# Sovereign Bonds since Waterloo


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## Abstract

How risky is sovereign debt and why are investors willing to hold it? This paper studies sovereign bonds as an asset class, based on a comprehensive new database of 200,000 monthly prices of foreign-currency government bonds traded in London and New York between 1815 (battle of Waterloo) and 2017, covering 88 countries. Our main insight is that the returns on external sovereign bonds have been surprisingly high, as investors are over-compensated for the risk and volatility they face. We term this phenomenon the "sovereign risk premium puzzle". Real ex-post returns averaged 7% annually across two centuries, including all years of default, major wars, and global crises. This corresponds to an average excess return of 4% above US or UK government bonds. The observed returns are hard to reconcile with conventional theoretical models and with the degree of credit risk in this market, as measured by historical default and recovery rates. Using a newly compiled archive of more than 300 sovereign debt restructurings since 1815, we show that investor losses on external sovereign debt were rarely complete. Events of full debt repudiation are rare and the median haircut is below 50%, both in history and today. Moreover, creditor losses in distress are typically recovered quickly. On average, investors that bought bonds one year before a default, recoup their initial investment three years afterwards. Regarding the risk-return profile (Sharpe ratios), external sovereign bonds outperform "risk-free" government bonds, as well as corporate bonds and stocks. In the past decades, US equities had lower returns and a higher volatility than external sovereign bonds. While this paper takes a creditor perspective, future work will have to reexamine our results from the vantage point of debtor countries. Why do countries pay the high observed premia?



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## 1. Introduction

The battle of Waterloo in 1815 can be seen as the birthday of modern sovereign debt markets - and of its recurring boom-bust cycles. Napoleon's defeat and the end of French rule over Spain accelerated the independence of a dozen new republics in Latin America, which quickly started to issue sovereign bonds in London. The first Latin American debt boom ended abruptly in the financial panic of 1825, when most of the newly founded states went into default. Since then, many similar cycles of lending and default have followed, often involving the same defaulting countries, again and again.

Why are investors willing to hold external sovereign debt, despite the frequent defaults and the limited options to enforce repayment? To answer this question, the literature has mostly focused on the borrower's perspective, in particular on the debtor's cost of default.[2] This paper takes a different view – that of an investor. We study how creditors fared in sovereign debt markets over the short and long run. We collect monthly prices of more than 1,500 foreign-currency bonds issued and traded in London and New York over the past 200 years, with a total of 200,616 pricing observations and covering 88 countries.[3] External debt is defined by currency and place of issue and not by legal jurisdiction. Hence, sample selection is not dictated by any priors other than issuance practice.[4]

Our main result is that the returns on foreign-currency sovereign bonds have been surprisingly high over the past two centuries, as investors are over-compensated for the risks and volatility they face in this market. Despite frequent defaults, wars and global crises, the average real yearly ex-post returns on external sovereign bonds were 7% across countries and two centuries, about 4% higher than that of "risk-free" benchmark government bonds of the UK or the US. The risk-return properties outperform those of other tradable assets, in particular US and UK equities for which we also gather 200-year return series. The Sharpe ratio of a global portfolio of external sovereign bonds is most comparable to a broad portfolio of US stocks, which has a similar mean return, but also a higher standard deviation.

The findings go a long way in solving an old puzzle, namely why sovereign debtors undergo repeated cycles of over-borrowing and default, followed by subsequent market re-entry. The fact that sovereigns can return to markets so quickly after default has preoccupied the literature for decades.[5] In particular, it appeared puzzling that foreign investors have willingly returned to high-risk sovereigns that have defaulted with deep haircuts again and again, e.g. Ecuador, Greece or Russia (Reinhart et al. 2003 call these "serial defaulters"). Most recently, Argentina re-accessed international markets only months after

[2] Creditors know that defaulting is costly, due to reputation effects, market exclusion, output and trade losses, or legal risks (see Panizza et al. 2009, Aguiar and Amador 2014). These default costs make repayment credible and explain why investors are willing to lend to sovereigns, even if enforcement powers are limited.

[3] London and New York were the two dominant and most liquid trading locations in history (Michie 1987).

[4] We start with emerging markets today and then move backwards, adding sovereigns that have tapped London and New York markets in the past, including many of today's advanced countries such as Australia, Canada, Germany, Greece, Italy, Japan, Portugal or Spain.

[5] Eaton and Gersovitz (1981) assume permanent exclusion after a default, which is at odds with the data.

exiting its seventh default, including with a 100-year bond, which led market observers to conclude that credit markets were overheating.[6] There is also an ongoing sovereign debt boom in Africa, where highly indebted poor countries (HIPCs) such as Chad or Zambia have easily placed bonds abroad. Our results help to make sense of these market outcomes. Indeed, over the past 200 years, bonds of serial defaulters have been an attractive investment, as measured by a high return to risk ratio. This may explain why the phenomenon of serial default can exist in the first place.

The findings also overturn received wisdom in the empirical literature on sovereign debt. Previous studies concluded that external sovereign bonds are characterized by low returns at high levels of risk. This made it all the more puzzling why investors would be willing to buy this asset. Feis (1930), for example, famously concluded that lending to a foreign government is "an act of faith", as creditors have limited options to enforce repayment and often face catastrophic losses. The seminal work by Lindert and Morton (1989) seems to confirm this view. They compute internal rates of returns (IRRs) of sovereign bonds for 10 countries between 1850 and 1983 and finds average returns of just 0.4% above center country bonds. Eichengreen and Portes (1989, 1991) find nominal IRRs of 4-5% in the interwar years, only slightly above the returns on UK or US government bonds. For the more recent period, Klingen et al. (2004) use aggregate debt flows and find a 9% nominal return on sovereign debt for a large sample of developing countries between 1970-2000, about the same nominal return as Treasury bonds (zero premia). These and related papers, however, use limited sub-samples of countries and time (often periods/countries characterized by low returns, resulting in a downward bias)[7] and they include non-sovereign bonds, which tend to have lower returns.[8] Here, we provide the first long-run study on the risk-return properties of foreign-currency sovereign bonds using market prices and spanning all eras and regions. [9]

It may seem surprising that we are the first to quantify the returns on external sovereign bonds with long-run pricing data, despite the fact that this is one of the largest and oldest asset classes worldwide.[10] The likely explanation is data limitations. Studies on long-run asset returns typically use aggregate indices or data of representative benchmark bonds (e.g. Dimson et al. 2001, Homer and Sylla 2005, or Jorda et al.

[6] See Financial Times, June 22, 2017 "The rush for Argentina's 100-year bond points to an investment bubble".

[7] Eichengreen and Portes focus on the interwar years, an era of particularly low returns (see Table 4). Similarly, the sample of Klingen et al. (2004) is dominated by the 1980s and 1990s, a period of major turmoil in emerging markets, while they miss the good years after 2000.

[8] Less than 20% of bonds in Eichengreen and Portes (1989, 1991) were issued by a central government. If we drop non-sovereign issues from their sample we find higher average returns, which are comparable to our own average of 5.5% for the interwar years. Similarly, we find that the majority of bonds in Lindert and Morton (1989) are municipal, regional or corporate, but not sovereign. As a benchmarking exercise, we randomly picked 10 foreign-currency sovereign bonds from their sample and computed IRRs. For these bonds we find results similar to ours.

[9] Our results are more in line with two recent papers by Chabot and Kurz (2010), who find that returns on foreign government bonds in the period 1866-1907 outperform UK bonds by a factor of two and Borri and Verdelhan (2011), who use country level EMBI data between 1995 and 2011 and find yearly excess returns of 5%.

[10] Historically, bonds issued by foreign governments accounted for about 10% of all financial assets trading in London (Michie 2001). Today, foreign-currency sovereign bonds continue to be a dominant asset class, especially for emerging markets. In 2017, the BIS estimates US$1.9 trillion of outstanding ext. sovereign bonds (BIS 2018).

2017).[11] This standard approach, however, is not viable for external sovereign debt, due to the many defaults in this market and due to the heterogeneous treatment of bonds in default. A rigorous calculation of total returns on external sovereign bonds requires both pricing data, which is relatively easy to collect, as well as details on the fate of each bond in default, in particular on the timing and scope of missed or partial coupon payments and on detailed restructuring terms. This type of bond-level default data is much harder to collect and was not readily available prior to this project, making return calculations difficult.

Our second main building block is therefore an archive of external default and restructurings compiled by our team. We gathered data on more than 300 sovereign debt restructuring events with foreign private creditors and compute the resulting creditor losses (haircuts) bond-by-bond and deal-by-deal. By combining our granular bond price data with this new archive of defaults, we can build monthly return series on a bond level in a consistent manner, as well as representative country and global portfolios over long time spans. The result is the most ambitious dataset of sovereign debt to date.

While the findings help to demystify the puzzle of serial over-borrowing and default, they also raise new questions and are hard to reconcile with much of the macro-finance and sovereign debt literature. Quantitative models with sovereign default typically assume risk-neutral investors and sovereign risk premia that solely reflect the expected losses from default (e.g. Arellano 2008, Mendoza and Yue 2012, Aguiar and Amador 2014). When investors are risk-neutral, excess return above "risk-free" government bonds should be zero in expectation. Yet, we find excess returns that are in the range of 2-4% ex-post, not just in individual periods or sub-samples, but across 200 years and globally. Investors thus receive a compensatory premium for holding sovereign risk which significantly exceeds historical credit losses. This result is consistent with a small but growing theoretical literature that assumes risk-averse (or uncertainty averse) investors in this market (e.g. Borri and Verdelhan 2011, Lizarazo 2013, Grosse Steffen and Podstawski 2016, Pouzo and Presno 2016, Aguiar et al. 2017, Tourre 2017, Asonuma and Joo 2017).

The high returns we observe cannot be easily explained by historical default and recovery rates. Using our new restructuring database, we show that defaults do not usually wipe out sovereign creditors. Almost all defaults of the past 200 years have been solved by a debt exchange of old debt into new debt at a discount - with an average haircut below 50%. Moreover, we can show that bond prices typically recover quickly during and after default spells. On average, creditors recoup their pre-crisis investment (one year before) within three years after the default. Thus, investor losses in this market have mostly been partial and quickly recovered, except for a few outlier defaults involving major upheavals such as wars, revolutions, or the break-up of empires.

[11] Dimson et al. (2001) gather annual data on equities, bonds, and bills for 16 countries back to 1900. Their data on government bonds mostly builds on representative domestic-currency instruments. Jordá et al. (2017) provide yearly country-level indices of asset returns from 1870-2015 for 16 countries, including on housing. Compared to these studies, we zoom into one asset class and include 88 countries, 200 years, and monthly bond-level data.

On a more general level, our results show many parallels to the case of equity. Just like for stocks, sovereign external bonds show high excess returns coupled with a relatively low return volatility. The seminal work by Mehra and Prescott (1985) showed that standard asset pricing models are not able to reproduce the large empirically observed wedge between risky and riskless assets. Their contribution was followed by hundreds of studies on the equity premium puzzle, mostly using US data after WW2 (see Kocherlakota 1996, Campbell 2003), as well as a literature on similar asset pricing puzzles for corporate bonds in the US.[12] The findings in this paper point to a "sovereign risk premium puzzle", which is observable in many countries worldwide and both in history and today. This puzzle has remained underappreciated in the literature.[13]

Another contribution of our paper is that we move away from classifying sovereign default as zero-one events. The typical approach in the literature is binary: either a country is in a default or it is not. Here, we present the most comprehensive dataset to measure the magnitude of defaults, both in terms of haircuts and in terms of amounts in default.[14] By computing sovereign haircuts back to 1815 we add 160 years of data to our own previous work (Cruces and Trebesch 2013, Reinhart and Trebesch 2016, Fang et al. 2018), as well as to the datasets by Sturzenegger and Zettelmeyer (2006, 2008), Benjamin and Wright (2009) and Asonuma et al. (2017).[15] The long-run data show that credit events in this market are best described as partial default with recontracting, in the spirit of Bulow and Rogoff (1989), rather than as full defaults, as is typically assumed (e.g. Eaton and Gersovitz 1981, Arellano 2008, Mendoza and Yue 2012).

Regarding the sovereign bond price data, we greatly benefitted from the work by William Goetzmann and Geert Rouwenhoorst, especially for the period 1871 to 1930, by using their bond-level pricing data from the London Stock Exchange (available on the Yale website).[16] We contribute to this collection by adding information on (missed) bond payments and haircuts for each available bond. Moreover, we are the first to code a large dataset of prices and returns for external sovereign bonds on the New York Stock Exchange (NYSE), the main trading platform for foreign sovereigns after 1914. We also extend the data backwards, adding 50 years pre-1870. As a result, we expand existing datasets on sovereign bond yields and returns in history by a multiple (e.g. compared to Obstfeld and Taylor 2005). The coverage and granularity of our dataset on foreign-currency bonds comes close to that compiled on sovereign bonds of individual advanced countries, in particular on the United States, for which the CRSP Database provides monthly

[12] Chen et al. (2009) and Chen (2010) study the credit spread puzzle for corporate debt and summarize the literature on this issue. Asquith et al (1989) is an early study on the high excess returns on US junk bonds.

[13] Borri and Verdelhan (2011), Broner et al. (2013) and Tourre (2017) also find significant excess returns on foreign-currency sovereign bonds or CDSs, using more recent data and a sample that covers less than 15 defaults.

[14] There is already ample historical data on the occurrence and duration of sovereign defaults (e.g. Standard and Poor's 2006, Reinhart and Rogoff 2009 or Asonuma and Trebesch 2016), but no long-run dataset on sovereign recovery rates existed thus far.

[15] The new series for sovereigns complement the literature on corporate finance for which long-run data on corporate default and recovery rates existed already (Giesecke et al. 2011, Moody's 2017).

[16] A large literature has used data from the Investor' Monthly Manual, e.g. Ferguson and Schularick (2006), Krishnamurthy and Muir (2017), Mauro et al. (2002) or Mitchener and Weidenmier (2010).

instrument level data on US Treasuries back to 1925, or England, where Ellison and Scott (2017) collect monthly data on UK government debt instruments between 1694 and 2017.

For the modern (post-1994) period, we build on the extensive bond price collection by JP Morgan as part of their EMBI+ and EMBI Global indices (EMBI stands for Emerging Market Bond Index). To make the series consistent with our historical data, we construct global and country portfolios from granular data using monthly prices of more than 800 US dollars sovereign bonds, rather than the aggregate indices typically used in the literature.[17] In a final step, we combine the modern and historical data, thus providing a 200-year EMBI on a bond-, country-, and global level.

The paper proceeds as follows. In Section 2, we start by focusing on crisis spells, summarizing credit events and investor losses (haircuts) on external sovereign debt across two centuries. Section 3 moves beyond default events and shows sovereign bond prices and returns over the very long run. Section 4 explores the behavior of investor returns during sovereign default events to understand investor recoveries in this market. Section 5 then compares the risk-return characteristics of sovereign bonds with those of other asset classes. Section 6 concludes.

## 2. Creditor losses in historical perspective

This section shows that foreign private creditors frequently suffered losses in sovereign debt markets, due to default and restructuring events. However, these losses were almost always partial, not full. Cases of full debt repudiation on external debt are rare and defaults typically end in a negotiated settlement with haircuts well below 100%.

### 2.1. Sovereign debt restructurings 1815-2015

To identify creditor loss events, we conduct a census of all distressed sovereign debt restructurings with foreign commercial creditors (mostly bondholders, but in some rare occasions, banks) in the period 1815-1980. We then combine this historical sample with the one by Cruces and Trebesch (2013), which covers 1978-2013. The result is a full sample of sovereign debt restructurings with foreign banks and bondholders for 1815-2015. To select cases we apply the same criteria as in Cruces and Trebesch (2013) and focus on:

(i) restructurings of sovereign debt (bonds or loans by the central government)

(ii) distressed restructurings, defined as exchanges of debt at less favorable terms than the original bond or loan (as in Standard and Poor’s 2011)

(iii) restructurings with private, foreign creditors (international banks or bondholders). We do not include private-to-private debt restructurings, or those with official (bilateral and multilateral) creditors (see Reinhart and Trebesch 2016 and Schlegl et al. 2018 on official restructurings). Also restructurings on domestic currency debt are not included.

[17] This allows us to drop non-sovereign bonds included in the EMBI such as loans or publicly guaranteed bonds.

(iv) Restructurings of medium and long-term debt, but no short-term rollovers or bridge financing.

(v) We also disregard restructurings that were never implemented.

We used a wide variety of sources to compile our restructuring and haircut archive. Most importantly, we rely on the annual reports of bondholder organizations who negotiated with defaulting countries in the 19th and early 20th century, in particular the UK-based Corporation of Foreign Bondholders (CFB), the US-based Foreign Bondholders Protective Council (FBPC) and the French Association Nationale des Porteurs Français de Valeurs Mobiliéres. The reports provide rich details on past defaults and restructurings and are therefore our most important source. To cross-check the information by the creditor committees and to fill gaps in the data, additional sources were used, in particular annual investor reports such as Fenn's Compendium of the English and Foreign Funds, Fortune's Epitome of the Stock and Public Funds, Kimber's Records on Government Debts and other Foreign Securities, Moody's Manuals on Foreign and American Government Securities, and the London Stock Exchange Yearbooks. In addition, we considered case studies from the literature, communiques of the creditor organizations, official gazettes of the debtor country, and press articles. In sum, we used every piece of information we could find, extracted the information on defaults and restructurings, and then compared the data across each source available. This helped us to minimize mistakes and inaccuracies in the debt restructuring archive.

For the recent period (1970-2015) we include 187 sovereign debt restructurings as covered in the most recent update of Cruces and Trebesch (2013), plus the restructurings in Grenada 2015 and Ukraine 2015 which were covered by Fang et al. (2018). In the historical sample, we identify an additional 179 sovereign debt restructurings. Of these, 167 were implemented in the period 1815 to 1970 plus 12 that occurred *after* 1970 but were not included in the sample of Cruces and Trebesch (2013).[18] Out of the 179 newly identified deals, we could estimate haircuts for all but 10 deals[19], so that the new sample added here comprises 169 cases in 43 countries.

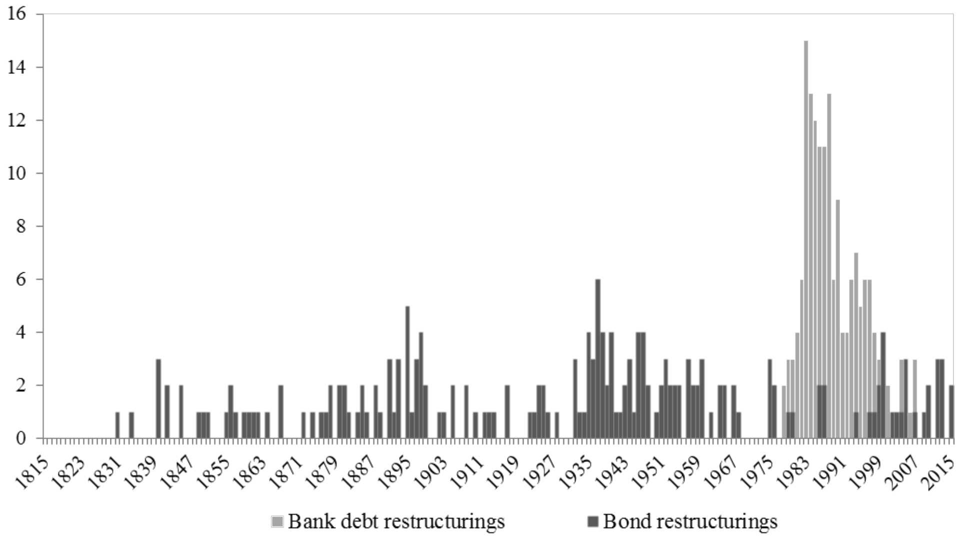
After combining the historical and the modern sample we get to 358 individual sovereign debt restructurings in 91 countries. Figure 1 shows the yearly distribution over the 200-year span. The 358 cases, however, are an upper bound. They include 80 cases in which the same default event results in more than one restructuring, because of selective restructurings towards different creditor groups (e.g.

[18] The 12 post-1970 restructurings which Cruces and Trebesch (2013) had missed were all long-delayed historical cases that go back to defaults of the 1930s. Except Zimbabwe 1980, they all involve Communist countries that had refused to negotiate or settle their debts with foreign bondholders for decades: Hungary 1975 (American bondholders), Poland 1975 (American bondholders), Romania 1975 (American bondholders), Poland/Danzig 1976 (American and British bondholders), Romania 1976 (British bondholders), Bulgaria 1979 (American bondholders), Czechoslovakia 1986 (American bondholders), Russia 1986 (British bondholders), Bulgaria 1987 (British bondholders), China 1987 (British bondholders) and Russia 1997 (French bondholders).

[19] The 10 cases for which we lack sufficient information are Austria 1816, Russia 1839, Tunisia 1870, Austria 1871, Schleswig-Holstein 1850 and Morocco 1904 as well as five smaller cases that only affected parts of the debt, namely Poland 1949 (side-deal with Swiss bondholders), Hungary 1950 (side-deal with Dutch bondholders), Hungary 1951 (side-deal with Swedish Bondholders), Yugoslavia 1959 (side-deal with Swiss Bondholders).

separate deals to USD and GBP currency bonds). Take the example of Brazil, which declared a full debt moratorium in October 1931. After a lengthy period of negotiations, Brazil restructured its USD and GBP bonds in November 1943 but it took five more years, until 1946, to settle its French Franc bonds. To avoid double counting, we merge such multiple restructurings of the same default into just one event, so that each default receives just one haircut estimate. This means that the 78 events with multiple restructurings boil down to just 34 cases, with a haircut estimate each (using restructured amounts as weights). The final (lower bound) sample used in the analysis therefore drops to 313 external sovereign debt restructurings in 91 countries. Appendix C provides further details, and a breakdown by country.

Figure 1: Sovereign debt restructurings with foreign private creditors 1815-2015




*Note*: This figure shows the number of external sovereign debt restructurings by year and debt instrument affected. In total we identify 203 sovereign bond restructurings and 165 restructurings involving bank loans. Bank debt restructurings occur exclusively in the period 1970 to 2000. Defaults and restructurings on official debts (e.g. bilateral debt or debt owed to the IMF) are not included.

## 2.2. Measuring haircuts

To measure sovereign haircuts, we follow the standard approach in the sovereign debt literature, namely that proposed by Sturzenegger and Zettelmeyer (2006, and 2008) and used by Cruces and Trebesch (2013), among others. Equation (1) compares the present value of the old and new debt instruments. Both payment streams are evaluated at the same discount rate:

$$H_{SZ_t}^{i} = 1 - \frac{\text{Net present value of new debt } \left(\mathrm{r_t^i}\right)}{\text{Net present value of old debt } \left(\mathrm{r_t^i}\right) + \text{arrears}} \tag{1}$$

This measure captures the wealth loss of an investor participating in a debt restructuring, because it accounts for the characteristics of both the old and the new debt, in particular any change in the maturity and interest structure. More specifically, $H_{SZ}$ compares the present value of the new and the old debt in a hypothetical scenario in which the sovereign kept servicing old bonds on an equal basis as the new debt. Take a small holdout creditor who avoided a haircut and whose old bond continues to be repaid as if no crisis happened (just like the €3bn holdouts of English law bonds). The SZ haircut measures how these holdouts fared in comparison to those creditors that participated in the exchange. The best approach for this comparison is using the same discount rate. Indeed, both the new bonds and the old (holdout) bonds face the same risk of a new default after the deal, and they both benefit from the debt relief effect. Cash payments as part of the restructuring are taken into account.

Haircuts are computed on bond-by-bond basis using information on a total of 1,134 defaulted sovereign bonds. To compute the aggregate haircuts for each restructuring event, we build a weighted average haircut across restructured bonds and use amounts outstanding as weighting basis.

For discounting, we follow Sturzenegger and Zettelmeyer (2006) and Cruces and Trebesch (2013) and use the "exit yield", which is the secondary market yield of the new instruments that start trading after the restructuring. This rate reflects the market's pricing of sovereign risk and thus the expected risk of a future default on the new obligations, taking into account the success (or failure) of the restructuring that was just implemented (including any beneficial effects of debt relief). Whenever possible, we use the secondary market yield of country $i$ in the month after exit from default using the bond pricing data summarized in section 3. For 44 debt restructurings, no market yield data was available, in particular in small and low-income countries with no liquid bonds trading in London and New York. In these cases, we use a "worst yield" approach, which means that we use the highest bond yield observable among non-defaulted sovereigns in the London or New York market at that point in time as a proxy for the country's own exit yield.

We apply the same haircut computation approach across the entire 200-year span to make the estimates as comparable as possible, but this required making a few simplifying assumptions, which are discussed in detail in Appendix C. In this Appendix, we also discuss how we deal with the so-called "sinking fund" structure of many historical bonds, bond buyback options, gold and currency clauses, country-break ups, as well as selective agreements and creditor discrimination. We also conduct several robustness checks and we provide calculation examples.

Regarding the robustness checks, we focus on the role of the discount rate and, for comparison, apply a 10% flat rate to all deals, as well as a "risk-free" lower bound rate (the yield on UK or US long-term government bonds at the exit of the restructuring). Moreover, we show results for face value (nominal reduction) haircuts and for the so-called "market haircut", which compares the face value of the old debt to the present value of the new debt. Taken together, we find that the haircut formula and the choice of the discount rate matters, in particular for the estimated means, but the overall picture and the dispersion of haircuts across space and time is similar irrespective of the methods used.

### 2.3. Restructurings and haircuts across 200 years

Figure 2 shows the main result on creditor losses, by plotting the size of haircuts (vertical axis) in restructurings of external sovereign debt between 1815 and 2015 (horizontal axis). As explained above, the data since 1975 comes mostly from Cruces and Trebesch 2013, while this paper adds the 160 years prior to that. Each observation represents one restructuring, where the size of haircuts is averaged across all instruments affected, weighted by amounts outstanding. The size of the circles represents the inflation-adjusted amounts affected by the restructurings (in real 2009 US$).[20] Some of the haircuts shown are negative, but these are only 10 events and they mostly occur at the start of debt distress.[21] To complement this picture, Table 1 provides summary statistics and adds information for different haircut measures.

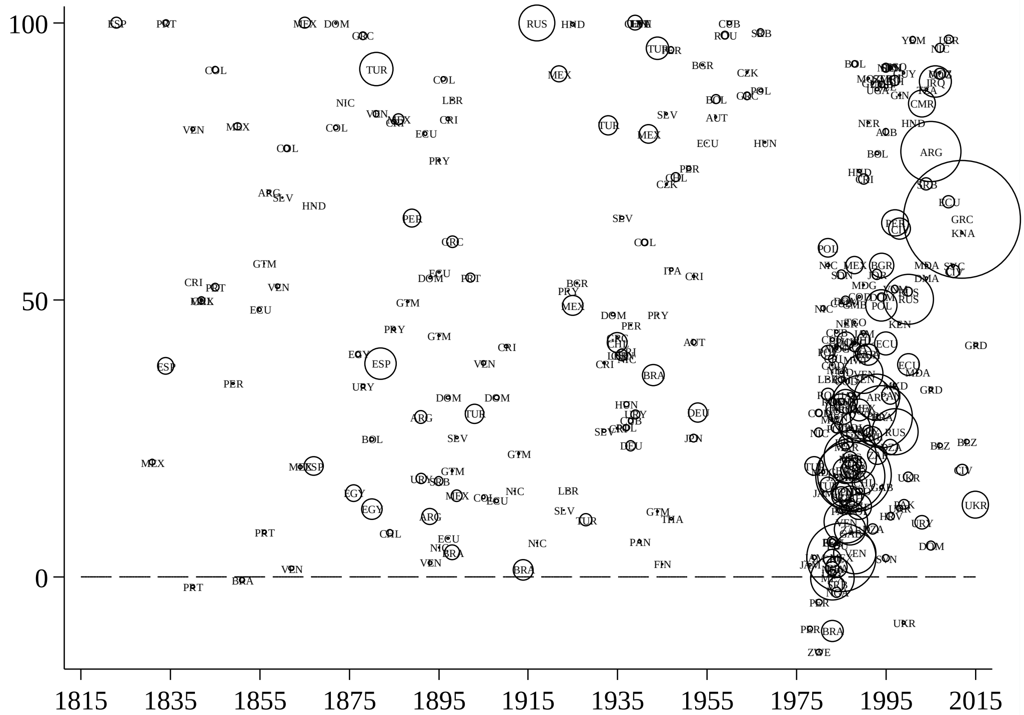
There are two main insights from the haircut data. First, there are strong recurring features over time. Both the average haircuts and their variation are surprisingly similar over the entire 200-year span. The level of creditor losses has averaged between 40 to 50% - with no visible time trend or outlier spells. Every decade since 1815 featured a few sovereign restructurings. The only major gap is between WW2 and the 1970s, the Bretton-Woods period with closed capital accounts and very limited cross-border lending, so that barely any new defaults or restructurings on privately-held sovereign debt occurred.[22] Since the 1980s, we have seen a strong increase in the number of restructurings, also because the number of independent countries is much higher today. The standard deviation of haircuts for the historical sample is large throughout the sample, at about 30%. Both then and now the dispersion of creditor losses is high, as some deals imply low haircuts of less than 20% while others reach 80% or more. Thus, overall, the historical haircut statistics strongly resemble those of more recent decades, despite the fundamental changes in institutions and markets since the 19th century.

[20] Total amounts of debt restructured were first converted to US$ using exchange rates provided by Officer (2018) and then adjusted for inflation using inflation rates provided by Wiliamson (2018).

[21] In these early stages of a crisis, sovereigns may do what it takes to avoid a default, e.g. by extending debt maturities at higher interest rates than before, as happened in 2001 in Argentina. These deals do not imply debt relief, but may nevertheless be beneficial for the government, at least in the short term.

[22] Bretton Woods was a period of closed capital accounts and thus, very limited, foreign-currency sovereign lending in private markets.

Figure 2: Haircuts in sovereign debt restructurings with foreign private creditors, 1815-2015




*Note:* This figure shows the size of haircuts (in % of debt affected) in sovereign debt restructurings with external banks and bondholders over the past 200 years. The calculations build on Equation 1 as well as the methodology and data sources described in Appendix C. The circle size captures the amount of debt involved, adjusted for inflation (using 2009 USD).

A second main insight is that debt repudiation and debt cancelations (haircuts of or close to 100%) are the exception rather than the rule. This is true even for the most tumultuous episodes of modern history, such as after the Great Depression and in the wake of major wars. The average haircut in the full sample is 44% and it drops to just 38% once we look at weighted haircuts (using amounts restructured in real US dollar terms). The historical average haircut is somewhat higher than that of recent decades, but the median haircut is also below 50% in history. Thus, both now and then, creditor losses are partial.

Arguably, the list of "worst defaults" is headed by Russia, when Lenin cancelled all external debts in the wake of the Communist revolution in 1917, but there are a few other drastic cases of debt wipe-outs. Specifically, we set haircuts to 100% in years of full repudiations, defined as a situation in which the government publicly announces the cancelation of external debts. Besides Russia 1917, this includes the Communist take-over of China in 1949 after the Maoist revolution[23] and Cuba 1960 after the Castro revolution.[24] There are five additional cases of debt repudiation, which all also occurred in the wake of

[23] China's external bonds had already been in default since 1939, but only after Mao came to power these debts were declared canceled and void.
[24] Many other countries that saw a Communist take-over also saw long delays and very high haircuts, but an explicit debt cancelation only occurred in China, Cuba and Russia.

major political upheaval and when a new government refused to service debts incurred by a previous ruler or regime: Spain 1824 (on bonds incurred by the Cádiz Cortes), Greece after 1826 (on bonds raised by the militias fighting for independence), Portugal 1834 (on bonds by Dom Miguel), Mexico 1866 (on bonds by Maximilian I) and the Dominican Republic 1872 (when its Senate enacted a law repudiating external bonds).[25]

Table 1: Sovereign haircuts with foreign private creditors (1815-2015)

| | Cases | Mean | Median | SD | Min | Max |
|---|---|---|---|---|---|---|
| **Haircuts across time** (by default-restructuring event) | | | | | | |
| Full sample (1815-2015) | 313 | 44 | 39 | 30 | -14 | 100 |
| Historical sample (defaults pre-1970, only bond exchanges occurred) | 138 | 51 | 48 | 32 | -14 | 100 |
| Modern sample (defaults post-1970, including bank debt restructurings) | 175 | 39 | 34 | 28 | -10 | 97 |
| Modern bond restructurings (the first "modern" bond exchange is 1998) | 23 | 37 | 37 | 21 | 6 | 77 |
| **Alternative measures** | | | | | | |
| Haircuts weighted by amount restructured | 313 | 38 | 31 | 27 | -14 | 100 |
| Face value haircut | 313 | 22 | 0 | 32 | -15 | 97 |
| Haircuts, bond-by-bond (average of 1,134 defaulted bonds) | 1,134 | 48 | 51 | 31 | -47 | 100 |

*Note:* Some of the haircuts shown are negative, but these are only 10 events and they mostly occur at the start of debt distress (see footnote above). A negative face value haircut only occurred in one case: the Mexican restructuring of 1864 (of -15%).[26] Weighted haircuts use restructured amounts in real terms (2009 USD).

Besides revolutions and regime changes, we find that haircuts are often very high when a country or empire ceases to exist (see Appendix C2 for further details on how we deal with country break-ups). For example, the defaulted debt of the Austrian-Hungarian Empire was only settled in the 1970s with an average haircut of 98%, while the bonds of the three Baltic countries were fully canceled after the Soviet occupation in August 1940. In the modern period, haircuts were close to 100% only in highly indebted poor countries (HIPCs) where the defaults of the early 1980s took nearly 30 years to settle. More generally, throughout history, we can confirm a very close relationship between default duration and haircut size, as shown for the modern period by Benjamin and Wright (2009).

[25] The debts affected in these cases of debt repudiation remain in default until today, or at least remained in default for more than a generation. The two exceptions are Spain and the Dominican Republic which settled their debts after 10 and 16 years, respectively, at a haircut of 40% and 95%.
[26] In Mexico of 1864 interest arrears were capitalized into new debts at a rate above 100% (for every 0.66 pounds of arrears outstanding, creditors received new bonds at a face value of 1 pound).

## 3. Sovereign bond returns, 1815-2016

### 3.1. Sovereign bond pricing database - sample and sources

This section introduces the dataset on sovereign bond prices and explains how we compute bond returns. Compared to Section 2, we thus move beyond sovereign default and restructuring situations and instead track the performance of foreign-currency sovereign bonds using bond prices. We start in 1815, during a decade in which London emerges as the world's dominant financial center (Michie 2001). While our data span until September 2017, we mainly show results until end-2016 to include only complete years.

To assemble the long-run bond pricing database, we use similar sample selection criteria as above. We focus on bonds issued (i) by central governments, (ii) in foreign (USD and GBP) currency, (iii) traded and priced on the London or New York Stock Exchange, (iv) with a fixed coupon rate (no floating rate instruments) and (v) with at least one full year of price data (at monthly frequency).

More specifically, in the historical sample, we include all bonds for which we could find pricing information on the LSE and/or NYSE and which fulfill the selection criteria above. To identify bonds and code prices (and other bond characteristics) we rely on several main sources. For the pre-1870 period, we use price data from the Money Market Review, The Economist, Circular to Bankers, Course of the Exchange, and Banker's Magazine. For the 1870-1930 period we mostly use LSE pricing data from the Investors Monthly Manual, as hosted by William Goetzmann and Geert Rouwenhorst at the International Center of Finance at Yale. We complement this source with NYSE bond price data which we coded from the "Bank and Quotation Section" of the Commercial Financial Chronicle (from 1905 to 1927 and 1954-1978) and from the Bank and Quotation Record (from 1927 to 1954). We also collect price data for bonds not traded on the New York Stock Exchange, but on the London Stock Exchange from 1930 to 1980. Here we relied on price quotations provided by The Economist and the Financial Times.

For the modern period, we use pricing data provided by JP Morgan, which is available for a few countries from 1990 onwards (the sample becomes representative only from 1994 onwards with more than 30 Brady bonds being actively traded). EMBI data have been very widely used in the sovereign debt literature (see the survey by Aguiar et al. 2016), but unlike previous authors we do not simply use the off-the-shelf country-level series from the EMBI+ and EMBI Global indices, but instead make use of the rich microdata on individual bonds that underlie the aggregate index. We rely, in particular, on data from the broadest of their indices, the EMBI Global, which includes sovereign and quasi-sovereign debt instruments from low and middle-income countries that have a minimum issue size of US$500 million, daily pricing data, and a remaining maturity of at least one year. For consistency, we focus on sovereign bonds issued in USD and GBP and therefore disregard local currency bonds, guaranteed bonds and bonds issued by public companies and banks that are included in EMBI Global.

Table 2: The bond pricing database: countries and bonds included

| | **Total sample** | **By era** | | | | |
|---|---|---|---|---|---|---|
| | | 1815-1869 | 1870-1913 | 1914-1945 | 1946-1989 | 1994-2017 |
| Number of countries covered | 88 | 21 | 43 | 51 | 39 | 62 |
| Share of countries covered in % | 89.29 | 31.71 | 74.42 | 89.29 | 52.94 | 46.09 |
| Pricing observations (monthly) | 200,616 | 3,432 | 55,812 | 60,384 | 26,484 | 54,504 |
| Number of active bonds | 1,509 | 67 | 364 | 441 | 213 | 732 |
| … issued in British pounds | 580 | 67 | 357 | 294 | 88 | 2 |
| ….issued in US dollars | 929 | 0 | 7 | 147 | 125 | 730 |
| Average maturity of bonds issued | 24 | 50 | 40 | 36 | 30 | 15 |
| Average coupon (nominal) | 6.0 | 5.0 | 4.7 | 5.1 | 5.2 | 6.9 |
| Average amount issued (nominal, in m USD) | 846 | 44 | 41 | 38 | 36 | 1,706 |

*Note*: This table shows an overview of the evolution of our sample since 1815. In total, we collect price data and bond terms for more than 1,508 bonds. GBP bonds were dominant until WW2 and account for 38% of the sample in total. The other 62% are USD bonds. The share of countries covered is given as percent of all independent countries worldwide. Besides the change of currency decomposition over time, we also find that bond characteristics change notably. Average bond maturity declines from an above 50 years in the 19th century, to just 15 years in the past decades. In parallel, average coupons increased from 5% to 7% p.a.

The final bond pricing sample includes 1,508 foreign-currency sovereign bonds issued by 88 countries.[27] Table 2 and Figure 3 provide an overview. We start in the early 19th century with 21 sovereigns having bonds traded in London. From about 1850 onwards, the sample of countries and bonds expands, as more and more governments tap the London market and investors show interest to invest in foreign government bonds. Our sample continues to grow between 1870 and 1913, a period that has been termed the "first era of financial globalization" and which is characterized by large-scale capital flows from London to periphery countries (Reinhart et al. 2018). After WW1, New York joins London as the second dominant financial center of the world, and our sample reaches a first peak. By the late 1920s, more than 300 sovereign bonds of more than 50 countries were actively traded in London and New York.

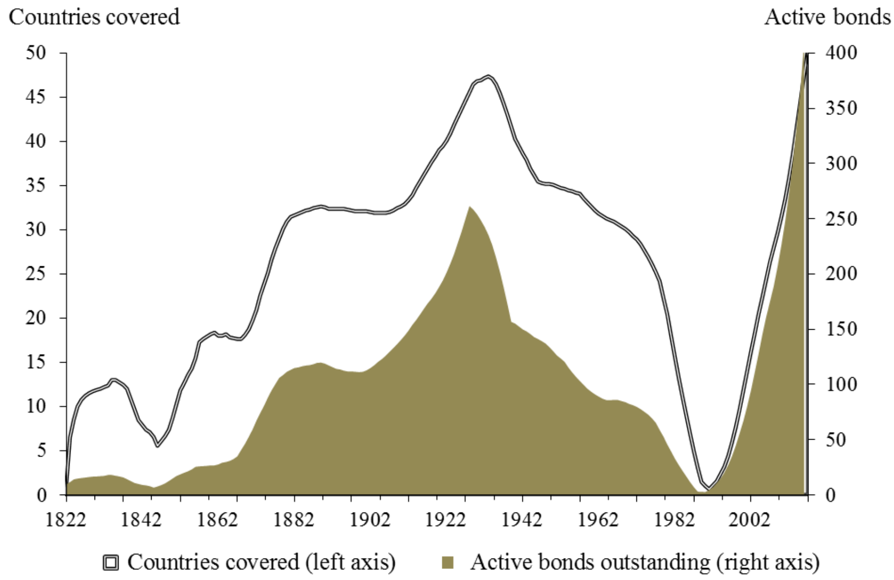
During the 1930s the sample shrinks considerably, for two main reasons. First, the Investor's Monthly Manual ceases to be published, meaning that the most important pricing source for the London market is no longer available (as an alternative, we rely on The Economist as a pricing source after June 1930, but the magazine does not cover all bonds trading in London at the time). Second, the number of actively

[27] Of these, 68 defaulted on their external debt at some point since 1815, namely, Angola, Argentina, Austria, Belize, Bolivia, Brazil, Bulgaria, Cameroon, Chile, China, Colombia, Costa Rica, Cote d'Ivoire, Croatia, Cuba, Czechoslovakia, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Ethiopia, Finland, Gabon, Germany, Ghana, Greece, Guatemala, Honduras, Hungary, Indonesia, Iraq, Italy, Jamaica, Japan, Jordan, Kenya, Latvia, Lithuania, Mexico, Morocco, Nicaragua, Nigeria, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Russia, Senegal, South Africa, Spain, Sri Lanka, Tanzania, Thailand, Trinidad and Tobago, Tunisia, Turkey, Ukraine, Uruguay, Venezuela, Vietnam, Yugoslavia/Serbia, Zambia. The remaining 21 countries never defaulted externally since 1815, namely Armenia, Australia, Azerbaijan, Belarus, Belgium, Canada, Denmark, France, Georgia, Ireland, Kazakhstan, Lebanon, Malaysia, Mongolia, Namibia, Netherlands, New Zealand, Norway, Slovakia, Sweden, and Switzerland.

traded bonds collapses in the wake of the great depression and during World War II, mostly due to a wave of sovereign defaults after 1929, but also because securities of enemy countries were banned from trading on the LSE and NYSE after 1939. As a result, the number of traded bonds for which we have monthly pricing information drops to below 200.

After 1945, during the Bretton Woods period, the sample declines further. In this era there were very limited international private investment flows and bank lending overtakes bonds as the preferred vehicle of cross-border lending to sovereigns. More specifically, between 1950 and 1990, only 16 countries issued foreign-currency bonds that were actively traded in London and New York, with a total of just 67 newly issued sovereign bonds in four decades. Instead, the 1970s and early 1980s became a golden era of sovereign syndicated bank lending, as developing countries borrowed heavily from commercial banks from Europe, the US and Japan - followed by large-scale defaults on these debts in the 1980s. By the early 1980s, only very few countries still had outstanding bonds at the LSE or NYSE and these instruments were mostly long-maturity bonds issued in the 1930s and 1940s.

Figure 3: Bond price sample: coverage across time




*Note:* The figure shows the coverage of our database by number of bonds (right axis) and countries (left axis, those with at least one active bond), for each year between 1815 and 2017. The sample includes only sovereign bonds issued in USD and GBP and traded in London and/or New York. Both lines are smoothed (5-year moving averages).

Bonds made a comeback only after the developing country debt crisis was resolved. A catalyst was the Brady plan of the early 1990s, which involved restructuring deals of defaulted bank loans into newly issued sovereign bonds - at a discount. The resulting Brady bonds make up for most of our sample in the early 1990s. Subsequently, however, more and more emerging markets start issuing foreign-currency bonds in London and New York. By the early 2000s, bonds had regained their once dominant position in international sovereign lending. As a result, our sample grows rapidly, to unprecedented numbers with more than 500 actively traded sovereign bonds by more than 60 countries worldwide. Further details on the sample and coverage are shown in Appendix B1.

### 3.2. Measuring bond returns

The ex-post nominal return for bond *i* of country *j* at time *t*, $R_{i,j,t}$, is driven by two main components: price changes and coupon payments. We calculate gross total returns assuming that coupons are reinvested without deducting any taxes and using the following formula:

$$R_{i,j,t} = \frac{P_{i,j,t} + C_{i,j,t}}{P_{i,j,t-1}} - 1 \tag{2}$$

where $P_{i,j,t}$ is the bond price of bond issue $i$ plus any accrued interest at the end of month $t$. $C_{i,j,t}$ represents the coupon payment. For the historical period coupon payments are assumed to be equally distributed over the coupon payment period according to standard practice (accrued interest).

Our baseline measures are real (not nominal) ex-post returns, using the monthly CPI index provided by Global Financial Data to adjust for inflation in US dollar and British pounds. Based on the CPI index we calculated monthly inflation $\pi$ with the following formula: $\pi_{j,t} = \left(CPI_{j,t} - CPI_{j,t-1}\right)/CPI_{j,t-1}$ and compute real returns $r_{i,j,t}$ for bond $i$ of country $j$ at time $t$ as follows:

$$r_{i,j,t} = R_{j,i,t} - \pi_{j,t} \tag{3}$$

To get yearly returns[28], we accumulate monthly returns over one year as stated in Equation 4, where $r_{i,j,t}^{T}$ represents the return of year *T* for bond $i$ of country $j$:

$$r_{i,j}^{T} = \prod_{t=1}^{12} \left(1 + r_{i,j,t}\right) \tag{4}$$

The arithmetic yearly average is then calculated as follows:

$$\frac{1}{T} \sum_{1}^{T} r_{i,j}^{T} \tag{5}$$

where $r_{i,j}^{T}$ is the realized return in year *T*, for the years 1 through *T*, i.e. the mean, annual real return for a specific period.

All results could be shown on a bond-month level, but we generally show yearly averages and focus on a global portfolio of all foreign-currency sovereign bonds outstanding - irrespective of the country of issuance. Besides the global portfolio we also show some results on the country-level, meaning that we

[28] Our results are similar when comparing bond prices at the beginning and end of a year (incl. coupon payments).

compute yearly mean returns of all active bonds of a country (country-level portfolio). To obtain portfolio returns we weight returns by nominal bond amounts in US Dollar, so that the portfolios show value-weighted returns of all bonds in circulation.[29] The annual portfolio return can be defined as follows:

$$r_{Portfolio}^{T} = \sum_{j=1}^{N} r_{i,j}^{T} * \frac{w_{i,j,T}}{\sum_{i=1}^{N} w_{i,j,T}} \tag{6}$$

where $w_{i,j,T}$ denotes the weight of the respective bond $i$ of country $j$ for year $T$ and $r_{i,j,t}$ is the realized return of the global- or country-level portfolio in year *T*.

We also show results for geometric (annualized) average returns throughout. The geometric mean gives the compounded, average annual return over the period 1 through $T$ and is not commonly used in the related work on long-run returns.[30] Indeed, our motivation to use arithmetic (and yearly) averages as a baseline, is that this facilitates a comparison with the literature and existing databases (e.g. with the EMBI indices, or Dimson et al. 2001).

To track performance over time we can compute total cumulative returns as follows:

$$\prod_{1}^{t} \left(1 + r_{i,j,t}\right) - 1 \tag{7}$$

which measures the total return between period 1 and *t*. This formula is particularly useful to assess returns in pre-specified event windows (such as around default spells, see Section 4 and Appendix B4). This formula can also be used to compute (i) the holding period return, which is the return from holding the investment for a specific period of time, as well as (ii) annualized real returns, to approximate average total returns assuming that the return had been the same each year.[31]

Moreover, to compute excess returns, we compare the total real returns of each of the bonds in our sample to the returns on a "risk-free" benchmark in each period. Our baseline are government bonds of the same currency, where $RP_{i,j,t}$ is the excess return for bond *j* of country *i* over the risk free rate, $r_{safe,t}$ so that $RP_{i,j,t} = r_{i,j,t} - r_{safe,t}$. Specifically, we approximate $r_{safe,t}$ by the return of 10-year UK bonds for bonds issued in British pounds (this is mostly relevant for bonds issued before WW2) or 10-year US treasury bonds (in particular for the modern, post-1994 sample, in which most sovereigns choose to issue abroad in US Dollars). Appendix A provides the sources for these series. For completeness, we also compute

[29] GBP values are converted to USD. For weighting, we use nominal issuance amounts. Using real amounts yields very similar results.

[30] There can be significant differences between arithmetic and geometric average returns. When returns have a lognormal distribution, the arithmetic return roughly exceeds the geometric return by one-half of the variance.

[31] More precisely, the annualized return, or geometric mean states the return that an investment would need to have achieved annually to reach its multi-year return. It can be computed as $\prod_{1}^{t}\left(1 + r_{i,j,t}\right)^{\frac{1}{t}} - 1$.

excess returns vis-à-vis UK or US bills, which is particularly useful when comparing the risk-return properties of external bonds to those of other asset classes (Section 5).

Further methodological details are discussed in Appendix B2 and B3, including a discussion on how we deal with historical bond features such as sinking funds.

### 3.3. Main results on bond returns

Table 3 summarizes our main results on long-run sovereign bond returns for the global portfolio in the long run. Henceforth, we always exclude the years 1974 to 1993 due to lack of representative bond pricing data in the 1970s and 1980s.[32] This means that the time series for the global sovereign bond portfolio ends in 1973 and starts again in 1994. Appendix B3 shows robustness checks, in particular on the role of bond maturity and bond liquidity.

In the total sample, foreign-currency bonds show an annual ex-post real return of 7.2%, including spells of turmoil due to default, wars and revolutions. The average is slightly higher when dropping WW1 and WW2 (1914-1918 and 1939-1945). The geometric total return is lower, as usual, with an average of 6.21%. This number represents the annual compounded return of an investor who has remained invested in this market for the last 200 years. After WW1, the nominal returns exceed real returns, while real returns tend to be higher than nominal returns in earlier periods, due to the many deflationary spells in the early and late 19th century (including the "Great Deflation" between 1870 and 1890).

Table 3: Returns on a global portfolio of external sovereign bonds, 1815-2016

| | Real Return | | | Nominal Return | | |
|---|---|---|---|---|---|---|
| | Arithmetic Mean | Geometric Mean | SD | Arithmetic Mean | Geometric Mean | SD |
| Full sample 1815-2016 (yearly) | 7.19 | 6.21 | 14.85 | 8.04 | 7.31 | 12.90 |
| … without world wars | 7.44 | 6.50 | 14.46 | 7.88 | 7.19 | 12.36 |
| By era (yearly) | | | | | | |
| 1815-1869 | 10.06 | 8.41 | 19.83 | 9.26 | 8.32 | 15.12 |
| 1870-1914 | 6.61 | 6.28 | 8.42 | 6.03 | 5.81 | 6.84 |
| 1915-1945 | 5.48 | 4.07 | 18.01 | 6.24 | 5.25 | 15.24 |
| 1946-1973 | 4.98 | 4.34 | 12.12 | 8.86 | 8.21 | 12.48 |
| 1994-2016 | 9.07 | 8.06 | 14.68 | 11.51 | 10.45 | 15.25 |
| Monthly returns | 0.62 | 0.55 | 3.69 | 0.70 | 0.64 | 3.61 |

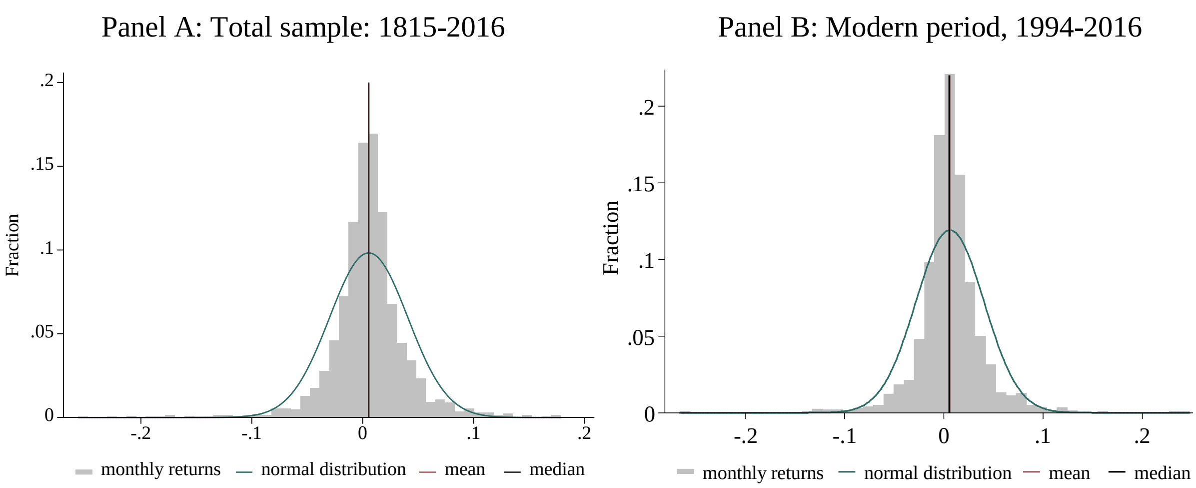
*Note:* Table 3 shows average ex-post investor returns in our total sample of 88 countries and 200 years, as well as for different subsamples. The country composition changes over time (see Appendix B1). All returns are yearly averages, except for the bottom line, which uses monthly frequency. Returns and standard deviations shown are based on a global portfolio that includes all outstanding foreign-currency sovereign bonds at each point in time.

[32] As we explain in Section 3.1. and in Appendix B1 the 1970s and 1980s are a period dominated by syndicated bank lending. Barely any sovereign bonds were issued abroad. As a result, the number of counties with actively traded bonds shrinks to less than 10 after 1973, making the "global portfolio" unrepresentative.

Turning to subsamples, the two main eras of financial globalization (1870-1914 and 1994-2016) stand out. These periods are characterized by average yearly returns of around 7-9% coupled with low or moderate volatility (the standard deviation is 8.4% and 14.7%, respectively). The early 19th century sees high average returns of about 10%, but also a high return volatility. The interwar years show the worst risk-return ratio, with lower-than-average real returns of 5.5% and a high standard deviation of 18%. The returns decline further in the three decades following WW2, mostly due to the fact that many bonds that went into default in the 1930s continued to be non-performing for decades. It took until the 1980s to settle all defaults of the 1930s and 1940s, with a total of 49 restructurings. At the same time, barely any bond issuances occurred, so that the averages for this era are biased downward due to selection effects.

We explore the impact of survival bias and sample composition in Appendix B3, by focusing on 13 countries for which we have a similar coverage for a very long time span (more than 100 years of data). The average returns for this more balanced subsample are similar to our baseline numbers. This alleviates concerns that our main finding is biased due to sample issues.

Figure 4: Distribution of monthly, real returns




This figure shows the distribution of monthly real returns of the global sovereign bond portfolio for the total sample period (Panel A) and for the modern post-1994 period (Panel B). The black line plots the normal distribution.

We also check the distribution of returns in the data. Due to the many defaults the distribution could be skewed, with fat tails, so that the standard deviation would understate the true degree of risk. To assess this, Figure 4 plots the distribution of monthly, real returns from our global bond portfolio. As can be seen, despite some positive and negative outliers, the monthly return distribution is roughly comparable to a normal distribution and this is also the case with annual data. Nevertheless, to be conservative, we also compute modified Sharpe ratios below, accounting for the higher volatility, skewness and kurtosis.

To allow for different investment horizons we next turn to holding period returns (HPRs). Table 4 shows average HPRs across years and countries (for completeness we start on a quarterly basis). After 10 years, the mean HPR in our full sample is 90.2%, with a median of 83.1%. The dispersion increases over time, with the upper bucket (75th percentile) reaching a 110% real return over 10 years, while the lower bucket (25th percentile) shows a cumulative return of 56%. We also show geometric and arithmetic means per year. Over time, the geometric mean decreases due to the occurrence of defaults. In contrast, the returns using arithmetic averaging remain in the range of 7% per year.

Table 4: Holding period returns on a global portfolio of external sovereign bonds, 1815-2016

| | Quarterly (Q1-Q4) | | | | Yearly (years 1-10) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q1 | Q2 | Q3 | Q4 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Mean (arithmetic, cumulative) | 2.6 | 4.3 | 5.7 | 7.2 | 7.2 | 15.4 | 23.2 | 30.9 | 39.1 | 47.8 | 57.3 | 67.7 | 78.5 | 90.2 |
| p75 | 5.7 | 8.5 | 11.1 | 14.4 | 14.4 | 24.1 | 35.7 | 48.3 | 62.8 | 71.4 | 80.2 | 95.0 | 97.3 | 109.8 |
| Median | 2.5 | 3.8 | 4.4 | 6.0 | 6.0 | 13.1 | 20.4 | 27.5 | 30.7 | 40.2 | 47.4 | 56.4 | 68.4 | 83.1 |
| p25 | -0.5 | -0.5 | -0.9 | -1.4 | -1.4 | 1.4 | 4.7 | 8.7 | 15.8 | 23.5 | 30.5 | 38.5 | 46.9 | 55.6 |
| Mean (arithmetic, avg. per period) | 2.6 | 2.1 | 1.9 | 1.8 | 7.2 | 7.2 | 7.0 | 6.9 | 6.9 | 6.9 | 6.9 | 7.0 | 7.0 | 7.0 |
| Mean (geometric, annualized) | 2.6 | 2.0 | 1.7 | 1.6 | 7.2 | 6.8 | 6.5 | 6.3 | 6.2 | 6.2 | 6.2 | 6.2 | 6.3 | 6.3 |

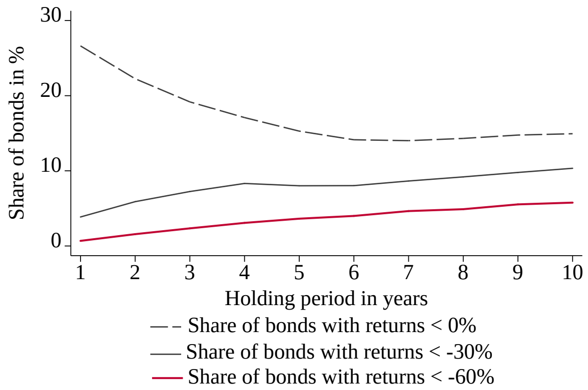
*Note:* This table shows holding periods ranging from Q1 to year 10. The average geometric mean is reported for quarterly holding periods on a quarterly basis, i.e. it gives the average, real compounded return for one quarter. For the annual holding periods, the geometric mean states the average, annualized return for the specific holding period. All return statistics are based on a global portfolio of outstanding foreign-currency sovereign bonds.

Figure 5 zooms further into the bottom 25%, by focusing on the worst performers. We calculate the share of bonds with negative real compounded returns after different holding periods. In the full sample, in year one, up to 26% of observations see negative returns and this drops to about 15% in year 10. Moreover, there are about 10% of observations with substantial losses, showing a negative return of -30% or worse, as well as a small but growing share of bonds with even more negative returns between -30% and -60%. Observations in this bottom bin are dominated by spells after the Great Depression and around WW2, e.g. in Austria, Germany, Italy and in many Communist countries (China, Russia and Eastern Europe), where investors suffered bond price collapses that persisted for decades.

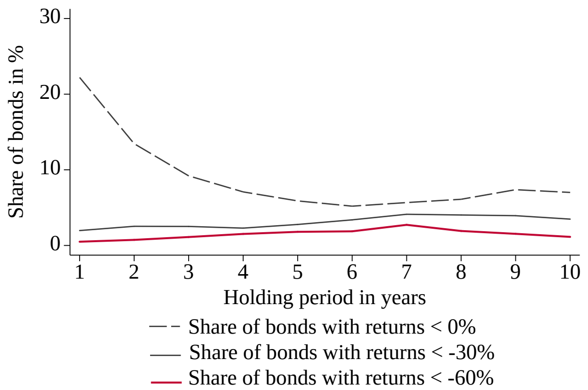
In the modern (post-1994) period, the share of bonds with negative returns is much lower than in the historical sample. After three years only about 9% of country observations remain in negative territory and after 10 years this figure drops further. The share with returns up to -30% is a small 2% initially and then increases to 4% (mainly driven by the long and severe Argentine default, as well as the years following the financial crisis of 2007-2008). To summarize, over the past decades, only a small subgroup of bonds saw protracted losses.

Figure 5: The bottom bin: share of bonds with negative returns

Panel A: Full sample, 1815-2016




Panel B: Modern sample, 1994-2016




*Note:* This figure shows the share of country bond portfolios with a negative, annual real return over different holding periods (years 1 to 10). Panel A includes all countries and years, while Panel B focuses on the modern (post-1990) subsample.

## 3.4. Returns by country

This section shows bond returns for individual countries and by country groups, in particular the group of serial defaulters. We also show statistics for excess returns above “risk-free” bonds as described above, using UK and US government bonds as benchmark for bonds issued in GBP and USD, respectively.

To group countries, we start with 49 sovereigns with multiple defaults on their external debts (two or more). This group of “serial defaulters” includes Argentina, Austria, Belize, Bolivia, Brazil, Bulgaria, Chile, China, Colombia, Costa Rica, Cote d'Ivoire, Cuba, Czechoslovakia, Dominican Republic, Ecuador, Egypt, El Salvador, Gabon, Germany, Ghana, Greece, Grenada, Guatemala, Honduras, Hungary, Indonesia, Jamaica, Mexico, Morocco, Nicaragua, Nigeria, Pakistan, Panama, Paraguay, Peru, Poland, Portugal, Romania, Russia, Senegal, South Africa, Spain, Sri Lanka, Tunisia, Turkey/Ottoman Empire, Ukraine, Uruguay, Venezuela and Serbia/Yugoslavia.

The second group ("Others") includes 20 sovereigns that never defaulted on their external debt issued in London and New York (Armenia, Australia, Azerbaijan, Belarus, Belgium, Canada, Denmark, France, Georgia, Ireland, Kazakhstan, Lebanon Malaysia, Mongolia, Namibia, Netherlands, New Zealand, Norway, Sweden and Switzerland). In addition, we include 19 countries that defaulted externally only once in their history (Angola, Cameroon, Croatia, Estonia, Ethiopia, Finland, Iraq, Italy, Japan, Jordan, Kenya, Latvia, Lithuania, Philippines, Tanzania, Thailand, Trinidad and Tobago, Vietnam and Zambia).

Table 5: Bond returns for different country groups and eras

| | Arithmetic mean (annual) | Geometric mean (annual) | SD | Excess return (mean, above UK/US bonds) |
|---|---|---|---|---|
| Total Sample (1815-2016) | | | | |
| Serial Defaulters | 7.4 | 6.2 | 15.8 | 4.5 |
| Other countries with ext. bonds | 6.3 | 5.8 | 10.7 | 3.4 |
| UK/US 10y gov. bonds | 3.3 | 2.8 | 9.9 | |
| Early 19th Century (1815-1869) | | | | |
| Serial defaulters | 10.6 | 8.8 | 20.4 | 5.9 |
| Other countries with ext. bonds | 7.4 | 6.8 | 12.3 | 2.2 |
| UK 10y gov. bonds | 5.3 | 4.7 | 11.3 | |
| Pre-WW1 (1870-1913) | | | | |
| Serial defaulters | 7.1 | 6.7 | 10.0 | 4.1 |
| Other countries with ext. bonds | 6.1 | 6.0 | 6.2 | 3.1 |
| UK 10y gov. bonds | 3.0 | 2.9 | 5.6 | |
| Interwar (1920-1937) | | | | |
| Serial defaulters | 6.0 | 4.1 | 19.9 | -3.5 |
| Other countries with ext. bonds | 10.1 | 9.1 | 15.7 | 0.9 |
| US 10y gov. bonds | 6.8 | 6.3 | 10.5 | |
| Today (1994-2016) | | | | |
| Serial defaulters | 9.2 | 8.1 | 15.1 | 5.6 |
| Other countries with ext. bonds | 7.4 | 7.0 | 9.4 | 3.8 |
| US 10y gov. bonds | 4.1 | 3.8 | 9.1 | |

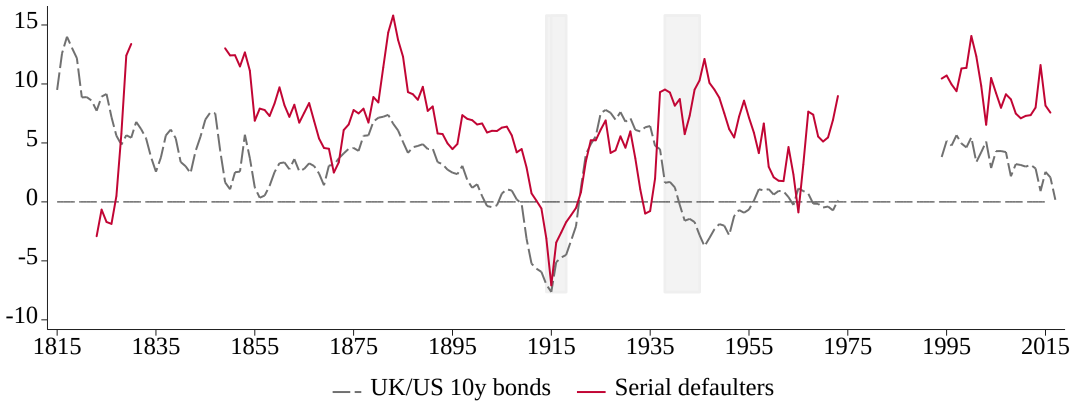
*Notes:* This table shows summary statistics of yearly total real returns on foreign-currency sovereign bonds across 200 years for different country groups, as defined in the text (serial defaulters are those with two or more external defaults). We also show returns of "risk-free" US/UK government bonds using a spliced UK/US series that combines the returns of UK 10-year bonds (until 1918) with that of US 10-year bonds (for the subsequent 100 years). Excess returns above UK/US bonds are computed on bond level.

Table 5 shows summary statistics for the three country groups, meaning (i) serial defaulters and (ii) others that issued debt in USD and GBP abroad (including one-time defaulters), and (iii) "risk-free" US or UK long-term government bonds. The returns of serial defaulters are higher in the full sample and in most sub-samples over time, except for the interwar period when US/UK bonds and those of other sovereigns perform better. The fact that serial defaulters see significantly higher returns (and a significantly higher standard deviation) indicates that investors are compensated for the risk they take when buying bonds of economically volatile countries with a bad credit history.

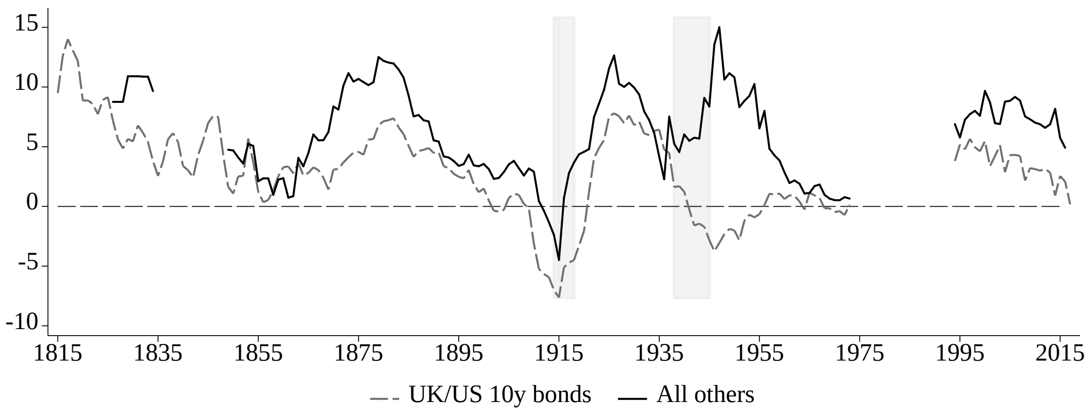
Figure 6 shows the average performance across country groups over time, by using 10-year moving averages since 1815. We again compare the returns on bonds of serial defaulters (Panel A) with those of other countries issuing abroad (Panel B), as well as on UK/US government bonds. The bonds of serial defaulters see significant excess returns above UK/US bonds in all periods besides the interwar years. The returns of serial defaulters (Panel A) also tend to be higher than those of other external bonds (Panel B), except in the 1920s and in the years after WW2.

Figure 6: Trends in sovereign bond returns, 1815-2017

Panel A: Returns on external bonds of serial defaulters vis-à-vis domestic US/UK gov. bonds




Panel B: Returns on external bonds by other countries vis-à-vis domestic US/UK gov. bonds




Note: This figure shows time series of 10-year moving-average returns on external sovereign bonds across 200 years. The shaded bars represent WW1 and WW2. The country groups are summarized in the text above. Serial defaulters are those with two or more external defaults. The UK/US bonds series is spliced, by combining UK 10-year bonds (until 1918) with US 10-year bonds (for the subsequent 100 years).

We next look at returns on the country level. Table 6 reports yearly, real returns (using arithmetic averages), for all countries for which we have more than 15 years of bond price data. Countries are ranked by average real returns. We also show excess returns (above UK/US bonds), the standard deviation of returns, as well as the number of sovereign default events and the share of years in default since independence. The country comparison is complicated by the fact that some countries, including most advanced countries, no longer issue in foreign currency in London or New York. Other countries only entered international capital markets in recent decades (see Appendix B1 for an overview of data coverage by country).

The results in Table 6 are consistent with our findings so far. Sovereign bonds of countries with a history of serial default tend to show higher returns, but also a higher volatility. The returns look surprisingly higher even for notorious "serial defaulters", such as Argentina, Ecuador, Greece, Mexico, Russia, Ukraine or Venezuela, which feature long-run excess returns between 5% and 12%. It is also remarkable that not a single country in Table 6 shows a negative arithmetic return, on average.

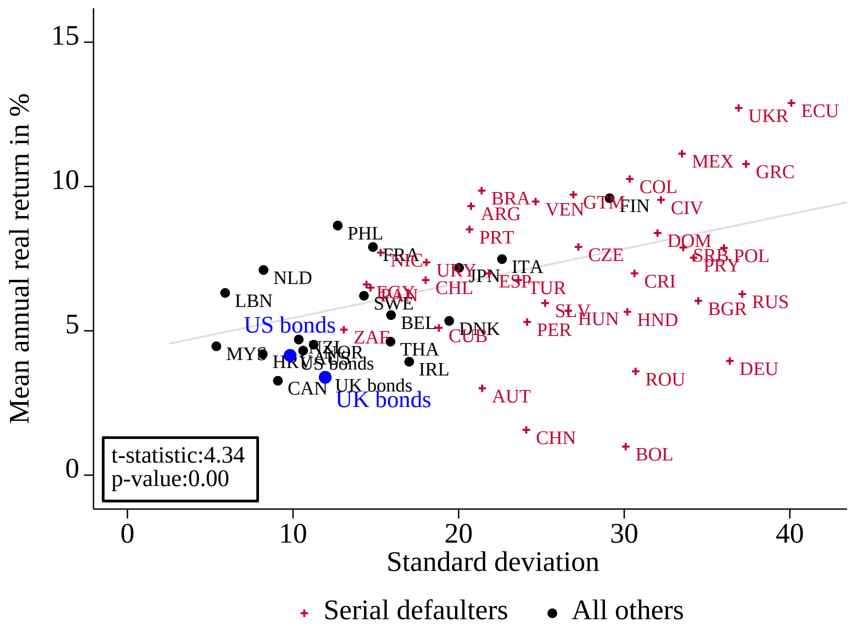
Table 6: Sovereign bond returns by country

| Country | Real return, arithmetic | | Excess return, real, arithm., above US/UK gov. bonds | Annual obs. with bond returns | Share of years in default since independence | Number of defaults (on private, ext. creditors) |
|---|---|---|---|---|---|---|
| | Annual mean | SD | | | | |
| Pakistan° | 17.3 | 39.1 | 14.3 | 16 | 9 | 3 |
| Greece* | 13.7 | 37.4 | 12.0 | 98 | 50 | 7 |
| Ukraine° | 12.6 | 36.9 | 9.5 | 15 | 15 | 2 |
| Ecuador | 12.2 | 40.1 | 7.6 | 48 | 56 | 9 |
| Mexico | 11.0 | 33.5 | 8.1 | 149 | 45 | 10 |
| Colombia | 10.8 | 30.3 | 8.2 | 112 | 37 | 10 |
| Brazil | 9.9 | 21.4 | 6.2 | 146 | 23 | 6 |
| Finland* | 9.7 | 29.1 | 6.5 | 42 | 6 | 1 |
| Guatemala | 9.7 | 26.9 | 5.6 | 55 | 35 | 7 |
| Cote d'Ivoire | 9.5 | 32.2 | 5.8 | 17 | 51 | 2 |
| Venezuela | 9.4 | 24.6 | 5.6 | 83 | 34 | 9 |
| Philippines° | 9.1 | 12.7 | 5.2 | 24 | 14 | 1 |
| Argentina | 9.1 | 20.7 | 5.7 | 112 | 32 | 7 |
| Czechoslovakia* | 8.8 | 27.2 | 7.3 | 47 | 66 | 3 |
| Portugal* | 8.6 | 20.7 | 5.2 | 75 | 11 | 4 |
| Poland | 8.4 | 36.0 | 6.1 | 69 | 40 | 3 |
| Dominican Republic | 8.3 | 32.0 | 3.8 | 56 | 27 | 7 |
| France* | 7.9 | 14.8 | 4.9 | 32 | 0 | 0 |
| Nicaragua | 7.7 | 15.3 | 4.5 | 36 | 47 | 6 |
| Serbia/Yugoslavia | 7.6 | 33.6 | 6.7 | 64 | 23 | 5 |
| Uruguay | 7.5 | 18.1 | 5.3 | 120 | 12 | 9 |
| Italy* | 7.4 | 22.6 | 4.9 | 111 | 4 | 1 |
| Spain* | 7.3 | 21.8 | 4.5 | 129 | 23 | 5 |
| Turkey/Ottoman Empire | 7.2 | 23.6 | 3.4 | 96 | 15 | 9 |
| Egypt | 7.2 | 14.4 | 3.5 | 90 | 3 | 3 |
| Japan* | 7.1 | 20.0 | 4.7 | 102 | 10 | 1 |
| Netherlands* | 7.1 | 8.2 | 2.2 | 27 | 6 | 1 |
| Costa Rica | 7.1 | 30.6 | 4.8 | 91 | 38 | 10 |
| Paraguay | 7.0 | 34.2 | 3.7 | 55 | 22 | 7 |
| Panama | 7.0 | 14.7 | 3.6 | 46 | 25 | 2 |
| Chile | 6.4 | 18.0 | 3.9 | 130 | 27 | 8 |
| Sweden* | 6.4 | 14.3 | 2.5 | 66 | 0 | 1 |
| Lebanon° | 6.3 | 5.9 | 3.5 | 18 | 0 | 0 |
| Hungary/Austria-Hungary | 6.2 | 26.6 | 4.5 | 115 | 42 | 5 |
| El Salvador | 6.1 | 25.2 | 3.2 | 75 | 26 | 6 |
| Bulgaria | 6.0 | 34.5 | 4.2 | 87 | 63 | 5 |
| Russia | 5.9 | 37.1 | 2.8 | 137 | 37 | 4 |
| Honduras | 5.7 | 30.2 | 1.2 | 69 | 60 | 3 |
| Belgium* | 5.7 | 15.9 | 3.2 | 73 | 0 | 0 |
| Cuba | 5.5 | 18.8 | 4.3 | 72 | 32 | 3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Denmark* | 5.3 | 19.4 | 3.3 | 77 | 0 | 0 |
| Peru | 5.2 | 24.1 | 3.1 | 114 | 39 | 8 |
| South Africa | 4.9 | 13.1 | 2.3 | 41 | 5 | 3 |
| New Zealand* | 4.7 | 10.3 | 1.7 | 88 | 0 | 0 |
| Thailand | 4.6 | 15.9 | 2.0 | 43 | 3 | 1 |
| Norway* | 4.5 | 11.2 | 1.6 | 66 | 0 | 0 |
| Malaysia° | 4.4 | 5.4 | 1.5 | 16 | 0 | 0 |
| Australia* | 4.3 | 10.6 | 1.2 | 75 | 0 | 0 |
| Croatia° | 4.2 | 8.2 | 0.5 | 20 | 20 | 1 |
| Ireland* | 4.1 | 17.0 | 1.8 | 29 | 0 | 0 |
| Romania | 4.0 | 30.7 | 2.0 | 79 | 32 | 3 |
| Germany* | 3.6 | 36.4 | 1.2 | 88 | 12 | 4 |
| Estonia* | 3.4 | 44.2 | 2.1 | 38 | 40 | 1 |
| Canada* | 3.2 | 9.1 | 0.9 | 100 | 0 | 0 |
| Austria/Austria-Hungary* | 2.3 | 21.4 | 2.0 | 52 | 17 | 2 |
| China | 1.4 | 24.1 | -1.0 | 108 | 13 | 8 |
| Bolivia | 1.1 | 30.1 | -4.5 | 23 | 21 | 4 |
| Average across all 88 countries in the sample | 7.0 | 20.1 | 4.4 | 48 | 20 | 3 |

*Notes:* The table shows average annual real returns by country using arithmetic averages across all bonds outstanding at each point in time. Only countries with 15 or more years of data are included. For countries marked with an asterisk (*) we only have historical bond returns (in the sample 1815-1973). For countries that are marked with a circle (°) we only have returns in the modern sample (1994-2016). See Appendix B1 for a detailed overview of the years covered by country. The default data use the recent update by Reinhart and Rogoff (2009).

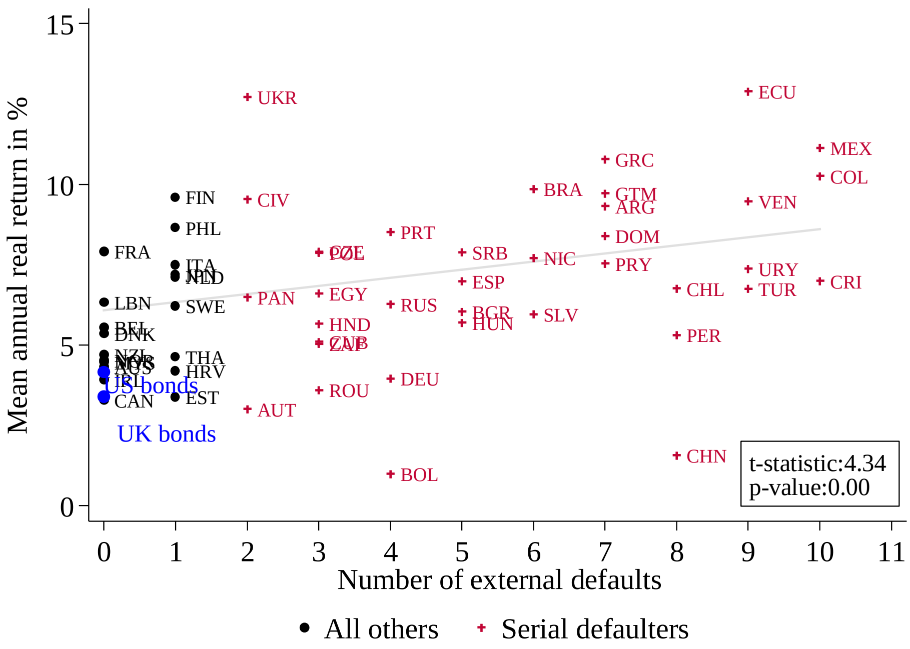
Figure 7: Sovereign risk-return profiles: returns and standard deviations, 1815-2016




*Notes:* This figure plots real, average returns on sovereign external bonds against their standard deviation by country, as shown in Table 6 (we include countries with 15 years or more of bond price data). Two outliers are dropped from the graph (Pakistan, Estonia), but they are included when estimating the fitted line and the t-statistic and p-value shown.

To visualize the risk-return patterns by country, Figure 7 plots the average annual real return against the standard deviation by country. Serial defaulters (marked in red) feature average yearly returns that are mostly in the range of 5-10% as well as a standard deviation of returns above 20%. The external bonds of other countries show both a lower average standard deviation and lower average returns. For completeness, we also show observation for the “risk-free” government bonds of the UK and the US (marked in blue), with an average yearly real return of 3.4% and 4.1% across the 200 years under study, and a standard deviation of 12 and 10, respectively.

Figure 8: The role of credit history: returns and default frequency, by country, 1815-2016




*Notes:* This figure plots real, average returns on sovereign external bonds against the total number of defaults since independence by country, as shown in Table 6 (we include countries with 15 years or more of bond price data). One outlier is dropped from the graph (Pakistan), but is included when estimating the fitted line and the t-statistic and p-value shown.

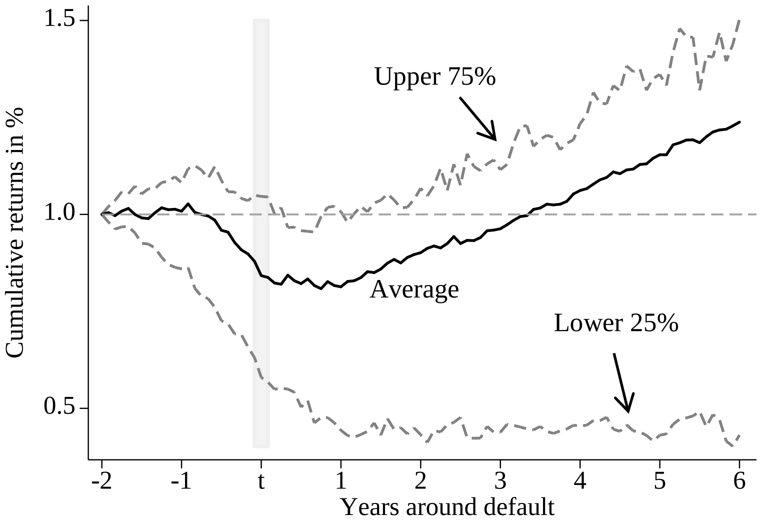
Figure 8 complements the picture by plotting the average real ex-post bond returns on the vertical axis against the total number of external sovereign default events (on bonds or bank loans) since 1815 (or since independence) on the horizontal axis (using the recent default data update from Reinhart and Rogoff 2009 and Reinhart and Trebesch 2016). Like before, we find bond returns to increase in the riskiness of a country, measured by the number of past defaults. The only serial defaulters with comparatively low returns (below 5%, on average) are Austria, Bolivia, China, Germany and Romania.

## 4. Bond performance in debt crises: combining returns, defaults and haircuts

This section studies the link between bond returns, defaults and haircuts, by combining the data on debt restructurings and creditor losses of Section 2 with those on bond prices and returns in Section 3.

Figure 9 shows a time series of total returns around all sovereign bond default events in our sample for which we have sufficient bond price data (97 cases out of a total of 158 sovereign bond defaults in the sample[33]). The total cumulative return series is indexed to one, two years (24 months) prior to the default. The bold black line shows the average across all bonds in the global portfolio, while the dotted grey lines show the upper and lower quartiles.

Figure 9: Cumulative returns on external sovereign bonds around default events




*Note:* This figure shows total cumulative returns on sovereign external bonds around default events, using real, monthly return data and taking into account losses due to missed coupons and haircuts. The total return series are normalized to one in year two (24 months) prior to the default. The bold black line shows the average across all bonds in the global portfolio, while the dotted grey lines show upper and lower quartiles. We include all 97 default episodes for which we have sufficient pricing data before and after the default.

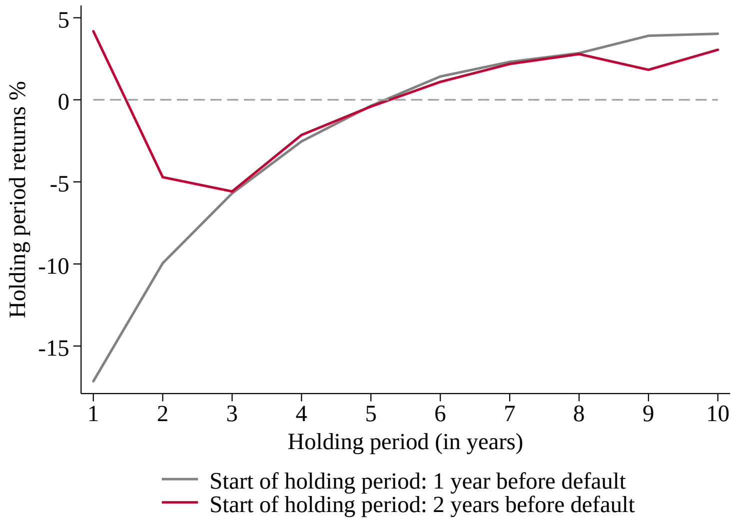
The total cumulative bond return drops markedly in the year pre- and post-default, by almost 20%. After that, however, total returns tend to recover fast. On average, an investor that bought bonds two years before a default breaks even just over three years after the default, thus fully recouping the losses suffered. The break-even point is similar for an investor that happened to enter one-year pre-default. Another important insight from Figure 9 is that the worst performers do *not* see a quick recovery. Investors who suffer from a particularly severe decline in total returns (those in the bottom 25th percentile) continue to show total returns in deep negative territory even six years post-default, far from breaking even. Put differently, we find that around one third of all debt crises for which we have data see protracted investor losses. Most of these occur in the historical (pre-WW2) period. In recent decades, only the default of Argentina 2001 and Ecuador 2008 caused protracted bondholder losses. In Argentina, it took until 2016 to recover the losses (a period of 15 years), while it took more than five years after Ecuador's 2008 default. Appendix B4 shows cumulative returns for a dozen serial defaulters, including Argentina and Ecuador.

As an alternative way to show the break-even point around default, Figure 10 builds annual geometric returns for different holding periods around default. We assume two scenarios. The red line shows HPRs for investors entering two years pre-default, while the grey line shows HPRs when entering one year

[33] This does not include the large number of sovereign defaults on syndicated bank loans (see Figure 1 above).

before. Those investing two years pre-default see their holding period returns drop from +4% in year one to below zero in the default year. Those investing one year before see strongly negative returns from year one. However, both the red and grey line show a break-even in year five, meaning three or four years after the default, respectively (depending whether they entered two or one year before).

Figure 10: Geometric holding period returns around default events




*Note:* This figure plots the average *geometric* returns for different holding periods under two different scenarios. In the first scenario investors enter two years before the default (red line), while in the second scenario (grey line) investors enter just one year pre-default. We include all 97 default episodes for which we have sufficient pricing data before and after the default.

Figure 11: Bond returns in debt crises: high vs. low haircut

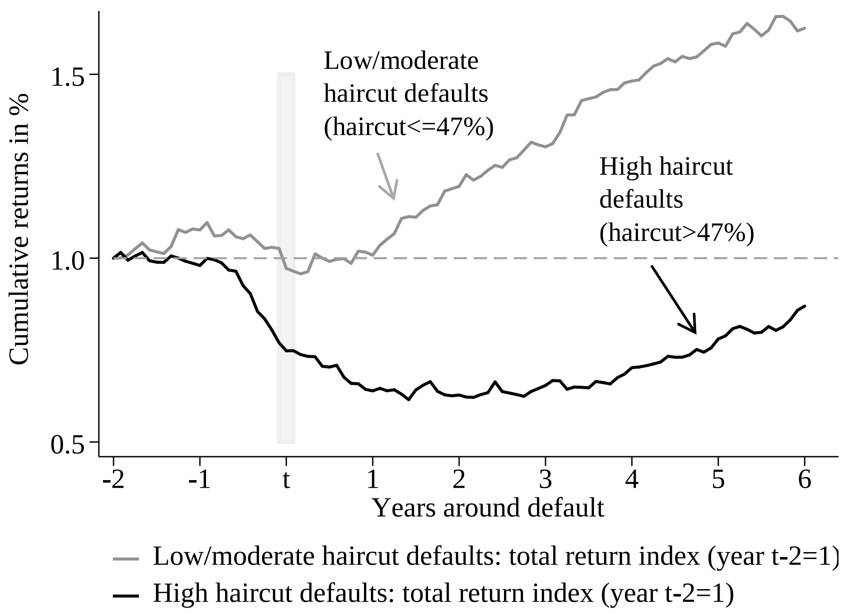



Figure 11 uses the same data but takes another perspective, by comparing sovereign defaults with “high” vs “low/moderate” haircuts. Defaults involving a haircut above the median of 47% are categorized as “high” haircut cases, while those with lower haircuts are categorized as “low/moderate”. As can be seen, the decline in investor returns is much smaller for low-haircut cases. In these events losses are recouped in little more than a year, on average. In contrast, the bond price collapse is pronounced in “high” haircut cases. Investors hit by deeper defaults need to wait more than six years, on average, to break even. Nevertheless, even for these severe defaults, losses are eventually recouped for the large majority of cases.

## 5. Comparison to alternative assets

In this section, we compare the returns on external sovereign bonds from our new database to that of other major asset classes traded on UK and US capital markets. Like before, we use a global portfolio time series including all foreign-currency sovereign bonds in the sample at each point in time. For comparison purposes, we start with “risk-free” assets in financial centers, by using returns data on US and UK bills and bonds (US and UK 3-month treasury bills as well as US and UK long-term government bonds), which are available for the full 200-year sample. We also gather long-run data on stock indices, using total return indices from the UK (FTSE) and the US (S&P index), from 1815 onwards. Moreover, we gather data on total returns on US corporate bonds in the long run, using returns on the S&P AAA Corporate Bond Price Index between 1900 to 1984 and from the Bank of America US Corporate AAA Bond Index from 1988 onwards. The detailed data sources are provided in Appendix A.

To compute excess returns on external sovereign bonds and to compare these to the excess returns of other assets we use two alternative approaches. First, we benchmark each asset (or bond) against monthly treasury bills (either UK or US bills, depending on the currency denomination of the respective bond or asset). This approach has the advantage that it is best suited for comparisons between assets and is used in related work e.g. Dimson et al. (2001) or Jordá et al. (2017). In a second step, we report excess returns above long-term UK or US bonds (10-year), which has been our approach so far but is less standard in the literature comparing asset classes over the long run. The resulting monthly excess returns series are used to compute standard deviations, as well as Sharpe ratios.

Table 7 shows the detailed results for the full sample, as well as for the sub-sample with more recent data (1994-2016). Figure 12 visualizes the main findings, by focusing on average returns and their respective Sharpe ratios across asset classes. Since the distribution of returns deviates slightly from the normal distribution, we also calculate modified Sharpe ratios following standard practice. [34]

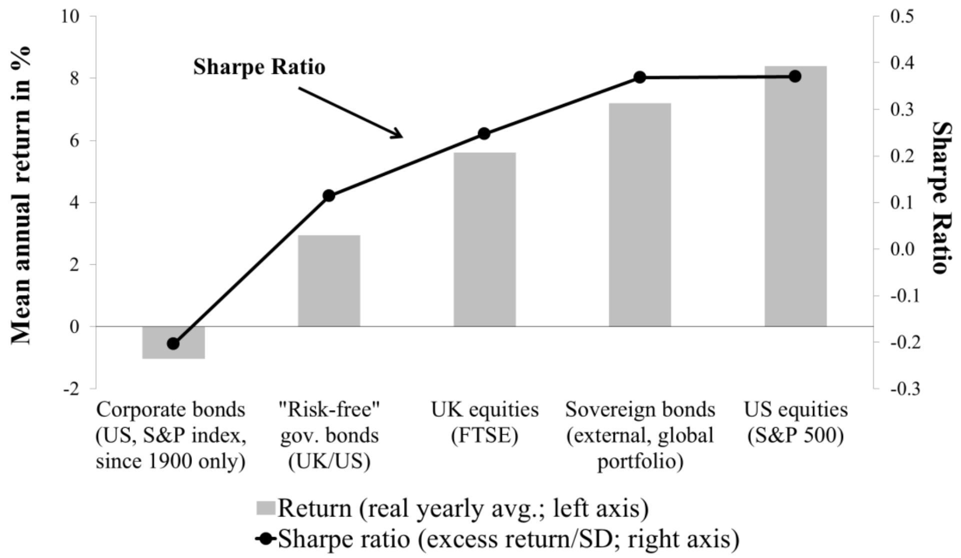
The main insight from Figure 12 and Table 7 is that, across the two centuries under study, a global portfolio of external sovereign bonds shows favorable risk-return properties compared to other financial

[34] We calculate adjusted Sharpe ratios as follows: $\text{Sharpe\_adj} = \frac{\text{excess return}}{\mu - Z*\sigma}$, with $Z = \left(z_c + \frac{1}{6}(z_c^2 - 1)S + \frac{1}{24}(z_c^3 - 3z_c) - \frac{1}{36}(2z_c^3 - 5z_c)S^2\right)$ where $z_c$ corresponds to the Z-score of the confidence interval (here: 95%) and μ,σ, S and K are the mean, variance, skewness and kurtosis of the returns. “Excess” denotes the return above the risk-free return. Z represents a penalty factor for negative skewness and excess kurtosis.

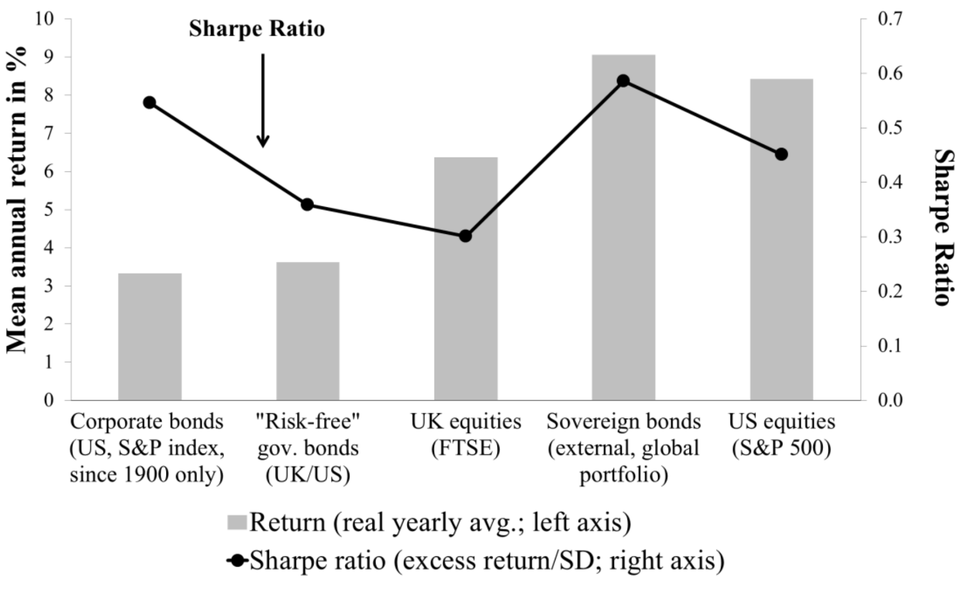
assets. Only US equities show a higher average return, but also a higher standard deviation. External sovereign bonds also show a high Sharpe ratio, on the same level as US equities, and exceeding that of UK equities, US corporate bonds and US or UK government bonds.

Figure 12: Risks and returns across alternative asset classes

Panel A: Full sample, 1815-2016




Panel B: Modern sample, 1994-2017




*Note:* This figure shows average annual real returns and Sharpe ratios (based on the time series of excess returns vis-à-vis US/UK bills) for the full sample period (Panel A) and for the modern period (Panel B) for different asset classes. See Table 7 for the underlying numbers.

Table 7: Risks and returns over 200 years: comparison to other asset classes

Panel A: Excess returns **above UK or US bills**

| | **Full Sample**, 1815-2016 | | | | | **Modern Sample**, 1994-2016 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean yearly return | Excess return | SD | Sharpe ratio | Adj. Sharpe ratio | Mean yearly return | Excess return | SD | Sharpe ratio | Adj. Sharpe ratio |
| Sovereign bonds (external, global portfolio) | 7.19 | 4.97 | 14.85 | 0.37 | 0.36 | 9.07 | 8.68 | 14.68 | 0.59 | 0.66 |
| US equities (S&P 500) | 8.39 | 6.84 | 18.69 | 0.37 | 0.42 | 8.43 | 8.12 | 18.05 | 0.45 | 0.59 |
| UK equities (FTSE) | 5.61 | 3.02 | 14.47 | 0.25 | 0.27 | 6.37 | 4.78 | 15.56 | 0.30 | 0.47 |
| US corporate bonds (S&P AAA, since 1900) | -1.04 | -1.31 | 8.71 | -0.20 | -2.08 | 3.33 | 3.03 | 5.82 | 0.55 | 0.73 |
| US Treasuries (10 year) | 4.11 | 2.56 | 9.51 | 0.34 | 0.39 | 3.63 | 3.32 | 9.63 | 0.36 | 0.58 |
| UK gov. bonds (10 year) | 3.06 | 0.47 | 11.43 | 0.06 | 0.07 | 4.66 | 3.07 | 8.51 | 0.38 | 0.50 |
| US bills (3-month) | 1.73 | | 5.58 | | | 0.31 | | 1.96 | | |
| UK bills (3-month) | 2.59 | | 6.91 | | | 1.59 | | 2.76 | | |

Panel B: Excess returns **above long-term UK or US bonds**

| | **Full Sample**, 1815-2016 | | | | | **Modern Sample**, 1994-2016 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean yearly return | Excess return | SD | Sharpe ratio | Adj. Sharpe ratio | Mean yearly return | Excess return | SD | Sharpe ratio | Adj. Sharpe ratio |
| Sovereign bonds (external, global portfolio) | 7.19 | 4.23 | 14.85 | 0.31 | 0.31 | 9.07 | 5.36 | 14.68 | 0.28 | 0.41 |
| US equities (S&P 500) | 8.39 | 4.28 | 18.69 | 0.23 | 0.26 | 8.43 | 4.80 | 18.05 | 0.21 | 0.35 |
| UK equities (FTSE) | 5.61 | 2.55 | 14.47 | 0.21 | 0.23 | 6.37 | 1.71 | 15.56 | 0.09 | 0.17 |
| US corporate bonds (S&P AAA, since 1900) | -1.04 | -2.74 | 8.71 | -0.55 | -4.34 | 3.33 | -0.29 | 5.82 | -0.06 | -0.07 |
| US Treasuries (10 year) | 4.11 | | 9.51 | | | 3.63 | | 9.63 | | |
| UK gov. bonds (10 year) | 3.06 | | 11.43 | | | 4.66 | | 8.51 | | |

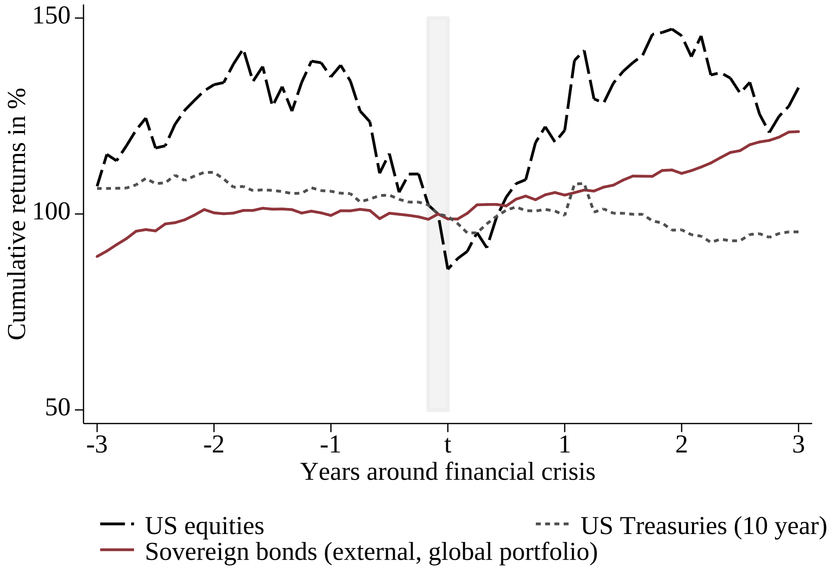
*Notes:* The table shows average yearly arithmetic returns of our global portfolio of external sovereign bonds as well as for other asset classes traded in London and New York. For comparison across assets, the time series of excess returns and Sharpe ratios (the ratio of excess returns over their standard deviation) are computed using UK/US bills of the same currency as "risk-free" benchmark (Panel A), or alternatively using excess returns above long-term UK/US bonds as a benchmark (Panel B). Recall that we only use USD and GBP denominated bonds in our baseline data sample. The formula to compute adjusted Sharpe ratios is shown in Footnote 34 above.

When looking at the modern (post-1994) sample, the global portfolio of external bonds fares even better, in comparison (Panel B of Figure 12 and Table 7). The average return on external sovereign bonds now surpasses that of US equities and also shows the highest Sharpe ratio of all asset classes under study. Investors seem to benefit from the relatively low number of sovereign bond defaults in the past 20 years.

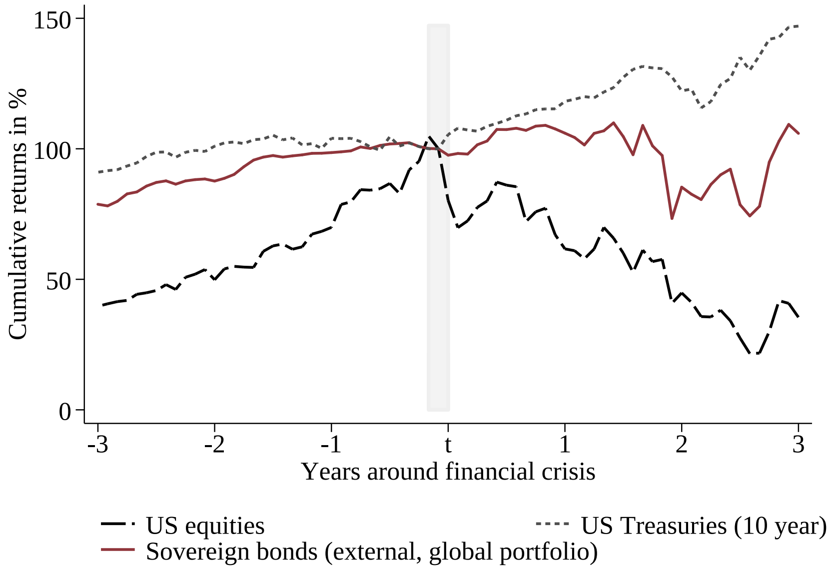
To conclude, we ask: Are sovereign bonds of periphery countries a substitute for government bonds and equities in the US or UK? In particular, does this asset offer protection against shocks in financial centers? To shed light on these questions we focus on major financial crises in the US and compare the return performance of US stocks, US Treasuries and of our portfolio of external sovereign bonds. Specifically, we show cumulative returns three years before and after the New York Panic of 1907 (crash month: October), the Great Depression (crash month: October 1929), and the recent Financial Crisis (crash month: Sept. 2008). Figure 13 shows the resulting monthly return series - indexed to 100 at the start of the crisis.

Figure 13: Asset returns during major financial crises

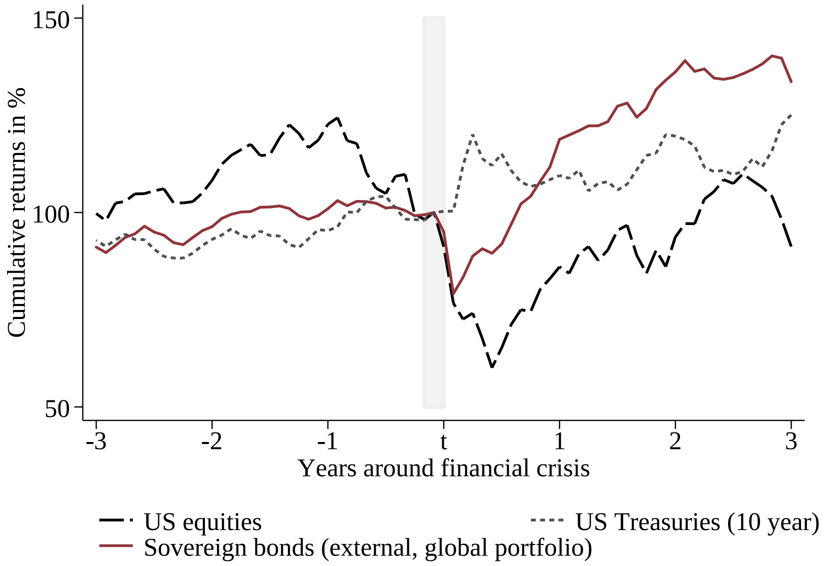
Panel A: New York Panic of 1907




Panel B: Great Depression



Panel C: Global Financial Crisis of 2008




*Notes:* This figure shows the cumulative return index around the following financial crises: the New York Panic 1907, starting in October, the Great Depression (dated on Black Tuesday in October 1929) and the Global Financial Crisis (culminating in September 2008). All graphs in the three panels above are indexed at 100 in the respective starting month of the crisis. All series are given in real values and show the compounded return based on Equation 4.

The case study results are broadly in line with the aggregate statistics. The real returns on external sovereign bonds are less volatile than those on equities. In all three crises, stock returns fall sharply during the crash, while the returns are comparatively stable for external bonds. Moreover, after three years, external sovereign bonds show higher cumulative returns than stocks in two out of the three crash events. Compared to US Treasuries, external sovereign bonds fare better in 1907, but worse during the Great Depression. In the Financial Crisis of 2008, external sovereign bonds perform similarly than their "risk free" US benchmark in the medium term, even though the return series is more volatile.

## 6. Conclusion

We show that the history of external sovereign bonds is a history of frequent investor profits and occasional, mostly temporary losses. Defaults and haircuts have been a recurring feature of this market, but on average investors were over-compensated for the risks they took, both with regard to the actual losses suffered in default and when compared to other asset classes such as equity. We term this result the "sovereign risk premium puzzle", since the observed returns are difficult to reconcile with standard models of asset pricing and sovereign debt.

The dataset we have assembled will facilitate research on new and old questions of international sovereign debt markets. In particular, we see the need to reexamine our results from the vantage point of debtor countries and with a view to debt sustainability. What is the appropriate scope of debt relief in distress (as a % of debtor country GDP)? How can serial restructurings and lengthy delays in crisis resolution be avoided? And, maybe most importantly, what motivates countries to pay the large observed premia to their foreign creditors (Amador 2012 suggests that they pay to quickly borrow again)? These questions relate to a large and influential literature on political economy problems in sovereign lending and borrowing (Alesina and Passalacqua 2016).

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# Appendix to "Sovereign Bonds since Waterloo"

## Appendix A: Financial and macroeconomic data

This Appendix lists the data sources on financial and macroeconomic variables that we use throughout the paper. We mainly rely on data by Global Financial Data (http://www.globalfinancialdata.com). All series are on a monthly basis.

3-month UK bills, monthly, since 1815

The 3-month UK bill return index in the 19th century builds on data on the 3-month yield on commercial bills (open market rates of discount) from 1815-1899. For the years 1815-1823 it comes from Homer (1967). For the period 1824-1899, the series is retrieved from the NBER Macro history database that published the open market rates of discount provided by the UK parliaments "Parliamentary papers" (1824-1857), The Economist and Investor's Monthly Manual (1857-1899). From 1900 on, the series splices data from the NBER Macro history database (1900-1913), from Morgan (1914-1923) and from the Central Statistical Office of the British government (1924-2017).

3-month US bills, monthly, since 1815

For the years 1815-1862, the 3-month US bills return series uses data provided by Homer (1967), Martin (1886), The Economist (1854-1861) and the periodical Hunt's Merchants Magazine (1843-1853). From 1862-1918, data comes from The Financial Review. From 1919 onwards, data is retrieved from the Federal Reserve Bank using 90-day Treasury bills. For the period 1835-1918, the bill index draws on the minimum coupon rate on US government bonds and commercial bills.

10-year US Treasury bonds, monthly, since 1815

The 10-year US Treasury bond return index is constructed using data by Homer (1967) and Martin (1886), both for the years 1815-1862, from The Economist (1854-1861) and from the periodical Hunt's Merchants Magazine (1843-1853). For 1862-1919 data comes from The Financial Review. From 1920 onwards, the data comes from the Federal Reserve Bank and Salomon Brothers (1995).

10-year UK government bonds, monthly, since 1815

The return index on 10-year UK government bonds was compiled from Neal (1990) for 1815-1823, from The Times (1824-1844), from the periodical The Banker's Magazine (1844-1852), and from the Central Statistical Office of the British government (1853 onwards).

S&P US Stocks Total Return Index, monthly, since 1815

From 1815 to June 1962, we use the US stock market returns index provided by Schwert (1990). From July 1962 onwards, we use the S&P US Stocks Total Return Index from Standard & Poor's.

FTSE UK Stocks Total Return Index, monthly, since 1815

This index is compiled from the following sources: Rostow and Schwartz (1953) which contains data on Bank of England Shares and the East Indies Company from 1815 to 1850, Hayek (1935) from 1851-1867, and Smith and Horne (1934) from 1874 to 1922. Additional sources are the periodical Banker's Magazine (1907-1933), The Economist (1933-1962), and The Financial Times from 1950 onwards.

GFD also uses data from the Central Statistical Office of the British government for the years 1939-1988 and Eurostat from 1989 until to today.

<u>UK CPI index, monthly, since 1815</u>

The total UK CPI index comes from the British Office for National Statistics.

<u>US CPI index, monthly, since 1815</u>

The monthly US inflation index comes from David and Solar (1977) for 1815-1820, and the Federal Reserve Bank for the years 1820-1874. Thereafter calculations are based on Synder (1924) and the Bureau of Labor Statsistics' Consumer Price Index (1913 onwards). From 1875-1912, the index is a constructed weighted price index based on wholesale commodity prices (20%), wages (35%), the cost of living (35%) and rents (10%).

<u>US Corporate bond total return index, monthly, since 1900</u>

The US corporate bond return series is spliced by combing the returns on the S&P 500 AAA Investment Grade Corporate Bond Index from GFD until 1984 with data from the Bank of America Merrill Lynch US Corp AAA Total Return Index thereafter, which we retrieved from the Federal Reserve Bank of St. Louis database.

<u>Detailed Source References:</u>

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<u>Newspapers</u>: The Economist, Financial Times.

<u>Periodicals</u>: Investors Monthly Manual, Banker's Magazine, The Financial Review.

# Appendix B: Bond prices and investor returns

## B1. Database of bond prices and returns

This section summarizes the sources and coding for our database of sovereign bond prices and returns across 200 years. As explained in the main text we focus on bonds issued (i) by central governments, (ii) in foreign (US dollars and British pounds) currency, (iii) traded and priced on the London or New York Stock Exchanges, (iv) with a fixed coupon rate (no floating rate instruments) and (v) with at least one full year of price data (at monthly frequency).

We first discuss the historical data, then move to the modern sample using JP Morgan's EMBI data (after 1990) and then describe the final, merged, 200-year dataset.

**Historical sample period, 1818-1980**

We focus on bonds trading in the main capital markets of each era. For the 19th century we use price data of those external sovereign bonds traded on the London Stock Exchange (LSE). From the early 20th century on, this data is complemented with bonds traded on the New York Stock Exchange (NYSE). New York becomes the dominant market for trading and issuing external sovereign bonds from the mid-1920s onwards.

To identify bonds and code prices we rely on several main sources. The pricing data from London for the early 19th century and until 1870 comes from the Money Market Review, The Economist, Circular to Bankers, Course of the Exchange, and The Banker's Magazine. For the 1869-1929 period we mostly use LSE pricing data from the Investors Monthly Manual, as coded and hosted by William Goetzmann and Geert Rouwenhorst at the International Center of Finance at Yale. We extend their data series of LSE sovereign bond prices by 50 years, using quotations from The Economist and Financial Times from 1930 to 1980. For illustration, Figure B1 shows an example of how this source looks like. The bond price data from the NYSE was coded from the "Bank and Quotation Section" of the Commercial Financial Chronicle (from 1905 to 1927 and 1954-1978) and from the Bank and Quotation Record (from 1927 to 1954).

Prices were coded on a monthly basis as follows: Our baseline is to use price data of the last trading or business day of the month. If end-of-month data are not available, we use the monthly average of high and low prices. If these are not available either, we code no price in that month.

Beyond prices, we draw on additional sources to collect the basic characteristics of each bond, in particular amount issued, issue date, maturity, coupon rates, coupon frequency, repayment schedule, guarantees or type of issuer. These are taken from bond manuals such as Fenn's Compendium of the English and Foreign Funds (1837-1838, 1855, 1857, 1863, 1867, 1869, 1874, 1876, 1883, 1889, 1893); Fortune's Epitome of the Stock and Public Funds (1800, 1810, 1820, 1824, 1826, 1833, 1838-1839, 1850-1851, 1856); Kimber's Records on Government Debts and other Foreign Securities (1918, 1919, 1922, 1934), Moody's Manuals on Foreign and American Government Securities (yearly 1920-1960), and the London Stock Exchange Yearbooks (1877-1878, 1880-1881, 1883-1888, 1890, 1894-1895, 1897, 1899-1901, 1905, 1907-1916, 1919-1920, 1925). For the years 1869 to 1929 bond features are also partly provided by the Investors Monthly Manual.

Figure B1: The Economist - example of historical bond price quotes

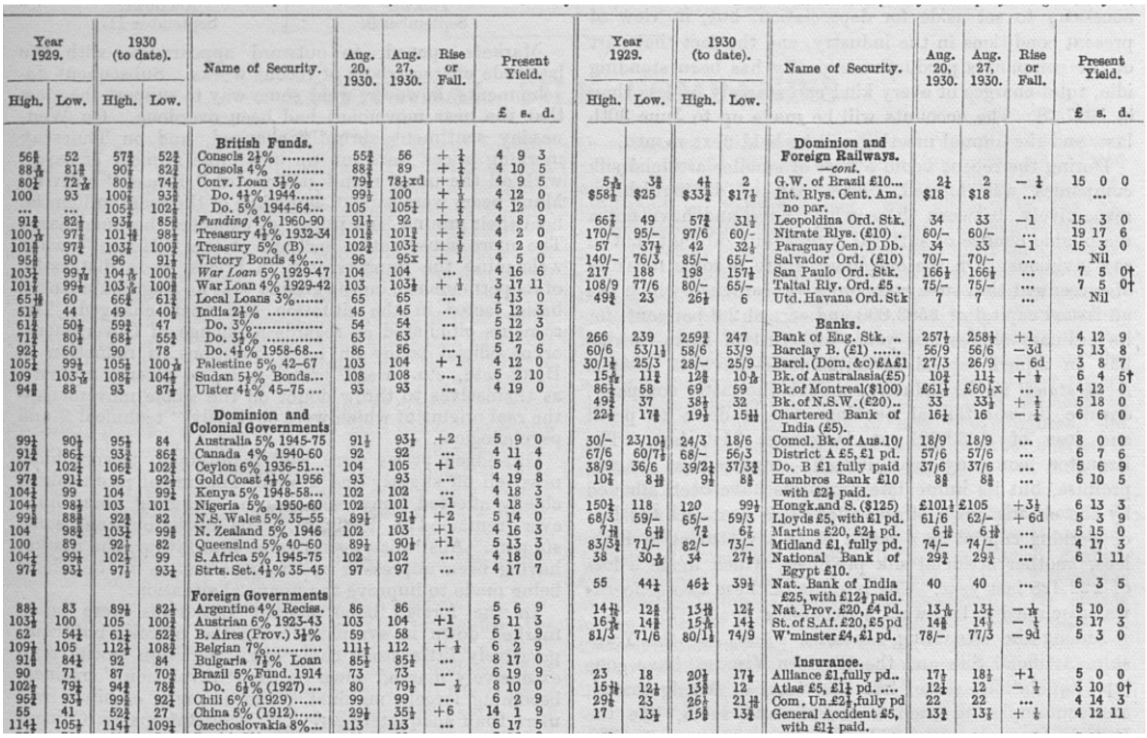
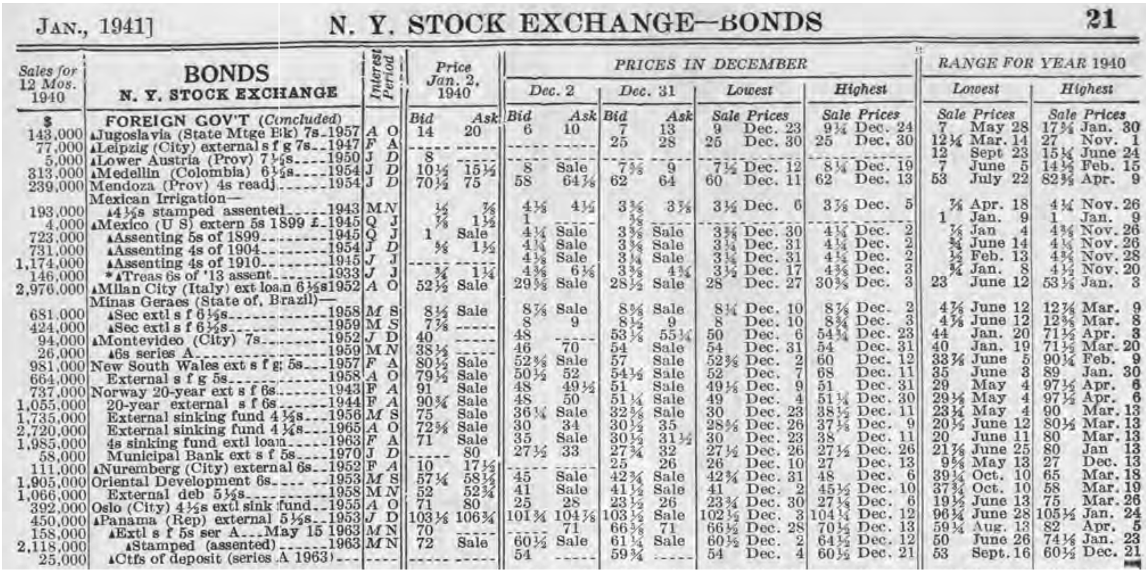


Figure B2: Bank and Quotation Record - example of historical bond price quotes



Sample: Overall, for the historical sample we gathered 290,378 monthly bond price quotes of 1,640 bonds traded in London and New York and listed in the original sources under categories such as "Foreign Government". Upon closer inspection, we drop more than 150,000 of these observations to only include sovereign bonds of independent states issued in US dollars or British pounds.

Specifically:

- We drop 361 bonds issued by former colonies of Antigua and Barbuda, Barbados, Fiji, Ghana, Grenada, Guyana, Hawaii, Hong Kong, Iceland, India, Indonesia, Iran, Jamaica, Kenya, Liberia, Mauritius, Morocco, Newfoundland, Nigeria, Palestine, Philippines, Saint Luca, Sierra Leone, Singapore, Southern Rhodesia, Sri Lanka, Straits Settlement, Sudan, Tanganyika, Trinidad and Tobago and Zanzibar. This reduces our data set to 252,850 monthly bond prices.
- We drop 287 bonds that were issued by provinces and municipalities but not by the central government, leaving us with 198,766 monthly prices.
- We drop 59 local currency bonds as well as 31 bonds denominated in other foreign currencies (e.g. German Mark or French Franc).
- We also drop 12 bonds that were guaranteed by other governments. These include the Greek 1833 bonds whose interest and principal payments were fully guaranteed by Great Britain, France and Russia, or the Austrian 6% guaranteed bond of 1923 which had been issued under the auspices of the League of Nations with guarantees by several European governments. Investor reports of the time regard these bonds not as debt owed by the issuing sovereign but as a liability of the guarantor sovereign. For example, the Investors Monthly Manual lists guaranteed bonds in the section of the guaranteeing nation, e.g. Great Britain.
- Finally, we drop 26 bonds with erratic and infrequent price quotes; 11 exotic bonds such as land warrant bonds or bonds issued by the Khedive of Egypt, but not by Egypt itself; and 32 bonds for which we did not find basic information on coupon, amount issued, or currency.

After these adjustments our final historical dataset covers 146,112 monthly prices and 777 sovereign external bonds issued in US Dollar and British Pound.

## Modern bond period, 1990-2016

For the modern period, we use pricing data provided by JP Morgan, which is available from 1990 onwards, albeit initially for less than five countries that issued these bonds in the wake of the Brady debt restructurings. Therefore, for the global index used in much of the paper, we start using this data in 1994 when the EMBI starts tracking 30 or more liquid sovereign bonds and is therefore more representative.

EMBI data have been widely used in the literature, but unlike most authors we do not use the off-the-shelf indices, but make use of the rich underlying micro data on individual bonds. We rely, in particular, on data from the broadest of their indices, the EMBI Global, which includes sovereign and quasi-sovereign debt instruments from low and middle-income countries that have a minimum issue size of US$500 million, daily pricing data, as well as a remaining maturity of at least one year. For consistency, we again focus on sovereign bonds issued in US dollars and British pounds and therefore disregard local currency bonds, guaranteed bonds and bonds issued by public companies that are included in EMBI Global. We complement this data using the Thomson Reuters Eikon Database to merge bond characteristics such as amount issued, coupon information, and amortization schedules.

In total the EMBI data cover 54,504 monthly price quotations of 732 sovereign external bonds issued in US Dollar and British Pound.

## Final bond pricing sample, 1815-2016

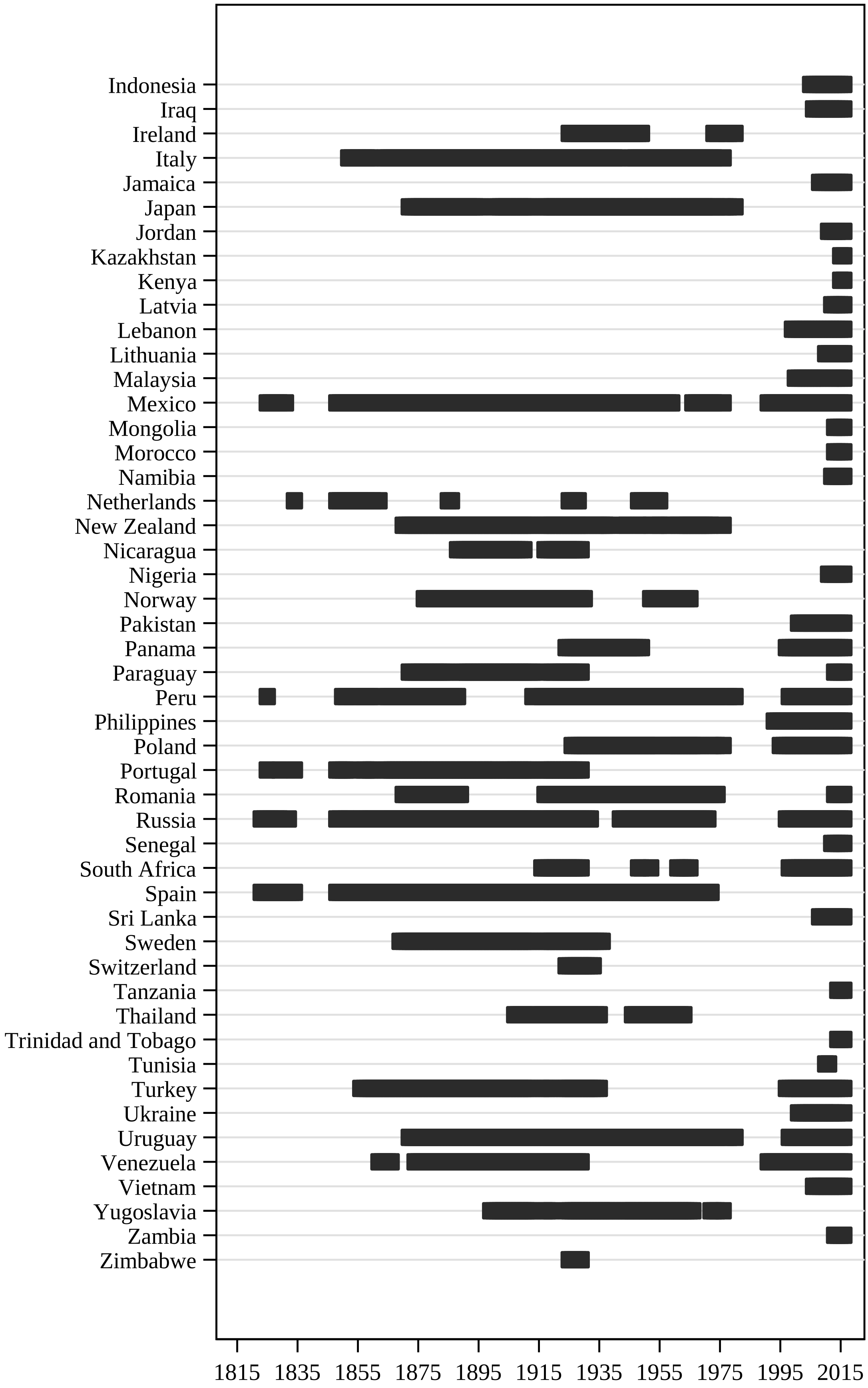
The final bond pricing sample includes 1,509 foreign-currency sovereign bonds with 200,616 monthly pricing quotations of 88 debtor countries. Of these, 68 defaulted on their external debt at some point since 1815, namely, Angola, Argentina, Austria, Belize, Bolivia, Brazil, Bulgaria, Cameroon, Chile, China, Colombia, Costa Rica, Cote d'Ivoire, Croatia, Cuba, Czechoslovakia, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Ethiopia, Finland, Gabon, Germany, Ghana, Greece, Guatemala, Honduras, Hungary, Indonesia, Iraq, Italy, Jamaica, Japan, Jordan, Kenya, Latvia, Lithuania, Mexico, Morocco, , Nicaragua, Nigeria, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Russia, Senegal, Seychelles, , South Africa, Spain, Sri Lanka, Tanzania, Thailand, Trinidad and Tobago, Tunisia, Turkey, Ukraine, Uruguay, Venezuela, Vietnam, Yugoslavia/Serbia, Zambia. The remaining 20 countries never defaulted externally since 1815, namely Armenia, Australia, Azerbaijan, Belarus, Belgium, Canada, Denmark, France, Georgia, Ireland, Kazakhstan, Lebanon Malaysia, Mongolia, Namibia, Netherlands, New Zealand, Norway, Sweden, and Switzerland.

Figure B3 shows the data availability per country and year. The apparent gaps on the sovereign bond price and return data series can mainly be explained as follows:

- In dozens of cases the data coverage ends because countries simply stop issuing new foreign-currency bonds in New York or London. This is particularly true for many advanced countries, e.g. in Europe, which now borrow almost exclusively in their own currency (Euro, Swiss Franc, Swedish Krona etc). In these cases, the series end after WW2 because old bonds mature and no new bonds enter the dataset.
- The gap in the 1960s, 1970s and 1980s can further be explained by the shift from bond to loan financing. In this period sovereign lending was dominated by syndicated bank loans and almost no country issued bonds abroad.
- Historically, the gaps in the 1830s, 1840s and 1850s are also due to a lack of new external bond issuances by (the much smaller group of) sovereigns at the time. In particular, most of the newly founded republics in Latin America faced difficulties in borrowing in London after the wave of defaults following the London Panic of 1825.
- Finally, there are a few cases in which bonds were actively delisted from the LSE or NYSE, e.g. during WW2 (the Axis powers Germany, Italy and Japan as well as annexed Austria and Bulgaria were delisted in 1941/42), or countries in default, such as Bolivia from 1935 onwards.

Figure B3: Coverage of return data by country, 1815-2017

Figure B3 (continued): Coverage of return data by country, 1815-2017



## B2. Computing Returns: Methods and Assumptions

This section discusses important bond features and assumptions underlying our return calculations.

***Treatment of debt restructurings:*** Our return calculations account for sovereign defaults and debt restructurings. First, we take into account missed payments or adjust coupon payments $C_{i,t}$ in case the sovereign made partial payments. In the event of a sovereign debt restructuring, we derive the total return for the respective month $t$ as follows:

$$r_t = \frac{\frac{FV_{new}}{FV_{old}} * P_{new\ bond} + C + cash}{P_{old\ bond}} - 1 \qquad \text{(B.1)}$$

where $P$, $C$ and $FV$ represent the bond's secondary market price, coupon payments and face values, respectively, $new$ and $old$ denote the old defaulted bonds and the newly issued exchange bonds, respectively, and $cash$ include cash payments or other forms of creditor compensation that is part of the settlement, e.g. to redeem missed interest payments in the form of short-term debt certificates or warrants. Any such bonus debt instruments are considered at market prices (if they are traded and prices are available), or alternatively at face value.

***Sinking funds (historical bonds):*** Most bonds in history are not due and payable at maturity, but have stretched out amortization schemes, often in the form of so-called "sinking fund" arrangements. The sinking fund goes back to at least the 18th century and its rationale is to smooth out the debtor's principal redemption schedule and to thereby reduce the risk of default at any given point in time (instead of having repayment spikes at maturity). There are two main types of sinking funds. The first, simpler type is a fixed sinking fund scheme that is comparable to a linear amortization plan - with equal payments stretching from the end of the grace period until maturity. Second, there are cumulative sinking fund schemes. These follow a predetermined, non-linear (typically increasing) annuity amortization plan written in the bond contract. The sinking fund payments were usually forwarded to a fiscal agent predetermined in the bond contract and this agent used the debt service to amortize the bonds. Often principal amortization payments were determined by a lottery. In that case, in each period, the fiscal agent randomly selects a subset of bonds among all outstanding bonds which are fully or partially repaid. The lottery is repeated until the sinking fund payments made by the sovereign in that period are depleted. To calculate returns we compute the amortization scheme of each bond on a monthly basis and take into account the total sum of repayments at each point, irrespective of whether payments were made to all bondholders or to only a subset of bondholders who won the lottery. This is because the lottery outcomes are random, so one can expect the price effect of the lottery to average out across outstanding bonds.

***Bond buybacks (historical bonds):*** About 80% of the bonds in our historical (pre-WW2) sample contain repurchase clauses. These allowed debtor countries to repurchase parts of their bonds in the secondary market before maturity. Specifically, debtor countries could use the amounts of the contractually agreed debt servicing (sinking fund) payments for the purchase of bonds (at below-par market prices) instead of repaying the debts at par. Such bond buy-backs were reportedly rather common to make partial payments in default situations, when bonds typically trade at depressed prices. We disregard these clauses when computing returns because buy-backs were non-coercive, meaning that investors sold their bonds on a voluntary basis via the secondary market.

***Gold clauses (historical bonds):*** About 50% of bonds in our pre-WW2 bond price sample include gold clauses. These gold clauses are not taken into account when computing returns since they were not legally binding, especially after the abrogation of the gold clause in the US in 1933 and Britain in 1931 As we discuss in Appendix C below, we find that gold clauses played almost no role in the restructuring agreements, meaning that bonds with or without gold clauses receive the same treatment (haircut). We also find no evidence that creditors holding gold-clause bonds ask for better terms in historical restructurings.

***Currency clauses (historical bonds):*** Our sample consists of bonds issued and denominated in USD and GBP. In the historical sample, some bonds contain currency clauses that gave creditors the right to receive repayments from the bond in another currency. We include such bonds, but only if the bond's face value was denoted in either USD or GBP and if creditors have the right to ask for repayment in USD or GBP as well, meaning that bond prices will not contain currency risk. For these bonds we thus disregard the fact that repayments could optionally also be received in another currency. However, we do exclude bonds issued in multiple currencies, meaning that the bond contract lists the bond's face value in more than one currency and the currency of repayment depends on contractual details, such as the choice of the stock exchange for settlement. This type of bonds potentially contains currency risks and could therefore bias our results. Specifically, we find (and exclude) 35 bonds issued in multiple currencies, namely by the governments of Austria, Denmark, France, Hungary, Ireland, Italy, Netherlands, and Switzerland between 1831 and 1929.

***Country break-ups (historical bonds):*** The political borders of Europe, Latin America or Asia saw major changes over the past 200 years and there were several major state break-ups. For our dataset of bond prices and returns we follow conventional practice at the time (e.g. in investor manuals) and assign the bonds of a country that was broken up or newly united to the respective successor state:

- Austria-Hungary: Bonds that were issued by the Austrian Empire or the Kingdom Hungary during the dual monarchy of Austria-Hungary were assigned to Austria or Hungary, respectively.
- Gran Colombia: Bonds issued by Gran Colombia, but assigned to Colombia after the break-up, were linked to Colombia. We use the same procedure for Venezuela. The bonds assigned to Ecuador were not trading in London.
- Ottoman Empire: Bonds of the former Ottoman Empire were assigned to Turkey.
- Prussia: Bonds issued by Prussia are assigned to the German Empire/Germany after 1871.
- Italy: Bonds issued by the Kingdom of Sardinia and Kingdom of the Two Sicilies are assigned to "Italy" after the Official Proclamation of the Kingdom of Italy in 1861.

## B3. Dissecting returns: effects of liquidity, maturity, inflation, attrition bias and price volatility

This section dissects the ex-post, real returns in our long-run sample of external sovereign bonds and checks the results for robustness. We explore the role of a) bond maturity, b) bond liquidity, c) the inflation rate used, d) selection effects (survival bias) and e) the contribution of price changes versus coupon payments for investor returns.

### a) Maturity and term structure

We start by exploring the role of bond maturity in our sample of sovereign external bonds. Table B1 shows average real ex-post returns by remaining maturity in three groups: 1-3 years, 4-10 years and more than 10 years. For recent decades (1994-2016), we find a large term premium, as bonds with short (less than 3 year) maturity show an average return of just 5.8%, compared to an average return of 9.7% for long-term bonds with more than 10 years remaining maturity (these findings are reminiscent of those in Broner et al. 2013). In contrast, we find no term premium for historical bonds, possibly because these bonds had very stretched out repayment profiles. As a result, the average term premium in the full sample is not very pronounced, with an average return of 6.4% for bonds in the 1-3 year range compared to 7% for bonds with more than 10 years remaining maturity.

Table B1: The role of bond maturity: summary statistics

| | Bonds | Real, arithmetic return | | Real annual, geom. return | Real excess return (annual, arithm.) | Amount issued in m USD | Mean coupon rate |
|---|---|---|---|---|---|---|---|
| | | Annual mean | SD | | | | |
| *Total sample, 1818-2016* | | | | | | | |
| 1-3 yrs remain. maturity | 503 | 6.37 | 18.90 | 5.15 | 3.68 | 289.42 | 5.82 |
| 4 -10 yrs remain. maturity | 856 | 6.87 | 13.95 | 5.98 | 4.39 | 377.64 | 5.71 |
| >10 yrs remain. maturity | 929 | 6.99 | 14.58 | 6.03 | 4.14 | 460.84 | 5.11 |
| *Historical sample, 1818-1973* | | | | | | | |
| 1-3 yrs remain. maturity | 219 | 6.50 | 20.53 | 5.06 | 3.94 | 30.14 | 5.33 |
| 4 -10 yrs remain. maturity | 310 | 6.27 | 13.51 | 5.43 | 4.05 | 31.22 | 5.33 |
| >10 yrs remain. maturity | 672 | 6.53 | 14.45 | 5.61 | 3.81 | 47.55 | 4.72 |
| *Modern sample, 1994-2016* | | | | | | | |
| 1-3 yrs remain. maturity | 284 | 5.77 | 7.29 | 5.54 | 2.42 | 1536.42 | 8.16 |
| 4 -10 yrs remain. maturity | 546 | 9.55 | 15.84 | 8.50 | 5.92 | 1944.10 | 7.41 |
| >10 yrs remain. maturity | 257 | 9.70 | 15.40 | 8.57 | 6.07 | 2922.63 | 7.44 |

**b) Bond liquidity (bid-ask spreads)**

The high ex-post returns we observe could partly be driven by liquidity risks. This section explores bond liquidity in our long-run sample of external sovereign bonds. More specifically, we draw on two subsamples of our dataset to examine bid-ask spreads in history and today. Historically, we make use of the price data (bid versus ask prices) from the New York Stock Exchange, which we have coded between 1904 and the early 1970s. For recent decades, we use bid and ask prices as provided by JP Morgan in their EMBI dataset since 1994. To complete the picture, we are currently also coding bid-ask spreads for all bonds traded on the London Stock Exchange after the 1870s (work in progress), since we found this data in historical issues of The Economist.

To categorize bonds, we follow the EMBI bond liquidity classification scheme of JP Morgan (1994) and focus on four liquidity groups:

- High liquidity: Average bid/offer price <3/8 %
- Medium liquidity: Average bid/offer price <3/4 %
- Low liquidity: Average bid/offer price <2 %
- Very low liquidity: Average bid/offer price >=2%

More specifically, to classify bonds, we compute the bid-ask spread for bond j in month t as follows:

$$Bid/Ask - Spread_{jt} = \frac{P_{j,t}^{ask} - P_{j,t}^{bid}}{\frac{1}{2}\left(P_{j;t}^{ask} + P_{j;t}^{bid}\right)} \qquad \text{(B.2)}$$

and then compute annual averages for each bond. Based on this we categorize each bond into in one of the four liquidity groups above.

Figure B4: Outstanding bonds by liquidity category (average bid-ask spreads), 1923-2016

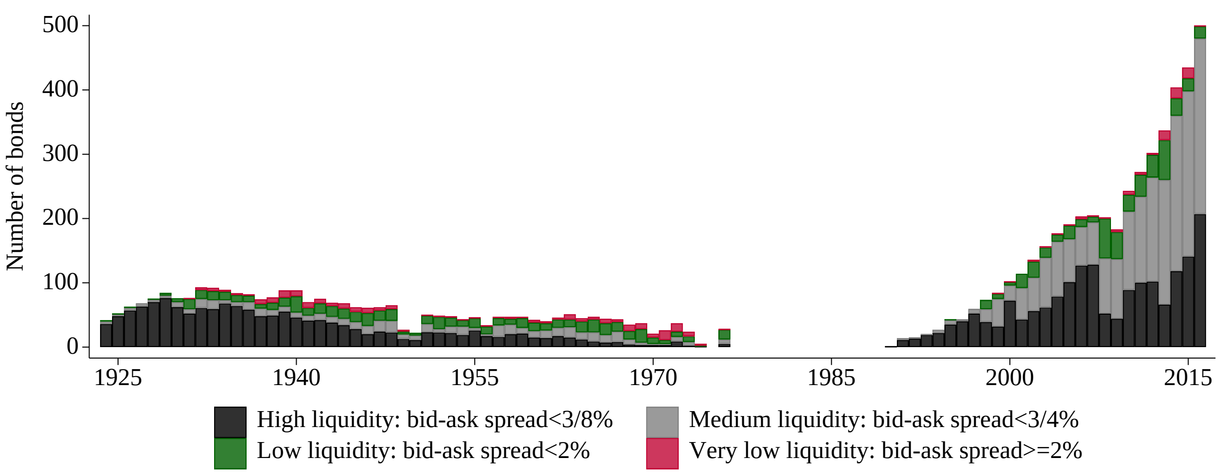



Figure B4 summarizes the liquidity features of our sample across almost 100 years, including more than 190 NYSE and 732 EMBI bonds for which we have bid-ask spreads (for the NYSE data we start in 1923, when we get a decent coverage of more than 50 bonds). Bonds were most liquid during the interwar years, on average. After the depression-era defaults of the early 1930s and in the wake of WW2, overall market liquidity decreases and the share of highly liquid sovereign bonds trading in New York drops significantly, in particularly post-1945. The market for external sovereign bonds becomes liquid again after the mid-1990s, although average bid-ask spreads remain at a lower level than in the 1920s.

Table B2: The role of bond liquidity (bid-ask spreads): summary statistics

| | Bonds | Mean spread | Real, arithmetic return | | Real annual, geom. return | Real excess return (annual, arithm.) | Amount issued in m USD | Mean coupon rate | Mean remaining maturity |
|---|---|---|---|---|---|---|---|---|---|
| | | | Annual mean | SD | | | | | |
| ***Full sample of bonds with bid-ask data*** | | | | | | | | | |
| *(USD bonds traded at the NYSE after 1904 and EMBI bonds since 1994)* | | | | | | | | | |
| High liquidity | 644 | 0.16 | 8.53 | 14.84 | 7.54 | 6.65 | 1096.40 | 5.78 | 16.34 |
| Medium liquidity | 722 | 0.52 | 6.62 | 20.03 | 4.70 | 4.47 | 483.50 | 6.06 | 15.18 |
| Low liquidity | 296 | 1.16 | 2.30 | 23.75 | -0.70 | 0.93 | 420.04 | 5.96 | 16.04 |
| Very low liquidity | 96 | 3.15 | 7.37 | 27.69 | 2.33 | 5.54 | 952.42 | 5.92 | 16.31 |
| ***Only years in default*** | | | | | | | | | |
| *(when bonds are often illiquid)* | | | | | | | | | |
| High liquidity | 96 | 0.17 | 8.42 | 21.19 | 3.78 | 9.45 | 1215.75 | 6.04 | 15.91 |
| Medium liquidity | 93 | 0.54 | 1.03 | 30.90 | -8.26 | 5.73 | 735.76 | 6.20 | 14.59 |
| Low liquidity | 78 | 1.17 | -3.15 | 32.59 | -14.38 | 1.98 | 342.96 | 5.98 | 14.88 |
| Very low liquidity | 37 | 3.31 | 4.16 | 35.28 | -9.76 | 7.74 | 220.26 | 6.48 | 13.60 |

*Note:* This table reports the real and excess return for the four assigned groups mentioned above. Amount issued is given in m USD. Mean coupon rate is the average, nominal coupon rate for each bond. Mean bid-ask spread is computed accordingly to the formula stated above. This bid-ask-spread is computed for every bond *j* in month *t* and then averaged over one year.

Table B2 reports average ex-post returns for each liquidity group, for the full sample for which we have bid-ask spreads and in a subsample of default years, when liquidity tends to decrease. As can be seen, “high” liquidity bonds (those with low bid-ask spreads) show a high average ex-post return of 8.5%, which is higher than our full-sample average of 7.2% (see Table 3 in the main text). This is also true in default years, where the most liquid bond show returns exceeding 8%. In comparison, “medium“ and ”low“ liquidity bonds tend to have lower-than-average returns, both in the full sample and during default (the last category of illiquid bonds contains less than 100 instruments and is not representative). In line with these results, we find a low correlation between returns and bid-ask spreads in the data (it is -0.09 for the historical NYSE data and 0.06 in the post-1994 EMBI data).

In sum, liquidity risk seems like an unlikely explanation for the high observed returns in our global external bond portfolio. Once we finish gathering bid-ask spread data for a broader sample (including bonds traded on the LSE), we plan to run more systematic exercises on the relationship between liquidity and returns in our data.

## c) Sample composition (survival bias)

Survival bias is a special case of selection bias that may distort our results. As evident from Figure B3 above, our global portfolio is not balanced, as countries (and bonds) exit and enter over the 200 years span we cover. Part of the entries and exits are explained by independence (newly founded countries start issuing debt abroad) or state break-ups (e.g. Yugolsavia), while other countries stop issuing foreign-currency bonds altogether (e.g. advanced countries such as Austria, Finland or Switzerland that issued external bonds during the interwar years but moved to domestic-currency bonds since).

We explore the role of sample selection and survival bias by focusing on a subset of 13 countries for which we have more than 100 years of data and thus many decades of overlapping coverage. These countries are, in descending order of years covered: Brazil (140 years of data), Chile, Russia, Uruguay, Mexico, Colombia, Peru, Greece, Italy, Spain, Costa Rica, Argentina, and Canada (100 years of data).

Table B3 shows the average real, ex-post bond return for this subsample of countries with extensive coverage and compares it to that of our baseline results (full-sample global portfolio average). As can be seen, the summary statistics (average returns and their standard deviation) are very similar in the full sample and in the sample of countries with extensive coverage. This alleviates concerns that our results are biased due to survival bias.

Table B3: Survival bias: returns for countries with extensive coverage

| | Real, arithmetic return | | Real annual, geom. return |
|---|---|---|---|
| | Annual mean | SD | |
| Baseline result (full sample, see Table 3) | 7.19 | 14.85 | 6.21 |
| Sub-sample of countries with more than 100 years of data | 7.45 | 15.37 | 6.36 |

*Note:* This table compares the average returns in our full sample (baseline result in the global portfolio) to those of a subgroup of countries for which we have similar coverage over more than 100 years. The 13 countries are (in ascending ordering from 140 years to 100 years): Brazil, Chile, Russia, Uruguay, Mexico, Colombia, Peru, Greece, Italy, Spain, Costa Rica, Argentina, and Canada.

## d) Inflation expectations

Our baseline results are expressed in real terms, using long-run data on consumer price inflation in the US and the UK (see Appendix A). Real returns compensate investors for the realized inflation in year $t$, but nominal returns will also reflect expected future inflation rates in $t+1$, $t+2$, etc. Using current realized inflation rates may thus bias the results. To account for this possibility, we check the robustness of our return estimates when using inflation rates 12 months ahead. Table B4 shows that the results are very similar when using either current inflation or inflation of year $t+1$.

Table B4: Real returns: the role of inflation

| | Real, arithmetic return | | Real geom. return, annual mean |
|---|---|---|---|
| | Annual mean | SD | |
| **Total sample** | | | |
| Using realized inflation in year t | 7.19 | 14.85 | 6.21 |
| Using inflation in year t+1 | 6.88 | 13.89 | 6.02 |
| **Historical sample, 1818-1973** | | | |
| Using realized inflation in year t | 6.88 | 14.91 | 5.90 |
| Using inflation in year t+1 | 6.50 | 13.74 | 5.66 |
| **Modern sample, 1994-2016** | | | |
| Using realized inflation in year t | 9.07 | 14.68 | 8.06 |
| Using inflation in year t+1 | 9.20 | 14.88 | 8.16 |

*Note:* This table gives summary statistics for the global sovereign bond portfolio when nominal returns are adjusted using current inflation in year t and, alternatively, using inflation in year t+1.

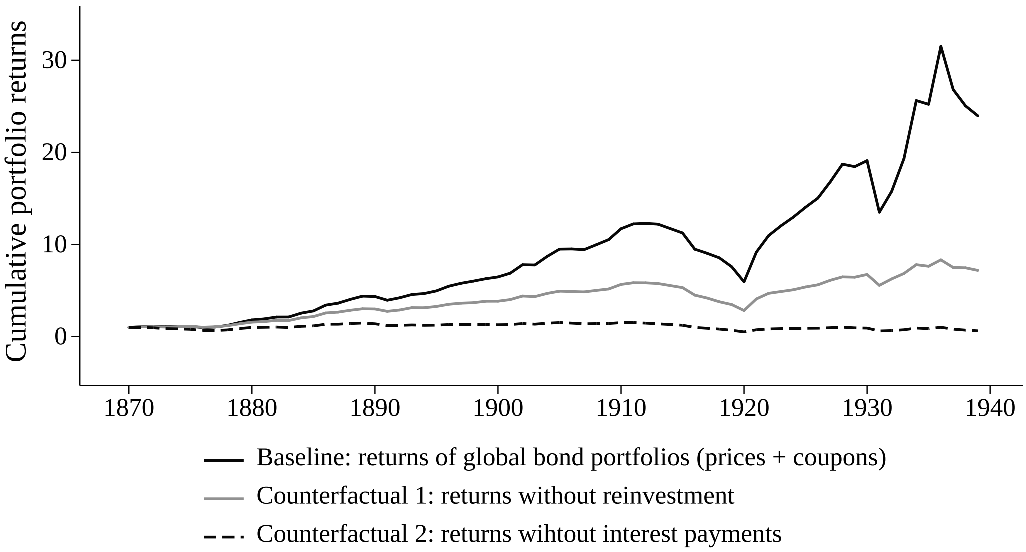
## e) Total returns: coupon vs. price effects

As explained in the main text, the total returns of a bond are driven by coupon payments as well as changes in the price of the bonds. This section explores the relative contribution of coupons and price changes for our results. We also assess the role of compounding, since all cumulative figures (e.g. those shown in Appendix B4) assume that returns are fully reinvested.

To do so we compare a baseline return series (compounded) to two counterfactuals. First, we assume that returns are not reinvested. Second, we ignore interest payments, meaning that we compute returns that are solely based on price changes while coupons are assumed to be zero. Figure B5 shows the result for the historical sample, focusing on 1870 until 1939, the historical spell with the broadest and most liquid sovereign bond market (we are working on replicating the same exercise for the modern post-1994 period).

The graph shows that the long-run investor returns in our data are almost exclusively driven by coupon payments. Without interest, the cumulative return over time would be almost zero This may seem surprising, but is very much in line with the findings for the stock market, where dividends are the main driver of investor returns (by a large margin), while prices account only for a small portion of returns (see Dimson et al. 2002)). We also find that our assumption that returns are reinvested has a large quantitative effect on the estimated total investor return over the long time span. In this 1870-1939 sample, the annualized, real return without reinvestment is just 3%, compared to approximately 5% in our baseline return measure (with reinvestment). Note, however, that the assumption on reinvestment only matters when we show cumulative or holding-period returns, but not for our baseline results tables, the Sharpe ratios etc., since these use average yearly returns.

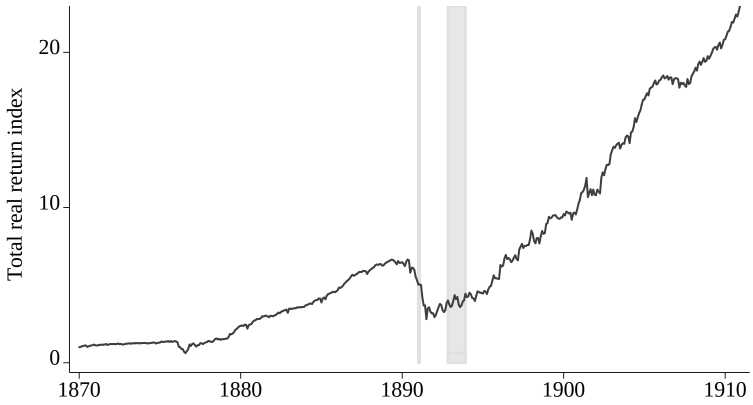
Figure B5: Cumulative returns (global bond portfolio, 1870-1939): coupon vs. price effects



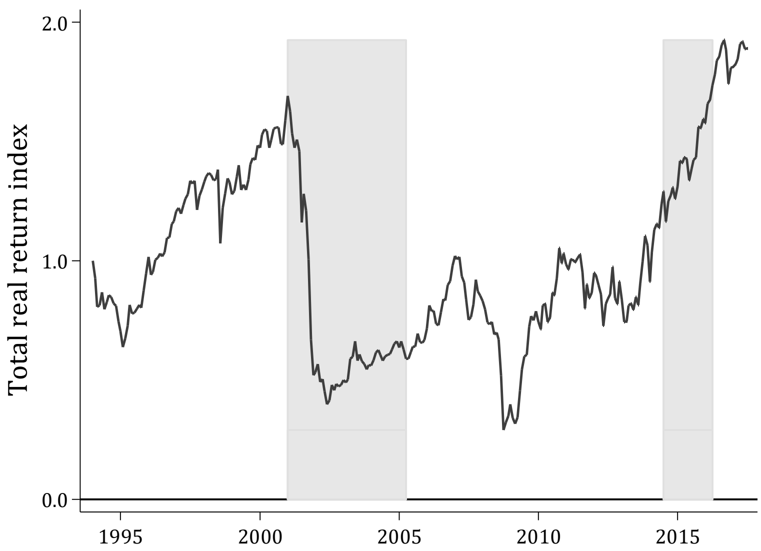
## B4. Case studies: total returns around sovereign default

This section shows selected case studies on total cumulative real returns around spells of sovereign default. Default episodes are shaded in grey. The indices are indexed at 1 at the start of the period.

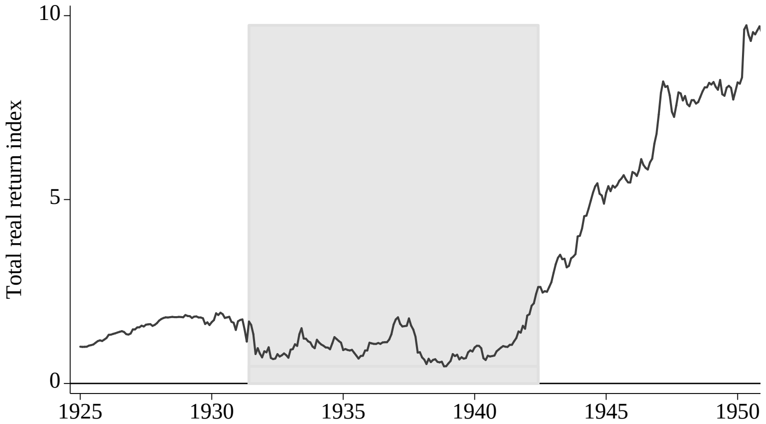
**Argentina 1870-1910:** Cumulative return index



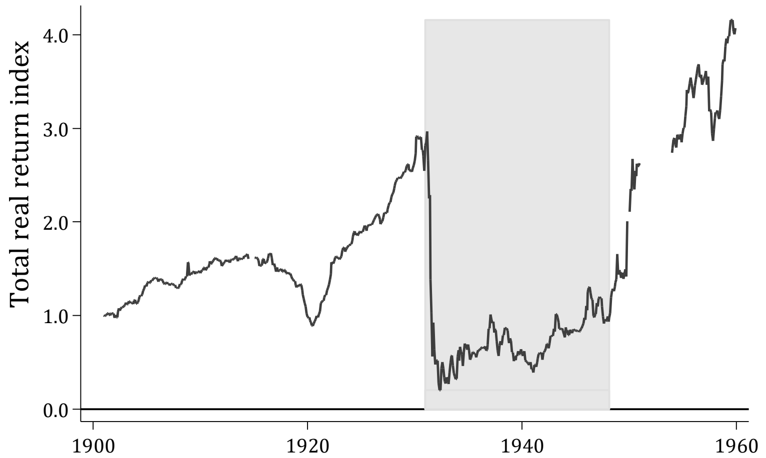

**Argentina 1994-2017:** Cumulative return index



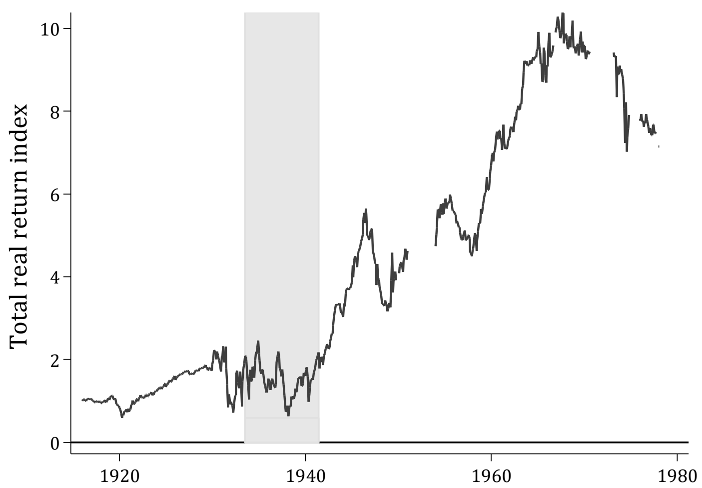
**Brazil 1925-1950:** Cumulative return index



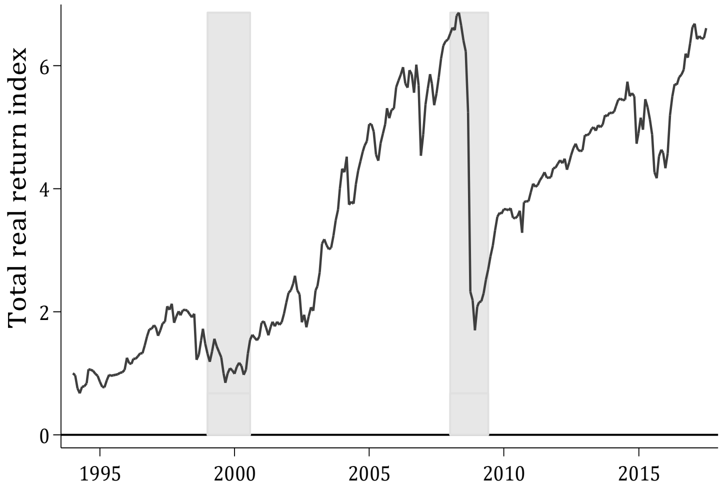

**Chile 1900-1960:** Cumulative return index



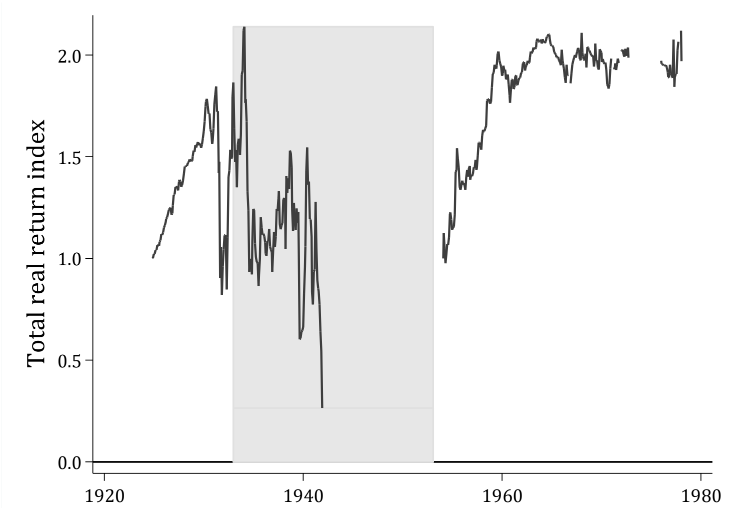

**Colombia 1915-1980:** Cumulative return index



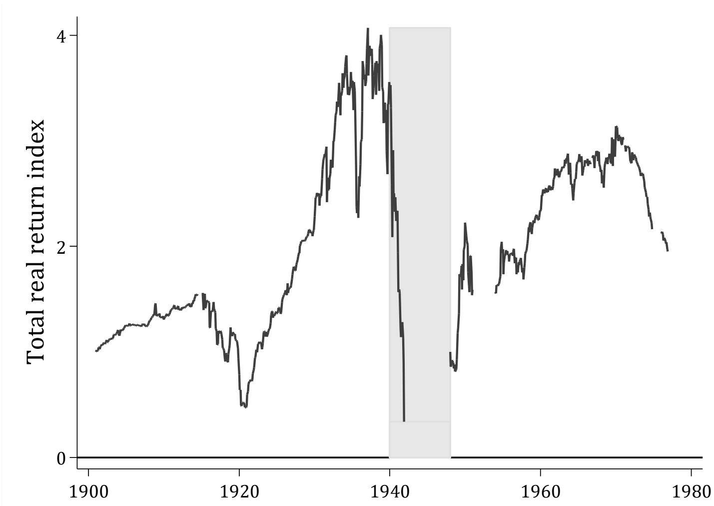
**Ecuador 1993-2017:** Cumulative return index



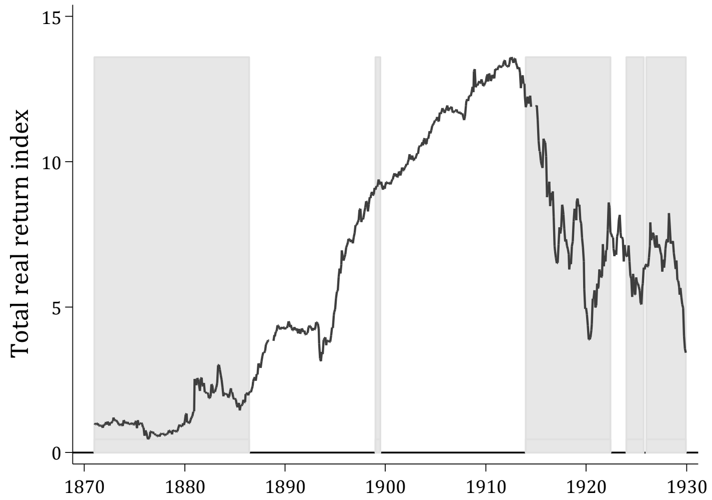

**Germany 1920-1980:** Cumulative return index



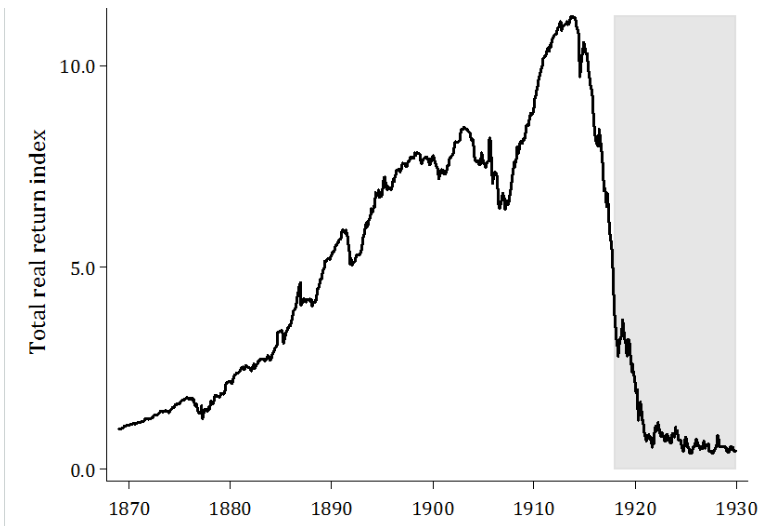

**Italy 1900-1980:** Cumulative return index



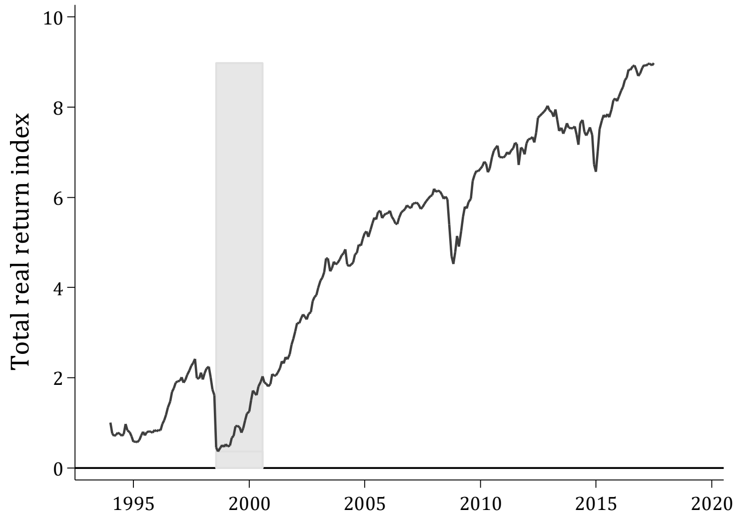
**Mexico 1870-1930:** Cumulative return index



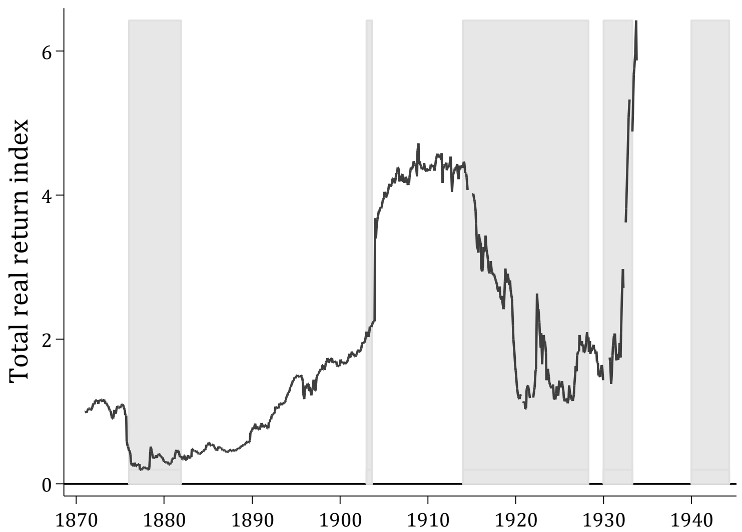

**Russia 1869-1930:** Cumulative return index



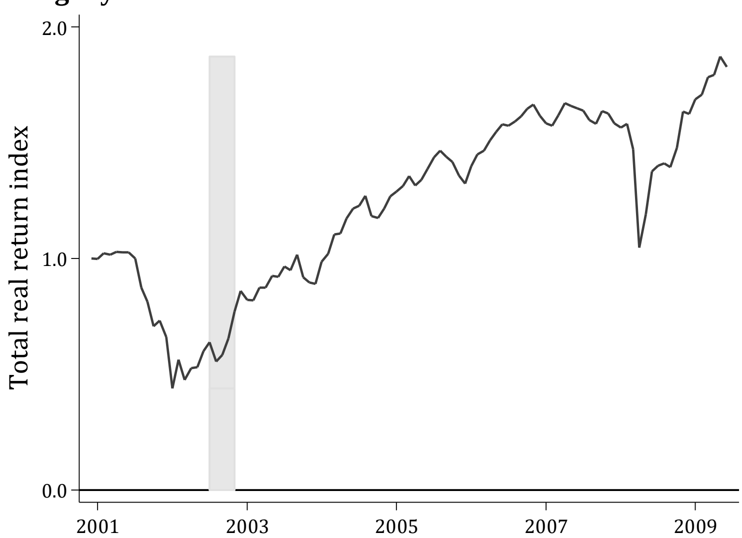
**Russia 1993-2017:** Cumulative return index




**Turkey 1870-1940:** Cumulative return index




**Uruguay 2001-2009:** Cumulative return index



# Appendix C: Debt restructurings and haircuts

## C1. Sample and data sources on restructurings

This Appendix describes our approach to identify sovereign debt restructurings in history, in order to complement and extend the sample compiled by Cruces and Trebesch (2013), which covers recent decades only. For the historical period, we draw on a large body of archival and other sources which we use to conduct a census of distressed sovereign debt restructurings with foreign commercial creditors since 1815. Before 1970, we only identify bond restructurings and not a single new bank debt restructuring. We then combine the newly identified historical cases with those by Cruces and Trebesch (2013) as well as Fang et al. (2018), which covers 1970-2015. The result is a sample of 358 individual sovereign debt restructurings with foreign banks and bondholders between 1815 and 2015. Once we merge multiple restructurings of the same default into one observation we end up with a final sample of 313 restructurings.

### C1.1. Case selection

We use five criteria to select cases, following Cruces and Trebesch (2013).

- First, we focus on defaults and restructurings on sovereign debt, meaning on bonds or loans owed by a country's central government, but not on debt of local or regional governments.
- Second, we include only distressed debt exchanges, defined as restructurings of bonds (or bank loans) at less favorable terms than the original bond (loan). We thereby follow the standard definition of distressed restructurings by rating agencies such as Standard and Poor's (2006, 2011). Restructurings that are part of routine sovereign liability management such as debt swaps and buybacks in normal times are disregarded.
- Third, we include restructurings of medium and long-term debt. We disregard short-term agreements such as 3-month debt rollovers, or deals that provide short-term bridge financing or maturity extensions of less than one year. However, we do include restructurings in which short-term debt is transformed into medium- or long-term debt, as was the case in Mexico's restructurings of the 1920s.
- Fourth, we focus on restructurings of private, foreign-currency debt, meaning external bonds or loans, which are typically held by foreign commercial creditors. We do not take into account defaults on private-to-private, or public-to-public debt, i.e. no debt exchanges of official (bilateral and multilateral) creditors such as the restructuring of public war debts in the wake of WW1 and WW2 (see Reinhart and Trebesch 2016 on these cases). Restructurings of domestic bonds are excluded, also because, for most of the 19th and 20th century, domestic-currency debt was predominantly held by domestic creditors. In our historical sample, there are only very few defaults and restructurings of domestic currency bonds that had been marketed and/or issued in London and/or New York and were therefore almost exclusively held by foreigners (these are Brazil 1898, Russia 1917, Mexico 1922, 1925 and 1942, Austria 1952, and Germany 1953). Following the rationale of Sturzenegger and Zettelmeyer (2008) and Cruces and Trebesch

(2013) we do include these quasi-foreign debt restructurings. However, the summary statistics and overall picture are essentially the same if we drop them.

- Fifth, we include only restructurings that are implemented. Interim agreements that were never completed are disregarded, such as the case of El Salvador 1922, where the parliament voted against the agreement, or Bulgaria in 1948, where the agreement with creditors was never legally recognized by the government. In addition, we disregard temporary deals that had the sole purpose of bridging the time until a permanent settlement and debt exchange (these preliminary agreements were particularly frequent in the 1930s and 1940s).

### C1.2. Sample of restructurings

For the recent period, 1970-2015, Cruces and Trebesch (2013) and Fang et al. (2018) include 187 sovereign debt restructurings. In this paper, we detect an additional 179 sovereign debt restructurings using the sources summarized below. 167 of the newly identified cases were implemented in the period 1815 to 1970. Moreover, we found 12 restructurings of external sovereign debt that occurred *after* 1970, but which were not included in the Cruces and Trebesch (2013) sample.[35] Out of the 179 "new" deals, we could gather sufficiently rich and detailed information to compute investor losses and returns in 169 cases, i.e. we know the instruments involved and have enough details on the terms of each of the old and new bonds. This means that we can estimate haircuts in all but 10 of the newly coded historical cases since 1815. [36]

The historical sample thus covers 169 historical restructurings in 43 countries. All of these were sovereign bond restructurings, while no cases of sovereign loan restructurings could be identified pre-1970, which confirms that external borrowing by sovereigns almost exclusively took the form of bonded debt in the pre-WW2 era. This stands in contrast to the 1980s and 1990s, which were clearly dominated by sovereign bank lending and almost exclusively saw restructurings of syndicated bank loans held by foreign commercial banks.

We also drop a total of 63 restructurings that do not fulfil our case selection criteria. More specifically, we drop 23 cases that were never implemented, as well as 64 agreements that were only temporary or focused on short-term debt and rollovers. In addition, we identified 10 default spells that were resolved

[35] These were long-delayed historical deals that all go back to defaults in the 1930s, mostly in Eastern Europe, namely Poland 1975 (selective deal with American bondholders), Romania 1975, Poland/Danzig 1976, Romania 1976 (selective deal with British bondholders), Bulgaria 1979 (with American bondholders), Russia 1986 (with British bondholders), Bulgaria 1987 (selective deal with British bondholders), China 1987 (selective deal with British bondholders) and Russia 1997 (selective deal with French bondholders).

[36] These 10 cases with a lack of sufficient information are Russia 1839, Tunisia 1870, Austria 1871, Schleswig-Holstein 1850 and Morocco 1904 as well as five smaller cases that only affected one particular creditor group, namely Poland 1949 (side-deal with Swiss bondholders), Poland 1950 (side-deal with Swedish bondholders), Hungary 1950 (side-deal with Dutch bondholders), Hungary 1951 (side-deal with Swedish Bondholders), Yugoslavia 1959 (side-deal with Swiss Bondholders).

without a restructuring, i.e. defaults cured with a debt exchange.[37] For these events it is, therefore, not possible to calculate a haircut.

The full sample of historical and modern sovereign debt restructurings assembled here covers 358 cases in 91 countries. Figure 1 in the main text shows the resulting 200-year timeline by year and worldwide, while Figure C1 shows the respective timelines on a country level. As can be seen, some countries witness multiple restructurings within just a few years, often due to parallel renegotiation rounds with different creditor groups. For example, in the 1940s, Brazil negotiated two separate agreements: one in November 1943 on bonds issued and traded in the UK and USA, and another one in March 1946 on bonds issued and traded in Paris (this deal was partly orchestrated by the French government and also called the "Franco-Brazil Financial Agreement"). The negotiations on these agreements were conducted separately, with the British CFB/American FBPC and the French ANPVM, respectively.

To avoid double counting these type of restructuring events we next merge multiple deals of the same default into single cases. We identify 78 cases of multiple restructurings (28 in the modern sample and 50 in the historical sample), which we merge into just 34 cases (43 cases less). To compute haircuts across multiple deals of the same default, we first add total amounts (using US dollar values) and then use a weighted average haircut using amounts affected across deals. For dating the merged deals, we use the main agreement, meaning that restructuring in which the largest portion of the defaulted debt was exchanged. In the Brazil example above, we compute an average haircut of the 1943 and 1947 agreements (using US dollar values) and assign the year 1943. This is because the bulk of Brazilian debt was to US/UK creditors, while the French agreement of 1947 was more of a side deal.

The final sample that we use for summary statistics and graphs in the main paper thus covers 313 restructurings across 91 countries.

[37] These include the temporary sinking fund suspensions by Colombia between 07/1915 and 06/1916, of Paraguay between 07/1914 and 12/1915, as well as Uruguay between 1915 and 08/1921. Another seven cases originated in the default and break-up of the Ottoman Empire (for details see the section on country break-ups below). Four countries, namely Iraq (1934), Italy (1932), Palestine (1928) and Syria and Lebanon (1933) eventually repaid their share of old Ottoman debt without a restructuring (year of repayment in parentheses). In contrast, the debt apportioned to Albania, Saudi Arabia (formerly Nedid and Hedjaz), and Yemen remained unresolved, i.e. no payment could be identified until 2015.

Figure C1: Sovereign debt restructurings by country, 1815-2015

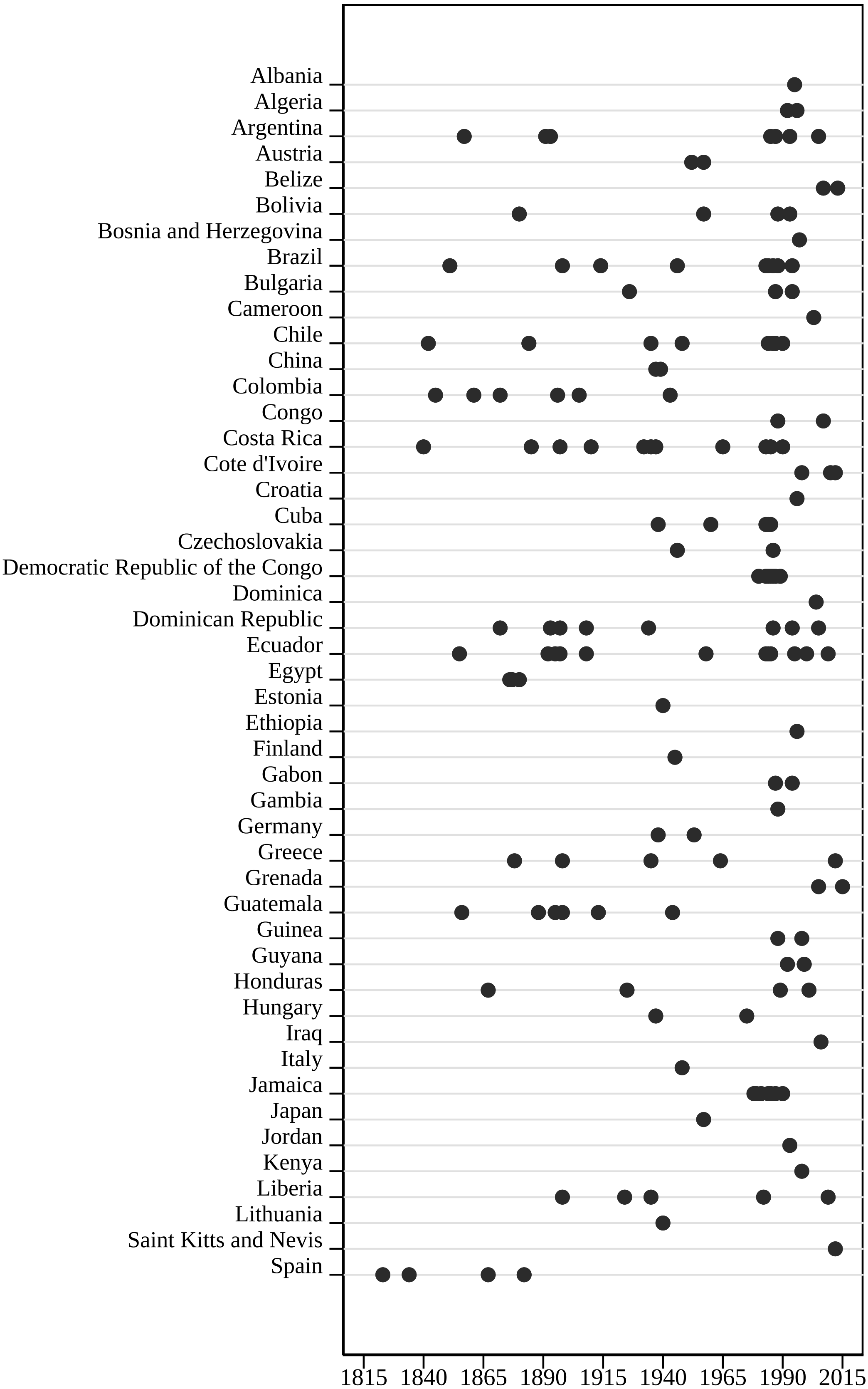
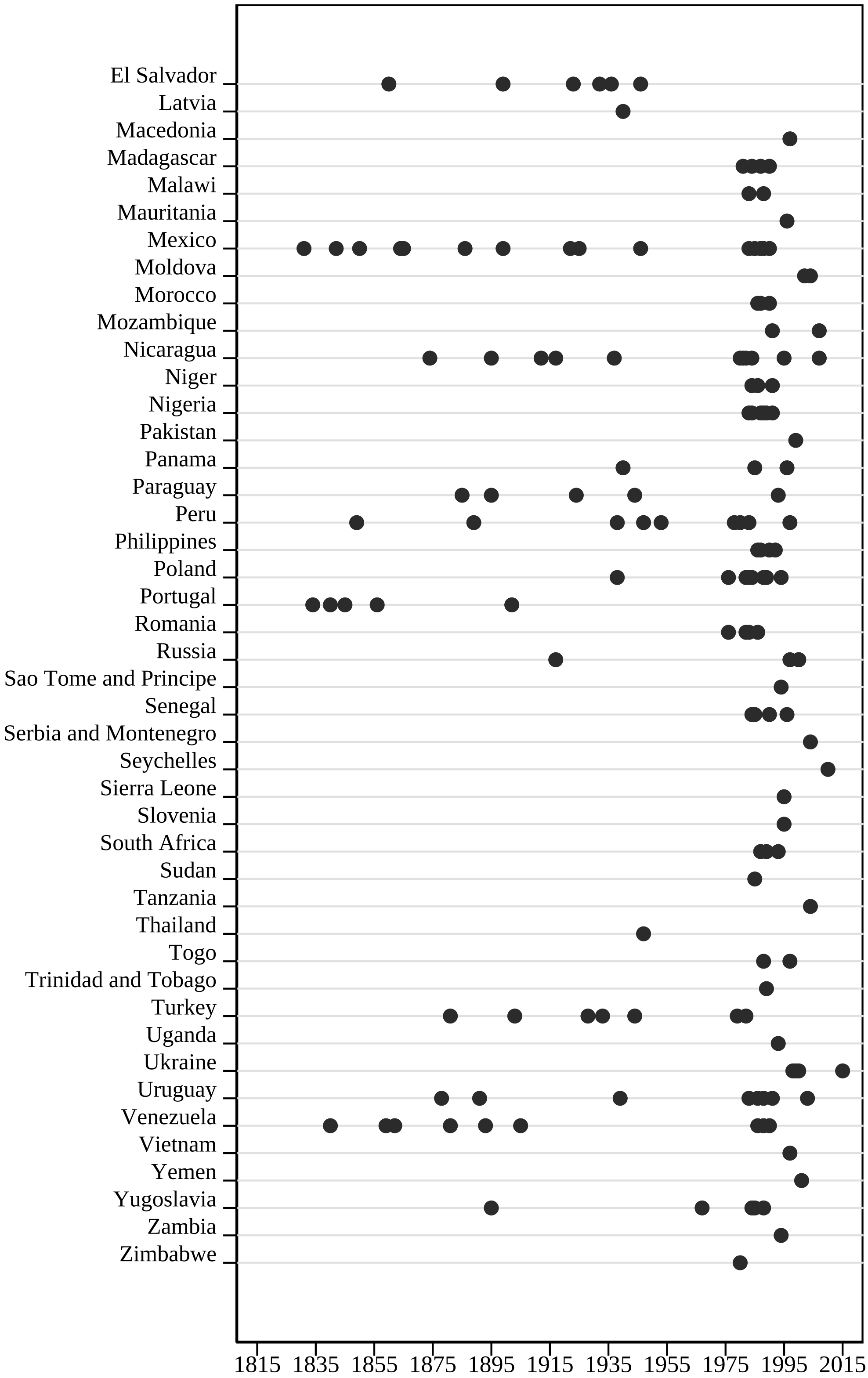


Figure C1 (continued): Sovereign debt restructurings by country, 1815-2015



### C1.3. Data sources on restructurings

This section describes the data sources behind our historical sovereign debt restructuring and haircut archive. On each restructuring, we collected data on the default and renegotiation dates (start, interim agreements and debt exchange), as well as on the bonds involved and their contractual terms such as the issue prices, the maturity, coupon rates, the repayment terms (grace period, amortization scheme), and the bond amounts (face value, amounts outstanding, nominal debt reductions).

Our starting point was the ground-breaking work of Suter (1990) and Stamm (1987), who provide a documentation of historical debt restructurings from 1820 to 1975. We also rely on Reinhart and Rogoff (2009), who document the start and end dates of historical default episodes. Unfortunately, however, these sources lack details on the restructuring terms and the bonds involved, so that it is not possible to estimate haircuts and to systematically compare old and new instruments in each exchange.

We therefore embarked on an extensive data gathering exercise using a variety of sources. In a nutshell, we used every piece of information we could find and then gather and compare the key details on the restructurings and bonds involved across each source available. This allowed us to reduce mistakes, detect contradictory information, and thereby generate a more reliable final dataset.

Most importantly, we rely on the annual reports published by creditor organization representing the bondholders who were affected by the sovereign’s default: the UK-based Corporation of Foreign Bondholders (CFB) (1876-1944, 1945-1986), the US-based Foreign Bondholders Protective Council (FBPC) (1934-1940, 1945-1950, 1953-1964/67), the Association Belge pour le Défense des Détenteurs de Fonds Publics (1898-1915), and the French Association Nationale des Porteurs Français de Valeurs Mobiliéres (1936-1945, 1948-1974, 1987-1988, 1996). The reports provide very rich details on past defaults and restructurings and were our most valuable source.

To cross-check the information by the creditor committees and to fill gaps, additional sources were consulted, in particular investor reports such as Fenn’s Compendium of the English and Foreign Funds (1837-1838, 1855, 1857, 1863, 1867, 1869, 1874, 1876, 1883, 1889, 1893), Fortune’s Epitome of the Stock and Public Funds (1800, 1810, 1820, 1824, 1826, 1833, 1838-1839, 1850-1851, 1856), Kimber's Records on Government Debts and other Foreign Securities (1918, 1919, 1922, 1934), Moody's Manuals on Foreign and American Government Securities (yearly 1920-1960), and the London Stock Exchange Yearbooks (1877-1878, 1880-1881, 1883-1888, 1890, 1894-1895, 1897, 1899-1901, 1905, 1907-1916, 1919-1920, 1925). Occasionally, we also relied on academic case studies, communiques of the creditor organizations, official gazettes of the debtor country, or press articles.

Table C1 provides an overview of the data sources used for our historical sample since 1815. For almost all historical restructurings (157 cases out of 169), we had at least two sources of information with details on the restructuring terms. As can be seen, the British Corporation of Foreign Bondholders covered almost all cases included in our historical dataset.

Table C1: Overview of sources used (historical sample since 1815)

| **Sources** | **Restructurings covered** |
|---|---|
| Corporation of Foreign Bondholders (UK creditors) | 146 |
| Suter (1990) and Stamm (1988) | 121 |
| Foreign Bondholder Protective Council (US creditors) | 65 |
| Moody's Manuals | 44 |
| Fenn's Compendium | 39 |
| London Stock Exchange Yearbook | 30 |
| Association Belge pour le Détenteurs de Fonds Publics | 25 |
| Fortune's Epitome | 21 |
| Kimber's Records | 21 |
| Association Nationale des Porteurs Français de Valeurs Mobiliéres | 18 |
| Other Sources | 34 |

## C1.4. Data quality index

In order to assess the quality of the information we gathered, we construct a data quality index for our historical sample, following the approach in Cruces and Trebesch (2013). The index is additive and consists of five binary indicators, thus ranging from a maximum of 5 (very good data availability) to 0 (very restricted data availability). The five indicators are:

1. Knowledge of the main contractual terms of the old restructured debt. This criterion is fulfilled if we have details on restructured amounts, on which parts had fallen due, as well as on the maturity period, redemption schedule and coupons of the old debt.
2. Knowledge of the key characteristics of the new debt. This is fulfilled if we have details on the type of debts and the amounts restructured, as well as on the maturity period, the repayment/amortization schedule and the interest rates of the new debts.
3. Whether the terms above are available by instrument, i.e. bond by bond.
4. Full consistency across the available sources. This is fulfilled if there is no contradictory information with regard to date, amounts, interest rates or repayment schedules.
5. Knowledge of when the restructuring is implemented. This is fulfilled if we know the exact month of the agreement and whether a deal was ultimately implemented or not (this is the case for all restructurings in the historical sample).

Table C2 shows the distribution of the data quality index for all newly identified sovereign debt restructurings since 1815 (in 20-year intervals). This table also includes cases for which we could *not* gather enough details to compute haircuts, i.e. the 10 cases for which data coverage is insufficient and which are therefore not included in our final sample. Indeed, the data quality index for these excluded countries is particularly low (1 on our index scale).

Table C2: Data quality index (historical sample)

| Period | Number of restructurings | Data quality index (1=worst, 5=best) | | | | | Average data quality |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | |
| 1815-1840 | 5 | 0 | 0 | 3 | 2 | 0 | 3.40 |
| 1841-1860 | 13 | 0 | 1 | 7 | 3 | 2 | 3.46 |
| 1861-1880 | 13 | 0 | 1 | 2 | 6 | 4 | 4.00 |
| 1881-1900 | 32 | 1 | 1 | 5 | 10 | 15 | 4.16 |
| 1901-1920 | 11 | 0 | 0 | 1 | 3 | 7 | 4.55 |
| 1921-1940 | 35 | 2 | 2 | 2 | 2 | 27 | 4.43 |
| 1941-1970 | 48 | 1 | 7 | 6 | 6 | 28 | 4.10 |
| post-1970 | 12 | 2 | 1 | 2 | 3 | 4 | 3.50 |
| **Total sample** | **169** | **6** | **13** | **28** | **35** | **87** | **3.95** |

The average data quality index in our historical sample is 4 out of 5 index points, compared to just 3.4 in the modern (1970-2013) sample of Cruces and Trebesch (2013). One reason for the surprisingly good data coverage in history is that the creditor and investor reports are very detailed. Moreover, it is usually easier to gather details on sovereign bonds compared to syndicated loans that are held on bank balance sheets (the latter played a major role in the 1980s and 1990s restructurings).

The best data coverage is observable during the interwar years (1921-1940) when the US-based Foreign Bondholders Protective Council (FBPC) is founded and starts issuing very detailed reports on each restructuring affecting US creditors. The information on restructurings that are covered by both the British CFB and the US FBPC is almost always fully complete. Moreover, in this period, we benefit from newly introduced investor reports, in particular the detailed Moody's Manuals and Kimber's Records. Unsurprisingly, the worst data coverage is in the early 19th century, when few investor reports existed and bondholder organizations, such as the CFB, had not yet been founded.

## C2. Computing Haircuts: Methods and Assumptions

### C2.1. Haircut formula

As in Cruces and Trebesch (2013) we compute investor haircuts in sovereign debt restructurings using three, widely used approaches:

The most basic measure is the face value haircut which merely captures the nominal debt reduction implied in the restructurings:

$$\text{Face value haircut} = 1 - \frac{\text{Face value of new debt}}{\text{Face value of old debt}} \qquad \text{(C.1)}$$

This measure is simplistic since it only captures nominal write-offs and ignores any changes to the maturity or interest rate of restructured debt. In our historical sample, only 39% agreements implied a nominal reduction on the principal face value (66 out of 169 in our final historical sample).

The second approach compares the present value of debt payments on the new instruments and compares it to the face value of the old debt. This measure can be coined as "market haircut", since it overstates the loss suffered by creditors (see Zettelmeyer et al. 2013, for a discussion) and has been used by market participants in the past. The formula can be written as:

$$\text{Market haircut } \left(H^i_{M_t}\right) = 1 - \frac{\text{Present value of new debt } \left(r^i_t\right)}{\text{Face value of old debt + arrears}} \qquad \text{(C.2)}$$

for country *i* that restructures its debt at time *t*. The country- and time-specific discount rate $r_t^i$ transforms the debt service stream of the new instruments into present value terms. As we explain in the next section, we use the "exit yield" as discount rate, i.e. the market yield on the new bonds prevailing immediately after the debt restructuring. When considering the amounts of old and new debt involved, we always include potential cash payments plus any possible payments arrears on interest.

Our third and preferred approach follows Sturzenegger and Zettelmeyer (2006 and 2008) and compares the present value of the old and new debt instruments. Both payment streams are evaluated at the same discount rate:

$$\text{SZ haircut } \left(H^i_{SZ_t}\right) = 1 - \frac{\text{Net present value of new debt } \left(r^i_t\right)}{\text{Net present value of old debt } \left(r^i_t\right) + \text{arrears}} \qquad \text{(C.3)}$$

The SZ haircuts are best able to capture the wealth loss of an investor participating in a debt restructuring, because it accounts for the characteristics of both the old and the new debt, in particular any change in the maturity and interest structure. More specifically, $H_{SZ}$ compares the present value of the new and the old debt in a hypothetical scenario in which the sovereign kept servicing old bonds on an equal basis as the new debt. More intuitively, imagine you are a small holdout creditor and your holdout strategy is successful in that you do not suffer from a haircut but your debt continues to be repaid as if nothing happened (just like the €3bn holdouts of English law bonds or the ECB-held bonds in Greece 2012, which both avoided a haircut). The SZ haircut measures how these holdouts fared in comparison to those creditors that participated in the exchange. The best approach for this comparison is using the same discount rate. Indeed, both the new bonds and the old (holdout held) bonds face the same risk of a new default after the deal, and they both benefit from the debt relief effect.

Note, that the market haircut will be the same as the SZ haircut in case debts mature before the restructuring date. This is true for 25 out of 169 cases, i.e. for about 15% of restructurings in our final sample where all bonds had matured by the time of the agreement, so that $H_{sz} = H_M$.

Our historical haircuts are computed on bond-by-bond basis using information on a total of 693 individual sovereign bonds. To compute the aggregate haircuts for each restructuring events, we consider all bonds involved in the specific restructuring and then build a weighted average haircut (using bond amounts outstanding as weighting basis).

## C2.2. Treatment of interest arrears

The treatment of interest arrears is important when computing creditor losses, since arrears can account for a large portion of outstanding debts, in particular when defaults are long delayed, as was often the case in the 19th century. More specifically, in our historical sample, interest arrears amount to 34% of the old outstanding principal, on average. In most restructurings, we know how interest arrears were treated, i.e. whether they were exchanged into new instruments or whether they were written off. However, for 32 out of 169 cases we lack information on the treatment of arrears and therefore assume that they were canceled, as was most often the case for those restructurings for which we do have full information.

Regarding amounts, we know the exact size of interest arrears in 39 out of 169 restructurings. For all other cases, we impute the stock of arrears in the restructuring year following standard practice in restructurings of the time and using the information on coupons and principal amounts available to us. More specifically, we add the amounts of interest payments on the outstanding (unpaid) principal for each year from default until agreement, even if the bonds have already matured. To give an extreme example, take the restructuring of Honduras in 1925, which had been in default for 52 years prior to the agreement in 1873. We thus add together all hypothetical interest payments from 1873 until 1925 using the contractual coupon rates of the four bonds affected and including years after maturity (the bonds had matured in 1884, 1885, 1886, and 1904, respectively). Partial interest service during the default period is known and taken into consideration, so that we subtract any payments on interest from the imputed arrears amount. Importantly, we do *not* compound interest, i.e. we do not assume interest payments on the arrears, since this was not common practice at the time (none of the 39 restructurings for which we have full information apply compounded interest).

## C2.3. Discounting approach

To compute present values, we follow Sturzenegger and Zettelmeyer (2006, 2008) and Cruces and Trebesch (2013) and use the “exit yield” discount rate, which is the secondary market yield of the new instruments that start trading after the restructuring. It reflects the market’s view of sovereign risk, i.e. the expected risk of default on the new obligations, taking into account the success (or failure) of the restructuring that was just implemented (including any positive debt relief effects).

Whenever possible, we use the secondary market yield of country $i$ at exit from default based on the extensive new bond pricing dataset we describe in the main paper. More specifically, for 125 out of 169 historical cases, we use exit yield market data available to us. For another 23 cases no debt discounting (and thus no yield data) was necessary, since the agreements were cash buy-backs of already matured bonds. For the remaining 46 debt restructurings, no market yield data was available. Most of these were small, low-income countries with no liquid bonds trading in London and New York. In these cases, we use a “worst yield” approach, which means that we use the highest bond yield observable among non-defaulted sovereigns in the London or New York market at that point in time as a proxy for the country’s own exit yield. The rationale behind this approach is that countries exiting from default usually have rather high yields and this is particularly true for smaller and poorer countries with limited access to external capital markets (i.e. those countries who are less likely to have liquid bond prices to start with).

The “worst yield” among all debtor countries with liquid bonds that are not currently in default is therefore a useful proxy for the yield of these smaller, poorer countries that just restructured their debt. For example, we use the Argentinian yield of 6.9% in January 1860 for the restructuring of El Salvador in that month, the Chilean yield of 8.3% for the restructuring of Ecuador in March 1955, or the Italian yield of 5.5% for the restructuring of Yugoslavia in July 1895.[38]

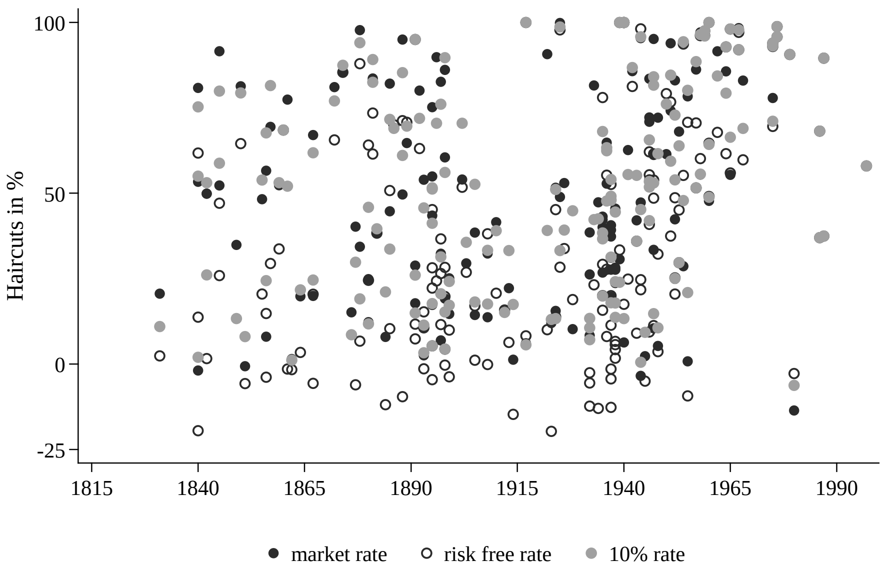
In order to check the sensitivity of the haircut estimates to the chosen discount rate we also compute haircuts using two alternative discount rates, (i) a risk-free rate (British consols from 1815 to 1918 and US treasury bonds thereafter), and (ii) a 10% flat discount rate across countries and time (the 10% flat rate is regularly used in recent IMF and World Bank reports). Table C3 and Figure C2 illustrate the results for the historical sample.

Table C3: Haircuts with different discount rates: summary statistics (historical sample)

| | Cases | Mean | Median | SD | Min | Max |
|---|---|---|---|---|---|---|
| **Market yields (baseline)** | | | | | | |
| Market haircut | 169 | 61 | 63 | 27 | -8 | 100 |
| SZ-haircut | 169 | 52 | 50 | 31 | -14 | 100 |
| **10% lump sum rate** | | | | | | |
| Market haircut | 169 | 60 | 61 | 24 | 0 | 100 |
| SZ-haircut | 169 | 51 | 52 | 30 | -6 | 100 |
| **Lower bound (risk free-rate)** | | | | | | |
| Market haircut | 169 | 29 | 28 | 43 | -89 | 100 |
| SZ-haircut | 169 | 36 | 28 | 37 | -87 | 100 |

[38] As an alternative approach, we tried using yields of surrogate countries as a proxy in the 46 cases for which actual exit yields were not available (as in Cruces and Trebesch 2013). The idea is to use yields from comparable sovereigns for which price data is available at the restructuring time, such as countries in the same region or of the same size and debt/GDP level. Historically, however, this surrogate approach worked less well, because the number of independent countries is much smaller in history and because most defaults in history were regionally correlated, i.e. there is less variation to exploit. Quantitative approaches, such as propensity sore matching, did not show satisfactory results either. We therefore prefer to settle on the plain and simple “worst yield” approach which results in reasonable yield proxies.

Figure C2: Haircuts with different discount rates: point estimates by restructuring year




As can be seen, the haircuts using a 10% lump rate are rather close to our baseline estimates using "exit yields", although the differences by country can be quite large. In contrast, the haircut estimates tend to be much lower (about half) when using the risk-free rate. The dispersion of our estimates, however, shows rather similar patterns overall and the number of cases with very high haircuts (close to or at 100%) is also not significantly higher or lower for different discounting approaches.

## C2.4. Historical sovereign bonds: special features and how we deal with them

The historical bonds issued in the pre-WW2 era often share features that are no longer common in today's bond markets. This section summarizes important historical bond features and explains how we account for them in our haircut calculations.

***Sinking funds:*** Most bonds in history are not due and payable at maturity, but have stretched out amortization schemes, often in the form of so-called "sinking fund" arrangements. The sinking fund goes back to at least the 18$^{th}$ century and its rationale is to smooth out the debtor's principal redemption schedule and to thereby reduce the risk of default at any given point in time (instead of having repayment spikes at maturity). There are two main types of sinking funds. The first, simpler type is a fixed sinking fund scheme that is comparable to a linear amortization plan - with equal payments stretching from the end of the grace period until maturity. Second, there are cumulative sinking fund schemes. These follow a predetermined, non-linear (typically increasing) annuity amortization plan written in the bond contract. The sinking fund payments were usually forwarded to a fiscal agent predetermined in the bond contract and this agent used the debt service to amortize the bonds. Often principal amortization payments were determined by a lottery. In that case, in each period, the fiscal agent randomly selects a subset of bonds (among all outstanding bonds) who will be fully or partially repaid. The lottery is repeated until the sinking fund payments made by the sovereign in that period are depleted.

***Bond buybacks:*** About 50% of the bonds in the sample of historical debt restructurings contain repurchase clauses. These allowed debtor countries to repurchase parts of their bonds in the secondary market. Specifically, debtor countries could use the amounts of the contractually agreed debt servicing (sinking fund) payments for the purchase of bonds (at below-par market prices) instead of repaying the debts at par. Such bond buy-backs were reportedly rather common to make partial payments in default situations, when bonds typically trade at depressed prices. Unfortunately, numbers are hard to find, since neither the governments nor the fiscal agents are required to report on secondary market buy-back operations and the relevant (re-) purchase prices (FBPC 1938, p. 315). As a result, we do not adjust our haircut estimates for these undercover buy-backs and instead assume that all debts are redeemed at par. At the same time, we do take into account explicit buy-backs where creditors agree to sell outstanding bonds at a fixed price against cash as part of a crisis resolution effort, as was the case in 38 historical restructurings. This approach to deal with buy-backs historically is consistent with Cruces and Trebesch (2013). They include 28 buy-back agreements of bonds against cash, but also disregard hidden government buy-backs in the secondary market (e.g. during Peru's default in the mid-1990s).

***Gold and currency clauses:*** About 35% of the restructured bond contracts include gold clauses. These gold clauses are not explicitly taken into account when computing haircuts since they were not legally binding, especially after the abrogation of the gold clause in the US in 1933 and Britain in 1931 (Wynne 2000, Lindert and Morton 1989). Indeed, we find that gold clauses played almost no role in the restructuring agreements, meaning that bonds with or without gold clauses receive the same treatment (i.e the same haircut) and creditors holding gold clause bonds did not even ask for a better deal according to the archival documents. The only cases in which creditors attempted to enforce gold clauses to achieve better treatment are a series of restructurings of French Franc bonds (Brazil 1946, Japan in 1957 and several Eastern European Countries after WW2).[39] Moreover, about 10% of the bonds in our historical sample contain some kind of currency clause. Currency clauses allow creditors to choose in which of a set of currencies they wish to obtain their principal and interest payments, using fixed or variable exchange rates as fixed in the bond contract. Details on creditor choices are however not available and it is again questionable whether the clauses had legal "teeth" and were credible. For simplicity, we therefore assume bonds to be serviced in their currency of issuances, which is similar to the approach of Lindert and Morton (1989).

### C2.5. Further methodological assumptions

This section sets out further methodological assumptions when computing haircuts.

***Timing:*** The month of the final agreement serves as a baseline date to compute cash flow streams. From there all interest and principal payments are computed on an annual basis, even if coupon payments are at a quarterly or semi-annual frequency. The yearly averaging is a helpful simplification also made in Lindert and Morton (1989) or Cruces and Trebesch (2013) but does not bias our results importantly.

[39] These were mainly debt buybacks in paper francs. If the agreement explicitly provided a higher buyback rate in lieu of the gold clause, gold values were converted in paper francs by the ratio 1:5, as it was done by the CFB (1946).

We assessed this based on 20 exemplary bonds across our sample and found that shifting from yearly to monthly or quarterly cash flows had no or only minimal effects on the final estimated haircut.

***Country break-ups and newly independent countries:*** The political borders of Europe, Latin America or Asia saw major changes over the past 200 years. In particular, there were several sovereign defaults that occurred just prior to, or as a consequence of, state break-ups. Fortunately, for each country break-up in our sample of default cases, we could gather detailed information on how the successor states agreed to apportion the old outstanding debt among each other. We then track the settlements on these apportioned debts and calculate the haircuts in each of the successor states. Prominent break-up cases involving a default include:

- The Central American Federation, which went in default in 1828. The successor states agreed to apportion the debt in 1832 in the aftermath of the break-up.[40]
- Gran Colombia, which defaulted in 1826. Debt apportionment was agreed in 1834.[41]
- The Ottoman Empire, which defaulted in 1914. The debt allotment among the successor states was a long and disputed process, which ended only in the late 1920s.[42]
- Austria-Hungary, which also defaulted in 1914 and which also saw a long debt resolution process of the various successor states, which took until the 1960s.[43]

***Selective agreements:*** We calculate haircuts for each debt restructuring implemented with external foreign creditors. Hence, selective agreements of the same debtor country but different creditor groups were coded separately in the raw dataset. However, as explained above we do merge cases of the same default even in the main paper and analysis. In case an agreement is explicitly targeted (and/or restricted

[40] Costa Rica assumed 1/12 (0.013m£) of the 6% bonds, 2/12 was allotted to El Salvador, Guatemala assumed 5/12 of the defaulted 6% bonds, Honduras assumed 2/12 of the debt, and the remaining 2/12 amounting to £0.0272m was assigned to Nicaragua. The restructuring cases involving old defaulted debts of the Central American Federation are Costa Rica in June 1940, El Salvador Jan. 1860, Guatemala May 1856, Honduras Jan. 1867 and Nicaragua Jan. 1874.
[41] Specifically, 50% of old principal (£3.3m) was apportioned to Colombia (formerly New Granada), 21.5% (or £2.1m) was assigned to Ecuador, and 28.5% (£2.8m) to Venezuela. The restructuring cases involving old debts of Gran Colombia include New Granada/Colombia in Jan. 1845, Ecuador in Sept. 1855 and Venezuela in Sept. 1840.
[42] The final dissolution of the Ottoman Empire started in the early 20th century. After WW1, the Treaty of Lausanne of 1923, constitutes the first formal agreement to apportion the old Ottoman debt, but several successor states objected to their share, followed by an arbitration process coordinated by the League of Nations. Eventually, 65.4% of the Ottoman debt was apportioned to Turkey and the remainder of 34.6% to the other successor states (with Albania 1.26%, Assyr 0.02%, Bulgaria 1.39%, Greece 8.54%, Serbia-Croatian Slovene States 4.2%, Nedjd and Hedjaz 1.26%, Iraq 5.25%, Italy 0.19%, Syria and Lebanon 8.41%, Palestine 2.54%, Transjordania and Maan 0.67%, Yemen 0.91%). The restructuring cases involving old Ottoman debt include Bulgaria in Oct. 1960, Greece in Dec. 1965, Trans-Jordan and Maan in Jul. 1936, Turkey in June 1928 and 1933, and Serbia-Croatian Slovene States in 1959/1960. Iraq paid off its old Ottoman debt share between 1928 and 1934, Italy in 1932, Palestine in 1928, and Syria and Lebanon before 1933. The defaults of Albania, Assyr, Saudi Arabia (formerly Nedid and Hedjaz), and Yemen remained unresolved, i.e. no repayment occurred.
[43] After WW1, the debt of Austria-Hungary was apportioned in the Lausanne agreement 1923 and in further supplementary agreements in the 1930s. The final settlement was protracted and got finalized only during the 1950s and 60s. The restructuring cases involving old Austrian-Hungarian debt include Austria in Dec. 1952 and Dec. 1957 (Austria-Hungary old debt share: 11%), Czechoslovakia in Jan. 1964 (share: 20%), Hungary in 1953 and March 1956 (share: 27%), Poland in March 1967 (share: 6%), Romania in Feb. 1965 (share: 22%), and Yugoslavia in Oct. 1960 (share: 14%).

to) a certain creditor nationality, we assume that all targeted bonds of that creditor group are settled by this agreement.

***Missing maturity or amortization data:*** For about 15% of the historical debt instruments, the maturity date is not available, although we do have details on the redemption scheme and amounts involved. Recall that these were not bullet maturity bonds but mostly sinking fund bonds with a very stretched out repayment schedule, often over a period of 40 years or more. For investors at the time, the maturity date was therefore not a crucial piece of information, also because creditors were unlikely to witness it in their lifetime. In case we lack the maturity date, we assume that the maturity ends at the date of the last amortization payment as inferred from the contractual terms of the bond. Furthermore, in 38 restructurings we had only partial information on the payment schedule of one or more of the bonds involved, meaning that we lack some or all details on the precise sinking fund scheme. In these cases, we assume a cumulative sinking fund of the amortization schedule (comparable with an annuity scheme), since this was the most common approach in the 19$^{th}$ and early 20$^{th}$ century.

***Perpetuities and consols:*** About 3% of the defaulted bonds for which we compute haircuts are perpetuities, meaning that they have no predetermined maturity date. For these instruments, we follow standard practice and approximate the net present value of the cash flow by the face value to coupon ratio. In case the start date of the amortization and sinking fund payments are not explicitly stated, which is rare, we assume that amortization starts immediately, since this is the case for almost all bonds in our historical sample.

***Contingent debts:*** Nine restructurings in our sample involve bonds with contingent payments, meaning that the amounts of future debt service were contractually linked to a specific revenue stream.[44] For example, in the 1898 restructuring in Greece, the bond contracts entail a lower bound of debt service payments of 2.5% per annum. On top of this, the contract stated that 49.2% of the receipts from stamp taxes, tobacco taxes, and monopolies (annual receipts in excess of 28.9m drachmae) were divided equally between interest and amortization payments. Similarly, in the Chilean debt restructuring in 1948 creditors could choose between fixed and variable interest rates. For the variable rate bonds, the annual interest payments were fully contingent and consisted of 50% of profits derived from the Chilean Nitrate and Iodine Sales Corporation as well as income tax paid by copper companies. For these and related cases, we compute a hypothetical debt service stream, by collecting data on the actual debt service streams based on the bondholder's manuals in normal times (pre-default), as well as historical data on the underlying revenue streams (from taxes or monopoly incomes). These imputed contingent debt service payments are then used to compute present values and haircuts for each bond at the point of the restructuring.

***Interest/coupon payments:*** Coupon rates are available for all defaulted bonds in our historical sample and these are almost always fixed. We therefore do not need to make strong assumptions when calculating future interest cash flows (except for the 9 bonds with contingent interest payments, see

[44] Namely in Chile 1948, Colombia 1861, Dominican Republic 1934, Ecuador 1895, Greece 1898 and 1964, Mexico 1831 and 1942 and Turkey 1881.

bullet point above). In particular, we do not need to make assumptions on forward interest rates as in the case of floating-rate loans that were dominant in sovereign debt markets of the 1970s or 1980s.

***Stripped coupons:*** We are aware that in the 19th century there are a few reported cases in which investors "stripped" coupon and amortization payments into two separate instruments, so as to sell the stripped coupons on the secondary market at a discount (Costeloe 2003). This was attractive for speculative buyers since sovereigns often continued partial interest payments in default, while halting amortization. However, this was not a dominant trading phenomenon at the time and there is a lack of documentation and data, so that we ignore any stripped coupon instruments when computing haircuts.

***Holdouts:*** The haircut computations in this paper aim to capture the loss of the average creditor participating in the restructurings. We therefore do not explicitly compute the losses or gains of holdout creditors, also because the details on side-deals with holdouts are not usually known (see Fang et al. 2018 for a detailed discussion). More generally, when computing haircuts, we use the amounts actually restructured and disregard debts that were not restructured (and possibly continue to be serviced). Nevertheless, for completeness, we did collect information on holdouts, and gathered detailed information for 44 of the deals. In this subsample, the average creditor participation rate was 91%, with a standard variation of 9%, indicating that participation was generally rather high and similar to the average participation rate in sovereign bond restructurings since the late 1990s (see Das et al. 2012).

***Previous Restructured Debt:*** Previously restructured bonds are treated the same way as other old instruments. The relevant future payment streams can be easily computed given the detailed knowledge on the terms of previous restructurings. In total, we find that of all 693 defaulted bonds in our historical sample, 286 were affected by more than one default and restructuring (about 40% of the sample). Of these, 224 were restructured twice, 32 were restructured three times, 13 were restructured four times, and the remaining 17 bonds being restructured five times or more. These numbers are remarkable and mirror the fact that many governments are serial defaulters in the 19th and early 20th century (Reinhart, Rogoff, and Savastano 2003). Moreover, many historical bonds had very long maturities (of up to 40 or 50 years), which makes it more likely that the same bond witnesses several defaults.

The most extreme example is Mexico, which originally issued bonds in 1824/1825 and restructured these a total of 8 times over a period of more than 100 years. Mexico first went into default on the bonds in 1827. In 1831, part of the interest arrears was capitalized into new deferred bonds and the original debt service resumed on all other instruments. In 1833, Mexico defaulted on the just issued deferred bonds and restructured them into consolidated bonds in 1842 (exchange 1). As early as 1851, the consolidated bonds were again exchanged into new 3% bonds, which went into default in 1864 (exchange 2). The accrued interest on these bonds was exchanged into a new 3% bond in early 1864 and the debt service on all other instruments resumed again (exchange 3). Just two years later, in 1886, Mexico restructured its entire stock of outstanding bonds, including the previously restructured debt, into new 3% bonds (exchange 4), which were again restructured into a large 5% bond more than 10 years later, in 1899 (exchange 5). After a renewed default in 1914, another restructuring agreement was concluded in 1922, which further lowered the scheduled interest payments and extended the maturities of the previously restructured bonds (exchange 6). Mexico defaulted again in 1924 and a new debt agreement was signed in 1925 (exchange 7). After a new default in the interwar years, Mexico restructured again in 1942 (exchange 8). The last payment on these bonds were finally made in 1960. In our main sample, each of these 8 restructurings is a separate agreement with its own haircut. However, we also compute "cumulative haircuts" if two or more agreements occur in the same default spell.

***Administrative Fees:*** Bondholder associations such as the CFB typically charge a small percentage fee to cover their expenses of renegotiating the debt with sovereigns. We could collect detailed information on fees in 35 out of the 169 restructuring cases in our historical sample. The data show that the administrative charges vary between 0.5% and 1.5% of principal restructured. For all other cases, we do not have exact details on the fees. We therefore disregard any fees paid by creditors. This is consistent with the approach in Cruces and Trebesch (2013).

***Exchange rate conversions:*** Our dataset on defaulted bonds focuses on hard currency debt, meaning bonds issued in British Pounds and US Dollars. However, some of the restructurings also include bonds issued in French Francs and other currencies.[45] More precisely, 20% of deals in our sample feature bonds of different currencies. To obtain the overall haircut in these cases, we convert all amounts into US Dollar using the exchange rates provided by Reinhart and Rogoff (2009) and Officer (2018).

### C2.6. Robustness: Computing haircuts as in Kaminsky and Vega-Garcia (2016)

As an alternative approach to our main haircut estimate $H_{sz}$, we also compute haircuts following Kaminsky and Vega-Garcia (2016). The main difference of their approach is that they approximate the amount of interest arrears by compounding old debts that have come due. This differs from our baseline approach in which we compute interest arrears based on the original bond terms and coupons. More precisely, they define the NPV of the old debt as follows:

$$\text{Net Present Value of Old Debt} = \sum_{t=t_d}^{t_a-1} S_t^{old}\,(1+r_t)^{(t_a-1)} + \sum_{t=t_a}^{t_m} S_t^{old}\,\left(1+r_{t_a}\right)^{-(t-t_a)} \qquad \text{(C.4)}$$

where $t_m$ represents the bond maturity year, $t_a$ the year of the agreement, $t_d$ represents the year of the default, and $S$ reflects the debt service payments of the old bond during its maturity period.

Equation C.4 consists of two components. The first term is the compounding term and applies to all debt instruments affected by the default and restructuring. It capitalizes the missed debt service payments (principal and interest) from the default year to the time of the restructuring, thus assuming the hypothetical case that all debts due after the default are reinvested in the market. Partial payments during

[45] In our historical sample, 56% of bonds are denominated in British Pound, 17% in US Dollars and 10% in French Franc. Another 11% of bonds are denominated in various other foreign currencies, including the Swiss Franc, Swedish kronor, Dutch Florin, Italian Lire, Belgian Franc, German Mark, Japan Yen, Czechoslovakian Kronor, and Spanish Pesetas. The remainder (6% of bonds) are denominated in domestic currencies, namely those pseudo-domestic bonds that were predominantly sold to foreign bondholders and typically traded in London or New York (see the discussion on case selection criteria and pseudo-domestic restructurings above).

default (if any) are taken into account in this calculation since we have debt service information on a bond-by-bond basis in each case. For compounding we use a risk-free capitalization rate here, which is the most conservative choice, namely the yield on British consols until 1918 and that of US-Treasury bonds afterwards. The second term is relevant for debts that have *not* come due at the time of restructuring. Following Sturzenegger and Zettelmeyer (2008) we discount these (hypothetical) post-restructuring debt payments on the old debt instrument with the exit yield.

Take the example of a bond which defaults in $t_d$=1875, is restructured in $t_a$=1890, and has the maturity year $t_m$=1895. The first term compounds all contractual (but unpaid) debt service flows on the old debt from the default year 1875 until the agreement year in 1890, so that the haircut accounts for the long delay in crisis resolution. The second term will sum up the contractually agreed payments on the old bonds for each year between the restructuring 1890 and maturity 1895, discounted with the exit yield.