal value is considered equivalent to the face value of liabilities" (Eurostat 2010 p.305). To avoid confusion with measures of the debt stock that are, or are not, adjusted for inflation, we do not use the term "nominal value" below.

n at time t is defined to be the undiscounted sum of any future amortization payments, or

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

In what follows, to distinguish this concept from the measures we introduce below, 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.

As is well known, 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.

Example 1 (Discount vs Par Bonds)**.** *Consider two one-period debt contracts 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 above, suppressing currency subscripts and country superscripts, the stream of payments associated with first debt can be represented as* $A_1(1) > 0$ *and* $R_1(1) > 0$*, while the second has* $A_2(1) > 0$ *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* $B^N(0) = A_1(1)$ *which is less than the contractual face value of the zero coupon bond* $B^N(0) = A_2(1)$*.*

This potential problem 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) 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 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 to interest payments than in middle income countries.[3] As a result, the relative indebtedness of low income countries may be overstated. As another example, there has been a dramatic shift amongst middle income countries over the past quarter century away from bank loans, typically issued at par with a positive coupon, towards bonds which are often issued at a discount. The use of contractual face values is also problematic when interest rates vary over time. As interest rates rise, the cash flows 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 to contractual form, it is necessary to treat all cash flows as though they are divided into amortization and coupon in the same proportions. Although this can be done in an infinite number of ways, we 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.[4] Specifically, we define the *zero-coupon equivalent face value* of a bond contract n, denoted B^{ZCE}, as

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

Note that we do not include cash flows that are never paid (paid at infinity) in this definition.[5]

The difference between the contractual face value of a debt and its zero-coupon equiv-

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

[4] Another alternative would be to treat all bonds as though they are par bonds. In 1997, the European statistical agency 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,b). 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, and our aim of constructing a measure that allows for cross-country comparisons of contractual structure, motivates our preference for the ZCE face value measure.

[5] Undiscounted measures of debt stocks like 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, as simple perpetuities are typically grouped with common stock for many purposes (for example, the Bank for International Settlements treats bank issued perpetuities as Tier 1 capital). In practice, the only sovereign issued perpetuities of which we are aware are consols, and the United Kingdom is not a member of our dataset.

alent (ZCE) value can be very large as the following theoretical examples drawn from the quantitative literature on sovereign debt demonstrate.

Example 2 (Hatchondo-Martinez/Arellano-Ramanarayanan)**.** *In order to keep track of a portfolio of bonds longer than one period maturity in a computationally tractable way, Hatchondo and Martinez (2009) and Arellano and Ramanarayanan (2009) examine debt contracts that take the form of a perpetuity with a coupon that decays exponentially at rate δ. Such debt contracts are 'memory-less' so that debt issued at different dates can be linearly aggregated. With these contracts, a debt with 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 $(1-\delta)^{s-t+1}$ coupon, or $R(s)=(1-\delta)^{s-t+1}$, at all dates $s>t+1$. In our notation, the contractual face value of a portfolio of b such bonds is given by $B^N_{HM-AR}=bA(\infty)=b$ while its ZCE face value is given by*

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

Hence, the ratio of ZCE to contractual face values is given by $1/\delta$ which is roughly a 20 fold difference for $\delta\approx 0.05$ as commonly used in the quantitative sovereign debt literature.

Example 3 (Chatterjee-Eyigungor)**.** *Motivated by similar tractability concerns, Chatterjee and Eyigungor (2009) examine a class of perpetuities that pay a constant coupon $R(s)=z$ for all s, and mature at rate λ each period. A portfolio of b such bonds issued at time t is associated with coupon payments of $z(1-\lambda)^{s-t}b$ 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*

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

while the ZCE face value is given by

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

For the values used by Chatterjee and Eyigungor (2009) $z=0.03$ and $\lambda=0.05$ the ratio of ZCE to contractual face values for these bonds is 1.57.

ZCE face values are particularly convenient for comparing levels of indebtedness in the data with levels produced by models from the recent quantitative literature on sovereign debt cited above that focus exclusively on zero coupon bonds. They are also useful in calculating the market price of defaultable debts when recovery rates are positive (see Benjamin and Wright, 2009). Finally, they are very simple to calculate.

However, this measure also disguises a number of important features of a country's stock of sovereign debt, the most notable of which is that it disguises differences in the profile of payments over time. As discussed in our companion paper Dias, Richmond, and Wright (2011), there are a number of practical problems associated with the construction of an appropriate measure of discounted cashflows. These include, but are not limited to, the fact that: the appropriate discount rate will vary according to the purpose for which the data will be used; appropriate discount factors will vary over time, across countries and possibly also over contracts; and, the absence of market prices for all but a small subset of sovereign debts. These difficulties are reflected in the fact that most studies of discounted debt service flows use an arbitrary rate that is constant over time and across countries (for example, Easterly 2001 uses the average LIBOR rate while Dikhanov 1986 uses a fixed 10 percent rate).

3 Data Sources

The primary source for statistics on external sovereign debt are derived from the World Bank's *Debtor Reporting System* (DRS) and are compiled in its *Global Development Finance* (GDF) publication.[6] 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 database is to generate projections of future debt service obligations of a country under various assumptions. Towards this end, the DRS

[6]Statistics on external debt are also available from the Joint External Debt Hub (JEDH), which is jointly maintained by the Bank for International Settlements (BIS), the International Monetary Fund (IMF), the Organization for Economic Cooperation and Development (OECD), and the World Bank (WB), and combines data from the DRS with data from creditor and market sources.

records the 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 below correspond to long term debt. Based on these data, and combined with forecasts for the paths of future interest rates (for floating rate debt) and exchange rates, it can be used to generate projections of debt service denominated in US 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 is confidential and direct access to the DRS is restricted. The data reported below is derived from an unpublished dataset 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 horinzon. To preserve comparability with GDF data, we denote the sum of cashflows from year t onwards as the stock of debt as of the *end of year* $t-1$.

4 Results

In this section, we examine the evolution of debt and debt payment terms using our zero coupon equivalent face value measure, and compare it to results using the standard contractual face value measure. We begin by examining the behavior of indebtedness 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 the effect of using the new measure on the relative level of indebtedness across countries and its implications for analyses of debt sustainability, and examine how the new measure changes our understanding of the composition and evolution of international debt flows.

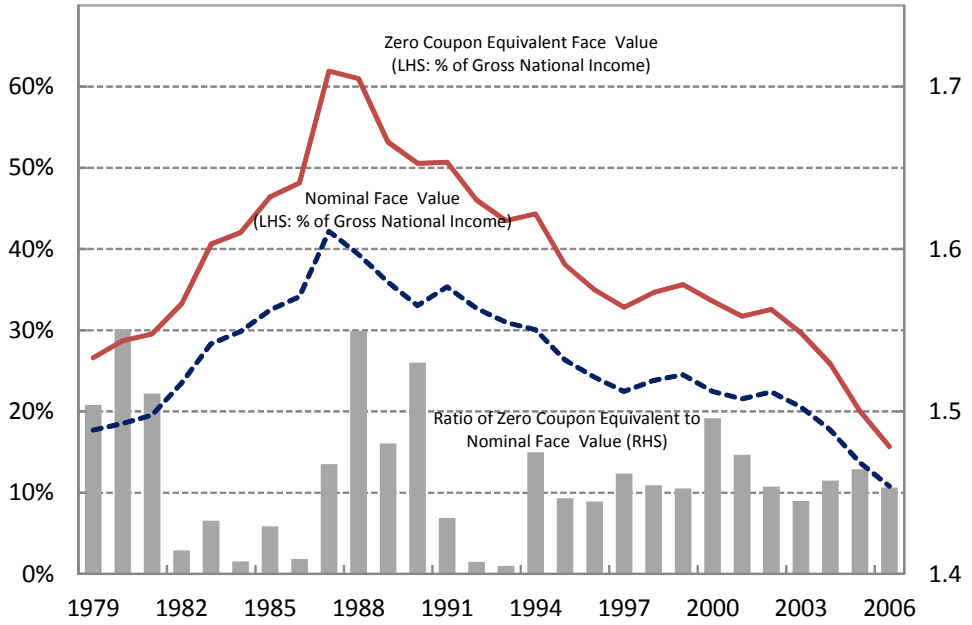

Figure 1: The Face Values of Sovereign Debt

4.A The Level of Indebtedness

Figure 1 plots the ratio of both contractual and ZCE face values of external sovereign debt as a percent of Gross National Income (GNI), along with the ratio of the two series to each other. By construction, contractual face values never exceed ZCE face values. Strikingly, ZCE face values are *much* larger than contractual face values, always exceeding contractual face values by at least 40% and sometimes by more than 50%. Whereas the contractual face value of sovereign debt peaked in 1987 at about 42% of GNI, ZCE face values also peak in 1987 but at 62% of GNI.

Although both series produce a similar picture of the evolution of developing countries indebtedness over the past 25 years, the relative size of contractual and ZCE face values has changed substantially. ZCE face values exceeded contractual face values by more than 50 percent 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 percent in the early 1990s, reflecting the lower interest rates incorporated into Brady bonds, before rising back to 45 percent by the turn of the millennium. Even though overall indebtedness levels declined thereafter, the relative difference between the series did

not change much.

As noted above, the quantitative theoretical literature on sovereign debt has focused almost exclusively on zero-coupon bonds.[7] When assessing the empirical performance of these models, researchers have compared the level of indebtedness measured using the contractual face values implied by the zero-coupon bonds that feature in the model, to 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 between 5 and 10 percentage points of GNI, which are dramatically below the levels of indebtedness observed in the data for emerging market countries (as shown in Figure 2, the ratio of the contractual face value of external sovereign debt to GDP for Latin American countries have, until very recently, varied between 20% and 50%). This finding has motivated a large literature to examine modifications of the benchmark model that deliver larger levels of indebtedness.

The importance of this research agenda is further emphasized once it is understood that theory and data have not been compared in a theoretically consistent way. 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 the same sample of Latin American countries, the ratio of the ZCE face value of debt to GDP has tended to be roughly 50 percent higher than the contractual face value measure, exceeding 80% at the peak at the turn of the 1990s.

Other issues concerning the comparison of theory to data need to be addressed. Of great importance is the fact that the models typically focus on one-period (which, given the common quarterly calibration, amounts to a three-month maturity) debt whereas the average maturity of debts in the data substantially exceed one year. One approach would be to define the period length in the theory to be consistent with the average debt maturity in the data. Another approach would further explore the use of longer maturity debt into these models as initiated by Hatchondo and Martinez (2009), Arellano and Ramanarayanan (2010)

[7] See, for example, Arellano (2007), Aguiar and Gopinath (2005), Yue (2010), Tomz and Wright (2007), and Benjamin and Wright (2009).

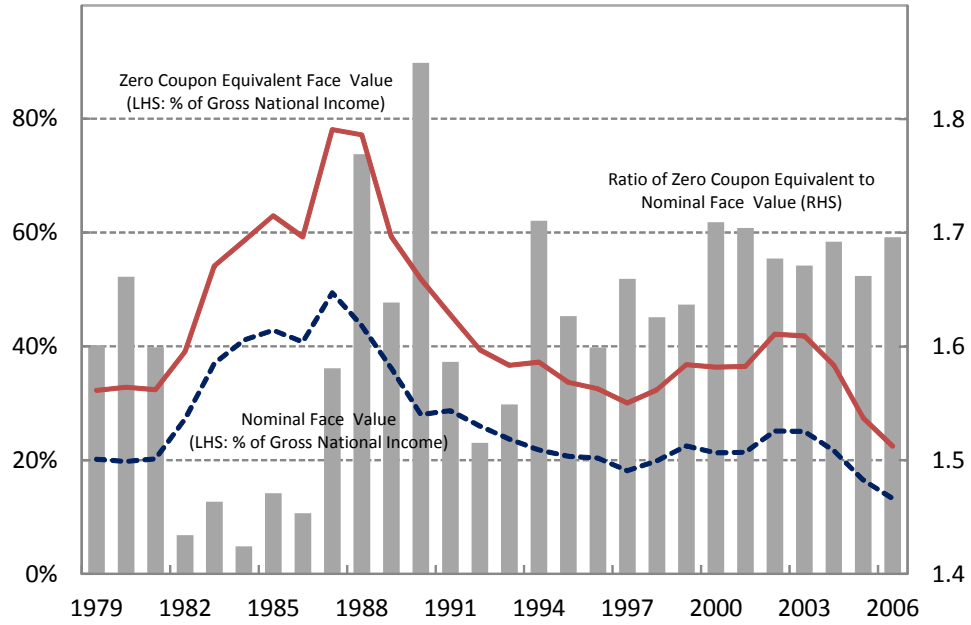

Figure 2: The Face Values of Sovereign Debt in Latin American countries.

and Chatterjee and Eyigungor (2009). As shown in the back-of-the-envelope calculations in the Section 2 examples above, these long maturity debt models produce ZCE face value indebtedness levels that are between 1.5 and 20 times as large as contractual face values, bringing their predicted debt levels much closer to the levels measured in this paper.

4.B Relative Indebtedness and Indicators of Debt Sustainability

Moving from contractual to ZCE face values in the computation of debt stocks also affects the relative ranking of countries by indebtedness. One area in which this is important is in the application of indicators of debt repayment difficulties. For example, until the mid-1990s, the World Bank classified countries as "highly indebted" if, amongst other indicators, the countries external debt (measured at contractual face values) to GDP ratio exceeded 50%. This designation has been used in assessing eligibility for debt relief. When debt stocks are recomputed using ZCE face values, the measured debt stock increases for all countries reducing the usefulness of the 50% threshold *per se*. More importantly, moving to ZCE face values changes the rank ordering of countries.

Table 1 illustrates this issue by tabulating those countries that were in the neighborhood of the 50% threshold in 1990 (when the threshold was used by the World Bank

	1990 Debt Face Value/GNI (%)	
	Contractual	ZCE
Countries Designated "Highly Indebted"		
Comoros	55.3	66.1
Egypt	56.0	74.8
Papua New Guinea	51.2	68.1
Poland	51.4	69.3
Philippines	54.2	81.1
Togo	53.2	68.6
Countries Designated "Moderately Indebted"		
Argentina	37.8	61.0
Cameroon	46.9	62.5
Indonesia	44.0	63.1
Mexico	31.8	67.2

Table 1: Relative Indebtedness Levels in 1990

in awarding the highly indebted designation) and for which the relative ranking is reversed when examined using ZCE face values. The most dramatic change concerns Mexico where the 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 four countries designated as highly indebted.[8] A similarly large adjustment occurs for Argentina which, like Mexico, borrows at high market interest rates.

The World Bank has since moved away from the use of contractual face values towards present discounted values of debt service in designating countries as "highly indebted". This was motivated by the issue, discussed above, that contractual face values are misleading indicators of relative indebtedness when some countries have access to concessional financing (see Claessens et al., 1996 and 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 indebtedness and find that when external debt exceeds 60% of GDP, annual growth rates decline by about 2% per year. This finding has

[8]Besides Comoros, the other three countries that would be considered *highly indebted* based on the contractual value of the debt in percent of GNI and would have a ZCE debt below Mexico's are Ghana, Niger and Uganda.

	2006 Debt Face Value/GNI (%)	
	Contractual	ZCE
Countries Designated Above Threshold		
Dominica	66.9	87.1
Guinea	73.3	85.6
Jamaica	62.2	103.9
Sierra Leone	70.0	79.3
Countries Designated Below Threshold		
Panama	48.5	105.4
Uruguay	44.7	90.7

Table 2: Relative Indebtedness Levels in 2006

since become the starting point for a number of other studies of the relationship between indebtedness and economic growth (see Irons and Bivens, 2010 and Kumar and Woo, 2010).

Table 2 shows how the ordering of countries in the neighborhood of the 60% threshold varies when indebtedness is measured using ZCE face values for the last year of our data. The Table identifies two countries 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 the threshold.

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 ZCE face values depends on the evolving mix of borrowing instruments used in international debt markets debt instrument, as well as changes in world interest rates, and changing circumstances of a country which is reflected in varying country risk. As a consequence, measurements using ZCE 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, different income groups of countries, and the currencies in which countries borrow.

Debt Instruments

Figure 3 plots the ratio of ZCE to contractual face values for aggregates of five borrowing instruments. As shown in Figure 3, the ratio of the two face values has declined steadily

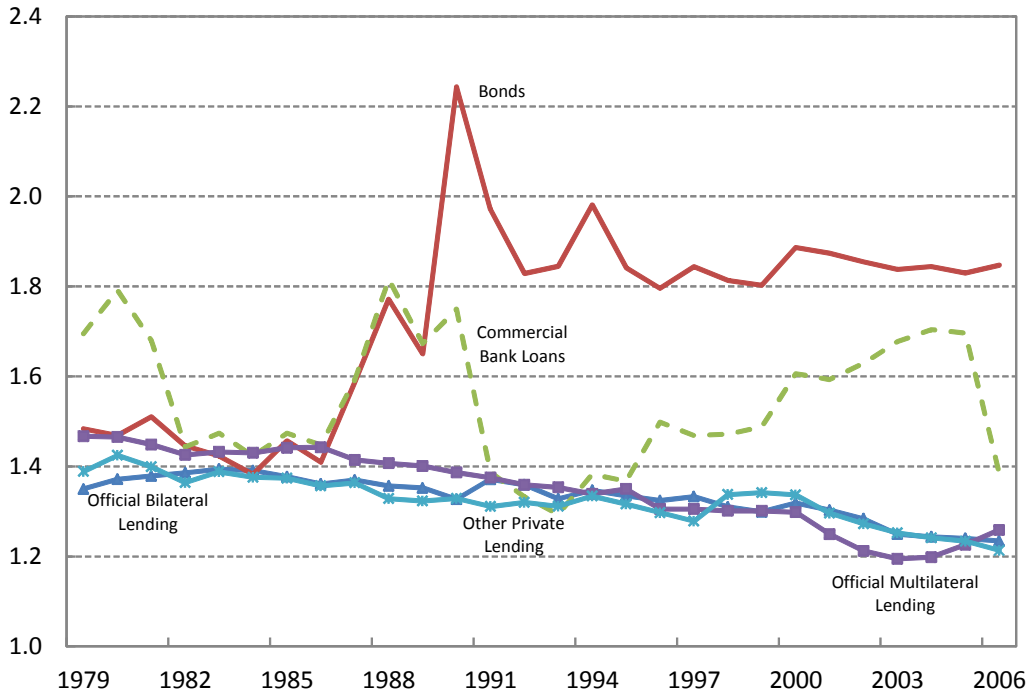

Figure 3: Ratio of ZCE to Nominal Face Values by Instrument

over time for both official lending categories as well as the other private category (which includes, amongst other things, long-term trade credit). Commercial banks loans have also declined over time, although there were large increases in the late 1980s, and also during the late 1990s and early 2000s, reflecting the changes in interest rates on commercial bank loans. The largest changes are due to commercial bond lending, where the ratio jumped from just over 1.4 in 1986 to over 2.2 in 1990, before stabilizing at roughly 1.8 thereafter. Set against the example above, this is initially surprising since bonds issued at a discount should, everything else equal, have higher ZCE to contractual face value ratios than equivalent loan contracts issued at par. However, this effect is dominated by the fact that the increase in bond lending was driven by bonds issued by riskier middle income countries facing market interest rates.

The high average interest rates on private lending to sovereign countries implies that moving from contractual to ZCE face values increases the relative importance of private sector lenders in the outstanding stock of sovereign debt. As show in Table 3, while private sector lending to sovereign countries had fallen to 42.4% by 2000 as measured using contractual

	Contractual			ZCE		
	1980	1990	2000	1980	1990	2000
Official Lending	43.9	57.9	57.6	39.7	51.2	50.4
(i) Bilateral	30.4	33.9	29.6	26.9	29.4	26.1
(ii) Multilateral	13.5	24.0	28.0	12.8	21.7	24.3
Private Lending	56.1	42.1	42.4	60.3	48.8	49.6
(i) Commercial Banks	36.8	20.6	11.8	42.5	23.6	12.7
(ii) Bonds	4.3	11.1	26.1	4.1	16.3	32.9
(iii) Other	15.0	10.4	4.5	13.8	9.0	4.0

Table 3: Instrument Shares of Total Debt

face values, private sector lending still accounted for 49.6% of lending when measured using ZCE face values. This was driven almost entirely by the growth in sovereign bond lending, whose total share of lending increases by 6.8 percentage points in 2000 when moving from contractual to ZCE face values.

Regions

Moving from contractual to ZCE 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 ZCE to contractual face values always above 50% and even reaching 85% 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. The ratio of ZCE to contractual face values is typically low for Sub-Saharan Africa reflecting their tendency to borrow from official creditors, often at concessional rates.

The differences in the instrument structure of sovereign debt across regions results in a misstatement of the relative indebtedness of regions. Table 4 presents the share of total outstanding debt owed by each of the World Bank's six regional groupings of developing countries. Adjusting for these measurement issues, Latin America now accounts for an additional 5.2% of total developing country debt, while all other regions are reduced.

Income Levels

Similar patterns appear when we consider income levels. When ZCE and contractual face values are compared, the difference is smallest for the high and low income countries. This is because both of these groups of countries are able to borrow at the lowest interest rates: the high income countries because they are considered a better credit risk, and the low

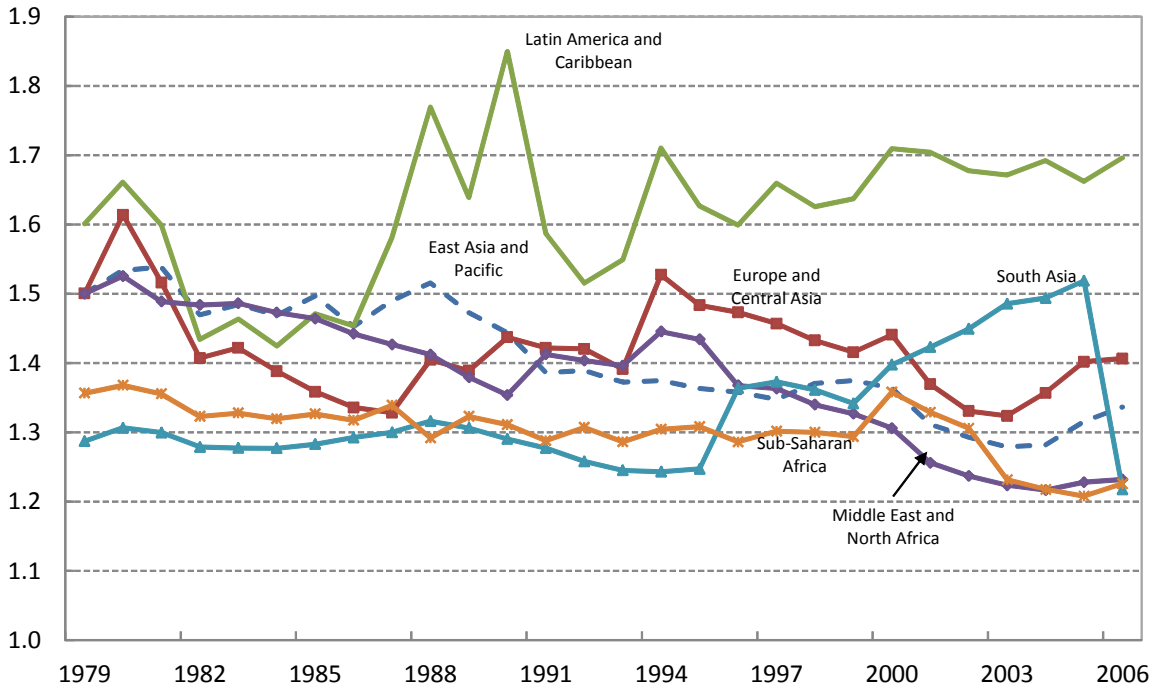

Figure 4: Ratio of ZCE to Nominal Face Values by Region

	Contractual			ZCE		
	1980	1990	2000	1980	1990	2000
Latin America & Caribbean	43.4	33.5	36.7	46.5	40.5	41.9
South Asia	10.6	13.5	11.8	8.9	11.4	11.0
East Asia & Pacific	10.5	17.3	22.3	10.3	16.3	20.4
Europe & Central Asia	8.6	10.7	8.7	9.0	10.1	8.4
Middle East & North Africa	14.9	11.7	7.9	14.6	10.3	6.9
Sub-Saharan Africa	12.1	13.3	12.7	10.7	11.4	11.5

Table 4: Regional Shares of Total Debt

	Contractual			ZCE		
	1980	1990	2000	1980	1990	2000
High Income	2.6	2.6	1.7	2.7	2.3	1.5
Upper Middle Income	53.6	43.5	44.9	56.3	49.9	49.6
Lower Middle Income	36.2	45.4	45.9	34.3	40.8	42.9
Low Income	7.8	8.5	7.4	6.6	7.0	6.0

Table 5: Shares of Total Debt by Income Level

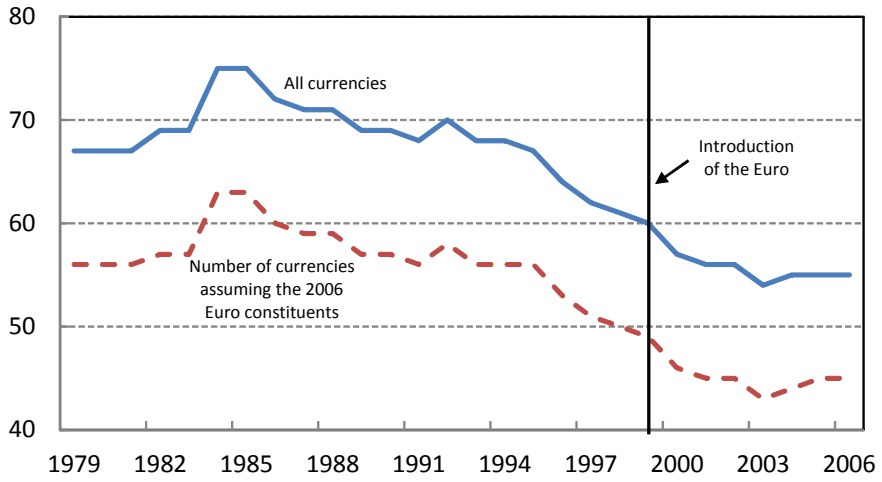

Figure 5: Number of Currencies Over Time

income countries because they are eligible for concessional loans from official lenders. The ratio increased for middle income countries with the largest differences, often in excess of 60%, being recorded for the upper middle income countries. As shown in Table 5, moving from contractual to ZCE face values increases the share of upper middle income countries in total developing country debt by, on average, roughly 5 percentage points.

Currency

Between 1979 and 2006, the total number of currencies in which outstanding external sovereign debt is denominated varied between a maximum of 75 (in 1984) and a minimum of 54 (in 2003), as shown in Figure 5. This variation is in part explained by the large reduction of the number of currencies used in trade credit, and other (non-bank and non-bond) forms of debt owed to private creditors. These types of loans correspond to the type of instrument that we labeled as "Other Private Lending" in Figure 6. In Figure 5 we also plot the number

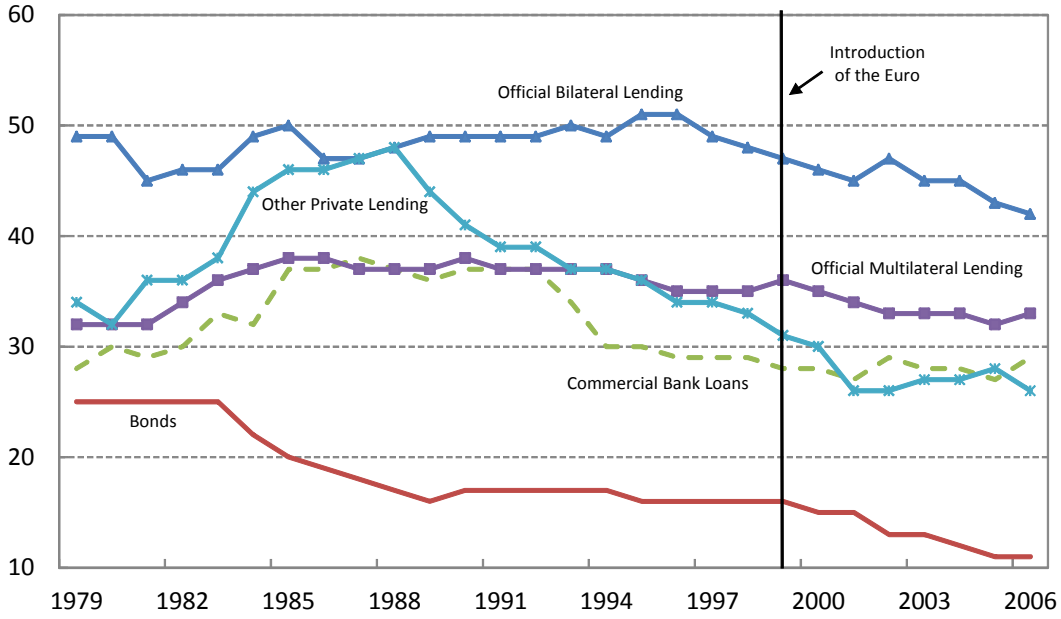

Figure 6: Number of Currencies by Type of Instrument

of currencies assuming the euro had existed throughout the period.[9] The first thing to note from the comparison of the two lines in Figure 5 is that the difference between the two is relatively stable as it varies between 10 and 12 currencies.[10] The second result to note regards the fact that after 1999, which corresponds to the official introduction of the Euro, there is no visible change in the downward trend in the number of currencies used.[11] This reflects the fact that a number of long maturity debt contracts issued originally in the home currency of a Euro-area member remained outstanding.

Even though the total number of currencies used is relatively large, borrowing is highly concentrated in a few currencies. To give a better idea of how concentrated borrowing is, in terms of the currency of choices, in Table 6 we show the 5 most important currencies at different points in time and also the share in total borrowing that these currencies represent.

[9] For this purposed we assumed the constituents of the euro in 2006: Austrian Schilling, Belgian Franc, Netherlands Guilder, Finnish Markkaa, French Francs, German Mark, Irish Pound, Italian Lire, Luxembourg Franc, Portuguese Escudo, Greek Drachma and Spanish Peseta.

[10] The two currencies that are not present the entire period are the Greek Drachma and the Irish Pound.

[11] The Euro was officially introduced in January 1, 1999, but the cash changeover only took place in January 1, 2002.

	Contractual Face Values			ZCE Face Values		
	1980	1990	2000	1980	1990	2000
1	USD - 65.4	USD - 57.2	USD - 62.5	USD - 68.9	USD - 62.4	USD - 68.5
2	DM - 7.9	YEN - 12.4	YEN - 13.4	YEN - 7.2	YEN - 11.0	YEN - 11.0
3	YEN - 7.9	DM - 8.7	SDR - 7.7	DM - 7.2	DM - 8.0	SDR - 5.8
4	FF - 5.4	SDR - 5.3	DM - 4.3	FF - 5.2	FF - 4.9	EURO - 4.0
5	GBP - 2.1	FF - 5.3	EURO - 4.2	CHF - 1.8	SDR - 3.9	DM - 3.8
Sum	88.7	88.9	91.9	90.3	90.3	93.1
$Euro_{2006}$	16.3	17.1	12.3	15.0	15.7	11.2

Table 6: Shares of Total Debt by Currency

In order to see how the importance of the Euro (or its constituents) evolves over time we also show the relative importance of the debt denominated in the home currencies of Euro-area members. Table 6 presents various results with respect to the most relevant currencies in external sovereign debt stocks. First, the U.S. Dollar is the most important currency in terms of external sovereign debt. Because bonds and commercial banks loans are normally denominated in U.S. Dollars, and we already know that these instruments tend to have higher interest rates, it is not surprising that the importance of the US Dollar increases when debt stocks are measured at ZCE face values. Second, the Japanese Yen and the IMF Special Drawing Rights (SDR) were the two currencies that gained the most importance during this period. In particular, in 1980 the SDR did not even make the list of the 5 most important currencies, but in years 1990 and 2000 it became the fifth and the third most important currency, respectively, when calculated based on ZCE face values. Similarly, the Yen in 1980 was slightly less important than the Deutsche Mark, but in 1990 and 2000 the share of the Yen in comparison to the Deutsche Mark was 3 and 4.7 percentage points higher, respectively. Third, throughout the sample period, and despite some changes in the relative importance of each currency, 90% of total debt stocks are concentrated in five currencies. Finally, for both contractual and ZCE face values, the importance of the Euro equivalent declined substantially between 1990 and 2000, however, from our data it is not possible to tell why the introduction of the Euro reduced the importance of the currencies that it replaces.

To conclude this part of the paper we show how currency composition varies across regions and income levels. Table 7 shows the share of debt for different currencies measured in ZCE face values by region and by income level in the year 2000. In this Table it is shown

	Euro_{2006}	Yen	Pound	SDR	USD	Other
Region						
East Asia & Pacific	4.9	25.0	0.6	4.2	64.5	0.7
Europe & Central Asia	22.1	10.3	0.5	4.3	61.3	1.6
Latin America & Caribbean	9.2	5.0	0.5	0.7	83.6	0.9
Middle East & North Africa	24.9	13.0	0.1	1.3	46.4	14.3
South Asia	5.1	12.9	0.4	18.2	62.2	1.1
Sub-Saharan Africa	19.3	5.7	0.7	18.9	45.2	10.2
Income Level						
Low	7.1	9.4	1.3	41.8	27.4	12.9
Lower-Middle	10.5	16.4	0.4	6.6	62.8	3.2
Upper-Middle	11.7	6.3	0.5	0.9	79.2	1.4
High	30.6	20.3	1.4	0.2	43.6	3.9
Overall	11.2	11.0	0.5	5.8	68.5	2.9

Table 7: Currency Composition by Region and Income Level

that currency concentration varies both with the region and with the level of income. First, even though the US Dollar is the most important currency, the level of importance can vary significantly. For example, in the year 2000, 83.6% of the external debt stock in Latin America and the Caribbean is denominated in US Dollars, while, for the same year, in Sub-Saharan Africa only 45.2% of external debt is denominated in US Dollars. Second, there appears to be some evidence that the external debt stock currency also depends on proximity. In East Asia and Pacific, the share of debt denominated in Euro and Yen is, respectively, 4.9% and 25.0%, while in Europe and Central Asia these figures are 22.1% and 10.3%. A similar explanation may apply to the share of US Dollars in the total debt stock of Latin America and the Caribbean. In terms of the currency denomination by income level, there are also some interesting patterns. First, the importance of the US Dollar is only verified for the lower- and upper-middle income countries. In the case of low income countries the most important currency is Special Drawing Rights (41.8%) and in the case of high income countries the difference between the first and the second most important currencies (US Dollar and Euro, respectively) is much smaller than in the cases of lower- and upper-middle income countries.

5 The Policy Implications of Measuring Indebtedness at Contractual Face Value

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 and how this may interact with 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 debtors 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

Another issue for which the distinction between principal and interest can be important relates to the process by which sovereign debts are restructured. Since 2003, 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[12] 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], amongst 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 divide repayments into principal and interest in the same way, then voting in proportion to principal holdings will produce the same outcomes as voting in proportion to a creditors overall exposure. When debt contracts divide future cash-flows in different ways either explicitly, or implicitly due to non-stationary repayment terms and different maturities, this will not be the case. In particular, the holders

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

of debts issued with higher coupons will have less voting rights than holders of equivalent debts with lower coupons.

This issue is of practical importance today, and is likely to increase in importance over time as *aggregation clauses* – clauses that group together different debt securities in the even of a renegotiation of sovereign debt – become more widespread. Uruguay has already issued bonds containing aggregation clauses[13] while other countries plan to do so in the future. 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" [emphasis added]. Proposals to introduce similar aggregation clauses in non-Euro-area sovereign bonds have also been discussed in policy circles (IMF, 2002). Interpreting this policy broadly, future debt restructuring negotiations would then involve negotiations across a very diverse set of debt instruments including potentially debts issued by both official and private sector creditors, banks and bondholders, issued at different maturities and in different currencies under different governing laws. As a result of this diversity, shares of outstanding principal are unlikely to be representative of the relative financial exposure of different creditors. Moreover, it is conceivable that a desire to maximize voting power in the event of a restructuring might influence the form of debt instrument desired by 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 form of a country's debts remains the same as their level in 2006. If we restrict attention to sovereign debt owed to private creditors, one potential source of conflict lies in the competing interests of banks and bondholders. Table 8 collects the countries for which, in 2006, voting in proportion to contractual face value would have yielded different results than in a restructuring where voting was in proportion to zero-coupon equivalent face value. With a simple majority voting threshold, the bondholders of Mexico would hold a minority share calculated in terms

[13] Uruguay's May 2003 issue of 10.50% Bonds due 2006 contained a clause allowing it to modify the reserved matters 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	
	contractual	ZCE
	75% Threshold	
Barbados	77.3	73.6
Chile	73.5	78.3
Seychelles	71.8	76.7
	50% Threshold	
Mexico	45.2	51.9

Table 8: Bonds vs Other Private Creditors in 2006

of contractual face value despite being more exposed in the sense of holding a majority of the ZCE face value stock of debt. With a 75% threshold, bondholders would possess the relevant super-majority by moving to ZCE face value voting in the cases of Chile and Seychelles. Somewhat surprisingly, a move to ZCE face value voting would lead bondholders to lose their majority in the case of Barbados.

In theory the *de jure* seniority of multilateral loans limits the potential for conflict between private sector creditors and multilateral official creditors in debt restructuring negotiations. In practice, the renegotiation of bilateral official creditor loans is typically predicated on private sector creditors receiving equal treatment. 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. We next examine the 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).

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. Table 9 collects those cases in which a move from contractual to ZCE face value voting would affect the ability of the official sector to obtain a super-majority, or alternatively prevent the private sector from obtaining a super-majority. In all eleven cases in the Table, a move to ZCE face value voting would lead to the official sector either losing its super-majority, or losing its ability to prevent private sector creditors from reaching a super-majority.

Taken together, these results suggest that more widespread adoption of broad ag-

	Official/Total	
	contractual	ZCE
75% Threshold		
Brazil	30.3	21.0
Dominica	76.3	71.3
Malta	31.3	19.2
Turkey	30.7	24.4
Uruguay	31.3	21.2
66% Threshold		
Grenada	46.3	27.1
St. Lucia	68.0	65.5
50% Threshold		
Ecuador	57.8	43.6
El Salvador	58.3	41.1
Philippines	50.7	40.6
St. Vincent & Gr.	50.8	49.9

Table 9: Official vs Private Creditors in 2006

gregation clauses with voting 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 their favor with policy makers. 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 claim and so maximize their voting power in the event of a restructuring. And in at least eleven cases, this would result in the effective subordination of official sector claims.

5.B Manipulation of Fiscal Statistics

There is often an incentive for the government of a country to present data on debt stocks, and fiscal deficits, in a favorable light. Sometimes this incentive is the result of specific accounting rules, such as the debt stock limits of the USA and Denmark, the budget deficit and debt stock restrictions imposed by the Maastricht Treaty on EU countries, or fiscal targets imposed by IMF lending arrangements. In other cases, the incentive arises implicitly from the desire to improve domestic political performance or the terms on which external debts

can be issued. The most common form of manipulation involves using proceeds from the sale of assets, ranging from privatization to the development of currency swaps, as used by Greece, to substitute for debt issuance. In addition, when the relevant statistics that are being targeted treat principal and interest asymmetrically, governments have also manipulated the contractual forms 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 US debt ceiling, which has been the subject of much recent debate, applies to the contractual face value of US sovereign debt, with the relevant law stating that "The face amount of obligations issued under this chapter [31 USCS §§ 3101 et seq.] 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 $ 14,294,000,000,000 outstanding at one time" (31 U.S.C. 3101(b)). Likewise, 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 p.305).

In the early years of the Maastricht Treaty, changes in the relative issuance of low-face-value-high-coupon and high-face-value-low-coupon debt by EU governments to understate either debt stocks or fiscal deficits appears to have been 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. Perhaps the best known example of these comes from Italy, which reduced the contractual face value of the stock of government debt by 1.9 percentage points of GDP in 2002 when Italy was close to the Maastricht debt threshold. In this example, the Italian Treasury with the Banca d'Italia bought back long-term bonds with a low coupon in exchange for a smaller amount of bonds with a much higher coupon. The use of ZCE face values would eliminate this incentive and, indeed, in response to these 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 issues at par (Eurostat 1997a, b).

Another example of the asymmetric treatment of interest and principal in fiscal targets comes from IMF Stand-By Arrangements with Argentina throughout the 1990s.[14] In the 1991 Stand-By Arrangement, the performance criteria targeted the overall cash balance of the government (which included interest payments) as well as the stock of outstanding disbursed external debt (IMF, 2001). By contrast, in the 1996 Stand-By Arrangement, the performance criteria targeted fiscal expenditures excluding interest payments on debt (IMF, 1996; see also IMF IEO, 2004). As a consequence, starting in 1996 Argentina had an incentive to switch to issuing low-face-value high-coupon debt in order to meet the IMF targets for non-interest expenditures.

Our database shows that Argentina responded to this incentive. Figures 7 and 8 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. Dollars denominated Argentine external sovereign debt. Both Figures show that, starting in 1996, the ratio of future interest payments to contractual face values for sovereign bonds jumps dramatically. Moreover, this pattern is not repeated for any other class of debt instrument, suggesting that it does not reflect some other change in the environment affecting Argentine borrowing.

6 Conclusion

Data on the stock of sovereign debt is typically presented at contractual face value. Defined as the 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 divide these cashflows into principal and interest in different ways). In this paper, we introduced a measure of the stock of sovereign debt that is invariant to contractual form – the zero coupon equivalent face value –

[14] 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.

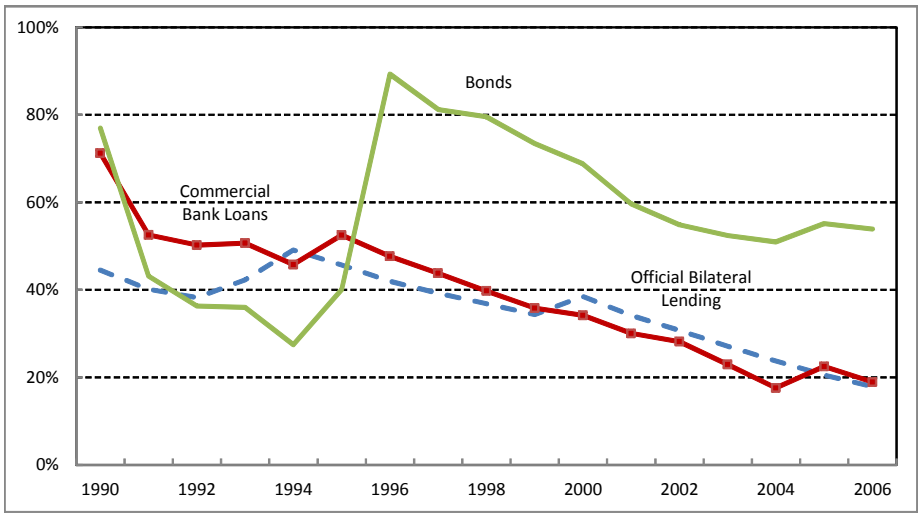

Figure 7: Ratio of the sum of interest to the sum of principal payments by instrument in Deutsche Marks for Argentina.

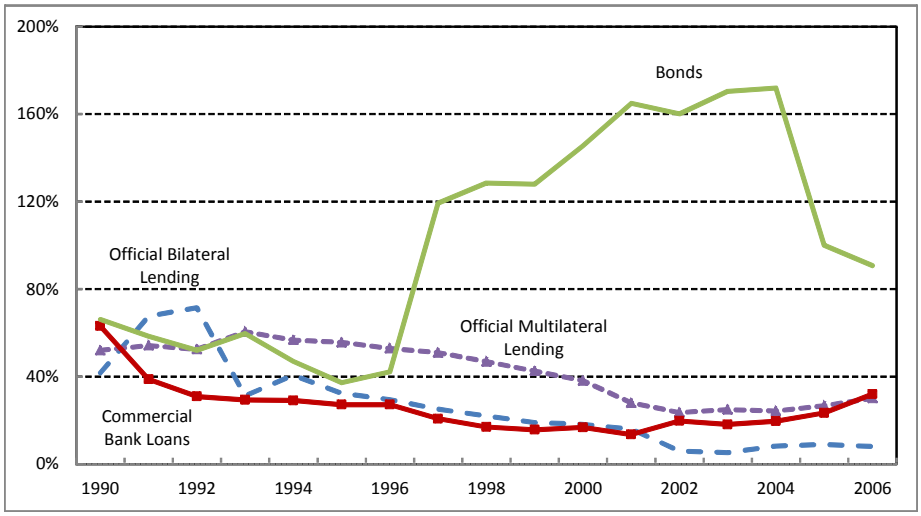

Figure 8: Ratio of the sum of interest to the sum of principal payments by instrument in U.S. Dollars for Argentina.

and applied it to data on the external sovereign debt of 100 developing countries from 1979 to 2006.

We found that using a measure that is invariant to contractual form paints a very different quantitative picture, and in some cases also a different qualitative picture, of the stock of developing country external sovereign debt. For example, according to our measure, 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. 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. 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, once indebtedness is measured in a way that is invariant to contractual form.

Our zero-coupon equivalent face value measure is particularly useful for comparing the data with 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 debt levels that are almost an order of magnitude smaller that 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 is found to be on average between an additional 40 and 80 percent worse than previously thought.

Finally, we pointed to the incentives for both creditors and debtors to manipulate the contractual structure of debts in light of the emphasis on contractual face values. For creditors, voting power during debt restructuring negotiations is in proportion to contractual face value. As aggregation clauses – which combine different debt instruments for the purpose of one restructuring – in debt instruments become more widespread, creditors holding high contractual face value debt 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 repayment (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 dataset.

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 a similar contract invariant measure of domestic sovereign debt. Second, as emphasized above, our paper has nothing to say about the desirability or appropriateness of different methods for discounting cash flows to arrive at an appropriate valuation for the stock of external sovereign debt. In a companion paper (Dias, Richmond and Wright 2011) we present a theoretical framework that suggests that the appropriate discount rate will vary according to the purpose for which the values will be used, as well as across countries and over time. We also present several methods for implementing the implications of that theory. Third, and relatedly, our paper also has little to say about 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 sub-set of the total number of countries that are available in the dataset. The reason was that we wanted to use a balanced panel in order to avoid potential attrition problems. In the original dataset there are 138 countries, while in our

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

work sample we use 100 countries. Table 10 contains this list of countries. In Appendix C we show that our results are qualitatively identical when we use the full set of 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.

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. Vicent 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 10: List of countries used in the calculations

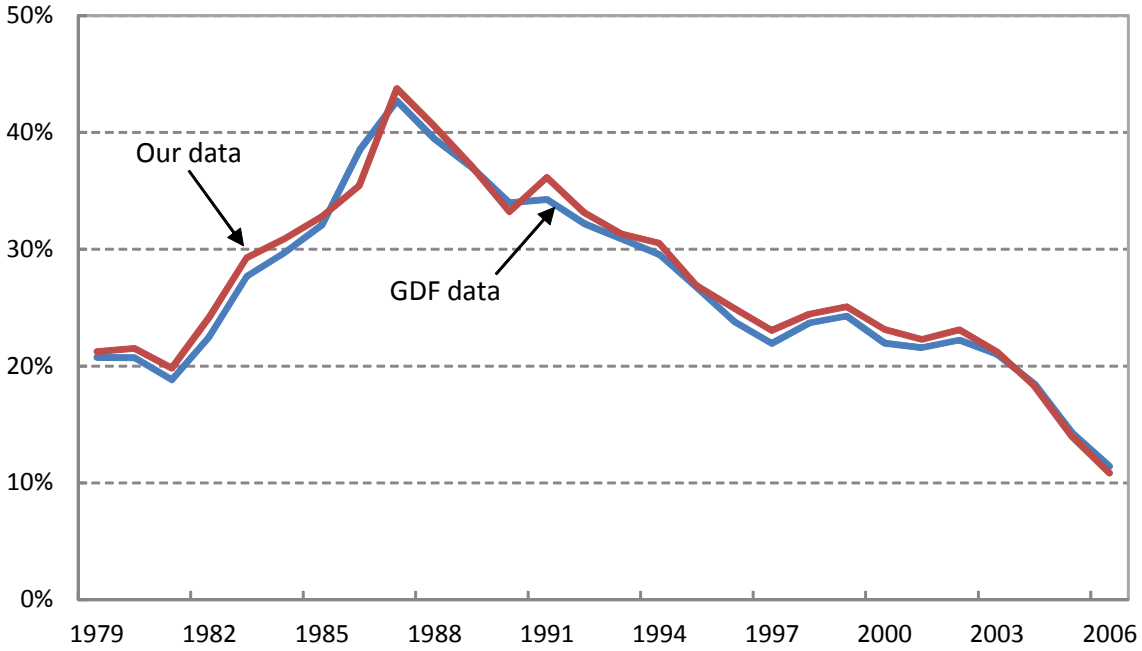

Figure 9: Comparing publicly available data with our data - aggregate values. Units: % GNI.

8 Appendix B: Comparison To World Bank Published Data

As argued above, our data when aggregated, almost replicates the publicly available data that is published by the World Bank. In this appendix our goal is to provide evidence supporting this claim.

In Figure 9 we compare some of our data with the data that is publicly available in the World Bank Global Development Financial indicators dataset. As it is visible in Figure 9 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 tends 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 is publicly available data.

Because in the paper we focus many of our analyses 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 11 and 12

	Publicly available data			Sum of Principal		
	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 11: Comparison Between Reported and Constructed Contractual Face Values by Debt Instrument (as % GNI)

	Publicly available data			Sum of Principal		
	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 12: Comparison Between Reported and Constructed Contractual Face Values by Region (as % GNI)

show that there are some differences between our data and the data that is publicly available, but, these differences do not compromise our main results.

There are a number of reasons why the published data on contractual face values, which are based on direct reports of contractual face values by the country, might differ from our construction of face values by summing principal flows. The first is that the country itself may have inadvertently reported contractual face values that differ form the sum of future principal specified in their loan agreements. The second concerns the way debt with tranches issued in different currencies are reported. In such cases, the 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, p. 12). As future principal repayments are specified using current and forecast future exchange rates, they can be expected to differ from amounts calculated using exchange rates at time of issue.

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 13: List of countries in our dataset that were excluded from the analysis.

9 Appendix C: Results From Unbalanced Sample

In the data we obtained from the World Bank there were a total of 138 countries but we only used a subset of 100 countries in our calculations. The main reason for this difference is the fact that we wanted 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 that motivated the exclusion of 38 countries: 1) for 17 countries, the data we obtained from the World Bank contains information for the entire sample period (1979-2006), but, we were not able to find reliable estimates of Gross National Income (GNI) for these countries over the whole sample period; 2) for the remaining 21 countries, the data on debt did not cover the entire sample period and for the reasons discussed above we decided to exclude them from the analysis. This last group of countries is mostly composed of former Soviet Union countries and other Eastern European countries - there are some exceptions. Below, we list the countries for which we have data but did not use in our analysis.

The set of countries that were excluded is not random and therefore it is expected

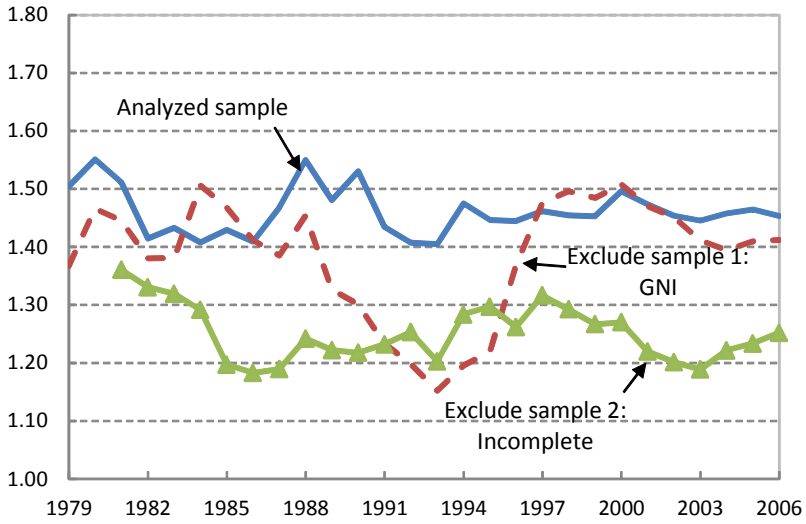

Figure 10: Comparison between samples: included vs. excluded countries

that certain results can be different for the set of excluded countries in comparison to the set of countries included in the analysis. To give an idea of how different these two sets of countries are we compare our proposed measure of debt stocks, zero coupon equivalent, with the commonly used sum of principal. We choose this statistic for two reasons: first for some countries we do not have GNI data for the entire sample period and therefore cannot compare the entire set of countries for the entire sample period; and second, the difference between ZCE and sum of principal is one the main points we make in the paper.

From Figure 10 it is visible that there are some differences between the three sets of countries. In particular, countries that were excluded due to missing data tend to have a substantially smaller difference between debt stocks based on ZCE and those based on the sum of principal. 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 countries that were excluded due to missing data never account for more than 4% of the entire debt stock. Regarding the set countries that were excluded due to 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 a period, between 1989 and 1996 where the differences 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.