

NBER WORKING PAPER SERIES

SOVEREIGN BONDS SINCE WATERLOO

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Working Paper 25543  
<http://www.nber.org/papers/w25543>

NATIONAL BUREAU OF ECONOMIC RESEARCH  
1050 Massachusetts Avenue  
Cambridge, MA 02138  
February 2019

We thank Melanie Baade, Angelica Dominguez, Carl Hallmann, Moritz Müller-Freitag, Khanh Phuong Ho, Tim Hofstetter, Philipp Nickol, Maximilian Rupps, Sebastian Rieger, Paul Röttger, Christopher Schang and Julian Wichert for excellent research assistance. We received very helpful comments from Laura Alfaro, Darrell Duffie, Gita Gopinath, Şebnem Kalemli-Özcan, Sam Langfield, Matteo Maggiori, Vincent Reinhart, Moritz Schularick, Frank Westermann and from conference participants at the NBER IFM Summer Institute 2018, the ASSA Meetings 2015, the Macrohistory Workshop in Bonn, the Sovereign Debt Conference in Zurich, DebtCon2 in Geneva, the Financial Crises conference at the LSE, as well as at seminars at UC Berkeley, Harvard, LUISS, EIEF, and at the Universities of Cologne, Frankfurt, Humboldt, Melbourne, Munich and Oxford. Josefin Meyer gratefully acknowledges support by the European Commission's Marie Curie Fellowship Programme under REA grant agreement no. 608129. Christoph Trebesch gratefully acknowledges financial support from the DFG Priority Programme "Experience and Expectation: Historical Foundations of Economic Behaviour" (SPP 1859) and from the Junior Researcher Fund of LMU München. All remaining errors are our own. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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Sovereign Bonds since Waterloo

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NBER Working Paper No. 25543

February 2019

JEL No. F30,F34,G12,G15,N10,N20

### **ABSTRACT**

This paper studies external sovereign bonds as an asset class. We compile a new database of 220,000 monthly prices of foreign-currency government bonds traded in London and New York between 1815 (the Battle of Waterloo) and 2016, covering 91 countries. Our main insight is that, as in equity markets, the returns on external sovereign bonds have been sufficiently high to compensate for risk. Real ex-post returns averaged 7% annually across two centuries, including default episodes, major wars, and global crises. This represents an excess return of around 4% above US or UK government bonds, which is comparable to stocks and outperforms corporate bonds. The observed returns are hard to reconcile with canonical theoretical models and with the degree of credit risk in this market, as measured by historical default and recovery rates. Based on our archive of more than 300 sovereign debt restructurings since 1815, we show that full repudiation is rare; the median haircut is below 50%.

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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 sought financing in London. The first emerging market debt boom, which also included the first Greek international bond, among others, ended abruptly in the financial panic of 1825. Since then, many similar cycles of lending and default have followed, often involving the same countries, again and again.

Given the frequent defaults and limited enforcement of external sovereign debt, why are investors attracted to this asset class? We tackle this question by examining how creditors fared in sovereign debt markets over the short and long run.<sup>2</sup> Two components are necessary to calculate total bond returns. The first of these are price series. We collected monthly price quotations of 1,400 foreign-currency bonds issued and traded in London and New York over the past 200 years, with a total of 219,968 observations covering 91 countries.<sup>3</sup> However, because of the recurring credit events of sovereigns, prices and bond characteristics are necessary but not sufficient to calculate returns. The second component is to quantify the investor losses due to sovereign default and debt restructurings ("haircuts"), for which we have compiled an extensive database covering missed payments, renegotiations, and face value write downs in more than 300 debt crisis episodes since 1815.

We find that the returns on foreign-currency sovereign bonds over the past two centuries compensate investors for the risks they face. Notwithstanding defaults, wars and global crises, the average real yearly ex-post return on a global portfolio of external sovereign bonds was 6.8% over the entire sample, about 4% higher than that of "risk-free" benchmark government bonds of the UK or the US.<sup>4</sup> Excess returns are driven by the high coupons offered in this market. Not surprisingly, returns tend to be lower in crisis-prone decades. Furthermore, the risk-return properties are in line with those of other tradable assets, in particular US and UK equities for which we also gather 200-year return series.

The results go a long way in solving the puzzle of serial default, or why sovereign debtors undergo repeated cycles of over-borrowing and default, followed by subsequent market re-entry (Reinhart et al. 2003). The fact that sovereigns can borrow again despite a bad credit history, has preoccupied the literature for decades.<sup>5</sup> Many high-risk countries that have serially defaulted also managed to place bonds

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<sup>2</sup> External debt is defined here by currency (we focus on British pound and US dollar debt instruments) and place of issue and trading (only those traded in London and/or New York). Hence, sample selection for our pricing data is not dictated by any priors other than location. Specifically, 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 and Spain.

<sup>3</sup> London and New York were the two dominant trading centers in the 200-year sample (Michie 1987).

<sup>4</sup> These results, on the whole, show a higher rate of return for this asset class than a number of the earlier studies, which are mostly based on a different methodology and a more limited sample of sovereign bonds. See Section 2.

<sup>5</sup> Eaton and Gersovitz (1981), among others, assume permanent exclusion after a sovereign default, which is at odds with the data (see also Aguiar and Gopinath 2006 and Panizza et al. 2009).

quickly post-default. In 2016, Argentina re-accessed international markets only months after exiting its seventh default, including with a 100-year bond, which led market observers to conclude that credit markets were overheating.<sup>6</sup> In the past years, Africa had its own issuance boom, as formerly highly indebted poor countries (HIPCs) such as Chad or Zambia easily placed bonds abroad. Our historical results help to make sense of these market outcomes, as this asset class is characterized by a high return to risk ratio. This helps our understanding of the serial default phenomenon.

Our paper departs from the literature on sovereign debt in three main ways. First, we take a different perspective – that of an investor. The bulk of the existing work takes the borrowing countries’ perspective, often focusing on the determinants and costs of default.<sup>7</sup> The second is the extensive time span and geographical coverage of our study; earlier work on creditor returns has studied short samples or a limited number of countries. The third is the granularity of our data, as we trace the financial history of more than 1,400 individual bonds on a monthly level, combining historical data on prices and haircuts due to default. The result is the most ambitious dataset of sovereign debt to date, taking further the work of Lindert and Morton (1989), Homer and Sylla (2005), and Obstfeld and Taylor (2005), among others.

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.<sup>8</sup> The likely explanation is data limitations. Studies on long-run asset returns typically use annual data of representative benchmark bonds or aggregate indices (e.g. Dimson et al. 2001, or Jorda et al. 2017).<sup>9</sup> This standard approach, however, is not viable for external sovereign debt, due to the many defaults in this market and because defaults come in different varieties and can affect bonds differently, resulting in heterogeneous outcomes (Meyer 2019). A rigorous calculation of total returns on external sovereign bonds thus 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 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.

The second main building block is our new archive of external default and restructurings. We compute creditor losses (haircuts) bond-by-bond and deal-by-deal and combine this information on restructuring outcomes with our monthly bond price data. Moreover, we trace missed or partial bond payments on a monthly level. Because, as we establish here, coupons are the main driver of total returns in this market,

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<sup>6</sup> See Financial Times, June 22, 2017 “The rush for Argentina’s 100-year bond points to an investment bubble”.

<sup>7</sup> See e.g. Hébert and Schreger (2017). For surveys see Panizza et al. (2009) and Aguiar and Amador (2014).

<sup>8</sup> 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. For 2017, the BIS reports a stock of US\$1.9 trillion of external sovereign bonds (BIS 2018), about the same as total German government debt or about 10% of total gross US government debt.

<sup>9</sup> 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) compile yearly country-level indices of asset returns, 1870-2015, for 16 countries, including housing. Compared to these studies, we zoom into one asset class and cover 91 countries, 200 years at monthly frequency, and instrument-level data.

it is important to measure interest payments accurately, especially during lengthy default spells. The data show that sovereigns in default on principal payments often continue to service coupons in full or in part, which pushes up investor returns. Moreover, coupon payments on the same bond can vary markedly over the course of a crisis. The granular default data thus allow us to build monthly total return series on a bond by bond basis in a consistent manner, as well as representative country and global portfolios over long time spans.

While the findings help to demystify the puzzle of serial over-borrowing and default, they 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. Aguiar and Gopinath 2006, Arellano 2008, Mendoza and Yue 2012). When investors are risk-neutral, excess return above “risk-free” bonds should be zero in expectation. Yet, we find real excess returns that are in the range of 2 to 4% ex-post for the full global sample, although there is considerable time variation. Thus, investors typically receive a compensatory premium for holding sovereign risk that exceeds historical credit losses. This result is consistent with a small but growing theoretical literature that assumes risk-averse (or uncertainty averse) creditors in this market.<sup>10</sup>

The high returns we observe cannot be easily explained by historical default and recovery rates. Using our new default and 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 into new debt at a discount - with an average haircut of 44% and a standard deviation of 30%. Moreover, we find that bond prices often recover relatively quickly during and after default spells, although the variation across episodes is large. On average, creditors recoup their pre-crisis investment (measured one year before) within five years after the default; and in 25% of cases (upper quartile) investors recover their losses in less than one year. There are, of course, outlier episodes involving major upheavals such as wars, revolutions, or the break-up of empires (e.g. in Austria-Hungary, China, or Russia). However, in the majority of debt crises, investor losses are partial.

On a more general level, our results reveal many parallels to the case of equity. Just like for stocks, we find that 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 a stream of studies on the equity premium puzzle, largely focusing on the US after WW2 (see Kocherlakota 1996, Campbell 2003). There is also research on the “credit spread puzzle” for

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<sup>10</sup> See Barro’s discussion of rare disasters with Epstein-Zin preferences (Barro 2006) and, more recently, Broner et al. (2013), Lizarazo (2013), Borri and Verdelhan (2015), Aguiar et al. (2016), Grosse Steffen and Podstawski (2016), Pouzo and Presno (2016), Tourre (2017), Asonuma and Joo (2018).

corporate bonds.<sup>11</sup> The high excess returns on external sovereign bonds have received much less attention, in large part because earlier studies found little evidence of excess returns in the first place (Section 2).

Because we quantify the outcome of each default episode, our analysis moves away from the typical binary approach in the literature where a country is either in a default or it is not. Like for currency or inflation crises, orders of magnitude matter. We measure the magnitude of defaults both in terms of haircuts and in terms of amounts in default, which allows to identify the shades of gray across countries and time.<sup>12</sup> The 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, Aguiar and Gopinath 2006, Arellano 2008, Broner et al. 2010).

Finally, by combining modern and historical sovereign bond return data, our study is the first to offer a 200-year version of the widely used EMBI (Emerging Market Bond Index) by JP Morgan.<sup>13</sup> Our 200-year EMBI has a monthly frequency and can be explored at the global-, country-, and bond level.

The paper proceeds as follows. In the next section, we review the related literature, especially work measuring sovereign haircuts and investor returns. Section 3 describes crisis spells summarizing credit events and investor losses on external sovereign debt across two centuries, while Section 4 moves beyond defaults and documents the history of sovereign bond prices and returns over the very long run. Section 5 explores the behavior of returns during sovereign default events to understand investors' recoveries in this market. Section 6 focuses on risk-return comparisons across asset classes, while Section 7 concludes and lays a path for future research.

## **2. Previous studies - sovereign debt returns and haircuts**

The related literature can be broadly grouped into two categories. Those papers which have attempted to quantify rates of return on sovereign debt or related emerging market investments and a literature that provides estimates of haircuts and recovery rates for sovereign credit events.

Within the first body of work, there are earlier papers that have calculated internal rates of return to assess how creditors have fared in these investments. Internal rates of returns (IRRs) take the perspective of a buy-and-hold investor tracing cash flows over the life of a debt instrument (from issuance until maturity, default, or retirement). The IRR is extracted from the cash flow data so as to yield a net present value of zero. Using that approach, Eichengreen and Portes (1988, 1991) show that the interwar years were a bad

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<sup>11</sup> 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.

<sup>12</sup> There is already ample 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.

<sup>13</sup> The theoretical and empirical literature use the EMBI as a benchmark of sovereign risk in emerging markets. The list is too extensive to enumerate, but salient examples include Aguiar and Gopinath (2007), Panizza et al. (2009), Mendoza and Yue (2012), Du and Schreger (2016).

period for investing in external bonds. Over the decade of the 1920s, nominal rates of return were around 4-5%, only slightly above the returns on UK or US government bonds.<sup>14</sup> In a similar vein, Lindert and Morton (1989) compute internal rates of return for 10 countries between 1850 and 1983, with an average return of 0.4% above center country bonds. This longer-term average is depressed by the high incident of defaults and higher haircuts on sub-sovereign and corporate bonds. Indeed, the majority of bonds in Lindert and Morton (LM, 1989) are municipal, regional or corporate. As such, it is difficult to tease out sovereign bond returns from these mixed samples. In an effort to do so, we randomly picked 10 foreign-currency sovereign bonds from the LM dataset, trace them over their life span, and computed IRRs. For these bonds we found results in the 4-9 percent range, significantly above the LM full-sample averages. For an era that predates our Waterloo starting point, Drelichman and Voth (2011) also calculate IRRs and find substantive (profitable) returns on short-term loans to King Philipp II of Habsburg Spain, despite his notorious serial defaults.<sup>15</sup>

Klingen et al. (2004) study the return performance of sovereign debt in a large sample of developing countries between 1970 and 2000, including, importantly, the dominant form of lending in that era: syndicated bank loans. They base their estimates on aggregate bank and bond flows, public and private, and find a 9% nominal return, comparable to that of US Treasury bonds at that time (zero premia). Following large-scale debt restructurings in the early 1990s under the Brady plan, fixed income markets reemerged as a dominant source of credit to emerging markets. The recent literature mostly explores this post-1990 sovereign bond era with an approach closer in spirit to the one developed in this paper, typically using JP Morgan's EMBI country series (e.g. Broner et al. 2013, Borri and Verdelhan 2015).<sup>16</sup> The results highlight excess returns by country in the 3-15 percent range, which is significantly higher than those reported by papers studying the pre-1990s period.

A broad take away from this literature is that through much of the 19<sup>th</sup> and 20<sup>th</sup> century, emerging market debt delivered returns that were only slightly above the risk-free rate (keeping in mind the above discussed caveat that there is a comingling of sovereign bonds with other debt instruments). This made it all the more puzzling why investors continue to flock to this asset class.

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<sup>14</sup> These averages combine sovereign, sub-sovereign (e.g. regional) and corporate bonds. Less than 20% of bonds in Eichengreen and Portes (1988, 1991) were issued by a sovereign.

<sup>15</sup> There is also a literature studying the overall portfolio return of British overseas investments before WWI using price data, but with no emphasis on sovereign debt. Edelstein (1982) finds that British investors gained a higher return abroad than at home using returns on 566 foreign stocks and bonds (private and sovereign), 1870-1913. Goetzman and Ukhov (2006) use the same data but apply modern portfolio theory. Chabot and Kurz (2010) compute returns on more than 4,000 stocks and bonds (private and sovereign) trading in the UK and the US 1866-1907. They report significant excess returns on foreign government bonds compared to UK government bonds. None of these contributions mention how the numerous sovereign defaults and restructurings are accounted for.

<sup>16</sup> Broner et al. (2013) use Bloomberg and JP Morgan EMBI data for eight countries between 1993 and 2003, covering two default spells. Borri and Verdelhan (2015) use EMBI aggregate indices for 41 EM countries 1995-2011, including eight default events on sovereign bonds, while, most recently, Tourre (2017) focuses on sovereign CDS prices from Markit for 27 emerging markets 2002-2016, of which six entered a default in this period.

As noted earlier, a necessary ingredient to the calculation of ex-post returns is to account for losses due to default or restructuring, which requires data on missed payments and haircuts. The research on sovereign haircuts has been largely confined to the modern (post-1970s) period and this sample is dominated by defaults and haircuts on sovereign syndicated bank loans, plus about 20 recent restructurings of sovereign bonds. In pioneering work, Sturzenegger and Zettelmeyer (2006, 2008) compute investor losses in eight sovereign bond restructurings since 1998, finding haircuts in the range of 13-73 percent. Using a similar approach, the paper by Cruces and Trebesch (2013) encompasses 187 restructuring events of both sovereign bonds and syndicated bank loans since 1978, with an average haircut of 38%. This compares to a 40% average in the study by Benjamin and Wright (2009) who use aggregate World Bank debt data to estimate haircuts in 90 debt crisis spells since 1980. Moody's (2012), Asonuma et al. (2017) and Fang et al. (2018) focus on about 20 bond restructuring events since 1998 and report comparable averages.

The study of historical haircuts has been limited to estimates for seven Latin American countries, as provided by Kaminsky and Vega-Garcia (2016) for 24 restructurings between 1815 and 1939 (average haircut of 48%), as well as by Jorgensen and Sachs (1989) on four interwar restructurings. There is of course a large literature on the incidence of defaults in history (e.g. Suter 1992, Reinhart and Rogoff 2009, and references therein). This literature, however, has been silent on the magnitudes of investor losses.

A strand of research that is closely related to the default dimension, although not focused on the sovereign debt market, is the work on corporate credit events (see Duffie 2011 for an overview).<sup>17</sup> For corporate debt, creditor recovery rates (one minus the haircut) are typically measured using prices around default, most often the trading price 30 days after the default event (e.g. Moody's 2011a). A limitation of this price-based approach is the arbitrariness of the dates chosen, which vary both in the academic literature and across industry reports.<sup>18</sup> An alternative is the concept of "ultimate recovery", which is defined by Moody's (2007) as "the recovery values that creditors actually receive at the resolution to default, usually at the time of emergence from Chapter 11 bankruptcy proceedings".<sup>19</sup> Ultimate recovery rates are the closest analogue to the widely accepted estimation approach in the sovereign debt literature, in the vein of Sturzenegger and Zettelmeyer (2006) and Cruces and Trebesch (2013), according to which haircuts are computed via discounted present value cash flows at the exit from restructuring.<sup>20</sup> The average ultimate

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<sup>17</sup> This literature includes two recent long-run studies on corporate defaults by Giesecke et al. (2011) and Moody's (2011), which go back to 1866 and 1920, respectively.

<sup>18</sup> Moody's (2011a) uses a price "roughly" 30 days after the default event. Early S&P reports use the average price 30 to 45 days post-default, while more recent S&P reports focus on exactly 30 days afterwards. Jankowitsch et al. (2014) use average prices of the first 30 default days.

<sup>19</sup> The preferred approach by Moody's is to use the trading price of the old defaulted instruments at the first available date at or after emergence from default.

<sup>20</sup> In a special report on sovereign debt, Moody's (2011b) compares recovery rates in 16 sovereign defaults since 1998, comparing 30-day post-default bond prices to estimates based on a present value method. The conclusion is that "the two approaches to estimating recovery values generally produce similar estimates" (p.14). In Appendix C2.3 we draw a similar conclusion for our much larger 200-year sample of haircuts and bond prices.



recovery rate for US corporate bonds reported by Moody's (2007) is 37% for defaults between 1987 and 2006 (implying a haircut of 63%), while Jankowitsch et al. (2014) find an average recovery rate of 38.6% for 2002-2010. One can plausibly infer that emerging market corporate fare even worse, with lower recovery rates (bigger haircuts). Given higher average haircuts for corporates compared to sovereigns, any empirical exercise that combines these two asset classes is bound to yield lower average returns for the mixed portfolio.

### **3. Creditor losses in historical perspective**

This section shows that creditor losses due to default and restructuring events occur fairly often in external sovereign debt markets. However, the losses are almost always partial. Debt repudiations (unilateral debt cancellations) are rare and defaults typically end in a negotiated settlement with haircuts well below 100%.

#### **3.1. Sovereign debt restructurings 1815-2016**

To estimate creditor losses in default one needs to move well beyond identifying the incidence of debt crises, as in Reinhart and Rogoff (2009) and others. We conduct a census of all distressed sovereign debt restructurings with foreign commercial creditors in the period 1815 to 1980. We then combine this historical sample with the updated restructuring and haircut dataset of Cruces and Trebesch (2013), which covers 1978-2013, and with Fang et al. (2018), to add events until 2016. The result is a full sample of sovereign debt restructurings with foreign banks and bondholders for 1815-2016. To select cases, we apply the same criteria as in Cruces and Trebesch (2013) and focus on:

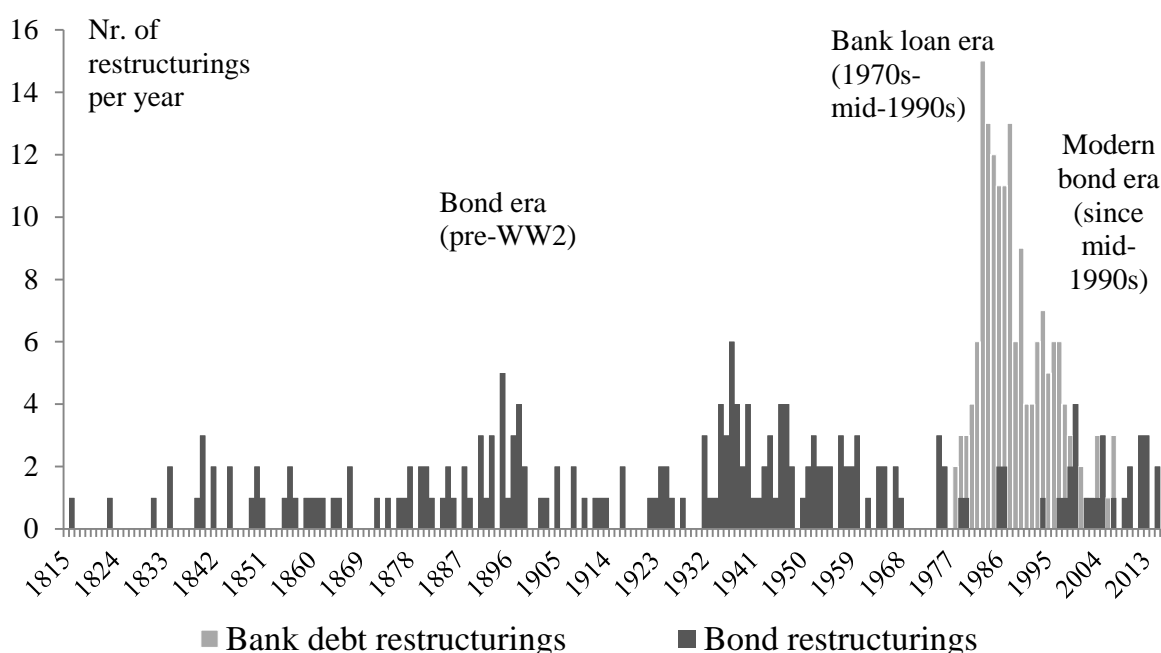
- (i) distressed restructurings, defined as exchanges of debt at a loss (as in Moody's 2012)
- (ii) restructurings of external sovereign debt, meaning bonds or loans by the central government and owed to private, foreign creditors, i.e. international banks or bondholders. We do not include private-to-private debt restructurings, or those involving official creditors such as government-to-government debts (see Reinhart and Trebesch 2016 and Schlegl et al. 2018 on official restructurings). Also restructurings on domestic-currency debt are not included.
- (iii) restructurings of medium and long-term debt. We thus exclude short-term rollovers or bridge financing deals.
- (iv) finalized deals. We thus disregard restructurings that were agreed on, but were never de facto implemented, for example when country parliaments reject an agreement.

We rely on a wide variety of sources to compile our restructuring and haircut archive. Importantly, we focus on the annual reports of bondholder organizations who negotiated with defaulting countries in the 19<sup>th</sup> and early 20<sup>th</sup> century, in particular the British Corporation of Foreign Bondholders (CFB), the US-based Foreign Bondholders Protective Council (FBPC) and the French Association Nationale des Porteurs Français de Valeurs Mobilières. 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 incorporate in our comprehensive database case studies from the literature, communiques of the creditor organizations, official gazettes of the debtor country, and press articles. Our integrative approach compares each data point on the restructuring agreements and the debt instruments involved across available sources.

The final sample used in the analysis includes 313 external sovereign debt restructurings in 91 countries since 1815.<sup>21</sup> This sample represents a lower bound. To avoid double counting, each default receives just one haircut estimate, so that multiple restructurings of the same default are combined using restructuring amounts as weights (for example when countries discriminate between creditor groups or by currency, e.g. restructurings of USD vs. GBP bonds, see Meyer 2019). Appendix C provides all the details and a breakdown by country. Figure 1 shows the yearly distribution over 200 years for the entire sample.

Figure 1: Sovereign debt restructurings with foreign private creditors, 1815-2016



*Note:* This figure shows the number of external sovereign debt restructurings (vertical axis) for each year, 1815-2016. Bank debt restructurings occur exclusively in the period 1970 to 2000. Restructurings of official debts (e.g. bilateral debt among governments or debt owed to the IMF and other official multilateral institutions) are not included. Domestic debt (local currency bonds not traded in London or New York) are not included, as these are a separate asset class.

<sup>21</sup> For 68 countries of the 91 defaulters we also constructed monthly time series of bond prices. For the remaining 23, we estimated haircuts but have no price data. In addition, we collected price data for another 23 countries that never defaulted on their external debt obligations (see Section 4), bringing the total pricing sample to 91 countries.

### 3.2. 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) and Moody's (2012), among others. The method is analogous to the concept of "ultimate recovery rates" in corporate debt defaults (Moody's 2007). The haircut  $H_t^i$  in restructuring  $i$  at time  $t$  is calculated by comparing the net present value (NPV) of the contractual payment streams of the *new debt* issued in the restructuring with the NPV of the *old debt* in default. Both payment streams are discounted using the same interest rate  $r$  at time  $t$ :

$$H_t^i = 1 - \frac{NPV \text{ new debt } (r_t^i) + \text{cash payments}}{NPV \text{ old debt } (r_t^i)} \quad (1)$$

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 intuitively,  $H_t^i$  compares the present value of the new and the old debt in a hypothetical scenario in which the sovereign keeps servicing any remaining outstanding old debts on an equal basis as the newly issued debt. Imagine a small holdout creditor who avoided a haircut and whose old, non-exchanged bonds continue to be repaid as if no default happened (akin to what happened to the €6bn holdouts on English law bonds in Greece 2012, see Zettelmeyer et al. 2013). Equation (1) captures how such a holdout creditor fares in comparison to all other creditors that participated in the exchange and received new bonds at less favorable terms than the old ones. For a meaningful comparison, the same discount rate has to be applied to compute the NPV of the new bonds and the old (holdout) bonds. Both old and new bonds face the risk of another default in the future and they both benefit from the debt relief effect of the restructuring.

Haircuts are computed on bond-by-bond basis. Because of the heterogeneous nature of the debt renegotiations it is not possible to simplify the calculations by relying on a "representative bond". Here we use information on a total of 1,134 defaulted sovereign bonds.<sup>22</sup> To compute aggregate haircuts for each restructuring event, we build a weighted average haircut across restructured bonds and use amounts outstanding as weighting basis.

To choose the discount rate  $r_t^i$ , 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 bonds that start trading after the restructuring. This rate reflects the market price 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. Whenever possible, we use the secondary market yield of country  $i$  in the month

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<sup>22</sup> We have pricing data for only a subset of these defaulted bonds.

after exit from default using the bond pricing data summarized in Section 4. For 44 debt restructurings, no market yield data was available, mostly in small countries and low-income countries with no liquid bonds trading in London and New York. In these cases, we use a “worst yield” approach, by using the highest bond yield observable among non-defaulted sovereigns in London or New York at that point in time as a proxy for the country’s own exit yield. Appendix C2 provides further details and shows robustness checks when using alternative discount rates. Among other checks, we apply a 10% flat rate to all deals, as well as a “risk-free” lower bound rate, by using the yield on UK or US long-term government bonds at the time of the restructuring.

To make the estimates as comparable as the data permit, we apply the same haircut computation approach across the entire 200-year span. The required simplifying assumptions are discussed in detail in Appendix C. The Appendix also discusses how we deal with the so-called “sinking fund” structure of many historical bonds, bond buyback options, gold and currency clauses or country-break ups. Moreover, we show results for alternative haircut measures, in particular the 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. In addition, we check the correlation between our haircut estimates and bond prices around the start of default. This is relevant, because, as noted above, the corporate debt literature typically uses market prices at the default onset to estimate bond recovery rates. 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.

### 3.3. 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 2016 (horizontal axis). As explained, the data since 1975 comes from Cruces and Trebesch (2013) and predominantly includes haircuts on sovereign bank loans (plus about 20 recent sovereign bond defaults). This study adds the preceding 160 years, and thus, haircut estimates for more than 150 bond defaults for which no data existed. Each observation represents one restructuring spell, where the size of haircuts is averaged across all instruments involved (volume weighted). The size of the circles represents the inflation-adjusted amounts of debt affected by the restructurings (in real 2009 US\$). Some of the haircuts shown are negative, but these are only 10 events and they mostly occur at the start of debt distress.<sup>23</sup> To complement this picture, Table 1 provides summary statistics and adds information for different haircut measures.

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<sup>23</sup> 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. These deals do not imply debt relief, but may nevertheless be beneficial for the government, at least in the short term. Often proving insufficient to deal with the debt sustainability problem, these initial deals are followed by later restructurings with larger haircuts.



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 38% once we calculate weighted haircuts (weighting by restructuring amounts in USD). The historical average haircut is somewhat higher than that of recent decades, owing largely to the fact that many of the defaults of the early 19<sup>th</sup> century and those of the 1920s and 1930s took decades to resolve. But the median haircut is nevertheless below 50% in history. In conclusion, creditor losses are mostly partial, not full. Default is not a binary (0,1) process, as usually modelled in the related literature.

Table 1: Sovereign haircuts with foreign private creditors (1815-2016)

	Cases	Mean	Median	SD	Min	Max
<b>Haircuts across time</b> (by default-restructuring event)						
Full sample (1815-2016)	313	44	39	30	-14	100
<i>Historical</i> sample (defaults pre-1970, only bond restructurings occurred, no bank debt)	138	51	48	32	-14	100
<i>Modern</i> sample (defaults post-1970, incl. 152 bank debt defaults and 23 bond defaults)	175	39	34	28	-10	97
... subsample of 23 <i>recent bond restructurings</i> (note: first “modern” bond exchange is 1998)	23	37	37	21	6	77
<b>Alternative haircut measures</b>						
<i>Weighted</i> haircuts, by amount restructured	313	38	31	27	-14	100
<i>Face value</i> haircut	313	22	0	32	-15	97
<i>Bond-by-bond</i> haircuts (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 23). A negative face value haircut only occurred in one case: the Mexican restructuring of 1864 (-15%), since 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). Weighted haircuts use restructured amounts in real terms (2009 USD).

Arguably, the list of most infamous defaults involving repudiations is headed by cases involving revolutions. For instance, Lenin cancelled all external debts in the wake of the Communist revolution in 1917. Other drastic cases of debt wipe-outs (full cancelations) include the Communist take-over of China in 1949 after the Maoist revolution<sup>24</sup> and Cuba 1960 after the Castro revolution.<sup>25</sup> In addition, we identified five cases in which a new government or ruler refused to service debts incurred by a previous regime (selective repudiation): 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),

<sup>24</sup> 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.

<sup>25</sup> 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.

Mexico 1866 (by Benito Juárez, on bonds issued by Maximilian I) and the Dominican Republic 1872 (when its Senate enacted a law repudiating external bonds). At the current conjuncture, the parallel case is whether Venezuela's "Maduro bonds" will add to this list.<sup>26</sup> In most repudiation cases, the debts remain in default until today, or were in default for more than a generation. The two exceptions are Spain and the Dominican Republic which settled after 10 and 16 years, respectively, at a haircut of 40% and 95%.

Besides revolutions and regime changes, we find that haircuts are often very high when a country or empire is dissolved (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, 100% haircuts are only observable for a small number of highly indebted poor countries (HIPC)s which defaulted in the 1980s and 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). As to the intuition why weighted haircuts are lower, this reflects the fact that for the poorest countries, where haircuts tend to be deeper, the amounts of debt involved are usually much lower, especially since WW2.

## **4. Sovereign bond returns, 1815-2016**

### **4.1. Sovereign bond pricing database - sample and sources**

This section presents our newly assembled comprehensive 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 from the Napoleonic Wars as the world's dominant financial center (Michie 2001). While our data span until September 2017, we mainly show results through end-2016 to include only complete years.

To assemble the long-run bond pricing database, we include all external sovereign bonds for which we could find pricing information on the London or New York Stock Exchange (LSE and NYSE). In line with the above, we focus on bonds issued by central governments in foreign (USD and GBP) currency. We include bonds with a maturity of at least one year and those with a fixed coupon rate, thus dropping a small number of floating rate instruments in the modern sample. Throughout, we coded end-of-month price quotations.

We rely on several main sources of bond price data. For the pre-1870 period, we use prices from the Money Market Review, The Economist, Circular to Bankers, Course of the Exchange, and Banker's Magazine. For the 1870-1930 period, we greatly benefitted from the work by William Goetzmann and

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<sup>26</sup> See Gulati and Panizza (2018).

Geert Rouwenhorst, by using their bond-level pricing data digitized from the British Investor Monthly Manual.<sup>27</sup> We contribute to this collection by adding bond-level information on the timing and scope of default, i.e. on missed or partial coupon and principal payments as well as on the restructuring terms. We also expand that dataset forward, by 50 years, adding monthly price quotations for external sovereign bonds trading on the LSE from 1930 to 1980, as provided by The Economist and the Financial Times.

Importantly, for the interwar period and post-WW2, we are the first to code and integrate in the analysis a large dataset of prices and returns for external sovereign bonds on the New York Stock Exchange (NYSE), which becomes the main trading platform for foreign sovereigns after 1914. Specifically, we coded NYSE sovereign bond price data from the Bank and Quotation Section of the Commercial Financial Chronicle (1905-1927 and 1954-1978) and from the Bank and Quotation Record (from 1927 to 1954). Taken together, the historical bond price sample spans the period 1815 until 1989 and includes more than 900 external sovereign bonds.

For the modern (post-1990) period, we build on the extensive emerging market bond price collection by JP Morgan as part of their EMBI Global indices. EMBI data have been very widely used in the sovereign debt literature, but unlike previous authors we do not rely on the off-the-shelf country-level EMBI series, but exploit the rich microdata on individual bonds that underlie the aggregate index. We focus on bonds that appear in the broadest of their indices, the EMBI Global, which are USD instruments from low and middle-income countries with a minimum issue size of US\$500 million and “easily accessible and verifiable daily prices either from an inter-dealer broker or a certified JP Morgan source” (see JP Morgan 1999 for details).

A main advantage of using the bond-by-bond EMBI data compared to the standard country-level indices is that we get a cleaner, more homogenous sample that is consistent with our historical time series, facilitating long-run comparisons. Scrutinizing and winnowing the sample is important for our purposes, because the EMBI includes many *non-sovereign non-USD* (or UK pond) instruments, such as bonds issued by large public banks, as well as local-currency bonds.

Specifically, we drop all EMBI bonds issued by public companies and other sub-sovereign bonds guaranteed by the government. Furthermore, we exclude local currency bonds, as well as a few dozen bonds in international currencies other than USD or GBP, such as French or Swiss Franc. The resulting dataset includes more than 500 external sovereign bonds from the EMBI. Some bonds have prices as early as 1990, but the sample becomes representative only from 1995 onwards, when more than 40 Brady bonds were actively traded. We therefore show results for the modern period starting in 1995.

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<sup>27</sup> Their dataset is hosted on the website of the International Center for Finance at Yale. A large literature has used their data and, more generally, data from the Investor’ Monthly Manual, e.g. Ferguson and Schularick (2006), Mauro et al. (2002) or Mitchener and Weidenmier (2010).



Our merged (historical plus modern) bond pricing sample thus covers 1,400 foreign-currency sovereign bonds issued by 91 countries.<sup>28</sup> The coverage and granularity of this global dataset comes close to that compiled for individual advanced countries.<sup>29</sup> For the US, the Chicago-based CRSP Database provides monthly instrument level data on US Treasuries back to 1925. For England, Ellison and Scott (2017) gathered granular data of prices and issuance patterns on UK government debt between 1694 and 2017.

When combining the bond price dataset with our archive on missed payments and debt restructurings described in Section 2 we carefully match the information at the bond-level. However, we do not have prices for all of the 1,134 bonds for which we computed haircuts, because some of the restructured were not regularly traded and quoted in New York or London. Similarly, it should be noted that only a subset of the 1,400 bonds for which we have pricing data were defaulted upon. Many bonds therefore appear in the bond price dataset but not in our default and haircut dataset and vice versa.

Table 2 and Figure 3 provide an overview on the data coverage. In the first half of the 19<sup>th</sup> century (after Waterloo) less than 20 countries had sovereign bonds traded in London. The sample grows markedly after 1850, especially 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. After WW1, New York joins London as the second dominant financial center of the world, and our sample continues to grow, reaching a first peak in the late 1920s. By 1929, after an extended issuance boom (see, for instance, Winkler 1933 or Wynne 1951), more than 350 sovereign bonds of more than 50 countries were actively traded in London and New York.

During the 1930s the sample shrinks, for two very different reasons. The first is about data availability, as the Investor’s Monthly Manual ceases to be published. Thus, the most important pricing source for the London market is no longer available. As a replacement, we gathered price quotes from *The Economist* and the *Financial Times* after June 1930 and until the 1980s, but these two sources do not cover all bonds trading in London at the time. The second reason is about global developments. The Great Depression and WW2, which were accompanied by widespread capital account controls and a wave of sovereign defaults after 1929, led to a sharp decline in cross-border lending worldwide (Reinhart et al. 2018).

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<sup>28</sup> Of these, 69 defaulted on their external debt at some point since 1814, namely, Algeria, Angola, Argentina, Austria/Austria-Hungary, 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, Haiti, 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, Thailand, Trinidad and Tobago, Tunisia, Turkey/Ottoman Empire, Ukraine, Uruguay, Venezuela, Vietnam, Yugoslavia/Serbia, Zambia, and Zimbabwe. The remaining 22 countries never defaulted on privately-held external debt since 1815, namely Armenia, Australia, Azerbaijan, Belarus, Belgium, Canada, Denmark, France, Georgia, Ireland, Kazakhstan, Lebanon, Malaysia, Mongolia, Namibia, Netherlands, New Zealand, Norway, Slovak Rep., South Korea, Sweden, and Switzerland.

<sup>29</sup> See also Maggiori et al. (2018) who use granular data on hundreds of thousands of financial instruments, including sovereign bonds, to examine the choice of issuance currency.

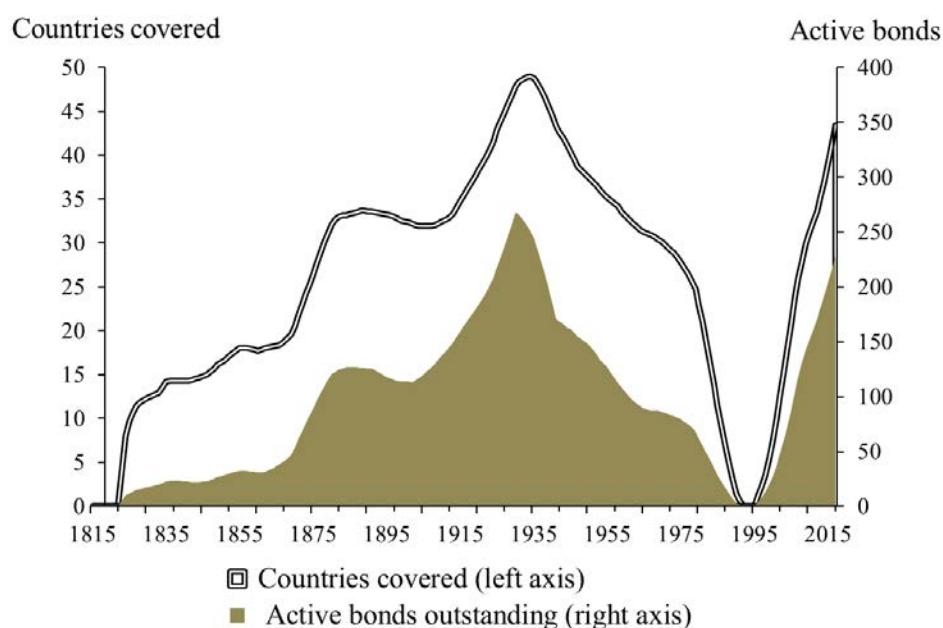
Moreover, securities of enemy countries or their allies were banned from trading on the LSE and NYSE after 1939. As a result, the number of traded bonds with monthly pricing information drops to below 200.

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

	Total sample	By era				
		1815-1869	1870-1913	1914-1945	1946-1989	1995-2016
Number of countries covered	91	30	45	52	41	67
Share of countries covered	70.5%	73.2%	88.2%	85.3%	34.2%	51.9%
Pricing observations (monthly)	219,968	11,536	60,876	71,533	32,031	43,992
Number of active bonds	1,400	140	405	472	229	556
... issued in British pounds	638	140	397	320	92	0
...issued in US dollars	762	0	8	152	137	556
Average maturity of bonds issued	26	46	42	37	31	16
Average coupon (nominal)	5.8	5.1	4.7	5.1	5.2	7.1
Average amount issued (nominal, in m USD)	605	33	41	65	36	1,444

*Note:* This table provides an overview of the evolution of our sample since 1815. The gap during between 1990 and 1994 is explained by the fact that only very few sovereigns had outstanding sovereign bonds at the time (see text). The norm for sovereign external borrowing in the preceding decades was bank loans rather than bonds. In total, we collect price data and bond terms for more than 1,400 bonds. GBP bonds were dominant until WW2 and account for 46% of the sample in total. The other 54% are USD bonds. The share of countries covered is given as percent of all independent countries worldwide. Besides the change of currency composition over time, we also find that bond characteristics change notably. Average bond maturity declines from 46 years in the 19<sup>th</sup> century, to just 16 years in the modern ear. Over the same period, average coupons increased from around 5% to 7% p.a.

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 2016. 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).

After 1945, during the Bretton Woods period, the sample declines further. This era sees only little international private capital flows and bank lending overtakes bonds as the preferred vehicle of cross-border lending to sovereigns. As a result, between 1950 and 1990, only 20 countries issued foreign-currency bonds that were actively traded in London and New York, with a total of just 74 newly issued sovereign bonds in four decades. While sovereign bond placements stalled, the 1970s and early 1980s became the era of sovereign syndicated bank lending. Developing countries borrowed heavily from commercial banks primarily in the US and Europe. This lending boom was followed by large-scale defaults on these debts. By the early 1980s, only a handful of countries still had outstanding bonds at the LSE or NYSE and these instruments are mostly long-maturity bonds issued in the 1930s and 1940s.

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 that securitized the former bank loans. The newly issued sovereign bonds were traded at a discount. The resulting Brady bonds make up for most of our sample in the 1990s. The re-emergence of an active sovereign bond market subsequently encouraged more and more emerging markets to 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 and reaches a second peak in 2016, with over 300 foreign-currency sovereign bonds of 59 countries being actively traded. Further details on the sample and coverage are shown in Appendix B1.

## 4.2. Measuring bond returns

The ex-post nominal return  $R_{i,j,t}$  for bond  $i$  of country  $j$  in month  $m$  is driven by two main components: price changes and coupon payments. We calculate monthly total bond returns as follows:

$$R_{i,j,m} = \frac{P_{i,j,m} + C_{i,j,m}}{P_{i,j,m-1}} - 1 \quad (2)$$

where  $P_{i,j,m}$  is the price of bond  $i$  in month  $m$  and  $C_{i,j,m}$  are coupon payments. As is standard practice, coupon payments are considered as accrued interest, meaning that they are equally distributed over the coupon payment period. For monthly data and quarterly coupons, we thus assume equal payouts in each of the four months. To calculate  $C_{i,j,m}$ , we measure missed or partial coupon payments based on our newly collected bond-level dataset on default and restructuring outcomes, see Appendix B2. That Appendix also explains how we account for bond haircuts when calculating  $P_{i,j,m}$ , i.e. how we deal with exchanges of old into new bonds at a loss. It is important to flag, however, that for the modern post-1995 EMBI sample there are a handful of credit events involving haircuts and missed coupon payments that merit further scrutiny to place these at par with the full documentation we provide for the earlier credit events. The available documentation provided by JP Morgan on how such cases are treated in their price and return series is limited and opaque. We do not account for taxes or transaction fees.

We use *real* ex-post returns as baseline measure, although we show results for nominal returns as well. By definition, all bonds in the sample are denominated in either GBP or USD, so that we need historical inflation data for the UK and US to compute real returns. For this purpose, we rely on the historical inflation indices provided by the Bank of England (for GBP bonds) and by the US Bureau of Labor Statistics (for USD bonds). For a USD bond, the monthly inflation rate is measured as  $\pi_{US,m} = (CPI_{US,m} - CPI_{US,m-1})/CPI_{US,m-1}$  so that the real ex-post return for this USD bond is given by  $r_{i,j,m} = R_{j,i,m} - \pi_{US,m}$ . The comparable process applies to UK bonds.<sup>30</sup>

To arrive at yearly returns<sup>31</sup>, we accumulate monthly returns of month  $m$  and year  $t$  as follows:

$$R_{i,j,t} = \prod_{m=1}^{12} (1 + R_{i,j,m})$$

To compute portfolio returns we aggregate sovereign bonds on a country and global level at each point in time. Specifically, we calculate monthly and yearly portfolio returns of all active bonds and weight these by bond value.<sup>32</sup> The formula for yearly average global portfolio returns can be written as follows:

$$R_t^{portfolio} = \sum_{i=1}^N R_{i,j,t} * \frac{w_{i,j,t}}{\sum_{i=1}^N w_{i,j,t}} \quad (4)$$

where  $w_{i,j,t}$  denotes the value-weight of bond  $i$  of country  $j$  for year  $t$  and  $R_t^{portfolio}$  is the realized return of the global portfolio including bonds 1 to  $N$ . In most years the global portfolio is comprised of a dominant currency (USD or GBP). The 19<sup>th</sup> century is dominated by GBP bonds, while the modern post-1995 sample only includes USD bonds. For some episodes, however, especially during the interwar years, our portfolio contains a mix of USD and GBP bonds. If this is the case, the returns on GBP bonds and USD bonds enter without converting them into a common currency to avoid bias. This means that, for those years, we take the perspective of an investor who holds all outstanding foreign-currency bonds irrespective of whether they are denominated in USD or GBP and who is hedged against currency fluctuations between these two currencies.<sup>33</sup>

To track the return performance over time, we mainly focus on arithmetic averages. This is because arithmetic returns are the benchmark measure in earlier work on long-run asset performance, e.g. in the

<sup>30</sup> Appendix B3 shows results to be similar when using inflation rates 12 months ahead instead of in month  $t$ .

<sup>31</sup> Our results are similar when comparing bond prices at the beginning and end of a year (adding all within-year coupon payments) instead of annual averaging.

<sup>32</sup> For weighting, we use nominal issuance amounts for the historical bonds. For the modern bond period we rely on weighting schemes provided by JP Morgan that are based on market capitalization.

<sup>33</sup> To obtain consistent weights  $w_{i,j,t}$  in portfolios with mixed currencies we need to convert bond amounts into a joint currency (USD). For this purpose, we use average exchange rates in the year of bond issuance.

EMBI index reports or in, Dimson et al. (2001). For a specific period, say, year 1 through  $T$ , the average portfolio return can be calculated as:

$$\frac{1}{T} \sum_{t=1}^T R_t^{portfolio} \quad (5)$$

where  $R_t^{portfolio}$  is the realized return on a given bond *portfolio* in year  $t$ . As an alternative, we also compute geometric means for each bond and portfolio, meaning the annualized return.<sup>34</sup>

Furthermore, as a complement, we also calculate total cumulative returns, which is particularly useful to assess returns in pre-specified event windows (such as around default spells, see Section 5 and Appendix B4). The formula can be written as  $\prod_{t=1}^T (1 + R_{i,t}) - 1$  and measures the total return of bond (or portfolio)  $i$  between period 1 and  $T$ , where  $t$  represents months or years. This formula can also be used to compute the holding period return, which is the return from holding the investment for a specific period of time.

To compute excess returns, we compare the total returns of each of the bonds in our sample to the returns on a “risk-free” or safe benchmark in each period. Here, we use total return series on 10-year UK and US government bonds as benchmark to calculate excess returns. This means that we match the total return of each of the GBP and USD government bonds of a periphery country with the return on long-term British government gilts or US Treasury bonds at each point in time. More precisely, we calculate  $RP_{i,j,t} = R_{i,j,t} - R_{safe,t}$ , where  $RP_{i,j,t}$  is the excess return of bond  $i$  of country  $j$  in period  $t$  and  $R_{safe,t}$  is the risk free rate, denominated in the same currency as bond  $i$ . Appendix A provides the sources for these risk free rates (total return series on UK and US bonds). For completeness, we also compute excess returns vis-à-vis UK or US bills, which is useful when comparing the risk-return properties of external sovereign bonds to those of other asset classes (Section 6).

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.

#### 4.3. Main results on bond returns

Table 3 summarizes our main results. The table shows average yearly sovereign bond returns for our global portfolio of foreign-currency bonds over 200 years. Henceforth, we do not show returns for the period 1974 to 1994 due to lack of representative bond pricing data in the 1970s and 1980s.<sup>35</sup> This means

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<sup>34</sup> There can be significant differences between arithmetic and geometric average returns, with arithmetic averages exceeding geometric ones when returns are volatile. Specifically, when returns have a lognormal distribution, the arithmetic return roughly exceeds the geometric return by one-half of the variance. The formula for the geometric average return for year 1 through  $T$  is  $\prod_{t=1}^T (1 + R_t^{portfolio})^{\frac{1}{T}} - 1$ .

<sup>35</sup> As we explain in Section 3.1. and in Appendix B1 the 1970s and 1980s are a period dominated by syndicated bank lending to sovereigns. Barely any sovereign bonds were issued abroad. As a result, the number of counties with actively traded bonds drops to less than 10 in the 1980s, making the global portfolio unrepresentative.

that the time series for the global portfolio ends in 1973 and starts again in 1995. Appendix B3 shows a number of robustness checks, such as on selection (survivorship) bias and on the inflation series used.

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
<b>Full sample</b> , 1815-2016, yearly	6.77	5.88	13.99	7.81	7.10	12.62
... without world wars	7.05	6.21	13.51	7.63	6.96	12.12
<b>By era</b> , yearly						
1815-1869	7.87	6.43	18.04	7.19	6.16	15.37
1870-1914	6.19	5.93	7.37	6.10	5.87	6.92
1915-1945	5.65	4.18	18.28	6.76	5.78	15.11
1946-1973	5.51	4.83	12.45	9.56	8.85	12.93
1995-2016	9.12	8.57	11.09	11.61	11.01	11.75
Monthly returns, full sample	0.60	0.54	3.63	0.70	0.63	3.56

*Note:* Table 3 shows average ex-post investor returns in our total sample of 91 countries and 200 years, as well as for different subsamples. The country composition is changing over time (see Appendix B1). All returns are yearly averages, except for the last line, which shows a 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.

In the full sample from 1815 until 2016, foreign-currency bonds show an annual ex-post real return of 6.77%, including spells of turmoil due to default, wars and revolutions. The average is slightly higher (about 7%) when dropping WW1 and WW2 (1914-1918 and 1939-1945). As noted earlier, because of the disappearance of new bond financing in the 1970s and 1980s, this sample omits the encompassing debt crisis in emerging and developing countries of the 1980s, where commercial bank loans (not bonds) occupied the center stage of the unfolding default drama. It is therefore plausible to expect that, during the 1980s, ex-post returns on sovereign loans were lower (certainly than in the modern bond era) as was the case during the depression of the 1930s, as discussed in the preceding section.

Nominal returns exceed real ones in the full sample, but this is driven by the period after WW1. In the 19<sup>th</sup> century, real returns tend to be higher than nominal returns, due to the many deflationary spells, including the “Great Deflation” between 1870 and 1890. The geometric total real return is lower, as usual, with an average of 5.88%. This number represents the annual compounded return of an investor who has remained invested for almost two centuries.

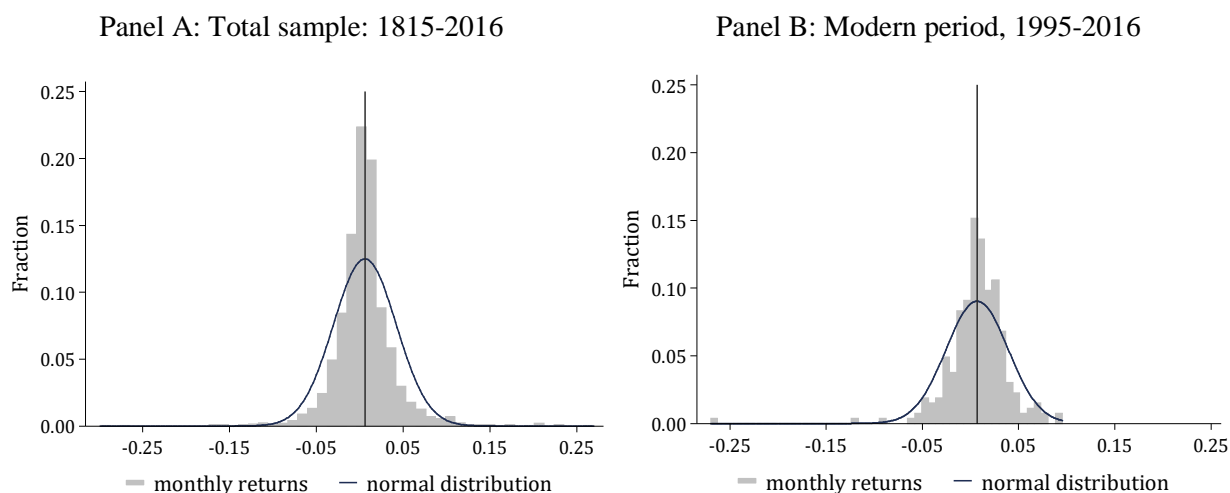
The observed returns can mainly be attributed to coupon payments (gains from interest) rather than to price changes (capital gains). Around 70%, or 5.87 percentage points, of the nominal yearly return of

7.81% over the last 200 years is due to coupon payments. Coupons are the main driver of returns in each decade, roughly contributing between 5 and 8 percentage points to the ex-post nominal returns.

Turning to subsamples, the two main eras of financial globalization (1870-1914 and 1995-2016) stand out. These periods are characterized by average real returns of around 6-9% per year, coupled with low or moderate volatility (the standard deviation is 7.4% and 11.1%, respectively). The early 19<sup>th</sup> century sees high average returns of about 8%, but also a high return volatility. The interwar years show the worst risk-return ratio, with lower-than-average real returns of 5.7% 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 issue of survival bias and sample composition in Appendix B3, by focusing on 15 countries for which we have more than 100 years of data each, resulting in a more balanced sample. The returns for these 15 countries are similar to our baseline numbers that build on all 91 countries, some of which enter only a few years. This alleviates concerns that our main finding is biased due to sample issues.

Figure 4: Distribution of monthly, real bond returns



*Notes:* 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-1995 period (Panel B). The blue line plots the normal distribution.

We also explore the distribution of returns in our global bond portfolio. This is important because the standard deviation can understate the degree of risk due to a skewed distribution with fat tails. Figure 4 shows that the monthly return distribution does not look overly skewed. Despite some positive and negative outliers, the plot is well approximated by a normal distribution (which is also true for the annual

data). To be conservative we nevertheless compute adjusted Sharpe ratios below, so as to account for volatility, skewness and kurtosis.

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)	2.7	4.6	5.6	6.8	6.8	14.6	21.8	29.6	37.9	46.2	55.3	64.9	75.0	86.1
p75	5.2	8.4	12.2	13.8	13.8	25.3	35.8	47.7	58.1	68.3	82.6	87.1	92.0	104.4
Median	2.5	3.6	4.2	5.7	5.7	11.9	18.9	23.6	32.7	40.9	48.1	57.2	69.2	82.0
p25	0.4	-0.9	-0.6	-0.6	-0.6	1.2	3.8	7.7	14.3	22.4	33.0	41.3	50.8	63.6
Mean (arithmetic, avg. per period)	2.7	2.3	1.9	1.8	6.8	6.9	6.6	6.6	6.6	6.6	6.7	6.8	6.8	6.9
Mean (geometric, annualized)	2.7	2.1	1.7	1.6	6.8	6.5	6.1	6.0	6.0	6.0	6.1	6.1	6.1	6.2

*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.

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 86.1%, with a median of 82%. The dispersion increases over time, with the upper bucket (75<sup>th</sup> percentile) reaching a 104.4% real return over 10 years, while the lower bucket (25<sup>th</sup> percentile) shows a cumulative return of 63.6%. 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 6% per year.

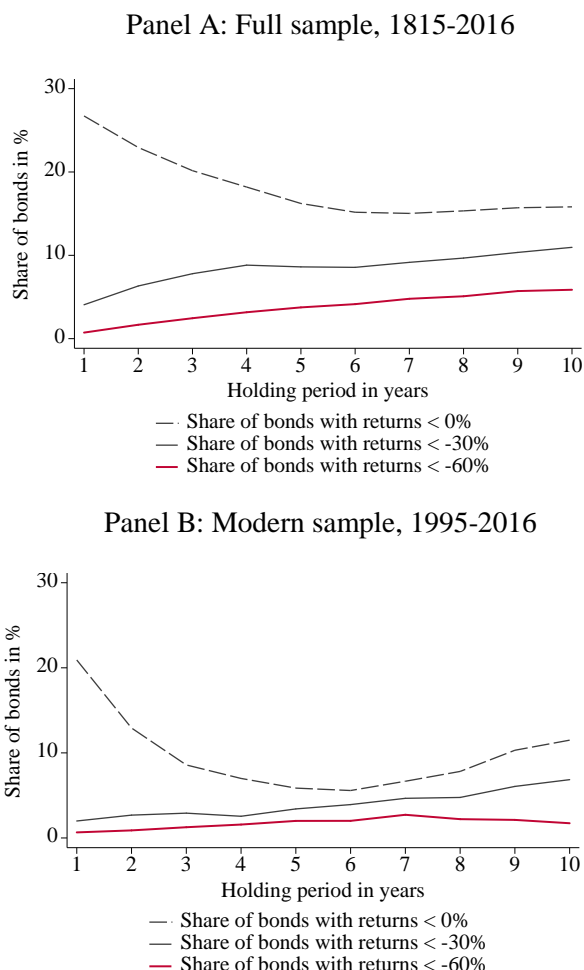
Figure 5 zooms into the sub-sample of the worst-performing bonds. We calculate the share of bonds with negative real compounded returns after different holding periods. In the full sample, in year one, more than 25% of observations see negative returns, and this drops to below 20% in year 10 (Panel A). Moreover, there are about 6% of observations with substantial losses, showing a negative return of -30% or worse, as well as a small but growing share of bonds with returns between -30% and -60%. Observations in this bottom bin are dominated by spells after the Great Depression and around WW2, e.g. in many Communist countries (China, Russia and Eastern Europe), which saw a large initial collapse in bond prices and defaults that persisted for decades.

In the modern (post-1995) period, the share of bonds with negative returns is much lower than in the historical sample (Panel B). After three years only about 9% of country observations remain in negative territory. The share with very low returns (-30% to -60%) is below 1% initially and then increases to 3%, mainly driven by the long and severe Argentine default, as well as the years following the financial crisis



of 2007-2008. Thus, over the decades since the crisis of the 1980s, only a small subgroup of bonds saw protracted losses.

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



*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 years, while Panel B focuses on the modern (post-1995) sample.

#### 4.4. Returns by country: the role of credit history and risk

This section shows bond returns for individual countries and by country groups, in particular for the group of serial defaulters. The returns by country or by group are averaged across all active bonds in the subsample and volume-weighted, analogous to the construction of the global portfolio. We also show 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.

We start with a group of 60 “serial defaulters”. These are countries that have defaulted on their external debt at least twice since 1815 and/or who were in default for protracted spells, defined as a share of years

in default above the sample median, which is 20% of years (since 1815 or independence). The default data are from Reinhart and Rogoff (2009) and updated by Reinhart and Trebesch (2016) and here.<sup>36</sup>

The second group of 31 countries (“Others”) includes non-defaulters and those that defaulted only briefly on their external debt to private creditors. Specifically, 22 sovereigns never defaulted (see Footnote 28), while 9 countries were in default less than 20% of years since 1815 (or independence), namely Algeria, Ethiopia, Finland, Italy, Japan, Jordan, Thailand, Trinidad and Tobago and Vietnam.

Table 5: Bond returns by country group and era

	Arithmetic mean (annual)	Geometric mean (annual)	SD	Excess return (mean, above UK/US bonds)
Total Sample (1815-2016)				
Serial Defaulters	7.0	5.9	14.9	4.1
Other countries with ext. bonds	5.8	5.3	9.8	3.3
UK/US 10y gov. bonds	2.5	2.1	9.0	
Early 19th Century (1815-1869)				
Serial defaulters	8.0	6.5	18.5	3.4
Other countries with ext. bonds	6.4	6.0	10.1	1.3
UK 10y gov. bonds	5.1	4.6	10.2	0.0
Pre-WW1 (1870-1913)				
Serial defaulters	6.7	6.3	9.0	4.2
Other countries with ext. bonds	5.7	5.6	4.9	3.2
UK 10y gov. bonds	2.5	2.5	3.9	0.0
Interwar (1920-1937)				
Serial defaulters	7.1	5.1	20.3	-2.4
Other countries with ext. bonds	10.4	9.3	16.7	1.2
US 10y gov. bonds	7.8	6.8	16.7	
Today (1995-2016)				
Serial defaulters	9.3	8.8	11.5	5.2
Other countries with ext. bonds	6.4	6.3	6.1	3.1
US 10y gov. bonds	3.3	2.9	8.5	

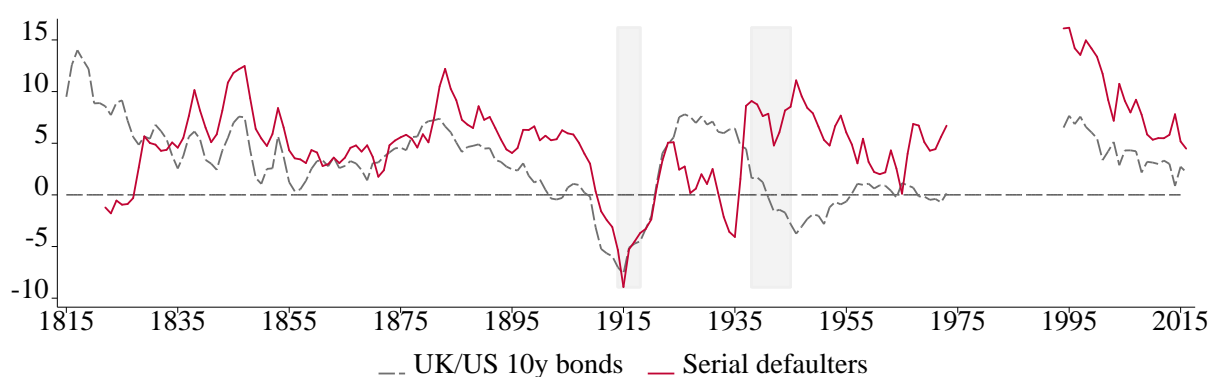
*Notes:* This table shows summary statistics of yearly total real returns on foreign-currency sovereign bonds across 200 years for different country groups. Serial defaulters had two or more external defaults or were in default for a very long time (their share of years in default since independence is above the sample median of 20%). Other countries are those that never defaulted or only for a brief period (share of years in default below the median). Excess returns above UK/US bonds are computed on the bond level.

<sup>36</sup> Specifically, the group includes Angola, Argentina, Austria/Austria-Hungary, Belize, Bolivia, Brazil, Bulgaria, Cameroon, Chile, China, Colombia, Costa Rica, Cote d'Ivoire, Croatia, Cuba, Czech Republic/Czechoslovakia, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Gabon, Germany, Ghana, Greece, Guatemala, Haiti, Honduras, Hungary, Indonesia, Iraq, Jamaica, Kenya, Latvia, Lithuania, Mexico, Morocco, Nicaragua, Nigeria, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Russia, Senegal, Serbia/ Yugoslavia, South Africa, Spain, Sri Lanka, Tunisia, Turkey/Ottoman Empire, Ukraine, Uruguay, Venezuela, Zambia, and Zimbabwe. Of these, Angola, Cameroon, Cote d'Ivoire, Croatia, Estonia, Iraq, Latvia, Lithuania and Zambia defaulted only once but for a protracted spell (spending more than 10% of years since independence/1815 in default).

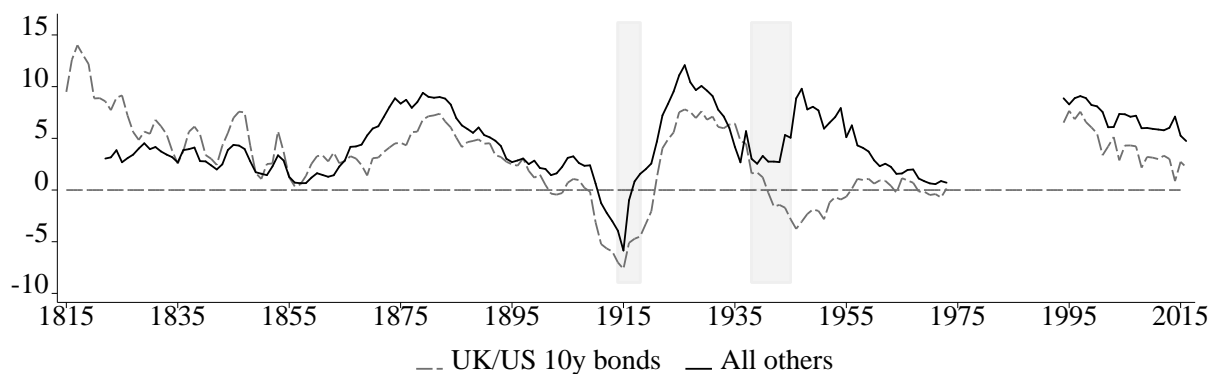
Table 5 shows summary statistics for the three groups, (i) serial defaulters, (ii) “other” sovereigns that issued debt in USD and GBP abroad, and (iii) “risk-free” US or UK long-term government bonds. The UK/US series is spliced, by combining the real yearly returns on 10-year UK gilts until 1918 with the return series on 10-year US Treasuries for the subsequent 100 years (see Appendix A for sources). We switch to US bonds after WW1 because New York overtakes London as the world’s main financial center during the interwar years, but the series looks similar if we consider both series over the entire 200-year span and simply use the average of US and UK long-term government bond returns. As a complement, Figure 6 shows 10-year moving average returns for each of the groups since 1815.

Figure 6: Trends in sovereign bond returns, 1815-2016

Panel A: Bonds of serial defaulters vs. UK/US bonds



Panel B: Other external sovereign bonds vs. UK/US bonds



Note: This figure shows time series of 10-year moving-average returns on external sovereign bonds across 200 years and on UK/US bonds. 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 or with protracted defaults.

The main takeaway from Table 5 and Figure 6 is that sovereign bonds of serial defaulters provided significantly higher returns compared to UK/US government bonds as well as in comparison to “other” periphery countries which have never defaulted, or only briefly. Serial defaulters show higher excess returns in the full sample and in most sub-eras, except for the interwar years, when bonds of center countries perform better. Furthermore, Panel B of Figure 6 confirms that bonds of “other” periphery

sovereigns have higher returns than UK/US bonds, except in the first half of the 19<sup>th</sup> century. This pecking order is also observable for the standard deviation of returns, which is highest for serial defaulters (in all eras), followed by that of “other” periphery sovereigns and that of UK/US bonds. The findings suggest that investors are compensated for the risk they take when holding bonds of volatile countries with a bad credit history. It is also consistent with Weil’s (1989) risk-free rate puzzle. In international finance, the phenomenon known as “exorbitant privilege” focuses on the comparatively low borrowing costs for the financial center countries. In Maggiori (2017), for instance, this outcome is the result of equilibrium risk sharing between countries with different levels of financial development.

We next look at returns on the country level. Table 6 reports yearly, real, average returns for all countries for which we have more than 10 years of bond price data. Countries are ranked by average real returns. We also show the standard deviation of returns, average excess returns (above UK/US bonds), as well as the number of sovereign default events and the share of years in default. The country comparison is complicated by the fact that some countries, including most advanced countries, no longer issue government bonds in London or New York. Moreover, some countries only entered international capital markets recently, resulting in an unbalanced sample. Appendix B1 provides details on data coverage.

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 high even for countries that have defaulted multiple times and over long periods, such as Argentina, Brazil, Ecuador, Greece, Mexico, Ukraine or Venezuela. These countries feature long-run excess returns between 4% and 12%. It is also remarkable that not a single country in Table 6 shows a negative arithmetic return, on average, and only two countries have negative excess returns, on average (Bolivia and China).

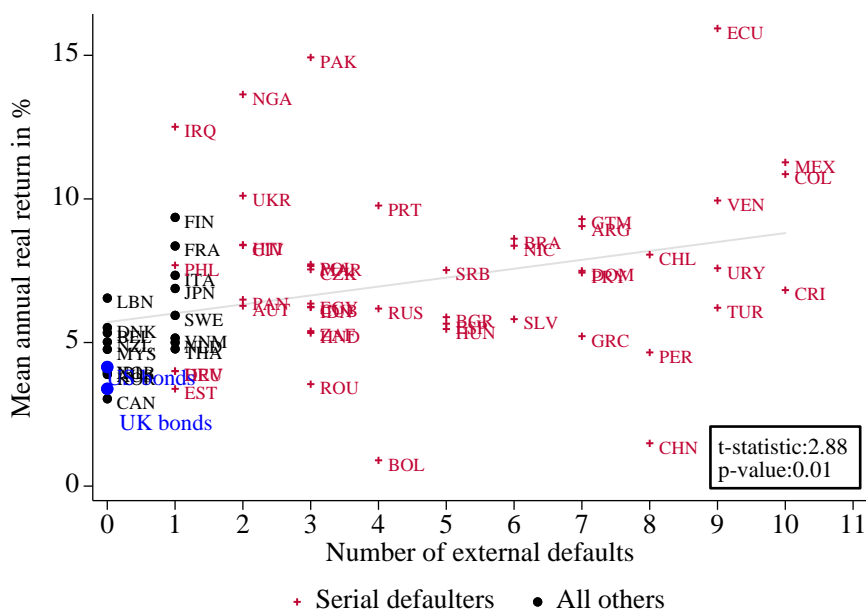
Table 6: Sovereign bond returns by country

Country	Real return, arithmetic		Excess return, real, arithmetic, viz US/UK bonds	Years with bond returns	Share of years in default since 1815 (or independence)	Number of defaults (on external, private creditors)
	Annual mean	SD				
Ecuador	15.7	45.3	11.5	47	56	9
Pakistan <sup>o</sup>	14.9	43.1	12.3	12	9	3
Nigeria <sup>o</sup>	13.6	20.8	10.0	18	18	2
Iraq <sup>o</sup>	12.5	34.2	9.3	10	24	1
Mexico	11.6	33.5	8.9	143	45	10
Colombia	11.1	30.9	8.3	127	37	10
Ukraine <sup>o</sup>	10.1	41.2	7.3	11	15	2
Portugal*	9.9	23.0	6.2	81	11	4
Venezuela	9.9	23.1	6.6	80	34	9
Finland*	9.6	29.5	6.7	41	6	1
Guatemala	9.1	30.1	5.2	72	35	7
Argentina	8.9	31.1	5.6	124	32	7
Brazil	8.7	20.7	5.7	145	23	6
Czechoslovakia*	8.6	27.3	7.2	47	66	3
Haiti	8.4	17.0	4.8	23	9	2

Cote d'Ivoire <sup>°</sup>	8.4	33.3	4.9	16	51	2
Nicaragua	8.4	14.2	5.4	34	47	6
France*	8.4	14.8	4.9	32	0	1
Chile	8.3	21.7	5.5	141	27	8
Serbia/Yugoslavia	8.2	32.1	7.1	73	54	5
Philippines <sup>°</sup>	7.7	8.5	3.5	22	14	1
Uruguay	7.7	18.3	5.6	117	12	9
Morocco	7.7	11.8	4.0	16	10	3
Poland	7.5	36.1	5.3	67	40	3
Dominican Rep.	7.4	30.7	3.1	51	27	7
Italy*	7.4	23.0	5.1	104	4	1
Japan*	7.3	20.1	5.3	98	10	1
Panama	7.0	14.7	3.7	46	25	2
Paraguay	7.0	34.3	3.7	54	22	7
Costa Rica	6.9	30.2	4.7	91	38	10
Egypt	6.9	13.5	3.4	93	3	3
Cuba	6.7	19.2	5.0	75	32	3
Turkey	6.6	24.5	3.1	86	15	9
Lebanon <sup>°</sup>	6.5	5.7	3.8	18	0	0
Indonesia	6.2	13.4	3.6	12	12	3
Hungary	6.2	26.7	4.7	111	42	5
Sweden*	6.1	14.0	2.5	66	0	1
El Salvador	5.9	25.1	3.1	75	26	6
Spain*	5.9	17.4	3.2	118	23	5
Bulgaria	5.9	34.4	4.2	87	63	5
Greece*	5.7	25.6	3.6	123	50	7
Russia	5.6	35.9	2.5	141	37	4
Denmark*	5.5	18.0	3.3	92	0	0
Belgium*	5.5	15.4	3.0	80	0	0
South Africa	5.4	13.4	1.6	51	5	3
Honduras	5.3	30.1	1.1	68	60	3
Vietnam	5.2	11.0	2.3	11	19	1
Netherlands*	5.0	4.3	2.4	14	6	1
New Zealand*	5.0	15.7	2.4	86	0	0
Thailand	4.8	14.6	2.4	53	3	1
Malaysia	4.8	4.8	0.6	11	0	0
Ireland*	4.7	15.6	2.1	25	0	0
Peru	4.6	24.9	2.2	118	39	8
Romania	4.5	30.0	2.3	78	32	3
Estonia	4.2	44.4	3.1	37	40	1
Austria	4.1	19.5	2.9	68	17	2
Norway*	4.0	11.1	1.6	66	0	0
Croatia	4.0	8.1	0.4	20	20	1
Australia*	4.0	10.3	1.2	75	0	0
South Korea	3.9	4.4	0.3	14	0	0
Germany*	3.6	33.4	1.2	101	12	1
Canada*	3.0	8.7	0.9	100	0	0
China	1.8	24.0	-0.3	109	13	8
Bolivia	1.0	29.5	-4.6	23	21	4
Full sample average (all 91 countries)	7	17	3.8	41	16	2

*Notes:* The table shows average annual real ex-post returns by country, using arithmetic averages across all bonds outstanding at each point in time (country portfolios). Only countries with 10 or more years of data are included. For countries marked with (\*) 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 (1995-2016). The default data are from Reinhart and Rogoff (2009), updated by Reinhart and Trebesch (2016). See Appendix B1 for a detailed overview of the years covered by country and on how we deal with country break-ups and country mergers when splicing the long-run country series (e.g. Austria-Hungary, Ottoman Empire, or Prussia-Germany).

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



To visualize the risk-return patterns, Figure 7 plots the mean annual real ex-post return against its standard deviation by country. The typical serial defaulter (marked in red) features average yearly returns in the range of 5-10% and a standard deviation of returns above 20%. For other periphery countries (without a

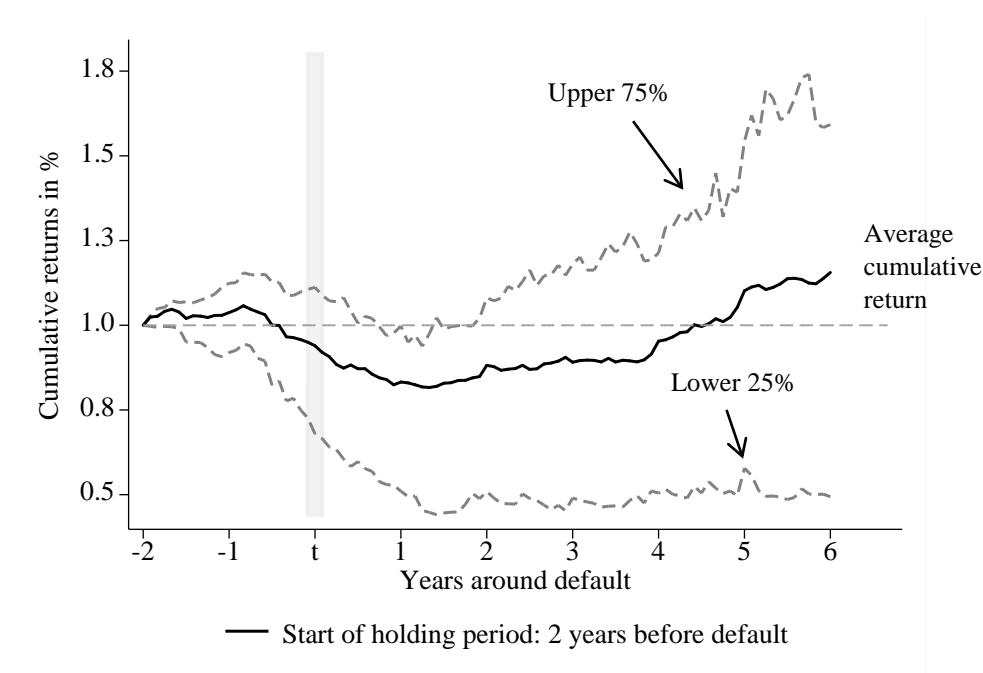
history of default), the average returns are lower, as is the standard deviation. We also show observation for “risk-free” government bonds of the UK and US (marked in blue) using the full 200-year series for both countries (the average yearly real return is 3.4% for US bonds and 4.1% for UK bonds, with standard deviations of 12% and 10%, respectively).

Figure 8 complements the picture by plotting the average yearly real ex-post bond returns on the vertical axis against the total number of external sovereign default events (on private external debt) since 1815 on the horizontal axis, again using the updated Reinhart and Rogoff (2009) default data. Similar to Figure 7, we find bond returns to increase in the riskiness of a country, as measured by the number of past defaults.

## 5. Bond performance around debt crises: 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 from Section 2 with those on bond prices and returns from Section 3.

Figure 9: Bond returns around sovereign defaults



*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 defaulted bonds, while the dotted grey lines show upper and lower quartiles. We include all 94 default episodes for which we have sufficient pricing data before and after the default.

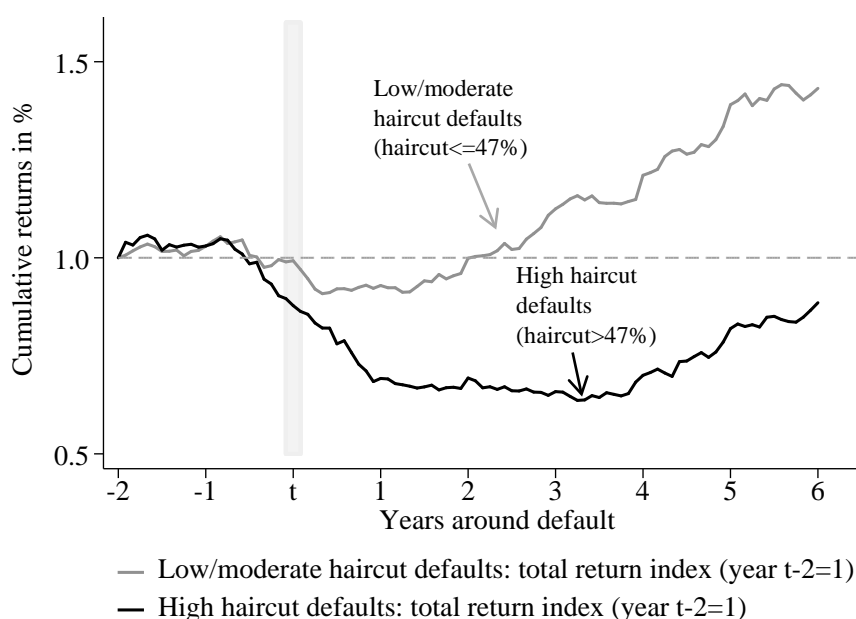
Figure 9 shows a time series of total returns around all sovereign bond default events in our sample for which we have sufficient bond price data, both in the run-up and the aftermath of default. These are 94 cases out of a total of 158 sovereign bond defaults in the sample. (this exercise does not include the many defaults on bank loans for which no prices exist, see Figure 1). 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.

Unsurprisingly, sovereign bonds perform badly in the wake of a default event. The total cumulative return drops by about 15% initially and then stagnates for a few years. Investors who enter two years pre-default break even four years after the initial default date, on average, thus recouping the losses suffered with some delay (can be described as a U-shaped recovery). However, the variation is large. About 25% of all defaults (upper quartile) see barely any drop in total returns and investors almost double their investment by year five after the default. In contrast, cases in the bottom 25% (lower quartile) do *not* show a recovery; the pattern is L-shaped, as six years after the first default, investors are still in deep negative territory, far from breaking even. Almost all of the defaults in this bottom quartile occur in the historical (pre-WW2) period, including those defaults that took decades to settle. Since the 1990s, only the bond defaults of Argentina 2001 and Ecuador 2008 produced long-lasting creditor losses. Specifically, it took investors until 2016 to break even in Argentina (15 years) and about five years after Ecuador's 2008 default. We also check holding period returns (HPRs) around default using geometric instead of arithmetic average returns. The takeaway is similar to that in Figure 9, as investors entering two years prior to the default break even about five years after that event, meaning that the geometric average turns positive.

Figure 10 uses the same data but compares defaults with “high” and “low/moderate” haircuts. Defaults with a haircut above 47% (the median in this sample of 94 cases) are categorized as “high” haircut cases, while those with haircuts below 47% are categorized as “low/moderate”. The decline in investor returns is much smaller for low-haircut cases. On average, losses are recouped within two years after the initial default. In contrast, investors hit by deeper defaults wait more than six years, on average, to break even.

Figure 10: Returns around default: high vs. low haircut cases

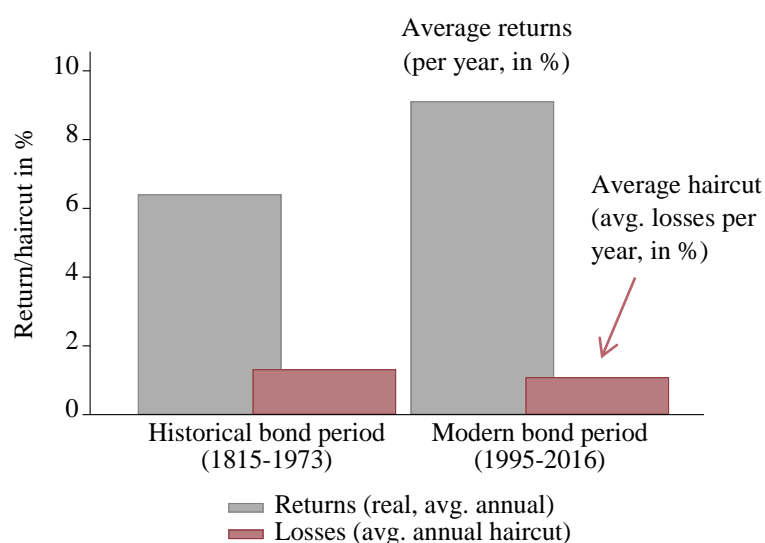




To complement the aggregate picture, Appendix B4 shows cumulative total return series for 11 serial defaulters across different eras and world regions. One example is the debt crisis of Russia 1998, which has been extensively studied, e.g. by Duffie et al. (2003). It is well-known that bond prices collapsed after August 1998. What has received less attention, however, is that investors that held on to the defaulted bonds fully recovered the losses by 2001, after Russia exited its two-year default spell. Moreover, those staying invested in Russian foreign-currency bonds more than quadrupled their investment by 2004. On the opposite side of the spectrum are bond “disasters” like Russia after 1918 or Chile after the Great Depression. These cases illustrate how investors can be stuck in a default for decades, without bond price recovery or coupon payments.

To move beyond default episodes, Figure 11 compares annual average real ex-post returns on sovereign bonds to the annual average haircuts, both in the historical bond period (1815-1973) and in the modern period (1995-2016). In the historical period, the average returns on our global portfolio of external bonds was 6.4%. This compares to an average investor loss due to bond restructuring events (haircuts) of just 1.3% across years. The gap is even larger for recent decades, with average yearly real returns of 9.1% and an average yearly haircut of 1.1% since 1995. Thus, over the past 200 years average returns clearly exceeded the average investor losses due to bond restructurings.

Figure 11: Returns vs. haircuts across years - historical and modern sample



*Note:* This figure shows mean ex-post real returns on our global portfolio of foreign-currency sovereign bonds and compares it to the size of haircuts, both computed as yearly averages. Results are shown separately for the historical period (1815-1973, left panel) and for the modern period (1995-2016, right panel). To calculate average yearly haircuts, we consider only bond restructurings, thus dropping many restructurings of sovereign bank loans of the 1980s and 1990s.

## 6. Comparison to other asset classes

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. As in the previous analysis, we use a global portfolio time series of returns on all active foreign-currency sovereign bonds in the sample, weighted by debt amounts.

### 6.1. Data preamble

For comparison, we start with “risk-free” assets in financial centers. Specifically, we use returns on US and UK 3-month treasury *bills* as well as US and UK long-term government *bonds*. The time series of US and UK sovereign bills and bonds are gathered for the full 200-year sample. For stocks, we use a spliced total return index for the UK (FTSE) and for the US (S&P index), both from 1815 onwards. To measure total returns on US corporate bonds, we use the S&P AAA Corporate Bond Price Index which is available from 1900 and until 1984 and combine this with the Bank of America US Corporate AAA Bond Index from 1985 onwards. The detailed data sources are provided in Appendix A.

To compute excess returns we use two approaches. First, we benchmark against monthly treasury *bills*, either UK or US bills, depending on the currency denomination of the respective bond or asset. Using bills facilitates the comparison across asset classes, including to long-term US/UK government bonds. Moreover, most of the earlier work on long-run returns uses bills as benchmark, e.g. Dimson et al. (2001) or Jordá et al. (2017). However, as an alternative, we also report excess returns above long-term UK or US *bonds*, which has been our approach so far but is less standard in the literature comparing asset classes. In what follows, the resulting excess returns series are also used to compute commonly-used metrics in this literature, such as standard deviations and Sharpe ratios.

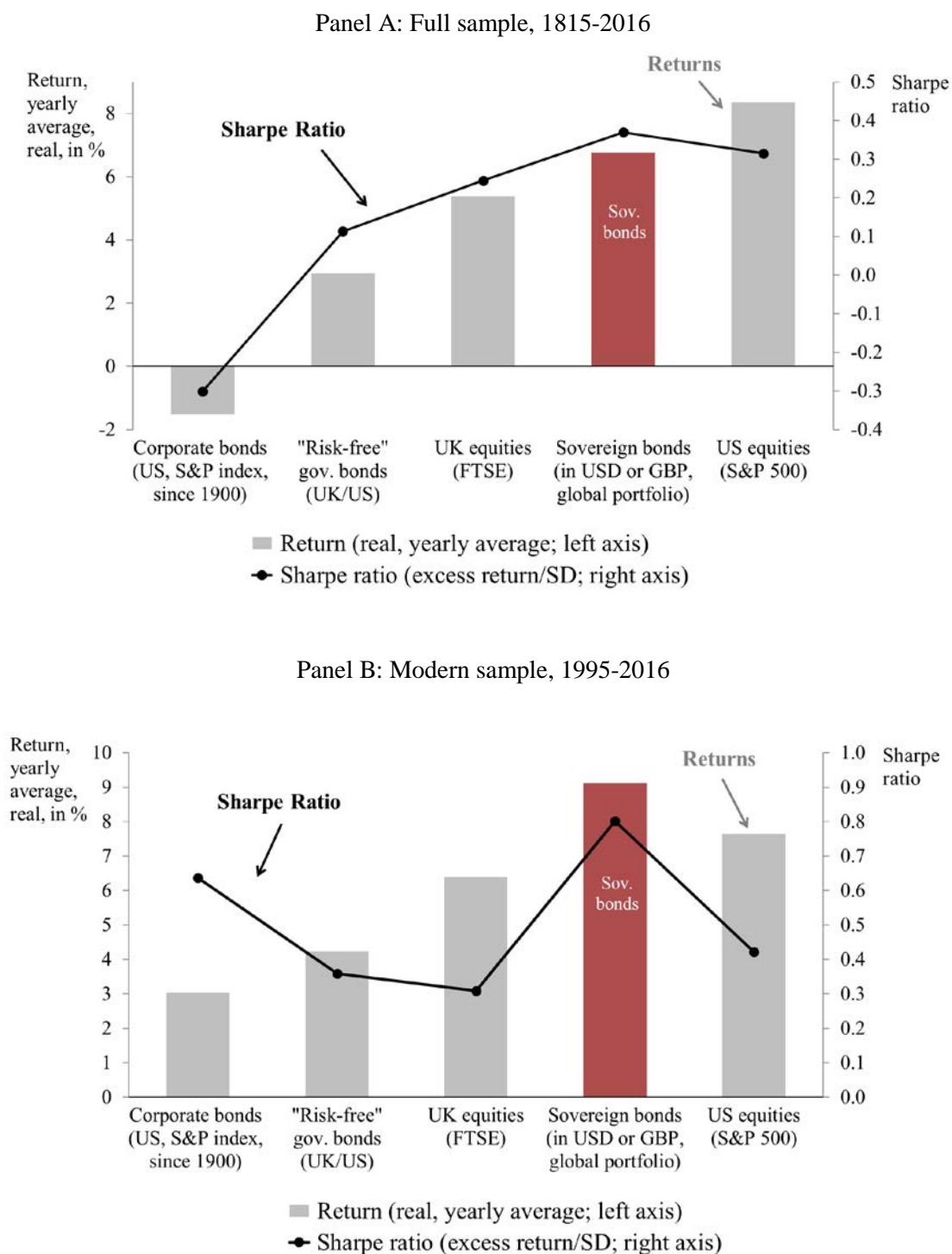
### 6.2. Results on asset comparisons

Table 7 shows the results for the full sample, as well as for the modern period sub-sample (1995-2016). Figure 12 visualizes these 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 report adjusted Sharpe ratios in Table 7, with results being similar.<sup>37</sup>

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<sup>37</sup> To calculate adjusted Sharpe ratios we follow standard practice so that  $\text{Sharpe}_{adj} = \frac{\text{excess return}}{\mu - Z \cdot \sigma}$ , 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  $\mu$ ,  $\sigma$ ,  $S$  and  $K$  are the mean, variance, skewness and kurtosis of the returns. “Excess return” denotes the return above the risk-free assets (US/UK bonds or bills).  $Z$  represents a penalty factor for negative skewness and excess kurtosis.

Figure 12: Asset classes across 200 years: risk and return



*Note:* This figure shows average annual real ex-post 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. Table 7 shows the underlying numbers.

Table 7: Asset classes across 200 years: excess returns above bills and bonds

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

	<i>Full Sample, 1815-2016</i>					<i>Modern Sample, 1995-2016</i>				
	Mean yearly return	Excess return	SD	Sharpe ratio	Adj. Sharpe ratio	Mean yearly return	Excess return	SD	Sharpe ratio	Adj. Sharpe ratio
Sovereign bonds (in USD or GBP, global portfolio)	6.77	4.74	13.99	0.37	0.38	9.12	8.92	11.09	0.80	0.76
US equities (S&P 500)	8.35	6.06	18.74	0.32	0.37	7.63	7.57	17.97	0.42	0.59
UK equities (FTSE)	5.39	3.00	14.03	0.24	0.28	6.38	4.95	15.71	0.31	0.49
US corporate bonds (S&P AAA, since 1900)	-1.51	-1.72	8.01	-0.30	10.65	3.03	2.97	4.78	0.64	0.86
US Treasuries (10 year)	4.16	1.23	9.36	0.20	0.19	3.29	3.23	8.52	0.39	0.67
UK gov. bonds (10 year)	2.87	0.49	10.97	0.06	0.07	4.93	3.50	7.79	0.48	0.56
US bills (3-month)	2.39		6.25			1.43		2.84		
UK bills (3-month)	1.99		5.40			0.06		1.92		

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

	<i>Full Sample, 1815-2016</i>					<i>Modern Sample, 1995-2016</i>				
	Mean yearly return	Excess return	SD	Sharpe ratio	Adj. Sharpe ratio	Mean yearly return	Excess return	SD	Sharpe ratio	Adj. Sharpe ratio
Sovereign bonds (in USD or GBP, global portfolio)	6.77	4.03	13.99	0.32	0.33	9.12	4.94	11.09	0.30	0.42
US equities (S&P 500)	8.35	4.19	18.74	0.23	0.26	7.63	4.34	17.97	0.18	0.34
UK equities (FTSE)	5.39	2.51	14.03	0.21	0.23	6.38	1.46	15.71	0.07	0.14
US corporate bonds (S&P AAA, since 1900)	-1.51	-2.84	8.01	-0.61	17.59	3.03	-0.26	4.78	-0.05	-0.08
US Treasuries (10 year)	4.16		9.36			3.29		8.52		
UK gov. bonds (10 year)	2.87		10.97			4.93		7.79		

*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 36 above.

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 assets. Only US equities show a higher average return, but these also have a higher standard deviation.

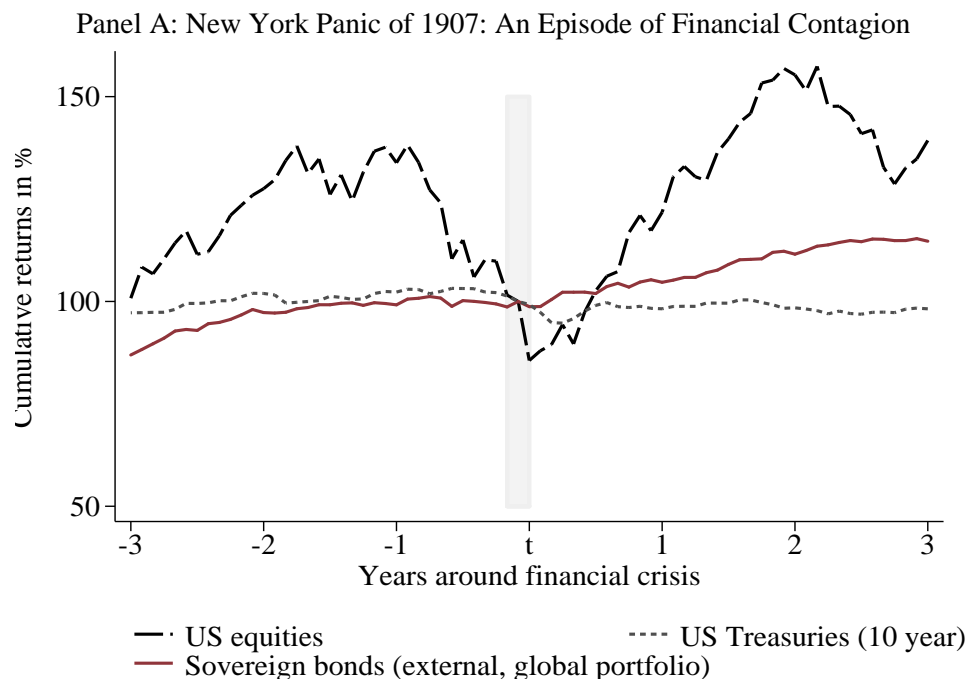
External sovereign bonds also show a high Sharpe ratio, on the same level as US equities, and exceeding that of UK equities, US corporate bonds and US or UK government bonds.

The modern (post-1995) period for the global portfolio of foreign-currency sovereign bonds fares even better (Panel B of Figure 12 and Table 7). The Sharpe ratio is the highest among the asset classes under study and the returns exceed those on US and UK equities as well as on US corporate bonds. High average coupon rates during the modern period coupled with the paucity of serious credit events has delivered the highest ex-post returns for this asset class in our two-century sample. The preceding statement, however, does not imply that this benign combination is set to become the “new normal” for the sovereign bond market, as rising evident debt difficulties in several developing countries can morph into new defaults quite abruptly.<sup>38</sup>

### 6.3. Total returns during major financial crises

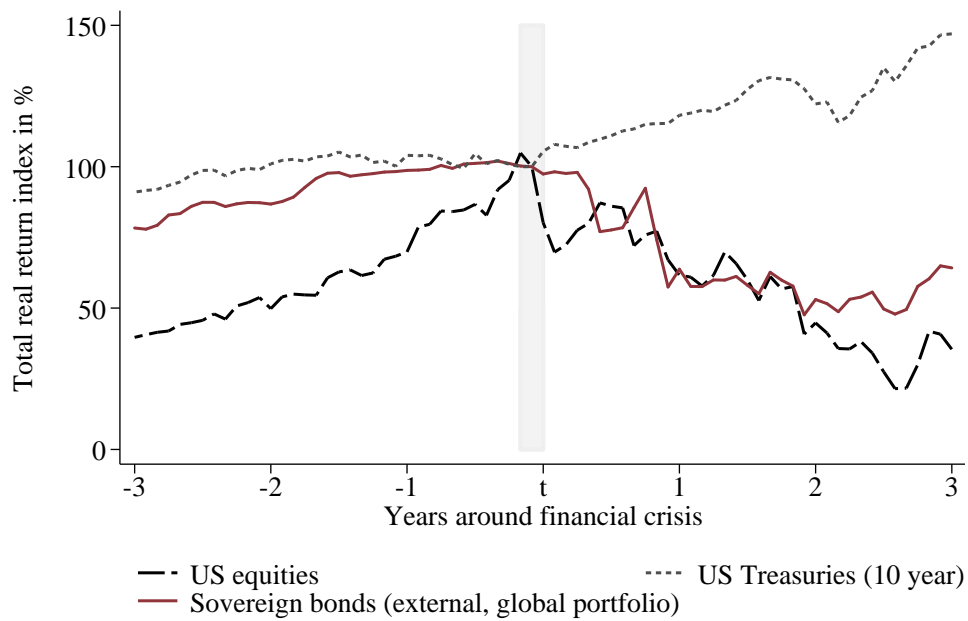
We next examine the performance of each asset class around selected major crises in the financial center(s) that have different features, as to their global effects. In particular, we compare the cumulative total return of US stocks, US Treasuries and of our portfolio of external sovereign bonds three years before and after (i) the New York Panic of 1907 (crash month: October), (ii) the Great Depression (crash month: October 1929), and (iii) the recent Financial Crisis (crash month: Sept. 2008). Figure 13 shows the resulting monthly return series - indexed to 100 in the starting month of the crisis.

Figure 13: Asset returns around major financial crises

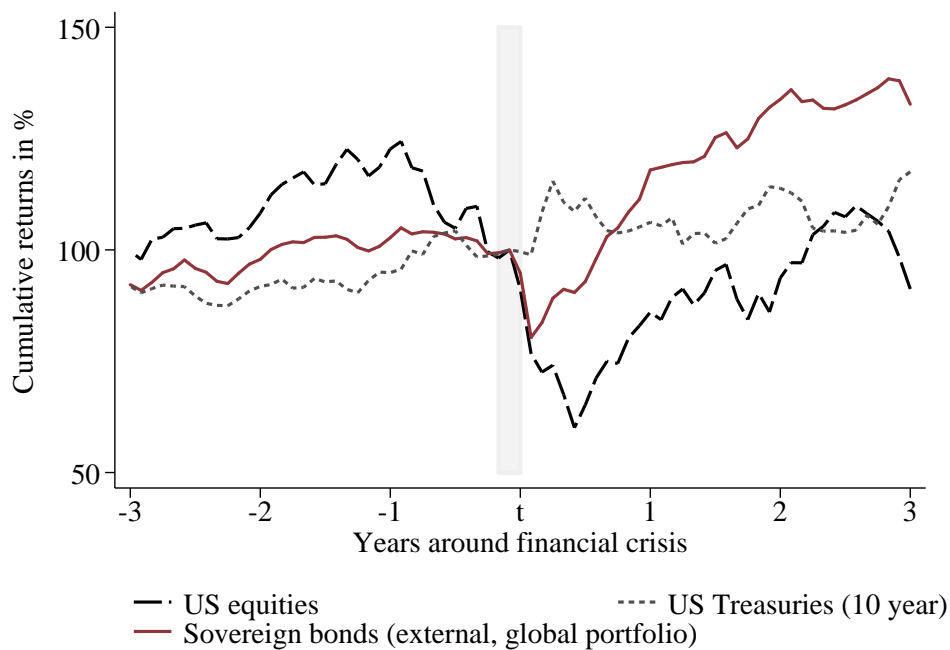


<sup>38</sup> See Reinhart et al. (2018).

Panel B: Great Depression: A Global Crisis



Panel C: Global Financial Crisis of 2008: An Advanced Economy Crisis



*Notes:* This figure shows a cumulative real return index around three financial crisis events: 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). The series are indexed at 100 in the starting month of the crisis.

The results from these case studies are broadly in line with the aggregate statistics summarized above. External sovereign bonds show higher cumulative returns than stocks in two out of the three spells (by the end of year three). The returns on our global portfolio also tend to be less volatile than those of stocks. Compared to US Treasuries, external sovereign bonds fare better in 1907, but significantly worse during

the Great Depression. In the Financial Crisis of 2008, external sovereign bonds deliver worse returns compared to US bonds at the height of the crisis, but subsequently show a much better performance. Summing up, these findings suggest that sovereign bonds of periphery countries can provide insurance against major shocks in the financial center. The high average coupon payments on external sovereign bonds help to stabilize total returns when prices are volatile.

## **7. Conclusion**

We show that the history of external sovereign bonds is a history of frequent investor profits and occasional losses. Defaults and haircuts have been a recurring feature in this market, but on average investors were compensated for the risks they took also when compared to other asset classes such as equity. We have uncovered an excess return over the past two centuries, which we deem as informative about the attitude of investors toward risk. The observed ex-post spreads are wide, even taking into account losses associated with default and debt restructuring.

The persistent (but time varying) excess returns over the risk-free rate that we document may arise because the risk-free rate is lower than conventional theory predicts. Mehra and Prescott's (1985) equity premium puzzle has its counterpart in Weil's (1989) risk-free rate puzzle. In international finance the property that the risk-free rate appears as abnormally low is more commonly referred to as the "exorbitant privilege" granted to the issuer of the safe-haven asset. The related literature on the global financial architecture directly connects to our characterization of the external sovereign bond market for dozens of countries (e.g. Gourinchas and Rey 2013, Broner and Ventura 2016, Maggiori 2017).

The data we have compiled will allow to reassess how markets price sovereign risk and how investors form beliefs about crash probabilities in emerging markets. A growing literature emphasizes expectations errors on the part of global investors. During periods of optimism and financial stability, creditors may become dismissive of the possibility of default and expect full repayment of the rich coupons offered in this asset class, resulting in lending booms. This recurrent pattern of "market exuberance" is integral to the narrative in Reinhart and Rogoff (2009) and is explored theoretically in Gennaioli and Shleifer (2018). Future work could use our data to test these notions, as well as new and old asset pricing theories, in particular models of long-run risk (Bansal and Yaron 2004) and disaster risk (Barro 2006, Gabaix 2012).

The paper will also facilitate research on sovereign defaults and their resolution (e.g. Broner et al. 2014, Corsetti and Erce 2018, Gourinchas et al. 2018, Erce and Mallucci 2018, Lorenzoni and Werning 2018, Aguiar et al. 2019). 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 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 borrow quickly again)?

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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 used in the paper.

#### 3-month UK bills, monthly, since 1815

The 3-month UK bill return index in the 19<sup>th</sup> 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. For more recent decades, the data comes from the Central Statistical Office of the British government for the years 1939-1988 and from Eurostat from 1989 until to today.

UK inflation/CPI series, monthly

The monthly UK CPI series comes from the Bank of England's (BoE) historical dataset sheet called "A Millennium of UK Data", Version 3.1, by Thomas and Dimsdale (2017). From 1914 onwards, we use the spliced monthly consumer price index. For the period before WW1, we use the spliced monthly wholesale/producer price index. These series are those recommended by the BoE.

US CPI series, monthly

The monthly "Historical Consumer Price Index for All Urban Consumers" is from the US Bureau of Labor Statistic and starts in 1913. For the period before that we rely on series gathered and cited by Reinhart and Rogoff (2009), in particular from the Historical Statistics of the United States. Note that we only have eight USD bonds in our sample that were issued before 1913.

US Corporate bond total return index, monthly, since 1900

The US corporate bond return series is spliced by combining 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.

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## 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 currency (only US dollar and British pound bonds), (iii) traded and priced on the London or New York Stock Exchanges and (iv) with a fixed coupon rate (no floating rate instruments).

We first discuss the historical data, then move to the modern sample that uses JP Morgan's EMBI data and then describe the final, merged, 200-year dataset.

#### Historical bond prices and returns, 1818-1980

For the 19<sup>th</sup> century we use price data of those external sovereign bonds traded on the London Stock Exchange (LSE). From the early 20<sup>th</sup> 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 their prices we rely on several main sources. The London price data for the early 19<sup>th</sup> 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 provided by Goetzmann and Rouwenhorst at the International Center for 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).

Our baseline is to use price data of the last trading or business day of the month. We deviate from this rule only for a few dozen bonds before 1850, when markets were not as developed and liquid. For that period, we use the last available price of a month and, in rare occasions, also the average between low and high prices of a month.

Beyond prices, we draw on additional sources to collect the financial and legal 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

Year 1929.		1930 (to date).		Name of Security.		Aug. 20, 1930.	Aug. 27, 1930.	Rise or Fall.	Present Yield.	Year 1929.		1930 (to date).		Name of Security.		Aug. 20, 1930.	Aug. 27, 1930.	Rise or Fall.	Present Yield.
High.	Low.	High.	Low.						£ s. d.	High.	Low.	High.	Low.						£ s. d.
<b>British Funds.</b>										<b>Dominion and Foreign Railways.</b>									
56½	52	57½	52½	Consols 2½% .....	55½	56	+ ½	4 9 3											
88½	81½	90	82½	Consols 4% .....	88½	89	+ ½	4 10 5											
80½	72½	80½	74½	Conv. Loan 3½% .....	79½	78½	xd	4 9 5		5½	3½	4½	2	G.W. of Brazil £100...	2½	2	- ½	15 0 0	
100	93	100½	93½	Do. 4½% 1944-.....	99½	100	+	4 12 0		\$58½	\$25	\$33½	\$17½	Int. Rlys. Cent. Am.	\$18	\$18	...	...	
82½	75½	82½	75½	Do. 5% 1944-64-.....	105	105½	+	4 12 0						no par.					
100½	97½	101½	98½	Funding 4% 1920-30	91½	92	+	4 8 9		66½	49	57½	31	Leopoldina Ord. Stk.	34	33	- 1	15 3 0	
101½	97½	102½	100½	Treasury 4½% 1932-34	101½	101½	+	4 2 0		170/-	95/-	97/6	60/-	Nitrate Rlys. (£10.)	60/-	60/-	...	19 17 6	
95½	90	96	91	Treasury 5% (B) ...	102½	102½	+	4 2 0		57	37½	42	32½	Paraguay Cent. D. Bb.	34	33	- 1	15 3 0	
103½	99½	104	100½	Victory Bonds 4½%	96	95½	+ 1	4 5 0		140/-	76/3	85/-	65/-	Salvador Ord. (£10)	70/-	70/-	...	7 5 0	
92½	85½	92½	85½	War Loan 5% 1923-47	104	104	+	4 10 0		217	188	198	157½	San Paulo Ord. Stk.	166½	166½	...	7 5 0	
65½	60	66½	61½	War Loan 4½% 1923-47	103½	103½	+	3 17 11		108/9	77/6	80/3	65/-	Tatal Ryr. Ord. £5	75/-	75/-	...	7 5 0	
51½	44	49	40½	Local Loans .....	65	65	...	4 13 0		49½	23	26½		Utd. Havana Ord. Stk	7	7	...	...	
61½	50½	59½	47	India 2½% .....	45	45	...	5 12 3											
71½	80	68½	55½	Do. 3% .....	54	54	...	5 12 3		266	238	259½	247	<b>Banks.</b>					
92	60	70	57	Do. 4½% .....	63	63	...	5 12 0		60/6	53/11	58/6	53/9	Bank of Eng. Stk. ...	257½	258½	+ 1	4 12 9	
105½	98½	105½	100½	Do. 4½% 1958-68 ..	86	86	...	5 7 6		30/1½	25/3	28½	25/9	Burley B. (£1) ....	56/9	56/6	- 3d	13 8 8	
109	103½	108½	104½	Palatine 5% 42-67 ..	103	104	+ 1	4 12 0		15½	11½	12½	10½	Barcl. (Dom. & Ex.) & A&L	27/3	26½	- 6d	3 8 7	
94½	88	93	87½	Sudan 5½% Bonds....	108	108	...	5 2 10		49½	37	38½	32	Bk. of Australasia (£5)	102½	111½	+ ½	6 4 5½	
				Ulster 4½% 45-75 ...	93	93	...	4 19 0		86½	58	69	59	Bk. of Montreal (\$100)	£61½	£60½	...	4 12 0	
										22½	17½	19½	15½	Bk. of N.S.W. (£20.) ...	33½	33½	+ ½	5 18 0	
														Chartered Bank of India (£25)	16½	16	- ½	6 6 0	

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

JAN., 1941		N. Y. STOCK EXCHANGE—BONDS												21					
Sales for 12 Mos. 1940		BONDS		Interest Period		Price Jan. 2, 1940		PRICES IN DECEMBER						RANGE FOR YEAR 1940					
N. Y. STOCK EXCHANGE								Dec. 2		Dec. 31		Lowest		Highest		Lowest		Highest	
\$				Bid	Ask	Bid	Ask	Bid	Ask	Sale Prices	Sale Prices	Sale Prices	Sale Prices	Sale Prices	Sale Prices	Sale Prices	Sale Prices	Sale Prices	Sale Prices
143,000	FOREIGN GOVT (Concluded)	A	O	14	20	6	10	25	28	26	28	25	26	25	26	12 1/2	13 1/2	12 1/2	13 1/2
77,000	Lugoslavia (State Mfg Ekt) 7 1/2-1957	A	O													7	May	17 1/2	Jan. 30
5,000	Julopaja (City) External 5 1/2-1947	F	A													12 1/2	Mar.	27 1/2	Nov. 1
813,000	Lower Austria (Prov) 7 1/2-1950	J	D	10 1/2	15 1/2	8	Sale	7 1/2	8	7 1/2	Dec. 12	8 1/2	Dec. 19	7	June	5	May	20	
239,000	Medellin (Colombia) 6 1/2-1954	J	D	70 1/2	75	58	64 1/2	62	64	61	Dec. 11	62	Dec. 13	53	July	5	June	14 1/2	Feb. 15
	Mendoza (Prov) ds road-1954	J	D													7	June	14 1/2	Feb. 15
	Mexican Irrigation															53	July	22	82 1/2
193,000	4 1/2% stamped assented-1943	M	N	1 1/2	1 3/4	4 1/2	4 1/2	3 1/2	3 1/2	3 1/2	Dec. 6	3 1/2	Dec. 5	1	Apr.	18	1	Nov.	26
4,000	Mexico (U S) extern 5 1/2 1899 E-1945	Q	J	1 1/2	1 1/2	4 1/2	Sale	3 1/2	Sale	3 1/2	Dec. 30	4 1/2	Dec. 2	1	Jan.	4	4 1/2	Nov.	26
723,000	Assenting 6% of 1899-1945	Q	J	1 1/2	1 1/2	4 1/2	Sale	3 1/2	Sale	3 1/2	Dec. 30	4 1/2	Dec. 2	1	Jan.	4	4 1/2	Nov.	26
1,174,000	Assenting 4% of 1904-1945	Q	J	1 1/2	1 1/2	4 1/2	Sale	3 1/2	Sale	3 1/2	Dec. 30	4 1/2	Dec. 2	1	Jan.	4	4 1/2	Nov.	26
1,460,000	Assenting 4% of 1910-1945	J	J	1 1/2	1 1/2	4 1/2	Sale	3 1/2	Sale	3 1/2	Dec. 31	4 1/2	Dec. 2	1	Jan.	4	4 1/2	Nov.	20
2,970,000	Treas 6% of 13 assent-1933	J	J	1 1/2	1 1/2	4 1/2	6 1/2	3 1/2	4 1/2	3 1/2	Dec. 17	4 1/2	Dec. 3	23	Jan.	8	4 1/2	Nov.	20
	Atlan City (Italy) ext loan 6 1/2-1952	A	O	52 1/2	Sale	29 1/2	Sale	28 1/2	Sale	28	Dec. 27	30 1/2	Dec. 3	23	Jan.	12	53 1/2	Jan. 3	
681,000	Minas Geraes (State of, Brazil)																		
48,000	Assent 5 1/2 1895-1958	M	S	8 1/2	Sale	8 1/2	Sale	8 1/2	Sale	8 1/2	Dec. 10	8 1/2	Dec. 3	4	June	12	12 1/2	Mar.	9
94,000	Assent 5 1/2 1895-1958	M	S	7 1/2	Sale	8	9	8 1/2	9	8	Dec. 10	8 1/2	Dec. 3	4	June	12	12 1/2	Mar.	8
26,000	Montevideo (City) 7s-1958	J	D	40	Sale	48	50 1/2	53 1/2	55 1/2	50	Dec. 6	54 1/2	Dec. 23	44	Jan.	20	71 1/2	Apr.	3
981,000	4 1/2s series A-1959	M	N	38 1/2	Sale	46	70	54	Sale	54	Dec. 31	54	Dec. 31	40	Jan.	19	71 1/2	Mar.	20
664,000	New South Wales ext s f g 5 1/2-1957	F	A	80 1/2	Sale	50 1/2	Sale	57	Sale	52 1/2	Dec. 7	58 1/2	Dec.						
1,055,000	20-year external s f g 6 1/2-1943	F	A	91 1/2	Sale	50 1/2	Sale	54 1/2	Sale	52	Dec. 12	56 1/2	Dec. 11	35	June	9	90 1/2	Feb.	9
1,735,000	External sinking fund 4 1/2-1956	M	S	75 1/2	Sale	48	50	51 1/2	Sale	49 1/2	Dec. 9	51 1/2	Dec. 31	29 1/2	May	4	97 1/2	Apr.	6
2,720,000	External sinking fund 4 1/2-1965	A	O	72 1/2	Sale	30	36 1/2	32 1/2	Sale	30	Dec. 23	38 1/2	Dec. 11	23 1/2	May	4	90	Mar.	13
1,985,000	ds sinking fund ext loan-1963	F	A	71	Sale	30	36 1/2	32 1/2	Sale	30	Dec. 26	37 1/2	Dec. 11	20	June	11	80	Mar.	13
58,000	Municipal Bank ext loan-1963	F	A	71	Sale	30	36 1/2	32 1/2	Sale	30	Dec. 26	37 1/2	Dec. 11	20	June	11	80	Mar.	13
1,141,000	Atlan City (Italy) external 6 1/2-1952	F	A	10	17 1/2	25	26	25	26	25	Dec. 10	27	Dec. 13	9 1/2	May	13	27	Dec.	13
1,905,000	Oriental Development 6s-1953	M	S	57 1/2	58 1/2	45	Sale	42 1/2	Sale	42 1/2	Dec. 31	48	Dec. 6	39 1/2	Oct.	10	65	Mar.	18
1,066,000	External deb 5 1/2s-1958	M	N	52 1/2	52 1/2	41	Sale	41 1/2	Sale	41	Dec. 2	45 1/2	Dec. 10	37 1/2	Oct.	11	55	Mar.	18
392,000	Oso (City) 4 1/2s ext sink fund-1955	A	O	71	80	25	28	23 1/2	26	23 1/2	Dec. 30	27 1/2	Dec. 6	19	June	13	75	Mar.	28
450,000	Panama (Rep) external 5 1/2s-1963	M	N	103 1/2	106 1/2	101 1/2	104 1/2	103 1/2	Sale	102 1/2	Dec. 3	104 1/2	Dec. 12	96 1/2	June	28	105 1/2	Jan.	24
2,118,000	4 1/2s stamped (assented)-1963	M	N	70	Sale	71	80	66 1/2	71	66 1/2	Dec. 28	70 1/2	Dec. 13	59 1/2	Aug.	18	82	Apr.	5
25,000	Cfts of deposit (series A) 1963-1963	M	N	72	Sale	60 1/2	Sale	61 1/2	Sale	60 1/2	Dec. 2	64 1/2	Dec. 12	50	June	26	74 1/2	Jan.	23
						54	Sale	59 1/2		54	Dec. 4	60 1/2	Dec. 21	53	Sept.	16	60 1/2	Dec.	21

Sample: Our original historical database contains 295,717 monthly bond price quotes of 1,644 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 half of these observations, so as to get to a homogenous sample of foreign-currency sovereign bonds issued by independent states in US dollars or British pounds.

Specifically, we drop:

- 388 bonds that were issued by a state under colonial status. These are colonial bonds by 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 247,995 monthly bond prices.
- 256 sub-national bonds, issued by provinces and municipalities but not the central government, reducing the sample to 204,704 monthly bond prices.
- 80 local currency bonds as well as 7 bonds denominated in other foreign currencies (e.g. German Mark or French Franc).
- 12 bonds that were explicitly guaranteed by other governments, via a respective clause in the bond contract. 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 IMM lists guaranteed bonds in the section of the guaranteeing nation, e.g. Great Britain.
- Finally, we exclude 9 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 37 bonds for which we did not find basic information on coupon, amount issued, or currency.

Our cleaned, final historical dataset after these adjustments covers 175,976 monthly prices of 844 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 bonds in their Brady debt restructurings. More details are provided in the draft.

In total the EMBI data used cover 43,992 monthly price quotations of 556 sovereign external bonds issued in US dollar (none is issued in British pound).

## Final bond pricing sample, 1815-2016

The merged (historical + modern) bond pricing sample includes a total of 1,400 (844 + 556) foreign-currency sovereign bonds issued and traded in London and New York with 219,968 (175,976 + 43,992) monthly pricing observations of 91 debtor countries. Figure B3 shows the data availability per country and year.

The apparent gaps in the sovereign bond price and return data series can mainly be explained by the fact that countries tapped New York and London markets irregularly. For example, there are nearly a dozen countries that placed foreign-currency bonds abroad during the interwar years, but stopped doing so after WW2. 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.). The series thus end because old bonds mature and no new bonds enter the dataset. Moreover, the gaps in the 1960s, 1970s and 1980s can be explained by the shift from bond to bank loan financing. In this period sovereign lending was dominated by syndicated bank loans and almost no country issued bonds abroad.

To deal with country break-ups and country mergers we follow conventional practice (in particular the practice in investor manuals and financial reports) and assign the bonds of a country that was broken up or newly united to the respective successor state(s):

### Country mergers:

- Australia: Bonds issued by New South Wales and Western Australia are assigned to Australia after unification in 1901.
- Germany: Bonds issued by Prussia are assigned to the German Empire/Germany after 1871.
- Italy: Bonds issued by the Kingdom of Sardinia and the Kingdom of the Two Sicilies are assigned to Italy after the Proclamation of the Kingdom of Italy in 1861.
- South Africa: Bonds by the Union of South Africa are assigned to South Africa after 1926.
- Yugoslavia: Bonds issued by Serbia and by Montenegro are assigned to Yugoslavia after 1918.
- Zimbabwe: Bonds of Southern Rhodesia and Rhodesia are assigned to Zimbabwe after 1980.

### Country break-ups:

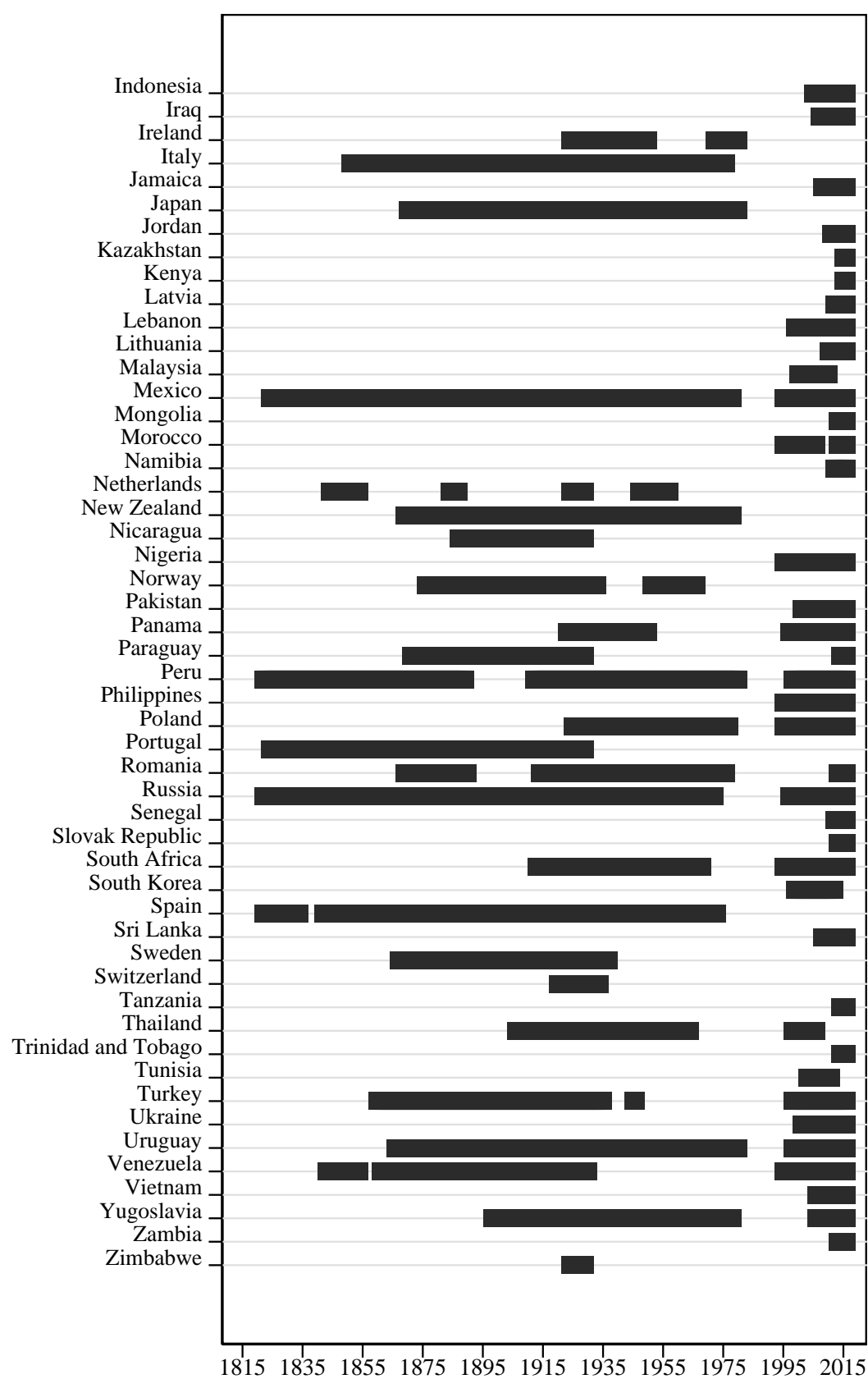
- Austria-Hungary: Bonds that were issued by the Austrian Empire or the Kingdom Hungary during the dual monarchy of Austria-Hungary are assigned to Austria or Hungary, respectively.
- Gran Colombia: Bonds issued by Gran Colombia, but assigned to Colombia after the break-up, were linked to Colombia. We 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.

For presentation purposes, in case of country mergers, we use the name of the new unified country to present the spliced series in Figure B3 and elsewhere (e.g. we denote the series as “Germany” instead of “Germany-Prussia”). Similarly, in case of country breakups, we use the name of the new country to denote the long-run spliced series (e.g. “Austria” instead of “Austria-Hungary”). Countries that existed only briefly or with limited foreign recognition are not included (e.g. the Confederate States of America).

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



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



## B2. Computing Returns: Data and Assumptions

**Treatment of partial and missed coupon payments:** A main challenge to compute total returns on historical sovereign bonds was to collect bond-level data on partial or missed coupon payments during spells of default. We retrieved information on interest servicing during crises from the historical reports of 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 Mobilières (1936-1945, 1948-1974, 1987-1988, 1996). To fill gaps, we also rely on the rich body of investor reports that we gathered for the long-run dataset of prices and restructurings (see Appendix B1 above and Appendix C1 below). Particularly helpful were reprints of (temporary) debt agreements, official announcements, or press releases of the debtor government. We typically extracted the relevant information on interest servicing from text statements such as: “Coupon due May 01, 1932 paid in Jan. 1933 at rate of 60% of the face value of the coupon.” For most bonds we have exact amounts and dates of payments. In case the date of partial coupon payments is missing we assume that the debtor paid on the due date of the coupon (original deadline). In case we do not find any indication that coupons are missed, we assume that they are fully paid. After gathering all coupon details we again calculate accrued interest by equally distributing the (full or partial) payments over the original coupon payment period (eq. 4). For example, in case of a yearly coupon frequency, we calculate returns by dividing the coupon paid by 12 (equal amounts per month).

**Accounting for debt restructurings/ haircuts:** We account for creditor losses due to a debt restructuring or debt write off. We do so by combining the old defaulted bonds and the new instruments that creditors receive in the exchange with the implicit assumption that creditors keep the newly restructured bond in the portfolio. We then account for the share of debt written off as well as for potential cash or so called “goodwill” payments that are made in the wake of a restructuring. More precisely, we expand equation (2) in the main text to calculate the return in the restructuring month  $t$  as follows:

$$r_{i,t} = (1 - writeoff) * \left( \frac{P_{new\ bond,t} - P_{old\ bond,t-1}}{P_{old\ bond,t-1}} \right) + \left( \frac{C_t + Cash_t}{P_{old\ bond,t-1}} \right)$$

Where  $P_{old\ bond,t-1}$  is the secondary market price of the old bond in the month prior to the restructuring,  $P_{new\ bond,t}$  is the price of the newly issued bond right after the restructuring,  $(1 - writeoff)$  is the nominal debt recovery rate, so in case of a face value reduction of 40%, this term would be  $(1-0.4)=0.6$ , and  $C_t$  and  $Cash_t$  are coupon and cash payments, respectively. In case the restructuring only involves a rescheduling of maturities but no face value debt reduction the term  $writeoff$  would be zero, but the change in maturities should be reflected in the secondary market price of the new bond (this type of debt exchange is sometimes called “debt reprofiling”). For the modern sample we rely on the EMBI return series that account for restructurings. Dissecting the EMBI data, in particular the treatment of the 15 modern-era bond defaults for which bond prices are available, is a worthy exercise for future work.

***Amortization schedules, sinking funds and bond buybacks (historical bonds):*** Most bonds in history are not due and payable at maturity (so called bullet bonds), but have stretched out amortization, often in the form of so-called “sinking fund” arrangements. During the 19<sup>th</sup> and early 20<sup>th</sup> century there are two main types of sinking funds in our sample of bonds. 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 non-linear, typically increasing annuity amortization plan written in the bond contract. The sinking fund payments were usually forwarded to a payment agent determined in the bond contract. This agent uses the debt service to amortize the bonds either by a redemption at par to bondholders or via repurchases on the secondary market. Redemption at par is attractive to investors because bonds typically trade at prices below par. For this reason, the allocation of repayments from the sinking funds were often assigned via lottery. In the lottery, the fiscal agent randomly selects a subset of bonds for full repayment, chosen among all outstanding bonds. This exercise is repeated until the sinking fund payments due in that period are depleted. In practice, redemption at par was the exception, while buy-backs on the secondary market were the rule. More than 80% of sinking fund bonds issued before WW2 contain buy-back clauses that authorized the agent to redeem funds via purchases on the secondary market (at prices below par) rather than via nominal repayments (which is costlier for sovereigns). To compute price-based return series we disregard the possibility that some of the redemptions are made at par, because the beneficiaries of the redemption lottery are random and market prices should reflect any expected redemption gains. We also prefer to be conservative and not add up potential capital gains due to redemption at par. As a result, the calculated returns on sinking fund bonds in history can be regarded as a lower bound.

***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.

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

This section dissects the ex-post, real returns in our long-run sample of external sovereign bonds and checks the results for robustness. Specifically, we explore the role of a) bond maturity, b) selection effects (survival bias) and c) the inflation rate used.

#### 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 (1995-2016), 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). The term premium for historical bonds is less pronounced than in the modern period (detailed results to come).

Table B1: The role of bond maturity: summary statistics

	Real, arithmetic return		Real annual, geom. return	Real excess return (annual, arithm.)	Amount issued in m USD	Mean coupon rate
	Annual mean	SD				
1-3 yrs remaining maturity	5.24	9.97	4.78	1.07	1326.12	8.00
4 -10 yrs remaining maturity	10.09	14.33	9.29	5.92	1366.17	7.61
>10 yrs remaining maturity	15.72	25.22	12.98	11.54	1688.47	7.49

#### b) 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 historical events such as 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 15 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 (145 years of data), , Mexico (143), Chile



(141), Russia (141), Colombia (127), Argentina (124), Greece (123), Peru (118), Spain (118), Uruguay (117), Hungary (111), China (109), Italy (104), Germany/Prussia (101) and Canada (100 years of data).

Table B2 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 B2: 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)	6.77	13.99	5.88
Sub-sample of countries with more than 100 years of data	6.46	15.62	5.36

*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.

### c) Inflation expectations

Table B3: Real returns: the role of inflation

	Real, arithmetic return		Real geom. return, annual mean
	Annual mean	SD	
<b>Total sample</b>			
Using realized inflation in year t	6.77	13.99	5.88
Using inflation in year t+1	6.27	13.27	5.47
Historical sample, 1818-1973			
Using realized inflation in year t	6.41	14.38	5.47
Using inflation in year t+1	5.82	13.51	5.00
<b>Modern sample, 1995-2016</b>			
Using realized inflation in year t	9.12	11.09	8.57
Using inflation in year t+1	9.17	11.41	8.60

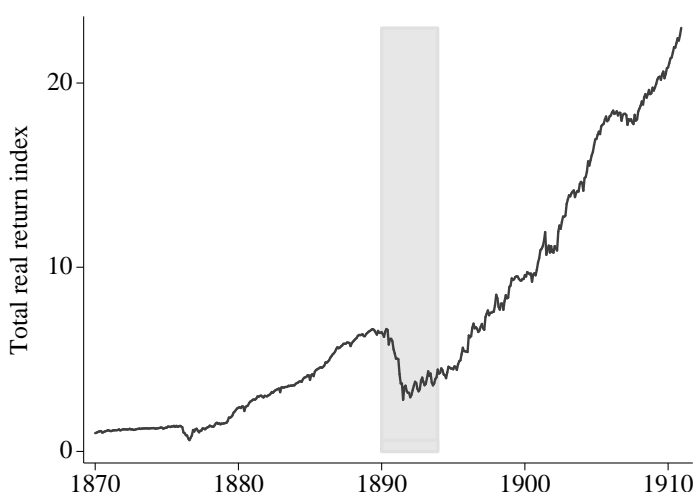
*Note:* This table gives summary statistics for the global sovereign bond portfolio when nominal returns are adjusted using current inflation in year t and, alternatively, using inflation in year t+1.

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 B3 shows that the results are very similar when using either current inflation or inflation of year  $t+1$ .

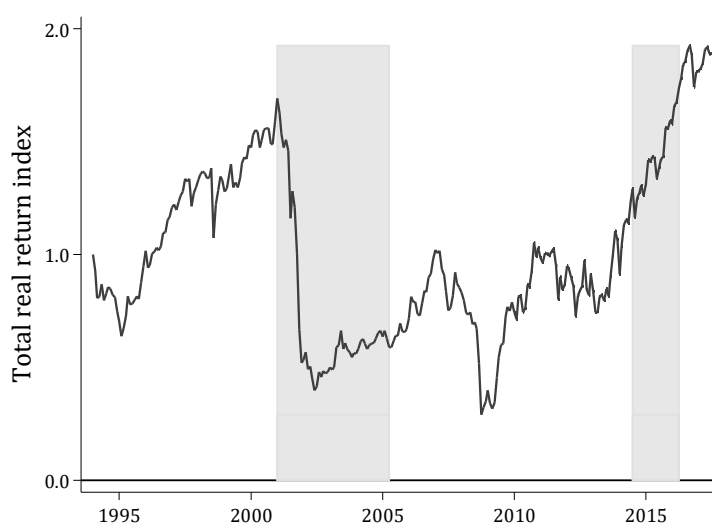
#### B4. Case studies: total returns around sovereign default

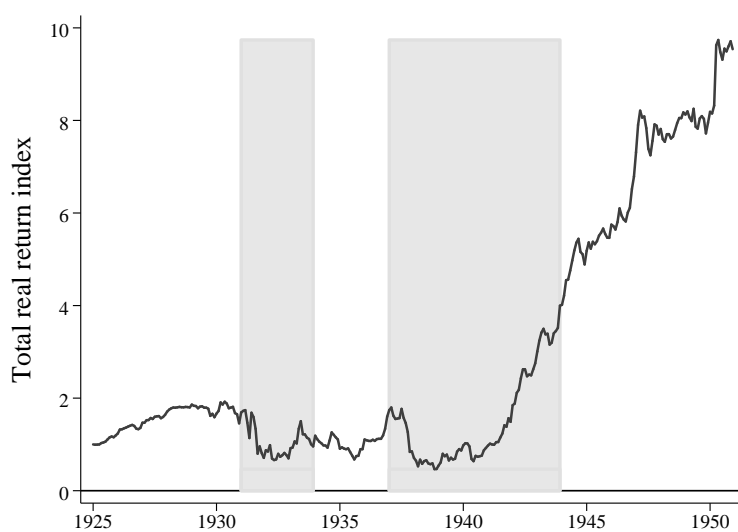
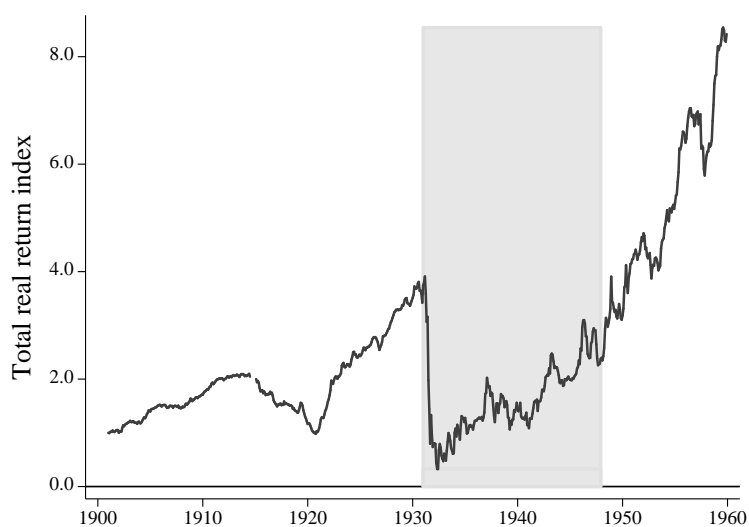
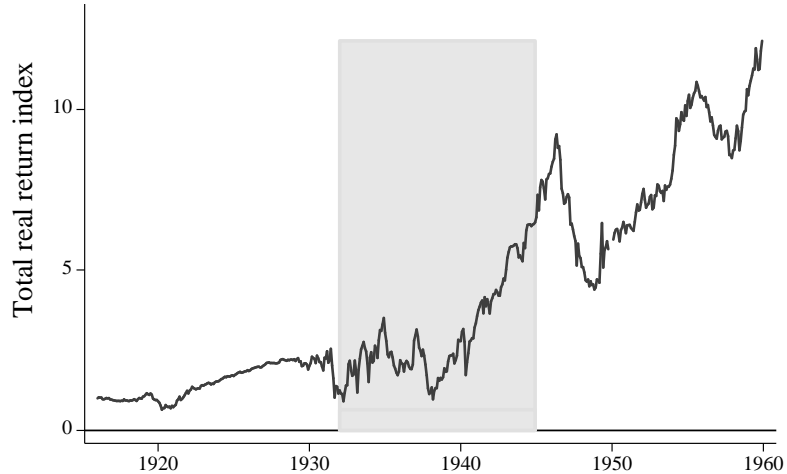
This section shows 11 case studies on total cumulative real returns around spells of sovereign default. The indices are indexed at 1 at the start of the period (January of the year). We assume reinvestment of principal and interest into the country portfolio. Default episodes are shaded in grey.

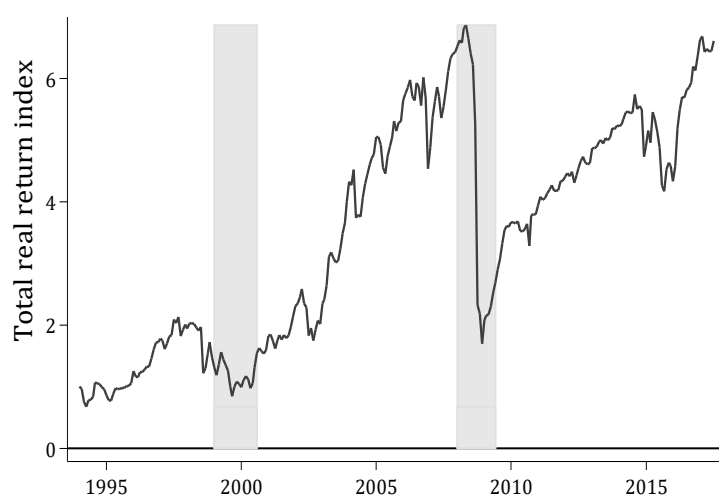
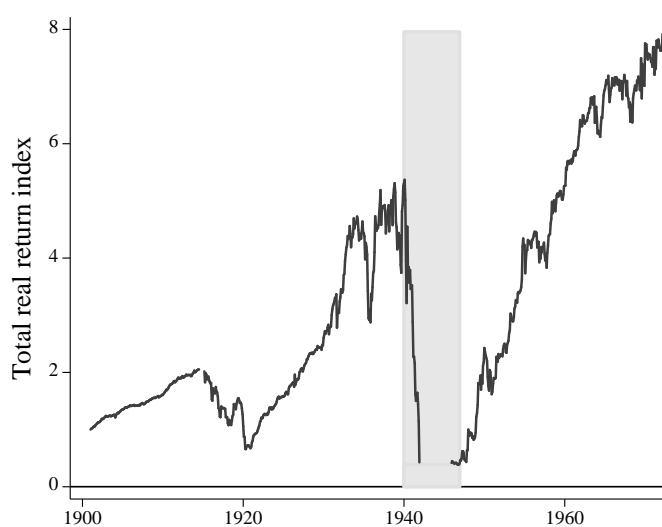
**Argentina 1870-1910: cumulative total return index**

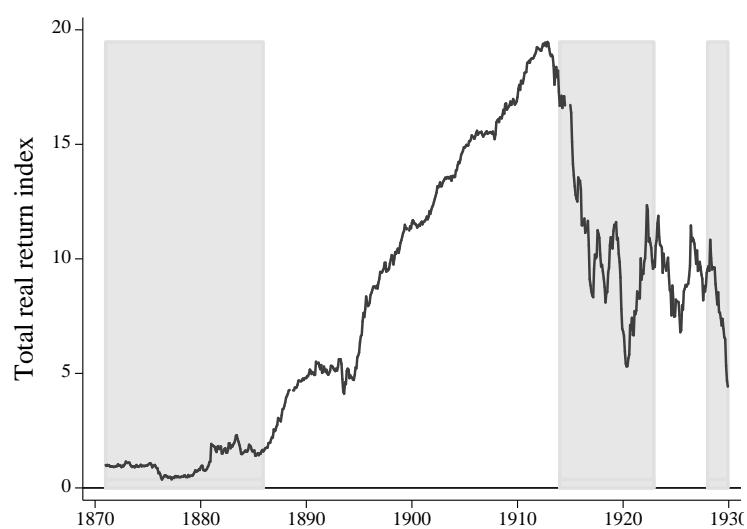
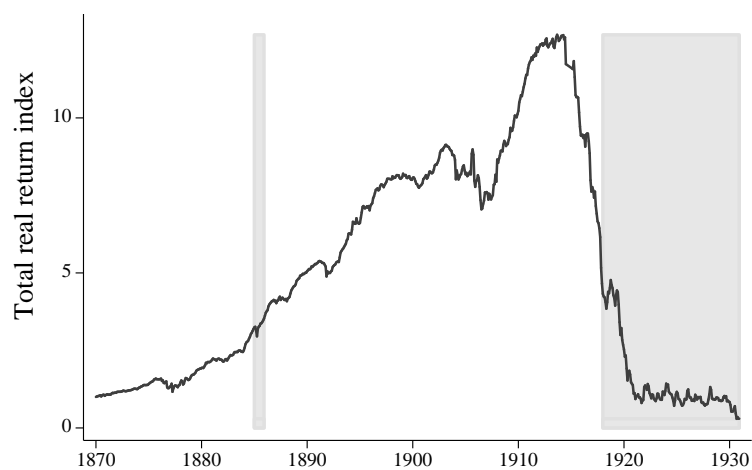
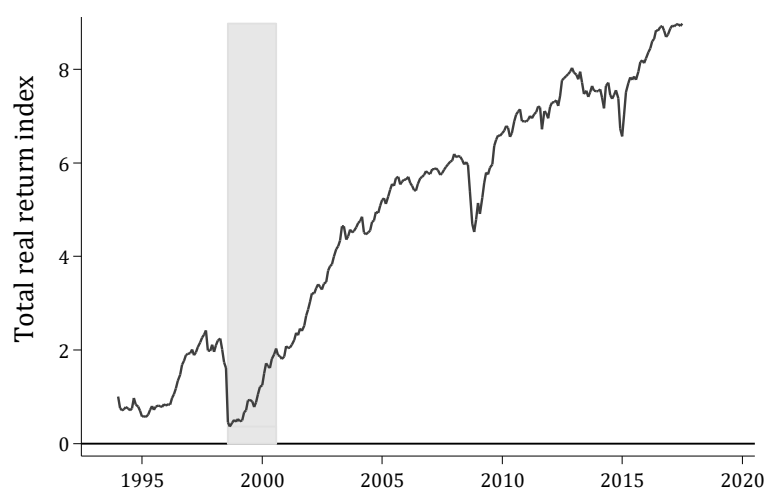


**Argentina 1994-2017: cumulative total return index**



**Brazil 1925-1950: cumulative total return index****Chile 1900-1960: cumulative total return index****Colombia 1915-1980: cumulative total return index**

**Ecuador 1993-2017: Cumulative total return index****Germany 1925-1975: Cumulative total return index****Italy 1900-1980: Cumulative total return index**

**Mexico 1870-1930: cumulative total return index****Russia/Soviet Union 1869-1930: cumulative total return index****Russia 1993-2017: cumulative total 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) and Fang et al. (2018), which cover 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.

#### C1.1. Case selection

Following Cruces and Trebesch (2013), we use five criteria to select cases:

- 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) or Moody's (2012). 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 do not include 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 and a few others.
- Fourth, we focus on restructurings of privately held, 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 19<sup>th</sup> and 20<sup>th</sup> 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

This subsection explains how we get to our final sample of 313 sovereign debt restructurings since 1815. We start with the modern part of the sample (1970-2013) and use data on 187 restructuring events covered in the most recent update of Cruces and Trebesch (2013). We add to this the recent restructurings in Grenada 2015 and Ukraine 2015 which are covered by Fang et al. (2018).

In the historical sample, we identify 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).<sup>1</sup> Out of the 179 newly identified deals, we could gather sufficiently rich information to estimate haircuts for all but 10 deals<sup>2</sup>, so that the historical sample of haircut estimates added here comprises 169 cases in 43 countries. All of these 169 historical cases were restructurings of sovereign bonds, while no loan debt restructurings could be identified pre-1970. This confirms that external borrowing by sovereigns almost exclusively took the form of bonded debt in the pre-WW2 era, in contrast to the 1980s and early to mid-1990s, when restructurings mostly involve syndicated bank loans held by foreign commercial banks. Note also that, in the historical sample, we drop 63 restructurings that did 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 without a restructuring, i.e. defaults cured with a debt exchange.<sup>3</sup> For these events it is, therefore, not possible to calculate a haircut.

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<sup>1</sup> 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).

<sup>2</sup> 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).

<sup>3</sup> 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.

In a first step, we thus combine 189 restructurings for the modern sample (187 in Cruces and Trebesch 2013, + 2 from 2015 from Fang et al. 2018) with 169 newly coded historical ones, resulting in a total of 358 individual sovereign debt restructuring events over 200 years. Figure C1 shows the respective timelines on a country level. These 358 individual restructurings, however, constitute an upper bound and need to be consolidated to avoid double counting. In particular, the sample includes 78 cases in which the same default features more than one restructuring, mostly because of selective restructurings with different creditor groups (e.g. USD vs. GBP currency bonds). As can be seen from Figure C1 some countries witness multiple restructurings within just a few years. Take the example of Brazil, which declared a full debt moratorium in October 1931. After lengthy negotiations, Brazil restructured its USD and GBP bonds in November 1943 but it took three more years, until 1946, to settle its few outstanding French Franc bonds. We merge such multiple restructurings of the same default into one event, so that each spell receives just one haircut estimate. Specifically, to compute haircuts across multiple deals of the same default, we calculate a weighted average haircut using amounts restructured in each deal (converted to US dollar values). To date 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 1946 agreements and assign the year 1943. This is because the bulk of Brazilian debt was to US and UK creditors, while the French agreement of 1946 was widely seen as a side deal.

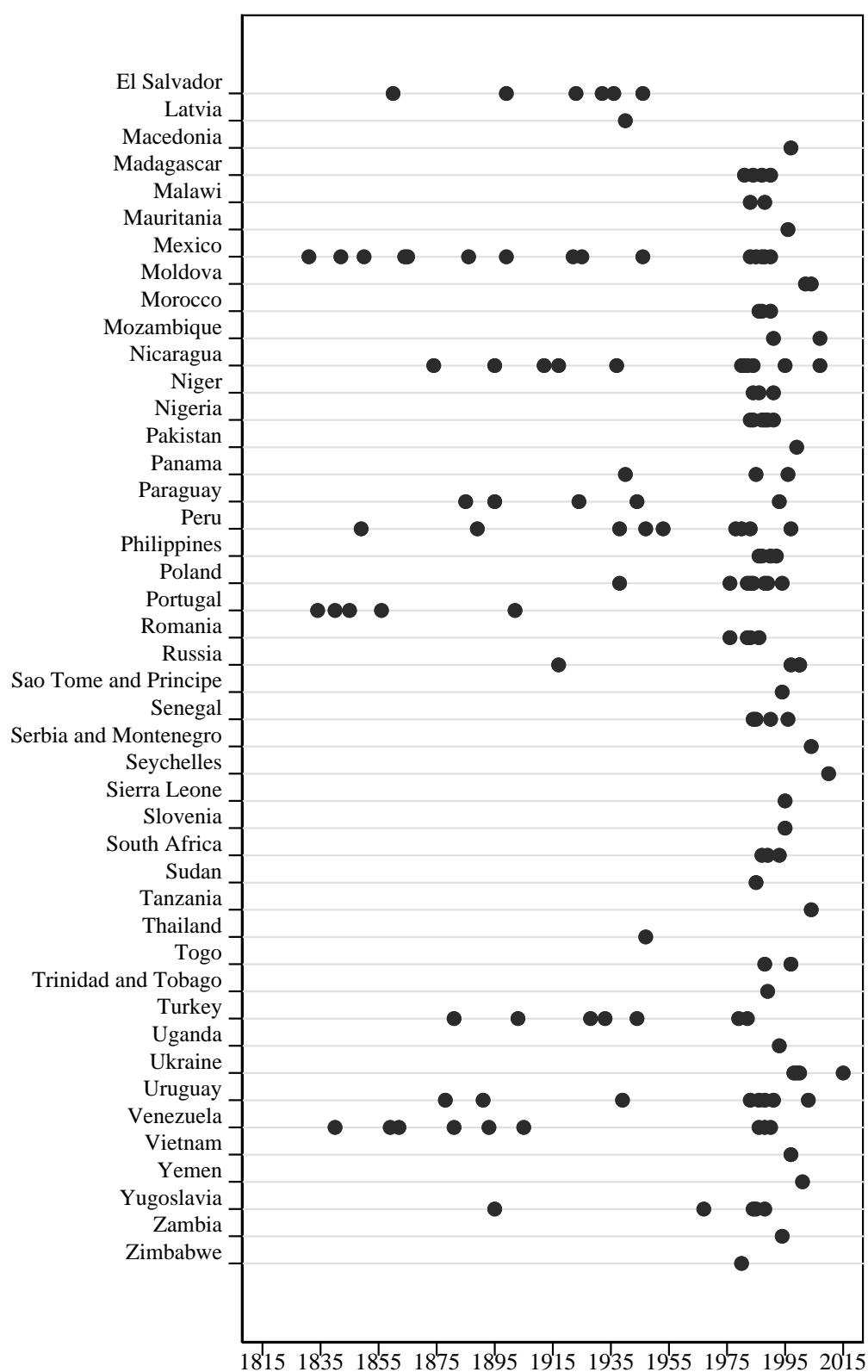
Overall, we identify 78 spells with multiple restructurings (28 in the modern sample and 50 in the historical sample) and these are merged into 33 cases (45 cases less). The final, lower-bound sample used in the analysis therefore drops to 313 external sovereign debt restructurings in 91 countries.



Figure C1: Sovereign debt restructurings by country, 1815-2016



Figure C1 (continued): Sovereign debt restructurings by country, 1815-2016



### 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 Foreign Bondholders (CFB) (1876-1944, 1945-1986), the 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 Mobilières (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 Mobilières	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
<b>Total sample</b>	<b>169</b>	<b>6</b>	<b>13</b>	<b>28</b>	<b>35</b>	<b>87</b>	<b>3.95</b>

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 19<sup>th</sup> 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:

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

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” because it has been used by market participants in the past. The measure overstates the loss suffered by creditors (see Zettelmeyer et al. 2013, for a discussion). The formula can be written as:

$$\text{Market haircut } (H_{M_t}^i) = 1 - \frac{\text{Present value of new debt } (r_t^i)}{\text{Face value of old debt + arrears}} \quad (\text{C.2})$$

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, 2008) and compares the present value of the old and new debt instruments. Both payment streams are evaluated at the same discount rate:

$$\begin{aligned} \text{SZ haircut } (H_{SZ_t}^i) \\ = 1 - \frac{\text{Net present value of new debt } (r_t^i)}{\text{Net present value of old debt } (r_t^i) + \text{arrears}} \end{aligned} \quad (\text{C.3})$$

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.

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. 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). Note, furthermore, that 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. As explained in the main text, this was the case in Russia 1917, China 1949, Cuba 1960 as well as on portions of the debt in Spain 1824, Greece after 1826, Portugal 1834, Mexico 1866 and the Dominican Republic 1872.

## 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 19<sup>th</sup> 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. 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. 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.<sup>4</sup>

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<sup>4</sup> 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

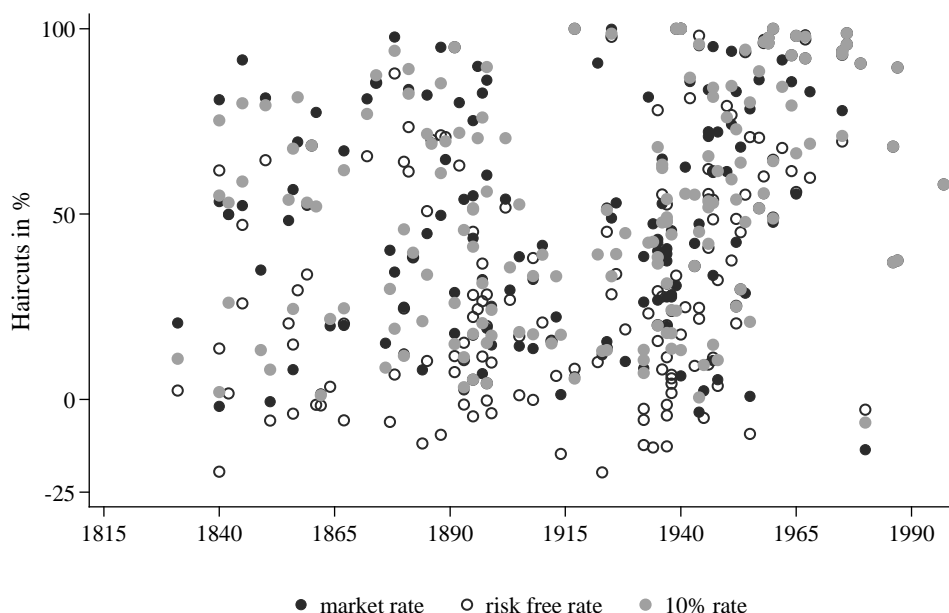
In order to check the sensitivity of the haircut estimates to the chosen discount rate we also compute haircuts using two alternative discount rates, (i) a risk-free rate (British consols from 1815 to 1918 and US treasury bonds thereafter), and (ii) a 10% flat discount rate across countries and time (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 in the historical sample: changing the discount rate

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

As can be seen, the haircuts using a 10% lump sum rate are rather close to our average baseline estimates using “exit yields”, although the differences by country can be large. 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.

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

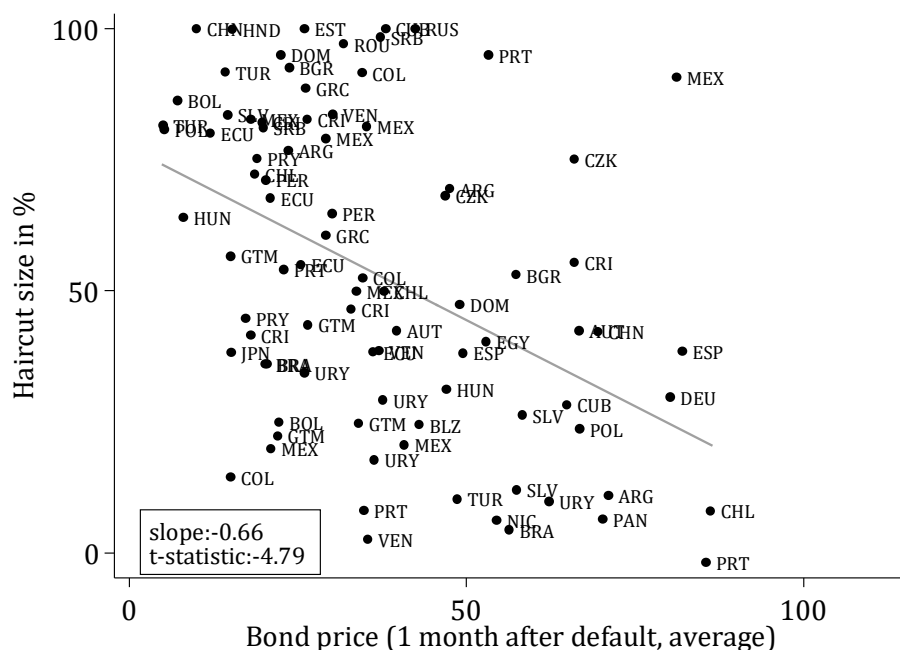


correlated, i.e. there is less variation to exploit. Quantitative approaches, such as propensity score matching, did not show satisfactory results either. We therefore prefer to settle on the plain and simple “worst yield” approach which results in reasonable yield proxies.



As noted above, the literature on corporate bonds uses bond prices around default events to estimate the size of recovery rates (or haircuts), e.g. Moody's (2011a) or Jankowitsch et al. (2014). To check the relationship between our haircut measure and market prices, Figure C3 plots the estimated haircuts on the vertical axis against the bond prices around 94 default events for which we have reliable pricing data. In line with standard practice we focus on the post-default prices and use the average bond price one month after the default for each country (portfolio averages). The correlation between the two proxies of investor losses is high, despite the fact that the haircut  $H_t^i$  measures losses at the *end* of a default spell (in a restructuring), while the prices on the horizontal axis are measured at the *start* of the default (one month after the credit event). Thus, at the onset of a default, bond markets predict the magnitude of creditor losses in a future restructuring reasonably well.

Figure C3: Haircuts in bond restructurings and bond price at onset of default



#### 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<sup>th</sup> 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. For our calculations, we compute the amortization scheme of each bond 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:** 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 valued when computing haircuts since they were not legally binding, especially after the abrogation of the gold clause in Britain in 1931 and in the US in 1933. 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).<sup>5</sup> 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).

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<sup>5</sup> 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).

## 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. 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:** There were several sovereign defaults that occurred just prior to, or as a consequence of, state break-ups. For each country break-up case we gathered 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.<sup>6</sup>
- Gran Colombia, which defaulted in 1826. Debt apportionment was agreed in 1834.<sup>7</sup>
- 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.<sup>8</sup>
- 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.<sup>9</sup>

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<sup>6</sup> 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.

<sup>7</sup> 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.

<sup>8</sup> The final dissolution of the Ottoman Empire started in the early 20<sup>th</sup> 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%, Assy 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%, Transjordan 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, Assy, Saudi Arabia (formerly Nedid and Hedjaz), and Yemen remained unresolved, i.e. no repayment occurred.

<sup>9</sup> 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%).

**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 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<sup>th</sup> and early 20<sup>th</sup> 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.<sup>10</sup> 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.

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<sup>10</sup> Namely in Chile 1948, Colombia 1861, Dominican Republic 1934, Ecuador 1895, Greece 1898 and 1964, Mexico 1831 and 1942 and Turkey 1881.

**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 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 19<sup>th</sup> 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. 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).

**Previously 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 19<sup>th</sup> and early 20<sup>th</sup> century (Reinhart et al. 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.<sup>11</sup> 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 dollars using the exchange rates provided by Reinhart and Rogoff (2009) and Officer (2018, <https://www.measuringworth.com/>).

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<sup>11</sup> 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).