

# Essays on Sovereign Debt and Commodity Markets

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To my parents  
Christoph and Isolde

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# Introduction

Borrowing via sovereign bonds has been a major source of government financing throughout the past 200 years. Despite this long history of international lending, sovereign bond markets still undergo episodes of busts that come with long-lasting negative economic consequences (Reinhart and Rogoff, 2009). Even today, investor sentiment still makes it difficult for governments to re-access markets after default, issuing long maturity debt or place debt at a low cost. Vulnerabilities such as the dependence on raw commodity exports compound these problems.

This dissertation empirically studies sovereign lending and commodity markets from three different but related angles. First, it analyzes the boom and bust periods of sovereign bond issuances starting from the date when Russia placed its first bond in international capital markets in 1815 (chapter 1). Second, it studies commodity price drops as a persistent factor associated with a rise in sovereign default risk among commodity dependent countries (chapter 2). Lastly, it sheds light on the evolution of maturity of sovereign bonds at issuance and the factors associated with the rise of (ultra-)long bonds (chapter 3). Besides the topical relation, the three papers unite their long-term perspective: While chapter 2 already covers 150 years of commodity price movements and sovereign risk, chapter 1 and chapter 3 address 200 years of sovereign lending.

This dissertation adds to academic literature on sovereign lending through capital markets and its relationship with commodity price fluctuations. A large body of literature centers around international capital inflows and outflows (e.g. see Portes and Rey (2005) and Rey (2013)). Within the field of capital flows, sovereign debt flows attract attention because they have been interconnected with major historical financial crises at least since the early 19th century. Due to data limitations, the sovereign debt literature has, however, primarily focused on the last 50 years, covering debt busts centered around the 1980s Latin American crisis, the 1997/98 Asian crisis or the 2009-12 European sovereign debt crisis.<sup>1</sup> Until now, there are only few exceptions that study sovereign bond flows even further back in time (see for example Meyer et al. (2019)).

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<sup>1</sup>See Kaminsky and Pereira (1996) for an overview on the 1980s Latin American crisis, Goldstein et al. (1998) for the the 1997/98 Asian crisis and Lane (2012) addressing the recent European sovereign debt crisis of 2010-2012.

With regard to commodity markets, this dissertation adds to a body of literature on commodity boom and bust periods (e.g. see Drechsel and Tenreyro (2018)). A growing part of the literature accounts for the countries' export composition in their analyses. However, the focus has been on energy commodities such as petroleum or oil (see Hamann et al. (2018)) or on the relationship between the volatility of terms of trade and sovereign default risk in the more recent past (see Hilscher and Nosbusch (2010)). Over the very long-run, only few papers study price movements which they relate to sovereign default risk (see Reinhart et al. (2016)). However, little is still known about the long-run relationship between sovereign default risk and commodity price movements controlling for the countries' export composition.

What are the main contributions and insights of this dissertation? Embedded in a collection of three essays, this dissertation contributes to the field of international finance with the goal of providing a reliable long-run view on the booms and busts of sovereign bond and commodity markets. This dissertation is comprised of my single-authored paper (chapter 3) as well as two co-authored papers (chapter 1 and chapter 2). Besides the analytical content, this dissertation provides two novel datasets that will enable future research to study long-run patterns in sovereign bond and commodity markets. Over the last four years, Christoph Trebesch and I have collected bonds issued in both domestic and external capital markets from various sources. We have compiled, cleaned and cross-checked the data with official listings and bond prospectuses whenever possible. Overall, we have identified 56,504 sovereign bonds (and syndicated loans) out of more than one million single instruments issued by 188 sovereigns worldwide. The data is used to study the research questions of chapter 1 and chapter 3 of this dissertation. Together with my co-authors for chapter 2, Angélica Domínguez-Cardoza and Josefin Meyer, I have created a database of unique raw commodity, export-weighted, country-specific price indices for more than 40 commodity dependent countries worldwide. Covering 42 raw commodities, our dataset is the first of its kind and allows us to study the last 150 years of international commodity markets and its relationship with sovereign default risk with a new perspective.

What do the three chapters cover in greater detail? In chapter 1, titled “**Sovereign Debt: The One Million Bonds Project**”, my co-author Christoph Trebesch and I study the evolution of sovereign lending with regard to when, where, and how much sovereigns issue on the basis of a newly created, micro-level dataset of emerging and developing sovereign bonds and syndicated loans, spanning two centuries from 1815 to 2019.

In total, we present four novel stylized facts on how sovereigns have fared in international capital markets. First, we show that there have been four main sovereign debt issuance booms in international capital markets since the 19th century. These booms started in the 1860s, the 1920s, the 1970s and the 1990s. All of these booms were centered around sovereign bonds, with the exception of the syndicated lending boom in the 1970s. Over the course of these boom periods, lending moved from the London Stock Exchange to

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the New York Stock exchange during the interwar period. So did the currency of issuance which moved from the British pound to the US dollar.

By moving to the cost side of issuing, we find that coupons and spreads on external sovereign bonds have been unusually high since the mid-1990s. Although coupon rates of emerging and developing economies have fallen over the last years, African sovereigns still face an average coupon of 7.3%.

Going from the boom to the bust side of issuances, we study the amount of time that sovereigns require to recover from a default and regain access to international capital markets. We find that the time to resumption has dropped considerably over the course of history. Before World War I, it took countries roughly 7.7 years on average to tap markets post default, while in the modern era (post 1990s) the recovery time has dropped to 5.2 years. Serial defaulters, i.e. countries that have defaulted at least three times in history, have experienced a similar drop in time to resumption.

Finally, we go beyond external capital markets and study domestic currency sovereign bond markets starting in the mid 1990s. We show that these markets have increased fourfold, making local-currency bonds a main emerging market asset class that has surpassed foreign-currency bond issuance in terms of volumes. This development is mostly driven by market players from Asia such as China and India that have continuously placed large amounts of debt in their own domestic capital markets in the last years.

The insights generated in chapter 1 allow to put the recent turmoil in sovereign debt markets in a long-run historical perspective. The “debt pandemic” is yet another illustration of the patterns uncovered in this chapter.

Chapter 2, titled “**Global Commodity Markets and Sovereign Risk across 150 Years**” extends the analysis of chapter 1 towards the bust side of hard-currency sovereign bond issuances and relates sovereign default risk to commodity price movements. My co-authors Angélica Domínguez-Cardoza, Josefin Meyer and I construct a novel dataset of country-specific commodity price indices based on raw commodity exports and commodity prices for 41 commodity dependent countries which we relate to sovereign yield spreads. Covering 42 raw commodities ranging from agricultural to mineral and metal to energy, our analysis is the first of its kind to measure the persistence and evolution of this relationship over 150 years accounting for the countries’ commodity export composition.

Empirically, we employ fixed-effects regressions with sovereign yield spreads on hard-currency sovereign bonds as our dependent variable to show that commodity prices are negatively associated with sovereign default risk throughout the last 150 years. We find that the countries’ export compositions do influence this relationship over time: while historically agricultural price movements drove this relationship, today it is driven by minerals, metals and energy raw commodities.

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Interest rate volatility is a crucial driver of business cycles in emerging and developing countries (Aguilar and Gopinath, 2007). Our paper uncovers commodity booms and busts as an important factor associated with interest rate fluctuations. This co-dependency provides a warning to sovereigns whose business cycles are driven by interest rates that move with commodity prices. This is particularly problematic for sovereigns that are dependent on exporting energy commodities today for which commodity price slumps are negatively associated yield spread surges.

One way to reduce sovereign default risk is via long-term borrowing. In chapter 3, titled “**Sovereign Bond Maturity: The Rise of (Ultra-)Long Bonds**”, I investigate the rise of (ultra-)long bonds, i.e. bonds with more than 30 years to maturity in external markets and more than 9 years to maturity in domestic markets, and the factors associated with this rise. Building on novel data on instrument-based sovereign bond maturity introduced in chapter 1, I provide descriptive evidence that maturity is surprisingly slow moving in the aggregate although a rising number of countries have been able to issue (ultra-)long bonds as time has passed. In the domestic market, the number of countries that are able to issue bonds of at least ten years to maturity has risen from 75 in the 1990s to 115 after 2010. In external capital markets, the number of countries issuing ultra-long bonds has increased from 3 in the 1990s to 14 post 2010.

The empirical evaluation shows that the countries’ financial developments is positively associated with long issuances in domestic bond markets. Having been able to issue bonds in the past before is also statistically significant and positively associated with long issuances. In case of the external bond market, having been able to issue ultra-long before is positively correlated with new ultra-long issuances.

Although this study presents empirical evidence that longer maturity bonds have become more prevalent over time, (ultra-)long bonds are still in the minority. More effort needs to be made in developing domestic financial systems for the average maturity to lengthen significantly. Governments can support this development via pension fund reforms that would not only increase the availability of long-term funds but would also foster investor appetite for long bonds issued in local currencies. Shielding countries from capital outflows during crises, e.g. via sound fundamentals and efficient institutions, could additionally contribute to more stable financial systems.

This dissertation sheds new light on sovereign borrowing and commodity markets. The recent Covid-19 pandemic has increased bond issuances and borrowing of the last 30 years to unprecedented levels. After an initial fall at the beginning of the pandemic, commodity prices also started to surge, driven by both demand- and supply-side effects. As seen in history, this double boom will eventually come to an end. To mitigate the risk of an economic collapse, targeted and clearly defined long-term policies are needed. Installing countercyclical fiscal policies could be one way to dampen the consequence of a double bust.

This dissertation seeks to inform future policy by providing insights into how booms and busts in sovereign lending and commodity markets have developed over the course of the last two centuries. Additionally, it shows which factors help reduce rollover risk, such as bonds with long maturities.

For economists and policy makers it is important to understand how and when booms and busts in sovereign bond markets occur in order to keep both long- and short-term risks to a minimum. While this dissertation has taken a step towards unraveling patterns in sovereign debt and commodity markets over the long run, future work may investigate potential channels that could be used to mitigate commodity price shocks or to aim to find the causal mechanisms behind the rise of (ultra-)long issuances. I hope that the data introduced in this dissertation will enable the analysis of these important topics.

# Chapter 1

## Sovereign Debt: The One Million Bonds Project

This chapter of the dissertation is co-authored with Christoph Trebesch.<sup>1</sup>

**Abstract:** Most research on sovereign debt uses aggregate data. In this paper we present initial results from what we call the “One Million Bonds Project” – a newly created instrument-level dataset spanning two centuries – from 1815 to 2019. The aim of our granular database is to cover all emerging market external sovereign bond and loan issuances over 200 years as well as all domestic sovereign issuances over the past 30 years (since 1990). The data reveal four main stylized facts: 1) There have been repeated sovereign debt issuance booms in international capital markets since the 19th century; 2) Coupons and spreads on external sovereign bonds have been unusually high since the mid-1990s. In the 2010s, the average bond spread at issuance was more than 1 percentage point higher than the historical average of the past 150 years; 3) The time to reaccess international capital markets after exiting default has dropped considerably over the course of history. In the past two decades, it took countries less than five years, on average, to tap markets after exiting default; 4) Since the mid-1990s, domestic sovereign bond issuances have increased fourfold, making local-currency bonds a main emerging market asset class that has surpassed foreign-currency bond issuances.

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## 1.1 Introduction

Sovereign debt is one of the most important macroeconomic challenges of our time (Blanchard, 2019). Despite this, granular data on sovereign borrowing is hard to come by. This project aims to fill this gap, by creating the first dataset of sovereign bond issuances at the micro level that combines all main existing data sources into a cleaner “consensus database” or sovereign bond “census”. Using this data we distil a set of stylized fact on debt issuance patterns and the cost of external financing (bond issuance yields) for governments over the past 200 years.

Prior to starting this project, there was no reliable, representative and granular dataset that allowed to study the characteristics of global sovereign debt markets in history and today. The main public databases by the IMF, the World Bank or the OECD typically provide aggregate time series at the country and year level. It is relatively easy to gather time series on public debt to GDP for a large number of countries, but much harder to get reliable data on the debt’s characteristics, such as the coupons or maturity of sovereign bonds, especially when it comes to emerging market countries.<sup>2</sup> Commercial data providers such as Bloomberg and Dealogic provide these details on the bond level, but a comparison across sources reveals surprisingly many errors, inconsistencies and coverage gaps.<sup>3</sup> Given the problems with the sovereign bond issuance data in widely used commercial sources, much existing research is likely to suffer from measurement errors.

To address these shortcomings, we have gathered, cleaned and merged instrument-level data on sovereign borrowing from a broad range of sources, with a focus on external borrowing by emerging markets. We started our data collection by gathering details on one million bonds issued since the 1970s. Specifically, we bring together data on more than one million corporate, public and government external and domestic bonds issued between 1970 and 2019. Of these, 570,000 are from Dealogic (DEA), 320,000 are from Bloomberg (BB) and 177,000 are from Thomson Reuters Eikon (EK, recently purchased by Refinitiv). Sovereign bonds (issued by the central government) make up for less than 10% of the final sample, but the very broad starting base helps us to generate the largest possible sample of sovereign bonds, since each database has its own filtering and data selection challenges, resulting in selected and biased samples. By starting from one million bonds, we can generate a more complete and more reliable data resource than that used in much of the existing research on the topic.

To create the final database, we first focus on external sovereign bonds. A main contribution of this project is to compare and correct details of each bond across our main sources by hand – and to complement this information using online sources and, whenever available, official bond listings. Besides detailed

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<sup>2</sup>The data problems are well known, see e.g. Dias et al. (2014) or Horn et al. (2019) for studies revealing caveats in the widely used debt datasets published by the World Bank.

<sup>3</sup>Kropp et al. (2018) document many errors in the Bloomberg sovereign bond data, which contain wrong details on issuance amounts, currency or interest rates.

bond-level comparisons, we also compare the external debt data at the aggregate level by collapsing our final, cleaned bond-level data to the country-year level and then comparing it to BIS statistics.

We extend the database on external bonds since the 1980s all the way back to the early 19th century when borrowing in international capital markets took off. Specifically, our analysis of external sovereign bond markets starts in 1815, when Russia issued its first bond in Amsterdam, and ends with Laos which issued its first international sovereign bond in late 2019. Our historical data (1815-1969) builds on various sources, in particular Fenn's Compendium, Moody's Manual of Investments, the London Stock Exchange Yearbooks and Meyer et al. (2019). One major problem with historical bond data sources is that they report tranches and series of data in bundles. We disentangled these tranches and series to correct for biases with regard to issuance and market access dates. In the historical period, our main focus is the London and New York market, i.e. the dominant financial centers of the past 200 years (New York overtook London with regard to external bond issuances in the early 1920s). However, we still include bonds issued on other stock exchanges if they appear in our sources, e.g. because they are issued and/or traded on the LSE or the NYSE. Our database thus almost entirely covers the universe of sovereign bonds issued in London and New York, but is not representative for bonds issued in Berlin, Paris or Amsterdam.

For the 1970s and 1980s, when external sovereign bond issuances all but disappear, we add syndicated bank loans, as these became the main external borrowing instrument for developing country sovereigns (Fernandez-Ansola and Laursen, 1995). The main source on syndicated loan placements is the World Bank's Borrowing in International Capital Markets as well as Dealogic. We again cross-check our data using the database of the seminal book by Stallings (2018).

To account for domestic bonds, we mainly rely on bond data from Bloomberg and Eikon.

After a comprehensive merging and cleaning process that is summarized in detail in the Appendix, we created two final datasets. First, a long-run database of external bonds, which contains 4,586 unique sovereign debt instruments of 132 emerging and developing economies worldwide over 200 years (1815-2019). Second, a modern database of domestic sovereign bonds, which contains 37,463 bond instruments issued by emerging and developing country governments over the past 30 years (1990-2018).

Based on the data we distil four stylized facts to inform theory and policy. First, there have been several major sovereign lending booms in international capital markets, including the 1860s, the 1890s, the 1920s, the 1970s and the 2000s. While the first two booms were shaped by bond issuances, the 1970s/80s were dominated by syndicated bank lending. In the 1990s, external bond market borrowing returned, with newly entering issuers from Asia and, particularly in the 2010s, from Africa. In history, the 1920s became the first lending boom financed in US dollars and via the New York market. Our granular data shows



that in 1919 the US dollar overtook the British pound as the main currency of international sovereign lending. The number of sovereigns borrowing in international bond markets has grown markedly over the past 200 years from 11 countries in the first half of the 19th century to more than 130 today. Moreover, issuance volumes have ballooned to 105.3 billion US dollar issuances in 2019. In terms of world GDP, however, sovereign lending was much larger pre World War I than at any time ever since. Indeed, Great Britain used to be a much bigger capital exporter in the 19th century than the US is today.

Second, the sovereigns' refinancing costs, i.e. the debts' interest on hard currency international bonds have been unusually high since the mid-1990s. In the 2010s, the average bond spread at issuance was more than 1 percentage point higher than the historical average of the past 150 years. African issuers, in particular new market entrants, are a major driving force of these high average coupons.<sup>4</sup>

Third, over the course of the last two centuries of borrowing in international capital markets, many countries had near-continuous market access, despite defaults and global crises. The time to reaccess after default has dropped significantly from 7.7 years, on average, before World War I (WWI) to 5.2 years during the modern bond era. Across continents, however, African nations still take the longest to reaccess capital markets after default (8.8 years).<sup>5</sup> This is partly driven by both new, non-established market players but also by established sovereigns like Egypt (19 years), which hints at a systematic bias against African sovereigns.

Fourth, with the return of borrowing via sovereign bonds came a vast development of domestic currency markets, which soon superseded external currency bond issuances in both number and volume. With regard to domestic currency markets, the strong growth was driven largely by Indian and Chinese issuances.

Our paper contributes to the literature on international capital flows and on sovereign debt. In the analysis of cross-border capital flows, researchers typically used aggregate country-level data (e.g. see Portes and Rey (2005), Lane and Milesi-Ferretti (2008), Bruno and Shin (2014), Reinhart et al. (2016)). Our paper is part of a nascent body of work that uses granular, instrument-level data to study global capital allocation. Coppola et al. (2021), in particular, create a dataset of mutual fund holdings around the world capturing several million bonds and stocks issued since the early 2000s. Kaminsky (2016) and Kaminsky (2017) study boom and bust cycles in international borrowing on the basis of individual bond and stock issuances over 200 years and with a focus on Latin America. Compared to Coppola et al. (2021), who start in the 2000s, we go back much further. We also place a stronger focus on sovereign debt and carefully cross-check and scrutinize the information on every single external sovereign bond issue

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<sup>4</sup>This is in line with Olabisi and Stein (2015) who find that African sovereigns place bonds at coupons that are about 2-3 percentage points above the coupon rate of other emerging and developing countries. They find that neither country ratings nor debt to GDP ratios are able to explain the high borrowing costs for African countries.

<sup>5</sup>European sovereigns need on average 6.3 years to reaccess, followed by 4.8 years among Asian and 3 years among American nations.

over the past 200 years. Compared to Kaminsky (2017) our dataset is much richer for the modern period, since we combine multiple sources and also include domestic bond issuances. Moreover, our analysis also considers other regions than Latin America.

In the field of sovereign debt, we see our project in the tradition of classic contributions that have provided novel facts on the international debt market such as Suter (2019) or Reinhart and Rogoff (2009), who both focus on the country-level data. In the recent literature, the paper most closely related to ours is Meyer et al. (2019), who study creditor returns and losses based on a sample of more than 1500 external sovereign bonds worldwide since 1815. Compared to Meyer et al. (2019), we do not only cover external bonds traded on secondary markets or those involved in a debt restructuring. Instead, our aim is to capture as many external sovereign bond issuances as possible, resulting in a sample of more than 4500 external bonds, three times larger than the sample in Meyer et al. (2019). Moreover, we do not constrain ourselves to bonds issued in London and New York, but also cover more than 30.000 domestic sovereign bond issuances.

With a view to our findings, the most novel insight is that issuance spreads on sovereign bonds have been unusually high in the past 30 years when compared to the historical average. Our finding on spreads in the primary market (ex-ante, at issuance) complements the result of Meyer et al. (2019) that total ex-post returns have been significantly higher since the 1990s.

Our granular data also adds new insights to the literature that has documented boom and bust cycles in international sovereign lending, e.g. Flandreau and Sussman (2004), Flores Zendejas (2016). Kaminsky (2016), and Kaminsky (2017) study these debt cycles of sovereign lending in the periphery in separation. Suter (2019) covers debt cycles between 1820 and 1990. Fishlow (1985) describes general trends in international lending, boom and bust periods. Our paper is the first studying sovereign debt issuances uninterruptedly over 200 years, at the global, country and instrument level. By adding our comprehensive dataset of external syndicated loans, we can study the four main issuance booms in much detail, including the pronounced 1970s lending boom that has not been studied in most earlier papers on boom and bust cycles in capital flows to developing countries.<sup>6</sup> In line with Fishlow (1985) and Kaminsky (2019), we also carefully document how the international bond market in London shrank from the early 20th century onwards, with fewer and fewer sterling issuances and how the US dollar took over as global issuance currency in the early 1920s.

We further provide new results to the debate on the cost of sovereign default, in particular on the time it takes sovereigns to tap international capital markets after a default. Market exclusion after default has long been and remains one of the central issues in the study of sovereign debt. See e.g. the empirical

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<sup>6</sup>For US corporates, Ivashina and Scharfstein (2010) explicitly study the cyclicalities in the borrowing of credit through syndicates.

studies by Jorgensin and Sachs (1989), Lindert and Morton (1989), Borensztein and Panizza (2009), Gelos et al. (2011), Richmond and Dias (2009) and Asonuma and Trebesch (2016) or the many theory papers assuming permanent or temporary market exclusion, e.g. Eaton and Gersovitz (1981), Aguiar and Gopinath (2006) or Arellano (2008). To our knowledge, we are the first to study the link between external default and market re-access over 200 years, thus providing the most comprehensive overview to date.

Lastly, the paper also contributes to a small but growing literature on domestic sovereign debt, e.g. Reinhart and Rogoff (2011), Du and Schreger (2016) or Ottonello and Perez (2019). Our paper compiles the largest dataset on domestic sovereign bonds to date and documents the strong growth of local currency denominated debt over the course of the last 30 years, with China and India making up for the lion's share of domestic currency issuances. We conclude that the problem of "original sin" (Eichengreen and Hausmann, 1999) has decreased. Since the 1990s, more and more emerging market and developing economies (EMDEs) have started to issue bonds in their own currency in international markets, including long-maturity instruments. This trend has accelerated since the financial crisis of 2008 (Hale et al., 2016).

The remainder of the paper is structured as follows. Section 1.2 describes the construction of our database on sovereign bonds and loans, including the methodology, assumptions and definitions applied. Section 1.3 presents our main stylized facts on the volume and price of sovereign debt. Section 1.4 concludes.

## 1.2 A granular sovereign debt database

### 1.2.1 Background: the historical evolution of sovereign debt markets

During the nineteenth and early twentieth century, sovereign bonds were the primary borrowing instrument for governments (Fernandez-Ansola and Laursen, 1995). In the early 19th century, only about 10 sovereigns tapped international capital markets. This number quickly grew to 27 in the 1860s and up to 68 before World War I. During this time London was the leading global financial center. World War I and the Great Depression then led to a shift in global debt issuance from London to New York.

In the 1970s, bank lending via syndicated loans became the prevailing external borrowing instrument by governments of EMDEs, especially in Africa and Latin America (see Stallings (2018) and Edwards (1986)). The syndicates were formed by Western banks and fuelled by excess liquidity from recycled petrodollars (Madura et al., 1991). The eurocurrency market boom lasted for a decade and was followed by a pronounced bust. After 1982, large parts of these loans went into default and through restructuring processes and many Latin American countries entered a "lost decade".

The modern era of sovereign lending by EMDEs began in the early 1990s. This time, sovereigns did not just issue internationally, but also developed their own domestic capital markets, which rapidly grew in volume. Local currency bonds have become a new major source of funding for EMDE sovereigns.

## 1.2.2 Building the database

We started our collection procedure by gathering data on more than one million corporate, public and government bonds, of which 177,000 are from Eikon (EK), 320,000 are from Bloomberg (BB) and 570,000 are from Dealogic (DEA). The three commercial databases provide bond issuances dating back until the early 1970s, however, with only limited coverage before the 1990s. On the loan side, we collected data of more than 150 countries that engaged in a total of 26,741 loan agreements between 1973 and 2013. For the historical sample, we collected data on 8,082 debt instruments (including duplicates) of which 2,506 come from the London Stock Exchange Yearbooks, 556 from Fenn's Compendium, 3,347 from Moody's Manual of Investments and 1,673 from Meyer et al. (2019).

For sovereign bond issuances, we focus on issuances of London and New York markets. Unlike Meyer et al. (2019), however, we include all bonds irrespective of the currency of issuance. By doing so, we are able to draw an encompassing picture of sovereign borrowing via bonds, which – especially during the modern bond period – includes many issuances in currencies other than the British pound or US dollar.

We implement a large number of data cleaning steps to get to our final sample of 4,586 external sovereign bonds. From the raw sample of one million bonds, we drop all bonds not issued by the treasury or the countries' central banks. This means that we drop all corporate bonds that make up the bulk of the original raw database. We exclude bonds issued as part of debt restructuring processes as well as municipal bonds. We also drop bonds which lack basic characteristics such as the issue year or the issue amount. To classify debt instruments thoroughly, we split summary bonds and sort them into tranches and series (in case of differing currencies, maturities, reopenings etc). This helps to avoid biases when reporting issue dates, currencies or issuance amounts. As our focus rests on emerging and developing countries, we further exclude all countries classified as advanced.<sup>7</sup>

On the loan side, we cover loans made by syndicates. Here, we focus on loans in every currency to lenders that are central governments, central banks, or agencies/administrations that are directly linked to the government. Hence, we exclude state-owned enterprises, local and state authorities, sovereign wealth funds and public corporations run by the government (this means we drop 23,242 loans). Additionally, we exclude all observations with missing information on the year, the loan volume or the term. We further drop short-term loans defined as having a maturity of less than one year, cancelled or withdrawn deals, loans extended by international development organizations or bilateral loans (as a result, 1,022

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<sup>7</sup>See Section 1.2.3 for a definition of country groups.

instruments and 20 countries are dropped from our database). For the final analysis, we further restrict our loan sample to the heyday of syndicated bank lending – between 1973 and 1989, which implies dropping another 1,036 observations. Lastly, we again focus on instruments placed by emerging and developing countries, thus dropping 255 loans of advanced countries.

### 1.2.3 Definitions and concepts

In this subsection we introduce core definitions and concepts that we have applied in the database construction and analysis. As explained, we focus on emerging and developing economies and consider both domestic and external capital markets.

#### Defining emerging and developing countries

To classify advanced countries, we follow Jordà et al. (2017) who focus on 17 main countries (Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States). Additionally, we classify Austria, Greece, Greenland, Hong Kong, Iceland, Ireland, Israel and New Zealand as advanced countries. All other countries are classified as EMDEs.<sup>8</sup>

#### Defining external and domestic capital markets

##### Sovereign bonds

In the historical sample, our database only covers external sovereigns bonds. To make sure we do not erroneously include domestic bonds in the sample, we use information on the currency and the bond name. Specifically, we drop all domestic currency bonds, i.e. all bonds denominated in the currency of the issuer country. We also drop bonds whose name suggests that they are domestic rather than external or were issued by a local body instead of the sovereign itself, e.g. names that include the terms “domestic”, “local” and “internal”.

For the modern (post-1990) period, we also aim to rigorously classify external bonds and avoid including domestic ones erroneously. For this purpose we apply a broad definition of domestic bonds. A bond is classified as domestic if the market of issuance is coded by the databases as domestic or local and if at least one of the three criteria is fulfilled: 1) the governing law is domestic, 2) the currency is domestic, 3) the ISIN’s first two letters is equal to the first two letters of the home country’s alpha-2 code (which points to a local market issue). Only bonds that do not fulfil one of these criteria are classified as external. In the case of euro-denominated bonds, the classification is not straightforward. Our solution to this problem is to follow the definition by Claessens et al. (2007) who classify a bond as domestic if the market

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<sup>8</sup>We exclude Bulgaria from our analysis due to error prone observations in the domestic bond dataset which we could not verify due to a lack of reliable control data.

type of a bond is given as “Eurozone” and if the currency is not external, the ISIN is not external and the governing law is not external.

### **Syndicated loans**

To avoid including domestic loans we drop all loans that involve only domestic banks (28 out of a total of originally 26,741). This is in line with Gadanez et al. (2002) who define a syndicated loan as external if at least one of the banks involved in the syndicate is from another country. In effect, the vast majority of loans in Dealogic and the World Bank are external. Only very few loans involve domestic banks.

## **1.2.4 Data sources**

In this subsection, we introduce all data sources from where we have gathered sovereign bond and syndicated loan data to form our unique bond-by-bond and loan-by-loan database.

### **Historical bond data (1815-1969)**

Our historical dataset aims to cover the entire universe of external sovereign bond issuances pre 1970 (“The historical bond period”). To describe the evolution of international borrowing via sovereign bonds, we create a unique micro-level dataset on externally issued sovereign bonds based on five different sources: Fenn’s Compendium (1815-1877), the London Stock Exchange Year-Books (1875-1945), Moody’s Manual of Investments (1918-1981) and a dataset by Meyer et al. (2019) (1815-1980). Based on these four sources, we have created a comprehensive database on sovereign bonds in history issued between 1815 and 1969.

#### **Fenn’s Compendium of the English and Foreign Funds**

The bond data from the bond manual “Fenn’s Compendium of the English and Foreign Funds” provides information on foreign debt traded and negotiated on the London Stock Exchange (Charles Fenn (1887), p.1). Fenn’s Compendium covers bonds from 54 countries which were issued between 1815 and 1892. The overall time span of reporting covers the years 1837 to 1893 for more than 544 bonds issued by 51 countries.

#### **The London Stock Exchange Yearbooks**

The London Stock Exchange Yearbooks report sovereign bonds traded on the London Stock Exchange (1845-1945) (The London Stock Exchange (1875), p. iii). The issuance years of bonds included by the London Stock Exchange Yearbooks range from 1815 and 1945, while the years of reporting covered range from 1845 to 1945. The London Stock Exchange Yearbooks cover information on domestic, colonial and foreign government stocks, corporate and bank securities as well as investment in public goods, e.g. railway, telegraphs, gas, water, mines or steamships. While all securities are listed alphabetically by debtor country, some city, provincial and territory instruments were reassigned based on country mergers

or country break-ups (see Appendix A.2.3).

### **Moody's Manual of Investments**

The bond data from Moody's Manual of Investments covers bonds outstanding between the years 1918 and 1981 with a focus on (but not limited to) bonds traded on the major stock exchanges (End et al., 2019), i.e. particularly the New York Stock Exchange at the time. In total, Moody's covers bond data for 102 countries. The issuance years of the bonds included range from 1814 to 1980, while the years of reporting range from 1918 to 1981. Although the data from Moody's is fairly comprehensive, End et al. (2019) point out that Moody's Manual of Investments has excluded instruments of minor interest to American investors such as over the counter or pension-like instruments, annuities or debt issued through state-owned enterprises or banks.

### **Meyer et al. (2019)**

The bond data provided by Meyer et al. (2019) (1815-1980) covers bonds that were traded on the London and New York Stock Exchanges in "hard currencies" (British pound sterling and the US dollar). The Meyer et al. (2019) dataset was compiled based on various sources, in particular newspapers, such as the Investors Monthly Manual, Commercial Financial Chronicle, Bank and Quotation Record, The Economist, Financial Times, as well as the Course of the Exchange, the Circular to Bankers and Banker's Magazin. To a smaller extent, some bond data from the London Stock Exchange Yearbooks and Moody's Manual on Investments had already been included in Meyer et al.'s (2019) dataset.

### **Syndicated loan data (1973-1989)**

To study international sovereign borrowing in the 1970s and 1980s, it is essential to consider syndicated bank lending. However, micro-level syndicated loan data covering the 1970s and 1980s is hard to come by. Two data sources that provide instrument level information on international bank lending are a series of World Bank reports as well as archived data in the Dealogic dataset. Based on these two sources, we have created a comprehensive database on commercial bank loans issued between 1973 and 1989. Specifically, the two databases are Dealogic Loanware (1980-1989) and the World Bank reports "Borrowing in International Capital Markets" (1973-1981q2). The World Bank reports are particularly comprehensive for the 1970s, while the Dealogic Loanware database is the most comprehensive source for the 1980s. Both data sources have been used in a variety of studies.<sup>9</sup>

### **World Bank**

The World Bank "Borrowing in International Capital Markets" (BICM) reports cover granular information on eurocurrency loans by country. The data was published in three different manners: The first report

<sup>9</sup>See for example Tomz and Wright (2005), Stallings (2018), Benczur and Ilut (2011) for studies using the World Bank data and Gadanez et al. (2002), Ivashina and Scharfstein (2010), Giannetti and Laeven (2012), Hale (2007), Cerutti et al. (2015) for studies employing the Dealogic data.

covers the years 1973 to 1975, inclusive, on a quarterly level. From then on, the BICM was published quarterly from 1974 to 1979 in separate issues. Lastly, from 1980 to 1981q2 the reports were issued semi-annually. In total, the BICM reports cover information on more than 4,200 long-term loan agreements for up to 81 sovereigns. Our focus lies on eurocurrency credits only, as these loans are granted by at least one bank that is situated in a country whose currency denomination is not domestic to the recipient country's currency.

### **Dealogic**

Our Dealogic data comprises data from both the Dealogic Bond and Loanware databases. The Loanware database provides us with sovereign lending data via syndicated loans from 1980 onwards. After downloading the data, we obtained an initial dataset that covered roughly 23,000 public and publicly guaranteed loans between 1980 and 2013 used to borrow in 191 countries. 3,200 of these loans were granted to 172 central governments. Comparing the World Bank and the Dealogic data, we find that in contrast to the World Bank, Dealogic also includes deals that were withdrawn, closed, or cancelled. Additionally, the Dealogic Loanware data is not restricted to eurocurrency lending. The data is also structured in tranches where several tranches can be assigned to one loan deal. Finally, Dealogic assigns a unique identifier to each loan and to each tranche which facilitates tracking the loan over time.

### **Modern bond data, external and domestic (1990-2019)**

We use three different data providers for the modern period: Refinitive Eikon (formerly Thomson Reuters Eikon), Bloomberg and Dealogic. Each of these three data providers suffer from incomplete and conflicting information on how much and under what terms a country has issued bonds. Taken together and cleaned for errors, however, the three sources become a rich basis to create a reliable "consensus" database. For data on external bonds, we have taken all three data providers into consideration and validated each bond by hand. To generate the domestic bond dataset, we focused on Eikon and Bloomberg as Dealogic does not provide sufficient information on domestic bonds.

#### **Refinitive Eikon**

We find Refinitive Eikon to be the most comprehensive among all three sources as it provides a good compromise between data quality and data coverage relative to Bloomberg and Dealogic. It is also easy to use and allows for quick bulk-downloads. From Refinitive Eikon, we downloaded domestic and external sovereign bonds, which were issued between 1970 and 2019.

#### **Bloomberg**

Similarly to Refinitive Eikon, Bloomberg covers data on both external and domestic public bonds. The Bloomberg data comes with several important issues: First, it seems to have the weakest data quality with many obviously erroneous data entries. Second, it seems to cover a lot of non-existing instruments. Many



of these “fake bonds” seem to have been created to impute bond pricing in the primary and secondary market (e.g. artificial zero coupon bonds or strip bonds), but these entries have remained in the database. Third, it is difficult to classify bonds as external and domestic, at least when compared to the other commercial datasets we use. Fourth, bond re-openings are not reported as separate instruments but added to the original issue so that it becomes tricky to separate original and intermediate bond issuances (bond histories are often documented only in the comments section). Our database covers Bloomberg data between 1970 and 2019.

### **Dealogic**

Our data from Dealogic covers both bond and loan issuances, i.e. public and private, between 1970 and 2013. While almost 50 percent of the bond data Dealogic provides covers private corporate bonds, the other half covers public corporations. Dealogic covers the smallest amount of government bonds compared to Eikon and Bloomberg, respectively. However, the data quality of the instruments is generally higher and more rich in detail than Bloomberg and, in part, Eikon.

### **1.2.5 Coding process, merging, and cleaning**

As our sovereign bond data comes from various sources, we applied several rounds of collecting, merging and cleaning before consolidating the individual datasets into a final “consensus” database with four main components: 1) The historical bond database that spans 1815 until the early 1970s, the syndicated loan database that spans 1973-1989, which starts in 1990 and is separated into an external sovereign bond and domestic sovereign bond database.

#### **Historical bond database (1815-1969)**

For the historical bond data, we brought together sovereign bond issuance information from Fenn’s Compendium, the London Stock Exchange Yearbooks, Moody’s Manual and Meyer et al. (2019). We hand-coded the bond data from scanned PDFs for all sources except for the data from Meyer et al. (2019), cleaned the data from each source separately, before merging and matching the data across databases using Stata’s dtalink. We have accounted for tranches, series and summary bonds to prevent bias in issuance timing which would otherwise become a serious issue when studying market resumption after default. We deal with missing values by following a multi-staged approach that takes into account information from the different providers as well as different variables. E.g. in the case of missing issuance amounts we use the amount outstanding or the amount authorized if they fulfill the criteria described in Appendix A.2.6.

#### **Syndicated loan database (1973-1989)**

We collected data from Dealogic (via a downloading process) and the World Bank’s Borrowing from foreign loans (PDFs which we handcoded). Merging these two datasets, however, raised two main issues:

(i) The loan data does not come with unique identifiers (e.g. ISINs in the case of bonds) and (ii) the datasets only overlap during one and a half years from 1980 to 1981. This limits cross-validation options between the two sources. To eventually match observations across databases, we used the Stata package `dtalink`.<sup>10</sup>

### **Modern bond database – external and domestic (1990-2019)**

We downloaded all active and inactive sovereign bonds from Refinitive Eikon, from Bloomberg, and from Dealogic for our modern bond external database. We merged the data between and within databases using the Stata program `dtalink` and divided the dataset into an external and a domestic bond database.

As our major focus lies on external sovereign borrowing, we verified the information included in the external bond dataset. To do so, we compared the data across all three sources with the help of more than a dozen research assistants. This external validation procedure helped us to correct mistakes in variables such as the original amount issued, coupons, coupon type, currency, issue and maturity date and issue price. The number of errors we corrected in this manner did not exceed more than 10% of all observations per variable. Nevertheless, by manually validating all external bonds, we were able to remove 1680 bonds from the external bond dataset, which had been erroneously included. Of the excluded bonds, 30% were issued in domestic markets. Another 30% only carried very little information and could therefore not be validated. Lastly, 12% were duplicates which had not been deleted during the prior merging and cleaning process.

During the validation procedure we made use of bond prospectuses and information provided by reliable webpages (such as Ministries of Finance or the London Stock Exchange). Overall, for almost one fifth of our data, we were able to obtain bond prospectuses via Refinitive Eikon. Including our google search, we were able to bring up this number to 25%. This means that we could cross-check a quarter of the final external bond sample using the original legal documents provided by the issuers.

### **1.2.6 Scope of the database**

Our database is the result of an extensive data collection effort which consolidates information on bond and loan characteristics from various sources. The database covers sovereign lending data of emerging and developing sovereigns worldwide including 47 former colonies.<sup>11</sup> For accountability, we cross-checked our data in the aggregate with other sources such as official government listings, Stallings (2018), the BIS and End et al. (2019). The main take away from this benchmarking exercise is that our granular “bottom up” database provides aggregate numbers that are very similar to the aggregates reported by the major international organisations that collect public debt statistics (see Appendix A.3.1 for more

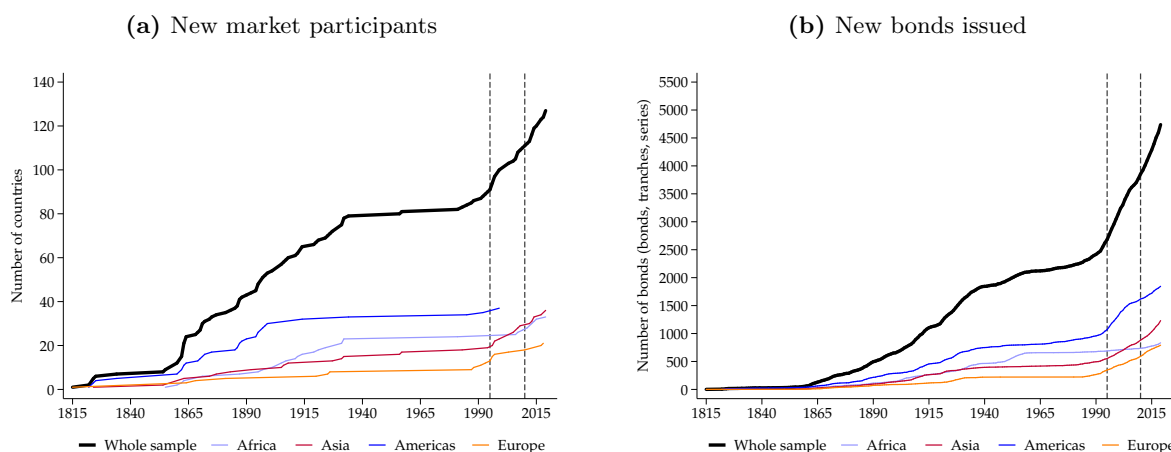
<sup>10</sup>See the section on `dtalink` for a detailed description of the method.

<sup>11</sup>The country overview in Appendix A.1, Table A.1 provides an indicator for former colonies.

information).

Figure 1.1a plots the cumulative sum of new market participants by geographic regions. The graph highlights the post-1995 period as the latest era of strong market expansion. It shows that the boom increased the sample of sovereign borrowing internationally by 19% between 1995 and 2010 and again by 12% between 2010 and 2019. Overall, the highest increase in market participants occurred after 2010, with 17 additional countries entering the market.

**Figure 1.1:** Cumulative sum of new market participants and number of issued bonds by region



*Notes:* The graph shows (a) the cumulative sum of new market participants and (b) the total number of new bonds issued (dark black) and split across four regions: Africa (light blue), Asia (red), Americas (blue) and Europe (orange). Dashed lines represent the years 1995 and 2010 that correspond to the latest booms in new market participants that went along with a boom in new bond issuances.

On the regional level, the 2010s mark the highest increase in market participants from Africa (five new entrants), in particular Sub-Saharan countries and Asia (seven). In Europe, the largest increase in market participants occurred already between 1990 and 2000 when Croatia, Gibraltar, Latvia and Ukraine entered external capital markets for the first time. For sovereigns from the Americas, the strongest rise in debutants occurred between 1860 and 1870 (Antigua and Barbuda, Bolivia, Dominican Republic, El Salvador, Honduras, Jamaica, Saint Kitts and Nevis, Uruguay). Bermuda (1992) and Aruba (1999) are the only countries from the Americas that have tapped international capital markets in the last 30 years.

Figure 1.1b shows the total number of external bonds, by cumulating newly issued bonds in every given year between 1815 and 2019, for the whole sample and by world regions. The graph shows that bond issuances markedly increased for the first time in the 1860s, resulting in the first wave of sovereign borrowing. The period of abundant bond issuances ended with the introduction of the Bretton Woods system, which almost led to a complete halt in sovereign borrowing. Since the mid 1990s, sovereign bond issuances reemerged driven largely by issuances from the Americas, Asia and Europe.

**Syndicated loan database (1973-1989)**

Our syndicated loan database covers 93 countries worldwide. More than 79% of all loans were issued in US dollars; almost 95% so in the 1970s. In contrast to bonds, most loans come with floating rates. In total, 96% of all loans are floaters.

**Domestic debt database (1990-2018)**

Domestic bond markets have developed vastly over the last 30 years. 124 EMDE countries have tapped domestic capital markets since 1990, with 88 of them actively issuing in 2018. The strong growth in domestic bond markets seems to originate both from the entrance of new market participants and from an increase in the countries' issuance volumes over time.

### 1.3 Stylized facts on sovereign debt markets, 1815-2019

Based on our unique sovereign bond and loan database, we report three main stylized facts on the volume and the price of sovereign debt.

**Stylized fact 1: Booms and busts in international capital markets since the 19th century**

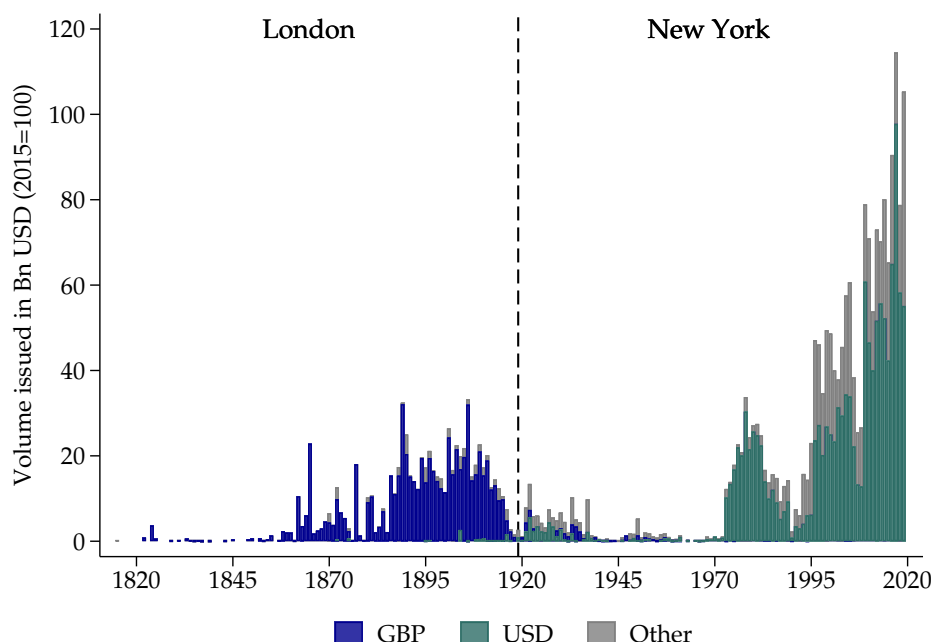
The first lending boom in our dataset occurs in the 1820s, when newly independent Latin American governments such as Colombia, Peru, Brazil, and Mexico attracted large-scale international investments and successfully placed bonds at high issuance yields (see Flores Zendejas (2016)). These countries used the money to finance military spending and domestic investments. The short-lived boom quickly ended in a period of defaults (Paolera and Taylor, 2012).

Up until the first World War, Britain was the world's center of capital exports. War financing was the major reason for sovereign borrowing in the 19th century as seen for example by the Boer War of the late 1890s in South Africa, during which the government borrowed more from abroad than the total sum raised in the five decades preceding the war (Clemens and Williamson, 2004). The interwar period marked the fall of the sterling and the rise of the US dollar to the world's leading currency – culminating in New York becoming the world's new financial center (Eichengreen and Flandreau, 2012).

Figure 1.2 shows the evolution of EMDE international capital market issuance split into three currency groups: the British pound sterling, the US dollar, and a third group, "Other", which comprises all issuances made in currencies other than the British pound or the US dollar. The graph confirms a clear shift from London as the global financial issuance center to New York at the end of the first World War and emphasizes the explosion of EMDE bond issuance after the debt crisis of the 1980s was finally resolved in the early 1990s. Over the past three decades, the share of US dollar bond issuance volumes has remained stable, while the the euro now accounts for on average 20% of total EMDE issuances. Other

issuances are denominated in a wide range of currencies such as the Japanese yen (11%) and up until the introduction of the euro also the German mark (4%). In the late 2010s, only about 0.9% of international bond issuances were denominated in British pounds.

**Figure 1.2:** Debt issued by leading currencies



*Notes:* The graph plots all EMDE issuances of sovereign bonds since 1815 that were made in international capital markets separated by currencies. British pound issuances are plotted in dark blue while US dollar issuances are highlighted in green. Issuances in all other currencies have been summarized as “Other”. During the syndicated loan period of 1970 to 1989, syndicated loan issuances were added to the plot. The black dashed line represents the first year in which the US dollar was the primary currency used in sovereign borrowing via bonds in international capital markets.

There have been several pronounced lending booms since 1815, including the 1860s, the 1890s, the 1920s, the 1970s and the 2000s. The first issuance boom in the 1860s had its roots in the 1850s, when predominately Latin American sovereigns, who had recently gained colonial independence (Paolera and Taylor, 2012). This issuance boom ended in the 1870s with the “Great Depression of the Nineteenth Century” (Marichal, 2014) which included several sovereign defaults, such as by Egypt and Turkey.

Moreover, the 1880s and the 1890s saw notable increases in issuance volumes, interrupted by the Baring crisis of 1890.

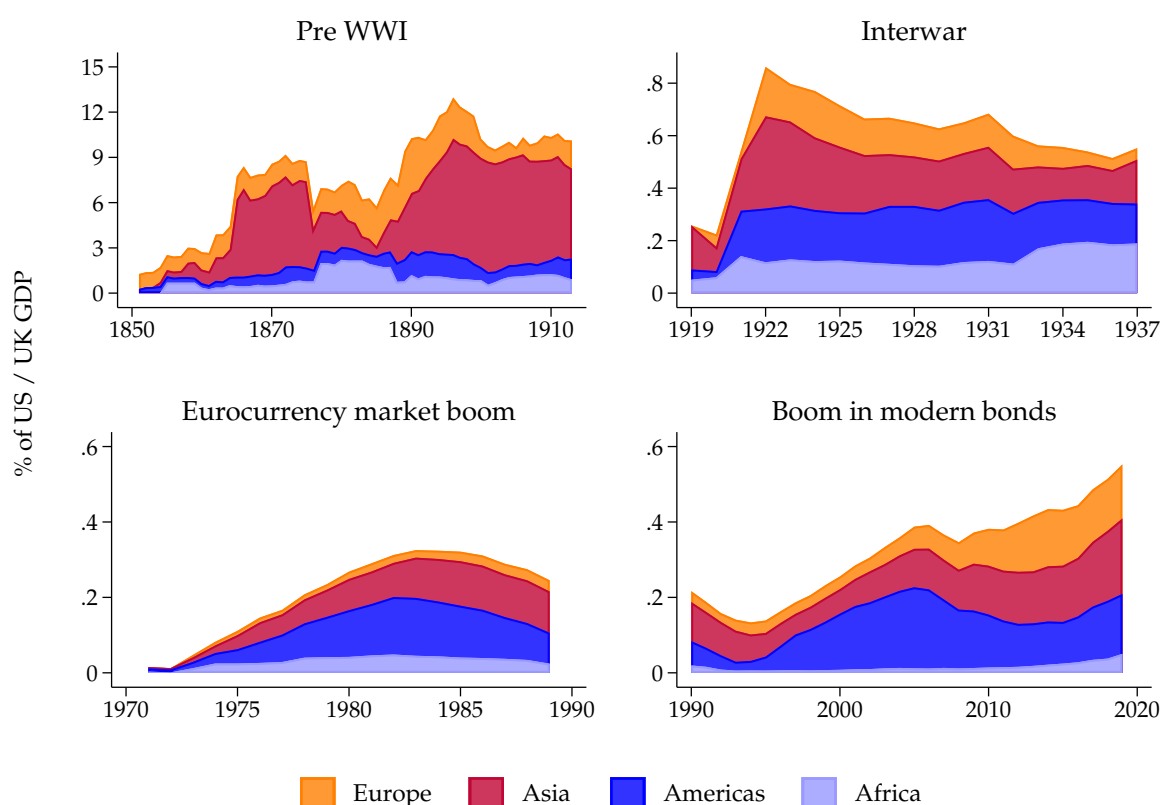
Another wave of issuances began in the 1920s, right after the end of WWI. 1919 marked the first year in which the majority of bonds issued was denominated in US dollars. Next to countries from the Americas, more and more European nations chose the US dollar as their prime issuance currency.

Before the start of the syndicated loan period in the 1970s, bond financing dried up and began to center around government to government lending (Sachs, 1989). The 1970s were then shaped by syndicated

lending, which came to an end in the late 1980s after a wave of sovereign defaults (Edwards, 1986). Although syndicated lending remained an active lending instrument thereafter, international bond markets (and shortly after, also domestic markets) returned as the predominant lending instrument in the mid 1990s.

Figure 1.3 plots the annual issuance amount as a share of world GDP during each of the four boom periods for four major geographic regions:<sup>12</sup> Africa, Asia, the Americas and Europe.<sup>13</sup>

**Figure 1.3:** Issuance booms of external sovereign bonds since 1850



*Notes:* The bond issuance volume as a share GDP is represented by the 10-year moving average to soften cyclicity in the data. For the period 1973-1989 we include syndicated bank loans into the analysis which were the major borrowing instrument during that period. Due to the shorter time period, we use a 5-year moving average. To weight the data by world GDP, we use UK GDP until 1919 and US GDP thereafter. Oceania has been excluded from the graphs due to its small size of issuance volume among emerging market and developing countries. The countries which constitute the main phase country drivers by era were South Africa, India (pre WWI); South Africa, Morocco (interwar); Hungary, Malaysia, Venezuela (1973-90 – syndicated loans); Argentina, Turkey (modern period).

By splitting the graph by regions we find that the booms were often regional in nature. For example, the Asian issuance boom between 1860 and 1875 was almost entirely driven by Turkey, with 35 issues between 1850 and 1880 and a mean annual real amount (2015 base) of appr. 1.5 billion US dollars.<sup>14</sup> Turkey's issuances constitute appr. 13% of all issuances between 1850 and 1880. Additionally, there was

<sup>12</sup>We first use UK GDP (pre 1919) and later US GDP as a proxy for world GDP. The switch from UK to US GDP occurs in 1919, when the US took over as the world's primary financial center.

<sup>13</sup>We exclude Oceania, whose issuances among EMDEs are neglectable low.

<sup>14</sup>There was one outlier year: 1865 with appr. 21.4 billion US dollars.

a small boom in African issuances between 1875 and 1890 driven by Egypt (in terms of volume) and South Africa (in terms of frequency).<sup>15</sup>

Overall, we find that in percent of UK (and since 1919 US) GDP, lending was much larger pre-WWI than at any time ever since. This implies that Britain was a much bigger capital exporter than the US is now. In absolute terms, bond issuances have increased substantially after 1980 and today have reached all-time highs. Yet, because of an stark increase in global GDP and US GDP, the relative values are comparably small.

Issuances as a share of US GDP experienced a considerable rise during the interwar period which was mainly due to the increase in European and Latin American issue frequency up until 1922. After 1922, issues remain more or less constant in relative terms. In absolute terms, however, the interwar period can be split into two contrasting parts. Between 1922 and 1932, total issuance amounts increased substantially. After 1932, issuances began to fall gradually, signalling the beginning of a bust period triggered by the Great Depression that persisted until the beginning of the post war recovery.

During the syndicated loan period in the 1970s and 1980s, loan issuances clearly exceeded bond issuances. The boom was driven by lending to Latin America and Africa.<sup>16</sup>

The issuance boom that started in 1995 was primarily driven by Latin American sovereigns, which account for 36% of total issuances in this period (in terms of volume) followed by Asian countries with 34% of total issuances. Within Asia, the biggest issuer has been Turkey, followed by Indonesia, Lebanon and China.<sup>17</sup>

In recent years, the global low interest rate environment and the “search for yield” have encouraged the market entry of poorer and smaller countries. Sub-Saharan African nations, in particular, have become active issuers in the 2010s. Also, Bolivia has tapped international bond markets for the first time in almost a century.

The cycles of global market entry show interesting historical regularities. To show this, we compare the year of market entry in history versus today. Specifically, Figure 1.4 compares the years in which countries initially issued sovereign debt in international capital markets during the pre-WWII (Figure 1.4a) and the post-WWII (Figure 1.4b) periods. Darker shading represent countries that issued bonds in external markets later in a given period than countries in lighter shades of blue.<sup>18</sup> A country can appear

<sup>15</sup>Similar to volatile issuances, average coupons also varied greatly during the pre WWI era, ranging between 2% and 6%.

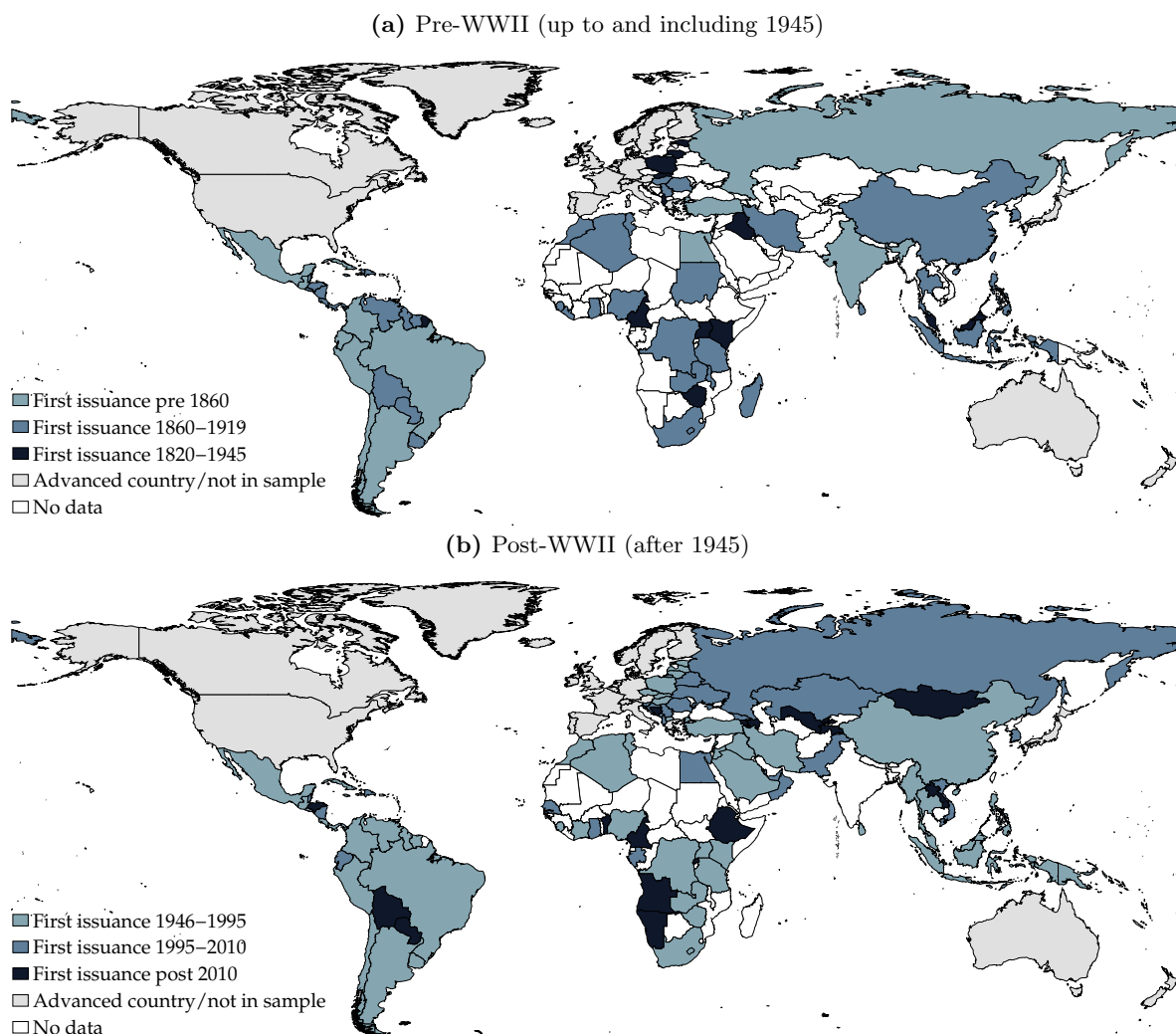
<sup>16</sup>Out of 89 different countries in the loan Market between 1973 and 1989, only 5 were European countries. Among the European loan issuances that are part of our sample, 79% come from Hungary (in terms of amounts).

<sup>17</sup>On the financing side, the modern bond period is shaped by a considerable downward trend in average coupons. Spreads over the US interest rate vary, however, only moderately and do not exhibit a significant downward trend as US interest rates have moved into the same direction.

<sup>18</sup>According to Refinitive Eikon and based on our definition of external and domestic bond markets, India’s focus on sovereign bond issuances after World War II has primarily been on the domestic bond market.

both in Panel (a) and Panel (b) of Figure 1.4, if it issued debt in both periods. The figure shows that South American nations tapped international capital markets early on in both historical eras. Similarly, we find that African nations, in particular Sub-Saharan African nations, have been latecomers, both in the pre- and post-WWII period.

**Figure 1.4:** Then vs. Now: Market entry into international capital markets



*Notes:* The plots show the timing of international capital market entry for all countries in our sample, during the pre- and post-WWII period, respectively. The later a country entered the market during a given period, the darker is its coloring on the map. Grey areas represent advanced countries that are not part of our sample. Remaining white areas, which we have labeled as “no data countries”, are centered around North Africa and Central Asia. For these countries, we could not collect any data which we assume is due to the fact that the countries’ sovereigns have not yet placed a bond in international capital markets.

## **Stylized Fact 2: Coupons and spreads on external sovereign bonds are at a historical high**

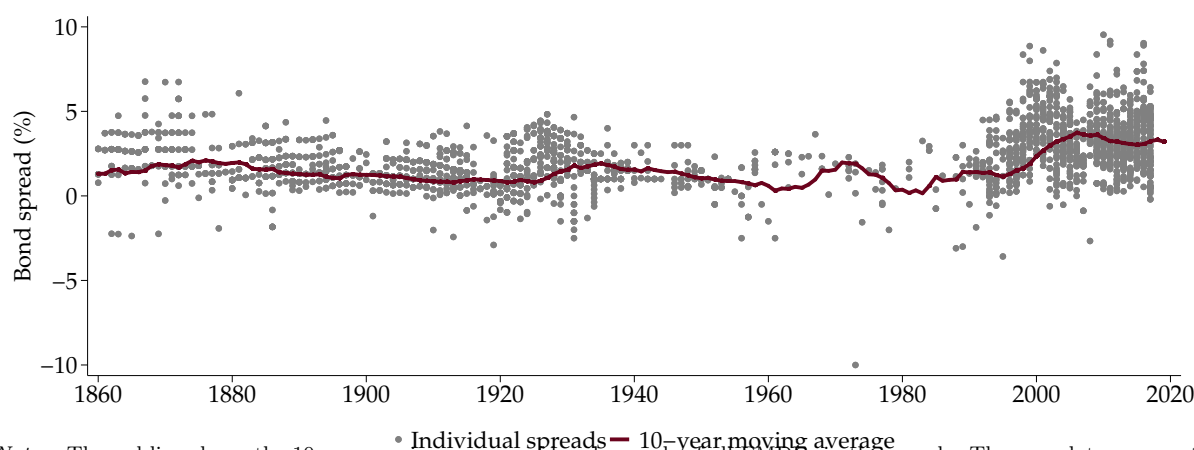
One advantage of our dataset is that it allows to trace the costs of debt issuance for sovereigns over the very long run. To compute spreads above “safe” bonds, we focus on the subsample of fixed coupon bonds



issued in British pounds or US dollars.<sup>19</sup> Interestingly, the level of coupons and spreads on hard-currency external sovereign bonds are currently unusually high, at least in historical comparison. In the 2010s, the average bond spread at issuance has even been more than 1 percentage point higher than the historical average over the past 150 years. This modern-day “bond spread puzzle” is not easy to explain.

Figure 1.5 starts by showing the evolution of sovereign bond spreads since the first issuance boom in the 1860s. Bond spreads are computed by comparing issuance coupons to the US/UK long-term bond rate using the same currency and focusing on longer-term bonds. The dark red line represents the 10-year moving average of the bond spreads of individual bonds that are shown as grey dots. The figure clearly shows that the 10-year moving average began to climb in the early 2000s and has remained above historical levels ever since.

**Figure 1.5:** 10-year moving average of hard-currency sovereign bond spreads



Notes: The red line shows the 10-year moving average of bond spreads of all EMDEs in the sample. The grey dots represent individual bond spreads. The bond spread of  $-10$  in 1973 belongs to Zimbabwe, which placed a bond with a coupon of 3%, significantly below the two-digit consol rate of the 1970s. The long-term US/UK bond rate data comes from the Bank of England, Global Financial Data and Historical Statistics of the United States.

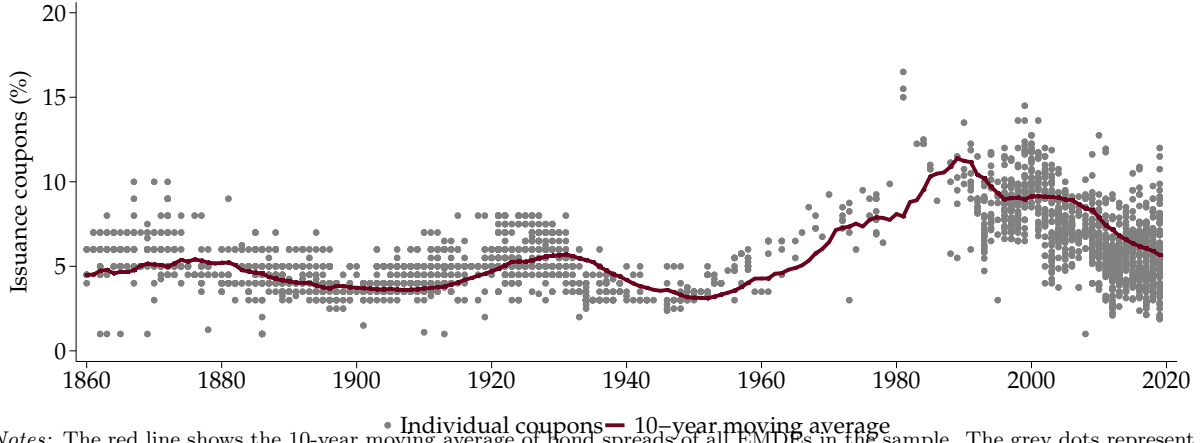
Figure 1.6 adds to this by showing that the raw coupons have also been unusually high in the past 30 years. Prior to World War II, coupons rarely surpassed 6 percentage points. This upper bound was shifted upwards markedly in the 1980s and 1990s when coupons on sovereign EMDE bonds surpassed 10 percentage points for a number of countries. On average, coupons hovered around seven to eight percentage points in the 2000s and five to six percentage points in the 2010s.

Appendix A.3.2 further explores these issues and reports various additional graphs, in particular by differentiating between bonds of new and old issuers, as well as dividing the data by regions and time. Furthermore, Table 1.1 the results of a statistical comparison of the differences between bond spreads of the modern bond period (1990-2019) and the historical eras WWI (1860-1913), interwar (1914-1945) and post WWII (1946-1970), respectively. As our data is not normally distributed, we use a Wilcoxon-

<sup>19</sup>By restricting the sample to US dollar and British pound issuances, we exclude 1,354 bonds from our external bond sample.

Mann-Whitney test to assess if bond spreads differ across eras. We find that in all three cases the null hypothesis (“equal distribution”) is rejected, suggesting that bond spreads in the past decades have been abnormally high.

**Figure 1.6:** 10-year moving average of US/UK bond coupons



*Notes:* The red line shows the 10-year moving average of bond spreads of all EMDEs in the sample. The grey dots represent individual bond spreads. The bond spread of  $-10$  in 1973 belongs to Zimbabwe, which placed a bond with a coupon of 3%, significantly below the two-digit consol rate of the 1970s. The long-term US/UK bond rate data comes from the Bank of England, Global Financial Data and Historical Statistics of the United States.

**Table 1.1:** Statistical difference of spreads across eras

	pre WWI vs. modern bond	interwar vs. modern bond	post WWII vs. modern bond
Mann-Whitney two-sample statistic	$z = -18.450^{***}$	$z = -17.882^{***}$	$z = -12.346^{***}$

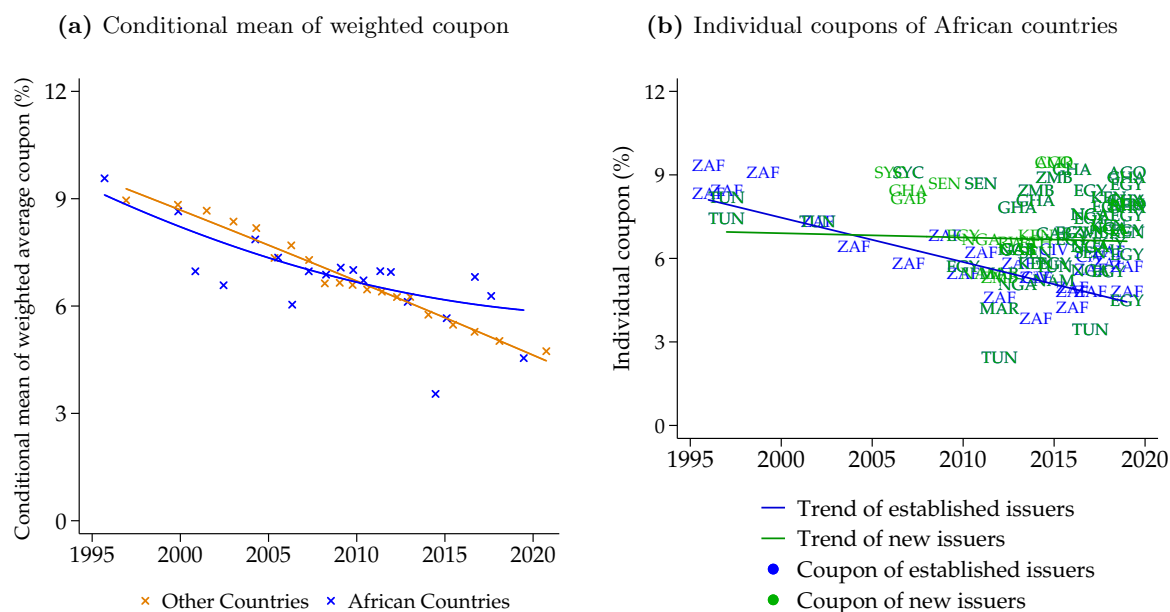
*Notes:* The table shows the  $z$ -scores of the Mann-Whitney two-sample statistic between the modern bond period and the three historical periods pre WWI, interwar and post WWII. Significance levels represent  $*p < 0.1$ ,  $**p < 0.05$ ,  $***p < 0.01$ , respectively.

The average coupon of five percentage points on EMDE US dollar sovereign bonds in recent years appears high when compared to the rapidly falling bond yields in advanced economies. Most large rich-country sovereigns now issue most of their bonds at coupons of zero accompanied by a decline in the world interest rate, a growing demand for safe and liquid instruments, as well as a global decrease in the growth rate of per-capita consumption (Del Negro et al., 2019).

Above we have seen that many African nations have been late entrants into international capital markets. This entrance of high-risk newcomers might explain part of the “high spread puzzle”. Figure 1.7 focuses on African bond issuances of the last 25 years and compares it to the rate of all other EMDEs. Specifically, Figure 1.7a plots the weighted average of African sovereign bond coupons over time. To control for time-invariant country-pair characteristics we show residuals from a regression of the respective series on country-pair fixed effects. The observations have been grouped into equally sized bins and the scatter plot shows the corresponding conditional means. The graph confirms that African sovereigns have issued bonds at higher coupons than other EMDEs, on average. While other EMDEs saw a continuous decline in average coupons over the past 30 years, African nations have experienced a slight increase in average

coupons during the 2010s. By 2019, the “Africa premium” amounted to 1.91 percentage points in interest above EMDE sovereign issuers from other continents.

**Figure 1.7:** Coupons of African countries since 1995



*Notes:* The two graphs show that bond issuances by African nations that have only recently tapped bond markets have been the driver of the persistently high 10-year average coupon among African nations. Figure 1.7a shows the weighted average of hard-currency coupons over time. To control for time-invariant country-pair characteristics, the graph shows the residuals resulting from a regression of the respective series on country-pair fixed effects. The observations have been grouped into equally sized bins and the scatter plot shows the corresponding conditional means. The right plot compares the coupon of established market participants (i.e. African countries that have tapped international capital markets before 1995), which are displayed in blue, to the coupons of new market entrants, which are green. The green and blue line show the coupon trend over time for the two groups.

To shed more light on the variation of sovereign coupon rates across countries, Figure 1.7b focuses on Africa and differentiates between issuances of newcomers and established issuers, i.e. those that had placed a bond prior to 1995. Established issuers are highlighted in blue, while issuances of new market participants are highlighted in green. The corresponding lines show the trend of both groups over time. As can be seen, the trend line of new market participants lies significantly above the line of established market participants. New entrants face a coupon of 7.3%, on average. These newcomers are the main driver behind the increase in the average coupon of African sovereigns since the mid 2000s.

**Stylized Fact 3: Countries’ reaccess to international capital markets after default is faster today than it was in the past**

In this section, we trace sovereign market access over very long periods of time. Specifically, we present issuance patterns by country across 200 years and take a particularly close look at the reaccess time after default spells. We find that the time to reaccess international capital markets after exiting a default has dropped considerably over the course of history. In the past two decades, it took defaulting governments

less than five years, on average, to tap markets post-default.

To measure sovereign default periods with private international creditors, we use data by Asonuma and Trebesch (2016) and Horn et al. (2020), which builds on the Standard & Poor's definition of default as the failure to meet a principal or interest payment on the due date (or within the specific grace period) or the restructuring of claims at a loss. To define market access, we follow Cruces and Trebesch (2013) and code years in which a sovereign places a bond in the international market as access years (we exclude bonds issued in the wake of restructuring operations).<sup>20</sup> While our main focus is on international bonds, we also consider international syndicated loans in the 1970s and 1980s. Of course, the sovereign might voluntarily abstain from tapping international markets. Market reaccess as measured here will thus be driven by both demand and supply factors. In line with Cruces and Trebesch (2013) we then measure time to reaccess as the number of years between the exit from default (the year of the “final” restructuring that brings the default spell to a close) until the first new sovereign debt instrument is issued in international markets.<sup>21</sup>

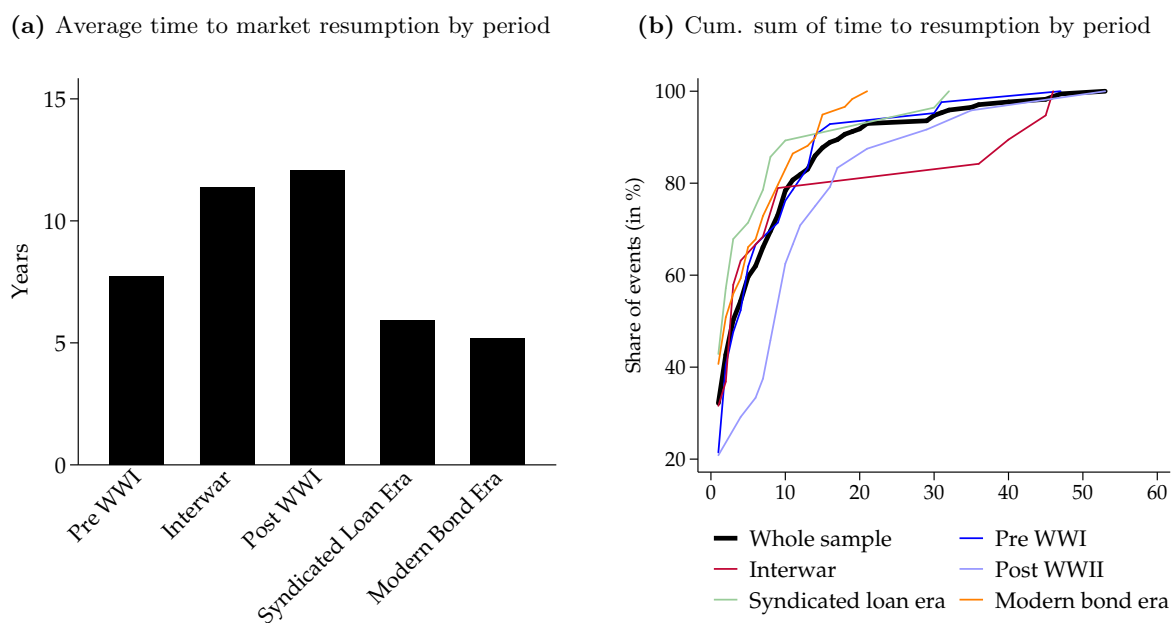
We start our analysis with Figure 1.8a, which plots the average time to market resumption following defaults in different eras - pre World War I (1815-1914), interwar (1918-1939), post World War II (1946-1970), the syndicated loan period of the 1970s and 1980s, and the modern bond period 1990-2019. To assign individual cases to the respective periods, we define the year of the end of the default episode as the reference year. For example, when a default period ends in 1950 and the resumption occurs in 1980, then the time until resumption is assigned to the post war period.

The graph shows that the mean average time to resumption of EMDEs after default increased from 7.7 years before the first World War to 11.4 years during the interwar period before dropping to 5.6 years for defaults ending in the 1970s or 1980s, and to 5.2 years, on average, in recent decades (since the 1990s). Figure 1.8b presents a different way of summarizing the data, namely as cumulative share of time to resumption. The share of events by time to resumption (x-axis) climbs the fastest during the modern bond era, followed by the syndicated loan era, the interwar period, and the post WWI era, thus confirming the finding of Figure 1.8a.

In Figure A.13a and Figure A.13b in Appendix A.3.3 we show results when counting the years to resumption from the beginning (instead of the end) of a default. This results in much longer exclusion spells.

<sup>20</sup>Note that the IMF defines market access as “the ability to tap international capital on a sustained basis through the contracting of loans and/or issuance of securities across a range of maturities, regardless of the currency denomination of the instruments, and at reasonable interest rates.” as written in the Staff Guidance Note for Public Debt Sustainability Analysis in Market Access Countries of 2013.

<sup>21</sup>Gelos et al. (2011) measure reaccess as the years from the start of default rather than from its end point. Another difference between our dataset and theirs is that they include private sector loans guaranteed by the sovereign, which shortens reaccess time. Despite the differences in the approach, our results are fairly comparable to Gelos et al. (2011), at least when restricting our analysis to their 1980-2000 sample.

**Figure 1.8:** Market access after default: Time to resumption across time and space

*Notes:* The left plot shows five bars that represent the average time to market access after default split by five eras: Pre WWI, interwar, post WWII, syndicated loan period, and modern bond period. Time to resumption during the syndicated loan era considers the issuance of syndicated bank loans. The last year of a default episode was used as a reference year for era allocation. The right plot shows the cumulative number of resumptions by time to resumption for the whole sample (thick black line) and the five eras pre WWI, interwar, post WWII, syndicated loan period, and modern bond period.

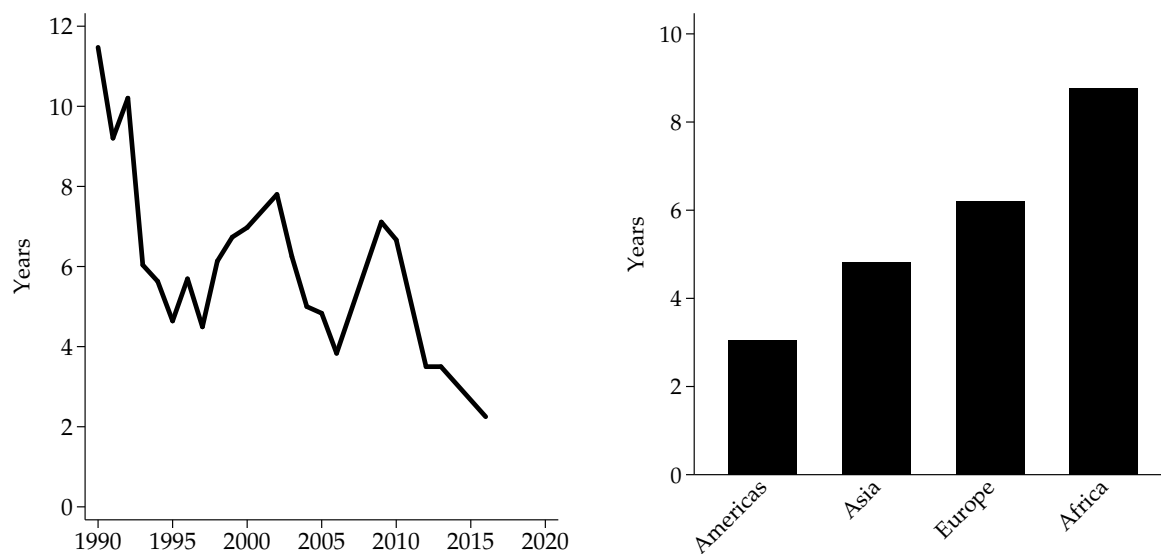
In a next step, we focus on market re-access in the past decades. Figure 1.9 shows that, since 1990, the time to market resumption has declined notably, to less than 5 years in the 2010s (Panel A). Furthermore, we show that market reaccess is quickest for Latin American countries (3 years on average) and most delayed for African countries (9 years on average, Panel B).<sup>22</sup> Even when excluding the outliers (Nigeria and Egypt) the average for Africa remains high. Also Eastern-European countries show above-average exclusion times, driven upwards by e.g. Bosnia (21 years), or Albania (15 years).<sup>23</sup>

<sup>22</sup>Tables A.11-A.18 in Appendix A.3.4 show the underlying data in detail.

<sup>23</sup>Appendix A.3.3, Tables A.8-A.10 show the average time to resumption after the end of a default period as well as the total number of defaults by country and time period (pre WWI, interwar, syndicated loan, modern bond). Again, the tables highlight the comparably long average time to resumptions for countries issuing during the modern bond period.

**Figure 1.9:** Modern bond era (1990-2019): Duration of market reaccess over time and by region

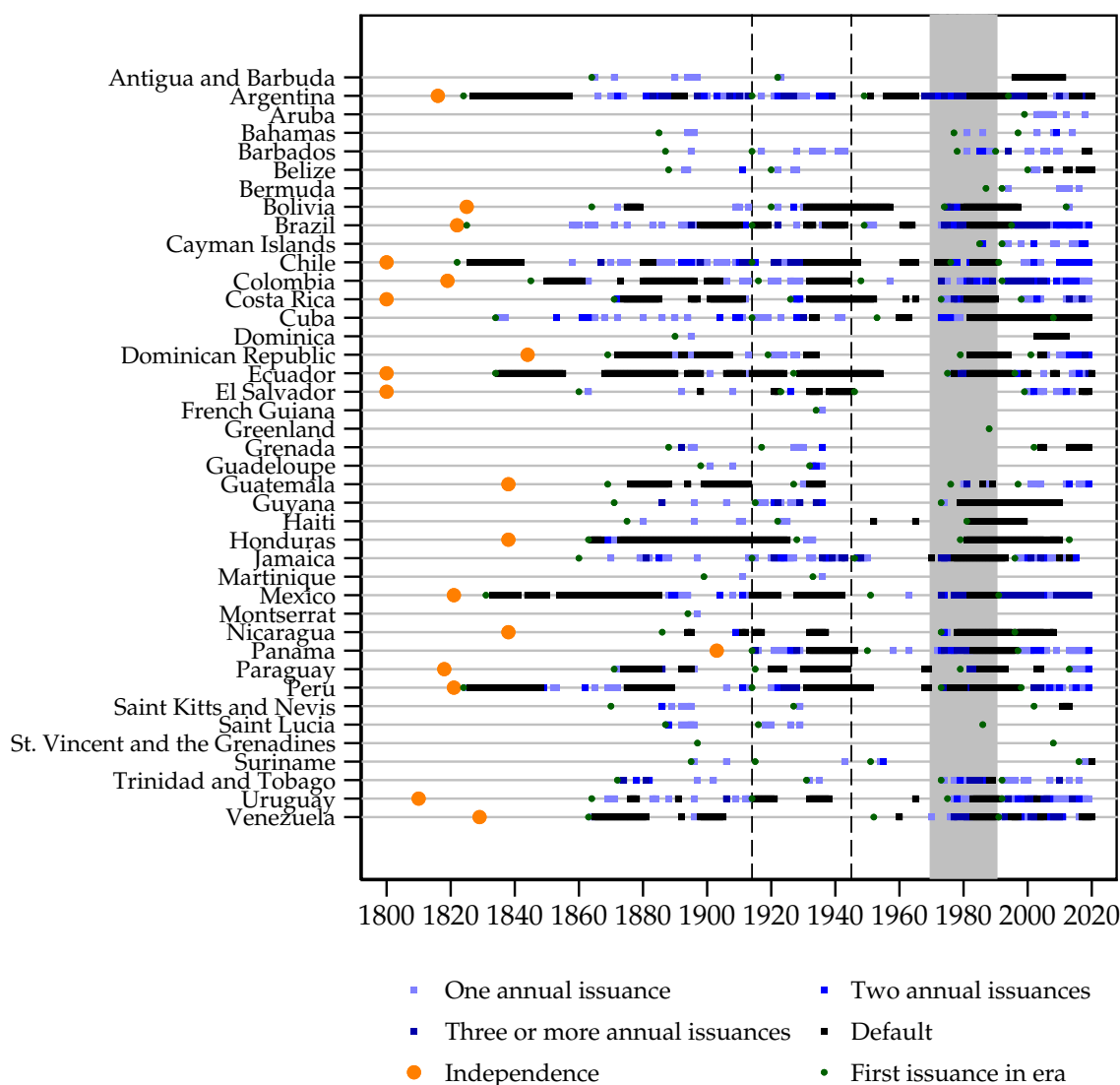
(a) Average time to market resumption post-default      (b) Average time to market resumption by region



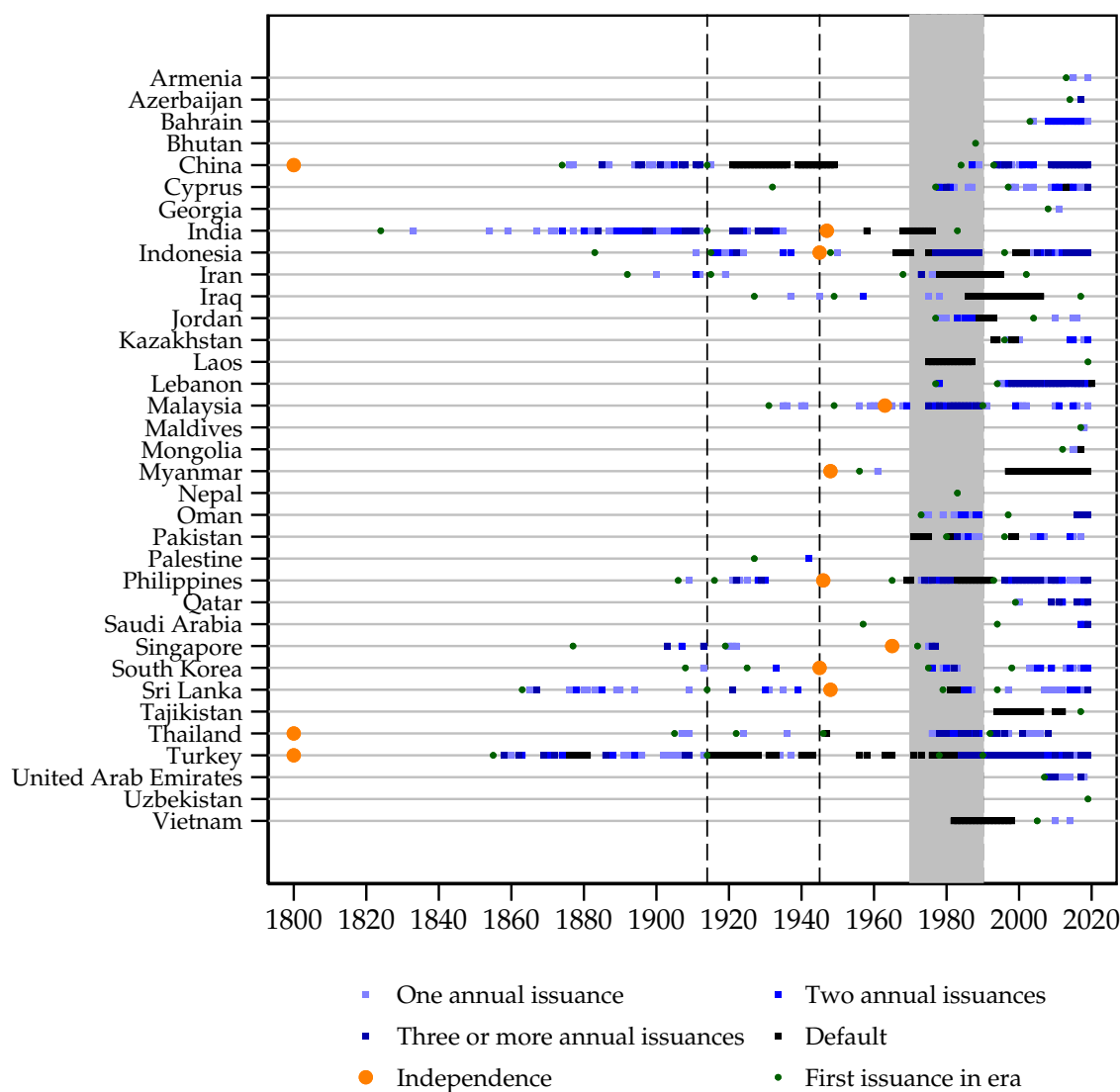
*Notes:* The left plot shows the 5-year moving average of the time to resumption (measured by the last year of default). The line ends in 2015 as we sort observations by default exit year, with Ukraine in 2015 being the last observation. The right graph shows average time to market access after default for four world regions: Europe, Asia, Americas and Africa.

In a final step, we plot defaults and issuance periods by country in Figure 1.12-1.13 and also in table format in Tables A.11-A.18.<sup>24</sup> As can be seen some sovereigns, in particular large countries such as Argentina, Brazil, China, Peru, Russia, South Africa and Turkey enjoyed near continuous access to international capital markets over the past 200 years, at least when they were not in default. The exercise also confirms that African nations take the longest to reaccess capital markets after default. By 2019, many African sovereigns continue without market access and have not tapped external markets since the crises of the 1970s and 1980s.

<sup>24</sup>Figure A.14-A.17 in Appendix A.3.3 mirror Figure 1.12-1.13 but put special emphasis on exclusion periods highlighted in red.

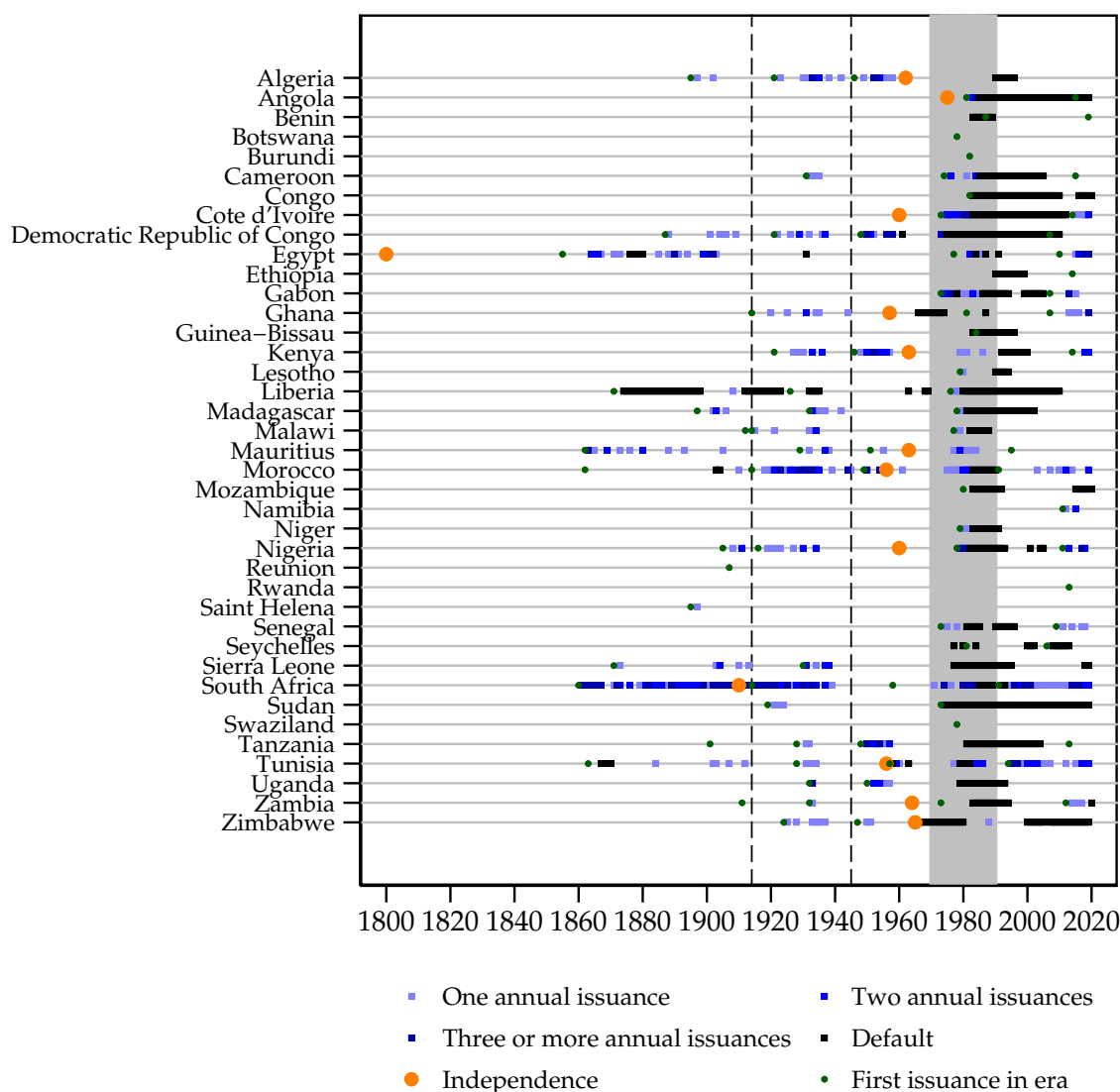
**Figure 1.10:** Latin America: international debt issuance and defaults since 1800

*Notes:* The graph shows issuances (blue dots) and defaults (black) dots for American nations. The lighter the blue, the fewer the number of issuances that were placed in a given year. Green circles represent the countries' first issuance in international capital markets in a given era (pre WWI, interwar, post WWII, syndicated loan or modern bond) and orange circles represent the year of independence (whenever applicable). The grey bar represents the 1970s and 1980s which are mainly dominated by syndicated loan issuances. Dashed vertical lines represent the start and the end of the interwar period (wars included). Years in which countries issued and a default took place, the plot shows a black dot indicating that the country was in default in that particular year. Data on colonial independence comes from Reinhart and Rogoff (2009).

**Figure 1.11:** Asia: international debt issuance and defaults since 1800

*Notes:* The graph shows issuances (blue dots) and defaults (black) dots for Asian nations. The lighter the blue, the fewer the number of issuances that were placed in a given year. Green circles represent the countries' first issuance in international capital markets in a given era (pre WWI, interwar, post WWII, syndicated loan or modern bond) and orange circles represent the year of independence (whenever applicable). The grey bar represents the 1970s and 1980s which are mainly dominated by syndicated loan issuances. Dashed vertical lines represent the start and the end of the interwar period (wars included). Years in which countries issued and a default took place, the plot shows a black dot indicating that the country was in default in that particular year. Data on colonial independence comes from Reinhart and Rogoff (2009).



**Figure 1.12:** Africa: international debt issuance and defaults since 1800

*Notes:* The graph shows issuances (blue dots) and defaults (black) dots for African nations. The lighter the blue, the fewer the number of issuances that were placed in a given year. Green circles represent the countries' first issuance in international capital markets in a given era (pre WWI, interwar, post WWII, syndicated loan or modern bond) and orange circles represent the year of independence (whenever applicable). The grey bar represents the 1970s and 1980s which are mainly dominated by syndicated loan issuances. Dashed vertical lines represent the start and the end of the interwar period (wars included). Black dots indicate that a country was in default in that particular year. Data on colonial independence comes from Reinhart and Rogoff (2009).

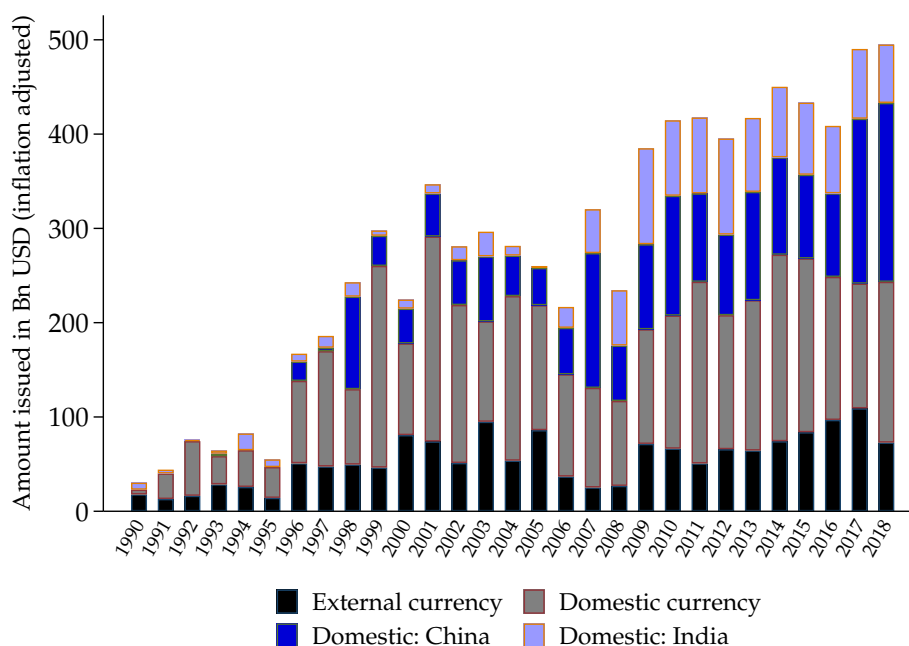


#### Stylized Fact 4: Local-currency bonds have become a main EMDE asset class

Since the mid-1990s, domestic currency sovereign bond issuances have increased fourfold, making local-currency bonds a main emerging market asset class that has surpassed foreign-currency bond issuance. This rise of domestic debt markets has been beneficial for many EMDEs, not least because of the reduction of currency mismatches (Hofmann et al., 2020).

Figure 1.14 quantifies the annual volume in EMDE sovereign bonds issued in domestic currencies and sets them in relation to issuances made in external currencies. Given the discussion on “original sin”, the graph focuses on medium- and long-term bonds defined as those with maturities of more than four years. We find that both external and domestic currency issuances have increased markedly since 1990, but domestic markets have boomed even more.<sup>25</sup> India and China were main drivers of the domestic debt issuance boom, but a pronounced rise in domestic issuance can be observed in EMDEs of Latin America, Africa and Eastern Europe as well. From a global perspective, the largest domestic issuers besides India and China are Mexico, Argentina and Brazil.

**Figure 1.14:** The rise of local currency bond markets



*Notes:* The graph plots the the real US dollar value of bonds issued in external and domestic currency with a term of more than four years. The domestic currency bar excludes China and India, which were added separately to highlight their enormous issuance sizes.

In Appendix A.3.5 we further show that Asian countries have the highest share of domestic currency issuances (see Figure A.18). In contrast, domestic issuances only constituted 4.1% of African nations’

<sup>25</sup>This finding is robust to using a different maturity cut-off, see Appendix A.3.5.

bond borrowing from 2015 to 2018.<sup>26</sup>

## 1.4 Conclusion

Data on sovereign debt is oftentimes error-prone, as existing commercial databases come with shortcomings such as missing values, selected samples and false entries. In this paper, we present the most comprehensive sovereign debt issuance database to date, which covers not only external bond (1815-2019) and syndicated loan issuances (1973-1989), but also domestic bond issuances (1990-2018). Using our granular bond-by-bond and loan-by-loan data, we have studied how and at what costs sovereigns have issued debt over the last 200 years. We have introduced four novel stylized facts of sovereign borrowing that can be summarized as follows:

First, we document the main sovereign debt issuance booms in history. Investors moved from external bond markets (pre WWI and interwar) to syndicated loan markets (eurocurrency credit era) and in recent years increasingly to domestic currency bond markets. While the UK was the predominant financial center in the 19th century, the US has become the dominant market place for international sovereign bond issuance since the 1920s.

Second, we have studied the costs of issuances, i.e. the interest rate (coupon) paid on newly issued sovereign debt. We find that, in historical comparison, the average coupon of EMDE external sovereign bonds has been unusually high in the 1990s, 2000s and 2010s. Despite negative interest rates on sovereign bonds in most advanced countries, many EMDEs continue to issue bonds with coupons above five percentage points, especially in Africa. As a result, during the 2010s, sovereign bond spreads were at historical highs. Future work should explore the drivers behind this “sovereign bond spread puzzle”.

Third, we have studied market re-access after defaults on the country level. The time until market resumption after default has fallen markedly since the end of World War II, as countries often tap international markets quickly after exiting a debt crisis.

Aside from the external bond market boom, domestic currency markets have become important issuance places for EMDE sovereigns. Since 1990, 107 countries have issued debt in domestic markets, placing more than 97% of their total bond financing there, on average. While external currency markets have also increased in volume over the last 30 years, domestic currency markets have outpaced them both in volume and in frequency. There is little indication that the boom in domestic bond markets in EMDEs will come to an end soon. On the contrary, we can expect more countries to issue their bonds domestically and potentially also default on them in times of distress.

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<sup>26</sup>Out of 58 African nations, 20 have been active in external and 37 in domestic currency markets between 1990 and 2018, inclusive.

# Appendix Chapter 1

## A.1 Country coverage

Table A.1: Country overview by debt type and era

Aruba <sup>†§</sup>	Algeria <sup>§#σ</sup>	Lesotho <sup>§*</sup>	Romania <sup>†§#σ</sup>
Angola <sup>†§*σ</sup>	Ecuador <sup>†§*#σ</sup>	Lithuania <sup>†§#</sup>	Russia <sup>†§#σ</sup>
Albania <sup>†§#</sup>	Egypt <sup>†§*#σ</sup>	Latvia <sup>†§</sup>	Rwanda <sup>†§</sup>
Andorra <sup>†</sup>	Estonia <sup>†§#</sup>	Morocco <sup>†§*#σ</sup>	Saudi Arabia <sup>†§*#</sup>
Netherlands Antilles <sup>§</sup>	Ethiopia <sup>†</sup>	Moldova <sup>§</sup>	Sudan <sup>*#</sup>
United Arab Emirates <sup>†§*</sup>	Fiji <sup>†§*#</sup>	Madagascar <sup>*#</sup>	Senegal <sup>†§*</sup>
Argentina <sup>†§*#σ</sup>	Faeroe Islands <sup>†§*#</sup>	Maldives <sup>†</sup>	Singapore <sup>§#σ</sup>
Armenia <sup>†§</sup>	Micronesia <sup>†</sup>	Mexico <sup>†§*#σ</sup>	Saint Helena <sup>#</sup>
Antigua and Barbuda <sup>§#</sup>	Gabon <sup>†§*</sup>	Marshall Islands <sup>†</sup>	Solomon Islands <sup>*</sup>
Azerbaijan <sup>†§</sup>	Georgia <sup>†§</sup>	Macedonia <sup>†§#</sup>	Sierra Leone <sup>§#</sup>
Burundi <sup>§*</sup>	Guernsey <sup>†</sup>	Mali <sup>§</sup>	El Salvador <sup>†§#σ</sup>
Benin <sup>†§*</sup>	Ghana <sup>†§*#σ</sup>	Malta <sup>§</sup>	San Marino <sup>§*</sup>
Burkina Faso <sup>§</sup>	Gibraltar <sup>†*</sup>	Myanmar <sup>§#σ</sup>	Yugoslavia <sup>†§*#</sup>
Bangladesh <sup>§</sup>	Guadeloupe <sup>#</sup>	Montenegro <sup>†§</sup>	Suriname <sup>†#</sup>
Bulgaria <sup>†§</sup>	Gambia <sup>§</sup>	Mongolia <sup>†§</sup>	Slovak Republic <sup>†§</sup>
Bahrain <sup>†§*</sup>	Guinea-Bissau <sup>*#</sup>	Mozambique <sup>†§*</sup>	Slovenia <sup>†§</sup>
Bahamas <sup>†§*#</sup>	Grenada <sup>†§#</sup>	Montserrat <sup>#</sup>	Swaziland <sup>§*</sup>
Bosnia and Herzegovina <sup>†§</sup>	Guatemala <sup>†§*#σ</sup>	Martinique <sup>#</sup>	Seychelles <sup>†§*</sup>
Belarus <sup>†§</sup>	French Guiana <sup>#</sup>	Mauritius <sup>†§*#σ</sup>	Chad <sup>§</sup>
Belize <sup>†#</sup>	Guyana <sup>*#</sup>	Malawi <sup>§*#</sup>	Togo <sup>§</sup>
Bermuda <sup>†*</sup>	Honduras <sup>†§*#σ</sup>	Malaysia <sup>†§*#σ</sup>	Thailand <sup>†§*#σ</sup>
Bolivia <sup>†§*#σ</sup>	Croatia <sup>†§</sup>	Namibia <sup>†§</sup>	Tajikistan <sup>†</sup>
Brazil <sup>†§*#σ</sup>	Haiti <sup>*#</sup>	New Caledonia <sup>#</sup>	Tonga <sup>§</sup>
Barbados <sup>†§*#</sup>	Hungary <sup>†§*#σ</sup>	Niger <sup>§*</sup>	Trinidad and Tobago <sup>†§*#</sup>
Brunei <sup>§</sup>	Indonesia <sup>†§*#σ</sup>	Nigeria <sup>†§*#σ</sup>	Tunisia <sup>†§*#σ</sup>
Bhutan <sup>*</sup>	India <sup>§*#σ</sup>	Nicaragua <sup>†§*#σ</sup>	Turkey <sup>†§*#σ</sup>
Botswana <sup>§*</sup>	Iran <sup>†*#</sup>	Nepal <sup>*</sup>	Taiwan <sup>§#σ</sup>
Chile <sup>†§*#σ</sup>	Iraq <sup>†*#</sup>	Nauru <sup>*</sup>	Tanzania <sup>†§#</sup>
China <sup>†§*#σ</sup>	Jamaica <sup>†§*#</sup>	Oman <sup>†§*</sup>	Uganda <sup>§*#</sup>
Cote d'Ivoire <sup>†§*#σ</sup>	Jersey <sup>†</sup>	Pakistan <sup>†§*</sup>	Ukraine <sup>†§</sup>
Cameroon <sup>†§*#</sup>	Jordan <sup>†§*#</sup>	Panama <sup>†§*#σ</sup>	Uruguay <sup>†§*#σ</sup>
Democratic Republic of Congo <sup>†*#</sup>	Kazakhstan <sup>†§</sup>	Peru <sup>†§*#σ</sup>	Uzbekistan <sup>†§</sup>
Congo <sup>*</sup>	Kenya <sup>†§*#σ</sup>	Philippines <sup>†§*#σ</sup>	Saint Vincent and the Grenadines <sup>†§#</sup>
Colombia <sup>†§*#σ</sup>	Kyrgyz Republic <sup>§</sup>	Palau <sup>*</sup>	Venezuela <sup>†§*#σ</sup>
Cape Verde <sup>§</sup>	Saint Kitts and Nevis <sup>†#</sup>	Papua New Guinea <sup>†§*#</sup>	Vietnam <sup>†§</sup>
Costa Rica <sup>†§*#σ</sup>	South Korea <sup>†§*#σ</sup>	Poland <sup>†§#σ</sup>	Vanuatu <sup>§</sup>
Cuba <sup>†*#</sup>	Laos <sup>†</sup>	Puerto Rico <sup>*</sup>	Yemen <sup>§</sup>
Cayman Islands <sup>†#</sup>	Lebanon <sup>†§*</sup>	Paraguay <sup>†§*#σ</sup>	Yugoslavia <sup>*</sup>
Cyprus <sup>†§*#</sup>	Liberia <sup>*#</sup>	Palestine <sup>#</sup>	South Africa <sup>†§*#σ</sup>
Czech Republic <sup>†§</sup>	Libya <sup>*</sup>	French Polynesia <sup>†</sup>	Zambia <sup>†§*#σ</sup>
Dominica <sup>#</sup>	Saint Lucia <sup>§*#</sup>	Qatar <sup>†§*</sup>	
Dominican Republic <sup>†§*#σ</sup>	Sri Lanka <sup>†§*#σ</sup>	Reunion <sup>#</sup>	

Notes: The table provides an overview on all 165 countries in the sample. † refers to sovereigns that have issued at least one bond in international capital markets since 1990, § refers to the domestic bond market, \* to the syndicated loan market and # to international capital markets in history. σ labels countries that used to be colonies in history (according to Reinhart and Rogoff (2009)).

## A.2 Methodological approach and assumptions

In this section, we describe our methodological approach and the assumptions made in this paper in detail.

### A.2.1 Details on defining external and domestic sovereign bond markets

In Section 1.2.3 we have described a multi-step approach to differentiate between external and domestic capital markets. The reasoning behind this approach is twofold. First, the literature on external and domestic debt remains inconclusive about a definite classification of bonds issued in external or domestic markets. So far, three kinds of classifications have been primarily applied: Differentiation by (1) currency, (2) governing law, or (3) actual bond holders.<sup>1</sup> The first definition has found weak applicability in recent years as the problem of “original sin”. Option (2) comes with the issue that it is rarely reported, and option (3) is a dynamic factor that may change over time.

One first step towards a solution to these issues is to split the dataset into a historical (pre 1970) and a modern period (post 1990).<sup>2</sup> We do so as the applicability of different classifications has changed quite strongly over time.

As our data providers for the historical bond era hardly ever mention the bonds’ underlying governing law, (2) is barely applicable for the historical bond period. The same is true for (3) (the bond holders) as our dataset provides information on time invariant debt characteristics. At the same time, information about the issuance place is available only for a limited amount of bonds. Even in the case that this variable is available, several issuance places are often mentioned. As issuance volumes cannot be attributed to different issuance places in most cases, solely relying on the issuance place to define capital markets would be insufficient. Instead, we proceed as follows:

In history, every bond came with an “obligation”, i.e. a name, which already revealed some information about the bond’s characteristics. E.g. the bond “4.5% Bond of 1850, due 1901” provides us with information on the coupon (4.5%), its issue year (1850) and its expected maturity year (1901). We consider the obligation to be highly reliable as it served as unique identifier during the historical period (similar to an ISIN today). Hence, whenever the obligation says that a bond was issued domestically, we exclude the bond from our historical dataset.

As information about whether the bond was issued internally or externally is only provided for roughly 10% of the bonds, we have employed another measure of identification: the currency of issuance. For

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<sup>1</sup>E.g. see Panizza (2008) for an overview.

<sup>2</sup>When we analyze 200 years of sovereign bond issuances, we reinclude the bond period 1970-1989 again, using the data from our historical sources to which we add bond information from the modern bond database for countries that the historical database does not cover.

the most part, bonds that were issued internationally were denominated in the currency of their issue place, e.g. a bond was issued in US dollar if it was issued in the US market. Additionally, if a bond was not issued in the currency of the financial center it was hardly ever issued in the sovereigns' domestic currency (Eichengreen and Hausmann, 1999).

For the modern period, we have obtained data on both external and domestic sovereign bonds. In contrast to the classification of debt in the historical bond period, the classification in the modern bond period is more complicated and therefore demands a more sophisticated classification rule. Nowadays it is much more common that bonds are issued in currencies other than the US dollars in international capital markets.<sup>3</sup> Additionally, the term "issuance place" has become even more ambiguous with the introduction of international clearing houses like Clearstream or Euroclear. Hence, we depart from the definition used for the historical period and have created the following decision rule instead:

First, we take a look at the currency composition of emerging market sovereigns in international and domestic bond markets. We find that the US dollar has been the prevalent issuance currency ever since EMEs started issuing internationally. However, other currencies have started to pick up (e.g. see also Hale et al. (2016)). In 2018, the share of domestic currency issuances in international capital markets almost reached 15%. Hence, classifying bonds into international and domestic issuances using solely the currency of issuance as an identifier would lead to the misclassification of issuance places of a large part of the bonds in our database.

The second definition assumes that international debt is issued under foreign law in international markets and domestic debt is issued in domestic markets under domestic law. Due to limited information on the bonds' governing law, solely relying on this variable as an identifier would lead to the exclusion of more than 20% of observations from our dataset. An additional source of bias that would arise if we relied solely on the governing law is based on the problem that Refinitive Eikon seems to copy the domestic governing law from the country of issue.

Lastly, looking at the supposed holders of a country's debt is also problematic as many countries do not track the final holders of their debt on a regular basis e.g. due to capacity limitations or offshore holdings (see Panizza (2008)).

As the three options mentioned above are full of shortcomings (1 and 2) or lack applicability (3), applying them separately would result in limited data coverage as well as in misclassifications. Hence, we have decided to apply (1) and (2), and combine them with additional information provided by the data providers we use. We found that this combination leads to the the highest possible credibility of our data while resulting in minimal misclassification errors.

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<sup>3</sup>This is, however, not often the case.

By following our decision rule, we are able to systematically assign every bond in our dataset to one of the two markets. Overall, our approach most closely resembles the definition used by the Bank of International Settlement (BIS) that employ data from Dealogic, Euroclear, Thomson Reuters and Xtrakter. The BIS define the market of issue using the bond's ISIN, the listing place and the governing law. We abstain from using the listing place in our analysis for two reasons: First, the listing place is missing for most bonds in our dataset. Second, whenever the listing place is not missing, several locations, which can be domestic or foreign, are often listed. Another difference between the BIS's definition and ours is that the BIS defines a debt security as international if at least one characteristic can be characterized as external. In contrast, we only classify debt securities as domestic if we cannot rule out that they are external.

## A.2.2 Country coverage of the modern bond sovereign bond database

Our bond dataset covers 156 emerging and developing economies that have issued a sovereign bond internationally over the last 30 and/or domestically over the last 29 years. After cleaning and merging the data from Refinitive Eikon, Bloomberg and Dealogic, and after excluding advanced countries, 28 countries were omitted from our external bond dataset. These countries are Afghanistan, Andorra, Netherlands Antilles, Brunei Darussalam, Central African Republic, Congo, Cook Islands, Curaçao, Dominica, Guadeloupe, Equatorial Guinea, Isle of Man, Libya, Saint Lucia, Macao, Maldives, Mauritania, Nepal, Nauru, Puerto Rico, Solomon Islands, Sint Maarten (Dutch part), Turks and Caicos Islands, Tonga, Virgin Islands (British), Virgin Islands (U.S.), Vanuatu, Yemen.

Most of these countries entered our dataset via Bloomberg and the reason for their exclusion is that most of these countries issued bills only.<sup>4</sup> As we exclude bills from our bond dataset, these countries were omitted as well.

Among all 156 countries, 32 countries issue only external sovereign bonds. In contrast, 24 countries issue domestic bonds only, according to our definition of external and domestic sovereign bond markets.<sup>5</sup>

A total of 31 countries were not covered by any of our data providers at the date of download.<sup>6</sup> To obtain a better understanding why we are missing these 31 countries, we compared our country list with the countries provided by the BIS's debt databases. We found that the BIS database additionally covers Haiti and Sudan. Neither of these countries could be found among our Dealogic, Refinitive Eikon or Bloomberg data; hence it remains unclear why the BIS reports issuances for these countries while Dealogic, Refinitive

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<sup>4</sup>These include Afghanistan, Netherlands Antilles, Brunei, Central African Republic, Congo, Equatorial Guinea, Saint Lucia, Madagascar, Mauritania, Nepal, Yemen.

<sup>5</sup>If we ignored the data sources' market type variable and instead applied a much less strict definition of external and domestic capital markets, the databases change as follows: By solely using the first two letters of the ISIN, we would assign 21,981 more bonds as external. If we went solely by the currency of issuance, we would assign 1,525 additional bonds as external, and 203 more bonds as domestic.

<sup>6</sup>Please not that the data coverage of Eikon, Bloomberg, and Dealogic may change in the future (relative to the point of downloading).



Eikon and Bloomberg do not.

### A.2.3 Country coverage of the loan database

Our final dataset covers 991 bank loans granted to 92 EMDE sovereigns between 1973 and 1989, comprising 833 syndicated and 158 single bank loans. Initially, we started off with 141 EMDE governments that engaged in a total of 3,063 loan agreements between 1973 and 2013. We exclude all observations with missing information on the year, the loan volume, or the term, short-term loans defined as having a maturity of less than one year, cancelled or withdrawn deals, loans extended by international development organizations or bilateral loans. 322 observations are dropped this way and 20 countries leave our sample. These are Afghanistan, Albania, Antigua, Azerbaijan, Bangladesh, Belarus, Ethiopia, Croatia, Kazakhstan, Kyrgyzstan, Kuwait, the Marshall Islands, French Polynesia, Sierra Leone, Chad, Tanzania, Ukraine, Vietnam and Yemen.

We further restrict our loan sample to the period between 1973 to 1989 as the Brady Plan agreements, which were completed during the international debt crisis, marked the transition from loan to bond financing in developing countries.<sup>7</sup> This leads to an additional omission of 1,684 observations and 30 countries. These countries are Armenia, Burkino Faso, Bulgaria, Bosnia And Herzegovina, Belize, Brunei Darussalam, Cape Verde, Djibouti, Algeria, Georgia, Guinea, Gambia, Grenada, Kuwait, Moldova, the Maldives, Macedonia, Mali, Montenegro, Mauritania, Namibia, Palestine, Romania, Russian Federation, Rwanda, South Sudan, Tajikistan, Turkmenistan, Uzbekistan and the Virgin Islands.

#### Data providers: The international loan market

##### World Bank

The World Bank data comes with information on the participating banks, the name of the guarantor and sometimes even reports fees. Overall, however, the data is restricted to a limited number of variables such as the country, borrower, sector, creditors, interest rate spreads, amounts committed<sup>8</sup>, and the year and month in which the credit was announced or signed.

*Sector classification.* Our focus lies on the borrowing behavior of sovereigns. Hence, we only consider loans granted to the central government, the central bank, federal ministries or subordinated agencies but ignore loans granted to local authorities and those guaranteed by the central government. From 1976q3 onwards, information on the sector is provided in the reports. Before that (1973-1975), we rely on information from repeated borrowers when available and assign the remainder by searching for the borrowers website and publicly available resources.

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<sup>7</sup>The trend becomes evident when looking at the number of deals. From its peak at 104 deals in 1981 they drop to 17 in 1990.

<sup>8</sup>In contrast to disbursed amounts.

*Dates.* In order to assign an issuance date to each loan, we include information on the month and year the credit was announced or signed. The loan’s term provides us with information on the expected year of maturity. Given all reports, information on the month of issuance is available for all sovereign loans. The term of the loan is provided for 94.6% of the initial data sample.

*Amounts.* The issuance amounts are reported in local currency and US dollar equivalents converted at end-of-month exchange rates. The amounts reflect the original commitment at the time the credit was signed or announced. Neither amendments nor alterations to the deals are considered, nor are actual drawings from the commitments. For simplicity, we assume that the whole amount is drawn in the same month that the credit was signed.<sup>9</sup> Many agreements have multicurrency options attached to grant flexibility to the borrower, but the data does not provide more specific information on this issue.<sup>10</sup>

*Interest rates.* Interest rates of syndicated loans are given as spreads above the LIBOR in most cases. Spreads are available for roughly 91% of all sovereign loans. Interest rates are expressed as the spread between the average interest rate offered to individual banks and a reference index, the LIBOR in most cases. This results from the possibility that different banks might have been offered different rates in the course of the loan negotiation. One caveat of the interest data is that no information is provided on the interest period, i.e. the intervals of interest payment. Given, however, that we are working with a yearly frequency, this did not influence our results.

## **Dealogic**

Dealogic starts reporting loans from the 1980s onwards. Its variables come with more granular information on loans than it is the case for the World Bank reports. Dealogic covers not just information on the dates and terms of the loans, but also on individual and average interest rates, contract clauses (e.g. cross-default clauses). Additionally, the data also covers information on repayment frequencies and loan fees. Every entity that was involved in the loan is listed. This includes guarantors and their sector, banks distinguished by their role in the loan agreement (lenders, mandated arrangers, bookrunners) and their parents and nationalities.

*Sector classification.* Dealogic provides a variable (“borrowertype”) to identify sovereign loans. Although the criteria are the same as for the World Bank data, we control for systematic differences between the datasets to allow for consistency between the sources.

*Dates.* Dealogic reports the date on which the deal was signed. Similar to the World Bank reports, we assume that the whole amount of a tranche was drawn on the credit date. In case information is missing (e.g. the maturity date or the issuance date) we make use of the term to calculate the missing

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<sup>9</sup>In most cases, banks offer a period up to one year during which the amounts can be drawn, however, drawings are often subject to minimum amounts and fees may be charged if amounts remain undisbursed.

<sup>10</sup>For confidence purposes, we compare our data to similar studies on the aggregate level (see Stallings (2018)) as well as on the loan-level (see Tomz and Wright (2005)).

observations.

*Amounts.* Dealogic provides variables for the tranche as well as the credit amount in US dollar, euro and in the currency of denomination. Given the characteristics of individual tranches, we proceed with the tranche structure without aggregation on the credit level and convert all missing US dollar amounts from one currency to US dollar using daily exchange rates taken from Refinitive Datastream.

*Interest rates.* Similar to the World Bank reports, interest rates are defined as the spread over an underlying base index, which in most cases is the LIBOR. Moreover, Dealogic provides information on the average and individual spreads and the base. If a loan agreement includes two base indices, we stick to the more common one (i.e. we give preference to the LIBOR over local indices).

*Banks.* The Dealogic data provides more detailed information on the participating banks than the BICM reports. In particular, the database distinguishes between leadbanks, lenders, bookrunners, leadarrangers. Moreover, it indicates the corresponding parent companies' names and nationalities. The coverage is high (more than 80%) for variables such as lender, arranger and leadbank, but at the same time low for bookrunners (22%). To classify syndicated loans we use information on the lenders and define a loan as syndicated if more than one lender is involved. Throughout the 1980s, the share of syndicated loans among the sovereign loan data ranged between 75% and 90%.

**Table A.2:** Overview syndicated loans

	Dealogic Loanware	World Bank	Merged
	Initial dataset		Final dataset
	All maturities	Maturity >1 yr	Maturity >1 yr
	All loan types	eurocurrency loans	Sovereign loans
	Separated in tranches and loans	Separated by commitment	Syndicated and single-bank
	Syndicated and single-bank	Syndicated and single-bank	
Years	1980-2013	1973-1981	1973-1989
# Observations	12,796	2,498	997
Countries covered	155	97	92
Sovereign	2,576	497	2,030
Local / State authority	589	76	-
Corporate	9631 <sup>11</sup>	1,925 <sup>12</sup>	-

*Notes:* The table provides an overview on syndicated loans collected from Dealogic and the World Bank. The last column shows the data covered after merging and cleaning the two datasets.

### Country break-ups, mergers, and former colonies

To guarantee the identification of a bond's issuing country, we have assigned iso3c codes to all bonds in our dataset. We developed the following approach to assign iso3c codes to countries that experienced break-ups, mergers or gained colonial independence and therefore do not have a single iso3c code over the

entire time period:

### Country break-ups and country mergers

To handle country break-ups and country mergers in our dataset, we follow conventional practice of investor manuals and financial reports and assign the bonds of a country that experienced changes with regard to its borders to the respective successor state(s).

**Table A.3:** Overview on country break-ups, mergers, and former colonies

Country	Country break-ups	Country mergers	Former colonies	Sources	Period
Argentina		Entre Rios, Santa Fe, Buenos Ayres		R, L, M, F	1824-1968
Belize			British Honduras	L, M	1888-1928
British East Africa			British East Africa	M	1950-1957
Colombia		Gran Colombia		R, L, M, F	1822-1957
Democratic Republic of the Congo			Belgian Congo	M	1887-1958
Dominican Republic		Santo Domingo		R, L, M, F	1869-1928
French Equatorial Africa			French Equatorial Africa	M	1909-1944
French Indo-China			French Indo-China	M	1896-1944
French West Africa			French West Africa	M	1903-1937
Ghana			Gold Coast	R, L, M	1900-1944
Guyana			British Guiana	R, L, M, F	1871-1956
Hungary	Austria-Hungary (Kingdom Hungary)			R, L, M, F	1868-1931
Indonesia			Dutch East Indies	R, L, M	1883-1959
Iran	Persia			M	1892-1968
Malawi			Nyasaland Protectorate	L	1912-1934
Myanmar			Burma	L, M	1931-1968
Nigeria			Southern Nigeria	R, L, M	1905-1950
Singapore			Straits Settlement	R, L, M	1877-1968
South Africa		Cape of Good Hope, Natal, Orange Free State, Orange River Colony, Transvall		R, L, M, F	1860-1958
Sri Lanka			Ceylon	R, L, M, F	1863-1954
Surinam			Dutch Guyana	L, M	1895-1967
Tanzania			Tanganyika, Zanzibar	R, L, M	1901-1957
Trinidad and Tobago			Trinidad, Tobago	R, L, M	1872-1948
Turkey	Ottoman Empire			R, L, M, F	1854-1940
Yugoslavia		Serbia, Montenegro		R, L, M	1881-1938
Zambia			Northern Rhodesia	L, M	1911-1959
Zimbabwe			Southern Rhodesia	R, L, M	1924-1959

*Notes:* The table provides an overview on country break-ups, mergers, and former colonies for all countries in the sample that experienced any of the three between 1815 and 1969. The source abbreviations R, L, M, F stand for Meyer et al. (2019), London Stock Exchange Yearbooks, Moody's Manual of Investments, and Fenn's Compendium, respectively. With regard to the modern bond period data and their sources, we assigned Yugoslavian bond issues to Serbia to guarantee consistency across time.

## A.2.4 Merging and cleaning the modern bond data

In this subsection, we explain in detail how we have merged and cleaned the data for the period from 1990 (modern bond era).

### Validating and classifying external bonds

To minimize coding errors and to achieve greater accuracy we manually validate each external bond across all sources that are available to us. The main aim of this exercise is to drop (i) duplicates, (ii) bonds that are erroneously classified as external bonds but are actually domestic and (iii) bonds that are not sovereign (issued by the central government). These bonds include strips, i.e. coupons that are traded separately from the principal and which are primarily secondary market instruments, unsuccessful deals, aid bonds, i.e. bonds that are guaranteed by foreign governments, publicly guaranteed bonds, and bonds issued for restructurings. We also drop bonds for which the issuance amount was missing.

We searched the websites of ministries of finance and statistics departments for official debt listings and sent out email requests whenever we couldn't find the information we were looking for. This allowed us to compare our database with listings from official authorities. Our requests eventually returned 25 results of which we chose eight that came with the level of granularity needed to compare the data with our database. These countries were Argentina, Brazil, Hungary, Indonesia, Lithuania, Poland, Tunisia, Venezuela. We picked these countries as they cover a total of three continents for both advanced and emerging market countries. The results revealed that bonds that appear in at least two of the three databases are also very likely to appear in the respective official listings. Based on these findings, we came up with a decision rule that says that we only include bonds in our database that either (1) appear in minimum two out of three databases or (2) can be externally validated e.g. via bond prospectuses.<sup>13</sup>

### Brady program

In order to avoid biases in market access patterns, we actively exclude bonds that were issued as part of restructurings e.g. bonds that were issued via the Brady program, whenever identifiable, e.g. via notes in Refinitive Eikon or the Bloomberg's Brady bond indicator.

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<sup>13</sup>This decision only refers to our external modern bond database.

### A.2.5 Merging and cleaning syndicated bank loans

Merging the Dealogic and the World Bank data comes with two major issues: (i) There is no unique identifier available for loans, and (ii) the data overlaps only over a period of one and a half years from 1980 to 1981q2. This leaves only little room for cross-validation between the sources. To match observations between the databases, we apply the Stata program *dtalink*.<sup>14</sup> The variables available for this purpose are quite limited due to the narrow scope of the World Bank reports. To identify matches, we had to come up with a different approach. We decided to rely on major variables like the country name and the name of the borrower, the year, month, term, amount, interest rates, currency and an identifier for the sector. By doing so, we were able to match two-thirds of all sovereign loans between the databases. The result is fairly robust.

When comparing the data from the two sources for the 18 months of overlap in 1980 and 1981, we find that this overlap is at almost 80%.<sup>15</sup> Given our merging approach, we were able to match loans across the databases irrespective of the specific number of tranches per loan. Based on these matches, we created a unique dataset that contains both data from Dealogic and the World Bank, e.g. we used additional variables from Dealogic such as the nationalities of banks and borrowers to cover the nationalities of banks, bank parents and the loan guarantors.

#### Cleaning the data

Until the cleaning stage, we kept the data together to be able to extract as much information as possible. Similar to the bond dataset, we are interested in loans with a tenure of at least one year to maturity. Hence, we start by excluding bonds of less than one year to maturity. In a next step, we restrict the dataset to sovereign loans only. This leaves us with 3,708 loans in our dataset. Additionally, we drop loans that have been withdrawn or cancelled, were granted by supranational organizations or development funds.<sup>16</sup> We further drop loans that are exclusively guaranteed by an external entity, i.e. a third-party government or an international organization. Finally, we exclude loans for which one of the key variables, i.e. the issuance amount, the credit date or the (expected) maturity date, is missing.

### A.2.6 Merging and cleaning the historical bond data

Apart from the Meyer et al. (2019) dataset, data from all sources that we have considered during the merging process have been coded separately in panel format. The coding mainly focused on external debt issued by sovereigns. Consequently, subnational bonds, e.g. city and provincial bonds, as well as international loans provided by international organizations have not been actively coded. Moreover, as the

<sup>14</sup>See Appendix A.2.8 for a detailed description of *dtalink*.

<sup>15</sup>We compared the data in terms of total loan amounts extended by month and in number of loans extended.

<sup>16</sup>These lender types account for 48% of loans in this country group.

historical period is characterized by instruments like loans and stocks that are not clearly differentiable from bonds we coded all instruments that met these requirements, in order to capture the magnitude of external sovereign debt issued during the historical period.

### **Bond information covered**

*Dates.* Issuance and maturity dates are in monthly frequency. In addition to the data by Meyer et al. (2019), all three sources also provide information on changes in interest and amortization.

*Amounts.* The three sources provide information on issuance amounts and in case of tranches at least the amount of the summary bond, if not the actual tranche amount. Additional information is provided on the amount authorized or contracted for as well as the amount outstanding. Adding onto the data provided by Meyer et al. (2019) that includes issuances in hard currency, i.e. British pound sterling and US dollar, using the three additional sources allows to include issuances in national currencies if the bond was issued externally. This adds another 2,932 bonds to the dataset. We convert all issuance amounts into US dollars using exchange rates from the Bank of England, Carmen Reinhart, Refinitive Eikon, Federico-Tena World Trade Historical Database<sup>17</sup>, Historical Bilateral Trade and Gravity Data set (Tradehist)<sup>18</sup>, IMF Interwar Debt Database (IDD)<sup>19</sup>, the International Monetary Fund (IMF) and Scavo.

*Interest Rates.* Interest rates are provided individually for almost all bonds with only 8% of bonds exhibiting missing values.

*Countries.* Based on the construction we add bonds of 29 countries to the Meyer et al. (2019) database. These are Albania, Algeria, Bahamas, Belize, Cameroon, Cyprus, the Democratic Republic of Congo, Dominica, French Guiana, Guadeloupe, Iraq, Lithuania, Madagascar, Malawi, Malaysia, Martinique, Monserrat, Myanmar, New Caledonia, Reunion, Saint Helena, Saint Kittens and Nevis, Saint Vincent and the Grenadines, Saudi Arabia, Slovakia, Surinam, Tunisia, Uganda and Zambia.

*Granularity.* By coding tranches separately that appear in Fenn's Compendium, the London Stock Exchange Yearbooks and Moody's Manual of Investments we can extract the exact timing of the issuance of each instrument. In doing so, we are able to avoid data bias in terms of issuance timing that would arise if summary information was used.

### **Tranches, series and summary bonds**

Tranches and series are not only a common phenomenon in the modern period. In history, bonds were issued in several installments as well, however, the reporting across sources differed widely. Very often a

<sup>17</sup>Federico, G., & Tena-Junguito, A. (2018). Federico-Tena World Trade Historical Database: World Exchange Rates Series. e-cienciaDatos.

<sup>18</sup>Fouquin, M., & Hugot, J. (2016). Two Centuries of Bilateral Trade and Gravity Data: 1827-2014 (Issues 2016-14).

<sup>19</sup>End, N., Marinkov, M., & Miryugin, F. (2019). Instruments of Debtstruction: A New Database of Interwar Debt. IMF Working Papers, 19(226).

bond that has been issued in several tranches is issued in partial amounts on different stock exchanges, at different dates and at different terms (e.g. for the interest rate or the maturity date). Even a combination of all of these factors is possible. Other issues arise when bonds were issued in serial issuances but information on the exact timing of the issuance is not available. Lastly, restructurings and defaults sometimes caused changes in the maturity date, the reporting of which often differed across sources. All of these factors complicate working with the historical data.

To keep the error rate to a minimum, we have manually checked the data and separated bonds into tranches according to the information available. Bonds were only separated when the details provided in the reporting sufficed, i.e. the bonds could be separated based on more than one variable. Most tranches have been separated based the amount issued, date of issuance, issue price and issue place. In addition to the respective amount issued in each tranche, the total amount issued of the summary bond was preserved to allow for matching across the sources.

Figures A.1 to A.3 provide an example for the coding of a Yugoslavian bond issued in six tranches in 1931, in an uncleaned and in a cleaned format. In order to separate the bond into tranches, we made use of the details provided in the underlying sources. In this example the information comes from Moody's Manual of Investments (Figure A.1). Based on the excerpt from the year book, we separated the original bond (Figure A.2) in six tranches that differ with regard to the amount issued and the issue place. Figure A.3 shows the cleaned tranches in the raw panel data.

**Figure A.1:** Example of tranching bond in Moody's Manual of Investments

**Offered—French Fcs 1,025,000,000 (about \$40,158,525); subscribed as follows (in French Fcs): Banque de l'Union Parisienne, France, 675,000,000; Schweizerische Bankverein, Switzerland, 125,000,000; Zivnostenska Banka, Czechoslovakia, 100,000,000; State Mortgage Bank of Yugoslavia, Yugoslavia, 50,000,000; Aktiebolaget Kreuger & Toll, Sweden, 50,000,000; Mendelssohn & Co, Holland, 25,000,000; total, 1,025,000,000.**

**Figure A.2:** Example of uncleaned tranching bond in coding

ID	no	Country	Year	AmountIssued	Currency	IssueDate	IssueYear	KindofDebt	IssuePlace
Yugos21	21	Yugoslavia	1932	1025000000	Fcs	June01	1931	bond	
Yugos21	21	Yugoslavia	1933	1025000000	Fcs	June01	1931	bond	
Yugos21	21	Yugoslavia	1934	1025000000	Fcs	June01	1931	bond	
Yugos21	21	Yugoslavia	1935	1025000000	Fcs	June01	1931	bond	
Yugos21	21	Yugoslavia	1936	1025000000	Fcs	June01	1931	bond	
Yugos21	21	Yugoslavia	1937	1025000000	Fcs	June01	1931	bond	
Yugos21	21	Yugoslavia	1938	1025000000	Fcs	June01	1931	bond	
Yugos21	21	Yugoslavia	1939	1025000000	Fcs	June01	1931	bond	
Yugos21	21	Yugoslavia	1940	1025000000	Fcs	June01	1931	bond	
Yugos21	21	Yugoslavia	1941	1025000000	Fcs	June01	1931	bond	
Yugos21	21	Yugoslavia	1942	1025000000	Fcs	June01	1931	bond	



**Figure A.3:** Example of cleaned tranching bond in coding

ID	no	Country	Year	AmountIssued	TotalAmountIssued	Currency	IssueDate	IssueYear	KindofDebt	IssuePlace
Yugos21a	21	Yugoslavia	1932	675000000	1025000000	Fcs	June01	1931	bond	France
Yugos21a	21	Yugoslavia	1933	675000000	1025000000	Fcs	June01	1931	bond	France
Yugos21a	21	Yugoslavia	1934	675000000	1025000000	Fcs	June01	1931	bond	France
...	...	...	...	...	...	...	...	...	...	...
Yugos21b	21	Yugoslavia	1932	125000000	1025000000	Fcs	June01	1931	bond	Switzerland
Yugos21b	21	Yugoslavia	1933	125000000	1025000000	Fcs	June01	1931	bond	Switzerland
Yugos21b	21	Yugoslavia	1934	125000000	1025000000	Fcs	June01	1931	bond	Switzerland
...	...	...	...	...	...	...	...	...	...	...
Yugos21c	21	Yugoslavia	1932	100000000	1025000000	Fcs	June01	1931	bond	Czechoslovakia
Yugos21c	21	Yugoslavia	1933	100000000	1025000000	Fcs	June01	1931	bond	Czechoslovakia
Yugos21c	21	Yugoslavia	1934	100000000	1025000000	Fcs	June01	1931	bond	Czechoslovakia
...	...	...	...	...	...	...	...	...	...	...
Yugos21d	21	Yugoslavia	1932	50000000	1025000000	Fcs	June01	1931	bond	Yugoslavia
Yugos21d	21	Yugoslavia	1933	50000000	1025000000	Fcs	June01	1931	bond	Yugoslavia
Yugos21d	21	Yugoslavia	1934	50000000	1025000000	Fcs	June01	1931	bond	Yugoslavia
...	...	...	...	...	...	...	...	...	...	...
Yugos21e	21	Yugoslavia	1932	50000000	1025000000	Fcs	June01	1931	bond	Sweden
Yugos21e	21	Yugoslavia	1933	50000000	1025000000	Fcs	June01	1931	bond	Sweden
Yugos21e	21	Yugoslavia	1934	50000000	1025000000	Fcs	June01	1931	bond	Sweden
...	...	...	...	...	...	...	...	...	...	...
Yugos21f	21	Yugoslavia	1932	25000000	1025000000	Fcs	June01	1931	bond	Holland
Yugos21f	21	Yugoslavia	1933	25000000	1025000000	Fcs	June01	1931	bond	Holland
Yugos21f	21	Yugoslavia	1934	25000000	1025000000	Fcs	June01	1931	bond	Holland
...	...	...	...	...	...	...	...	...	...	...

### Dealing with missing values in issuance amounts

Due to differences (and sometimes also errors) across data sources, there are several cases of missing values. We fill missing values in the bond's issuance amount using a multi-staged approach, which takes the amount outstanding and amount authorized into consideration. First, we replace missings in the amount issued variable with the amount authorized if the amount lies within a threshold of  $\pm 10\%$  to the first observation reported on the outstanding amount. Next, if the amount outstanding remains constant over time, we use the data on the amount outstanding to replace missing issuance amounts. We do so, as no changes in the amount outstanding are a strong indicator for erroneous coding, which resulted in the data on the amount issued being assigned to the amount outstanding variable. Third, we approximate the missing issuance amount using the first observation on the amount outstanding, if the latter is the greatest observed amount outstanding for the given instrument. In doing so, we closely follow the approach employed by End et al. (2019) who base their issuance variable on the amount outstanding. Overall, our results are robust to not filling missing values using our proxies.

### A.2.7 Post-merging work

We manually match bonds after merging the databases using Stata's `dtlink` (see description below) as the historical data often comes with missing or scarce information on major variables. Additionally, we apply a decision rule that allows us to consistently pick variables from the same source when bonds

were matched between at least two sources. We use the Meyer et al. (2019) dataset as our underlying dataset as Meyer et al. (2019) have already cleaned and double-checked the reliability of all bonds in their dataset. We judge Moody's to be the second most reliable source, as it comes with the most detailed information, in particular with regard to tranches and series, followed by LSE and Fenn's compendium, respectively.

### A.2.8 Stata's *dtalink*

The Stata program *dtalink* follows a probabilistic matching method that allows to link bonds within datasets (e.g. for detecting duplicates) and also across datasets. Probabilistic linking methods score each potential pair of records using matching variables and assigned weights (Newcombe et al., 1959; Fellegi and Sunter, 1969). The weights can be positive or negative, depending on how much the variables differ from each other. The use of calipers can help to adjust weights upwards or downwards depending on how closely the two variables match.

#### Caveats

The Stata program *dtalink* causes a trade-off between (i) variable selection, and (ii) weighting, caliper and cut-off selection. For our matching procedure, we decided to select the variables that were (a) available across all datasets, (b) available for most observations, (c) came with definitions that are equivalent across sources.

We chose the weights, calipers and cut-offs scores in the following way: We assigned the highest weights to variables that were available for most observations but matched less often (e.g. the amounts, dates and coupons). Variables that were consistently available but matched often (e.g. currency) were assigned lower matching scores but higher penalties for differences. Variables that were less consistently available were given lower weights. In all matching rounds, we set the iso3c-code (reflecting the country of issue) and the deal year as blocking variables, i.e. we forced them to be identical across matching datasets.

#### Differences in the application across time periods

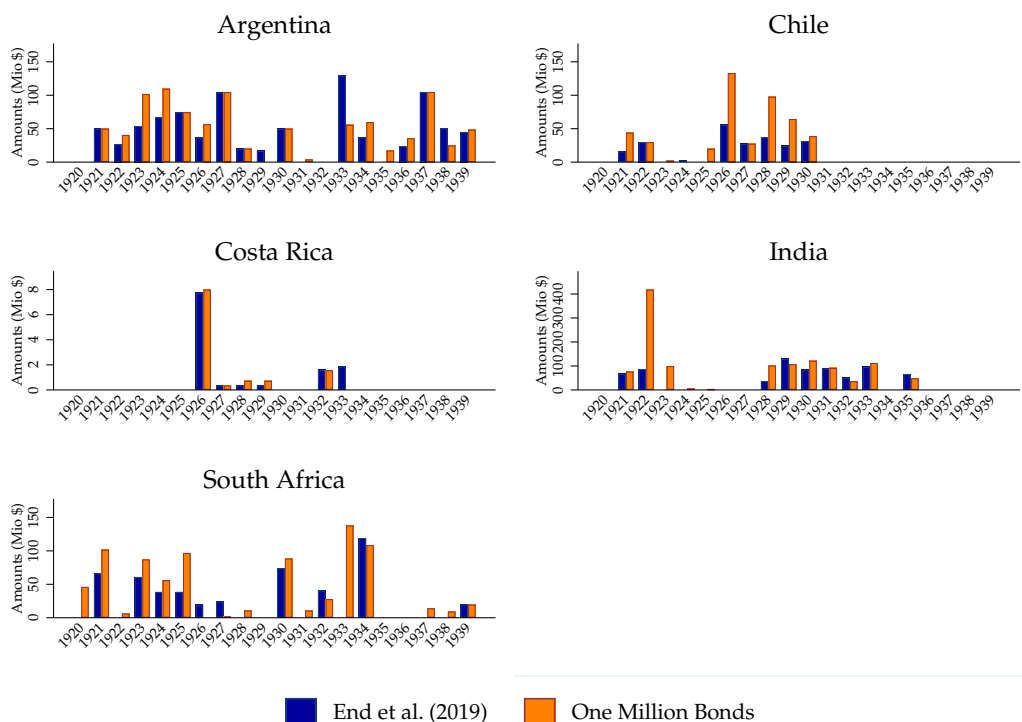
There are major differences across time in the historical dataset: (a) the amount of missing information, (b) the propensity of tranches in the historical data, (c) the ratio of bonds issued in domestic currencies, and (d) the lack of a unique identifier. Hence, our approach using *dtalink* differs in part from the one we apply for the modern period. In contrast to the modern period data, we have used various sets of matching variables, weights and caliper intervals which we supplemented with manual checks. To account for bond tranches and series, as well as differences in the reported currency of issuance across sources, we have included additional rounds in the matching process. These respective matching rounds use the total

amount issued across bond tranches, the amount issued, the currency of issuance, and the converted US dollar amount of issuance, to match observations.

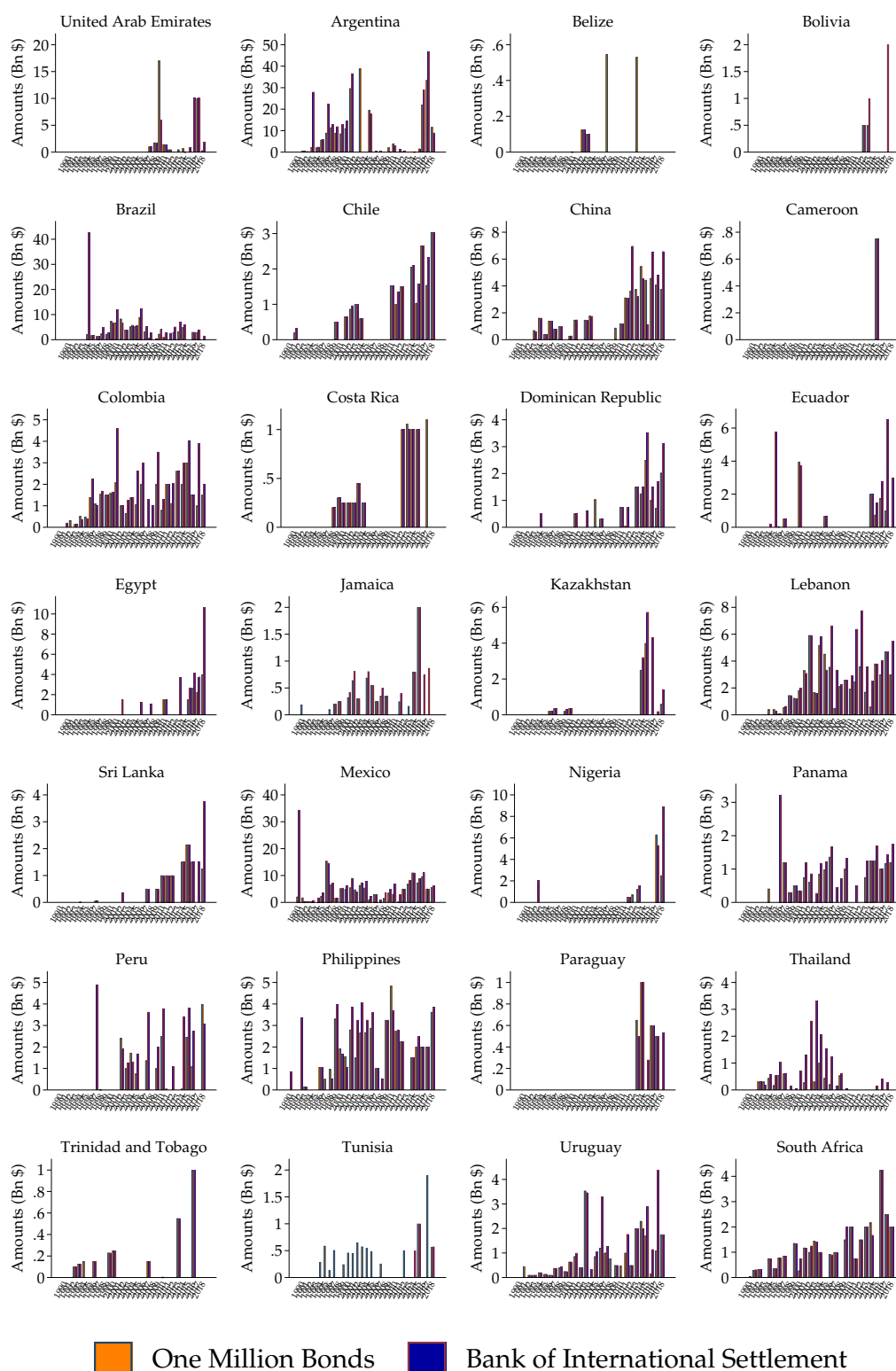
## A.3 Robustness graphs and tables

### A.3.1 Bond issuance comparison across sources

**Figure A.4:** Our sovereign bond data vs. data from End et al. (2019)

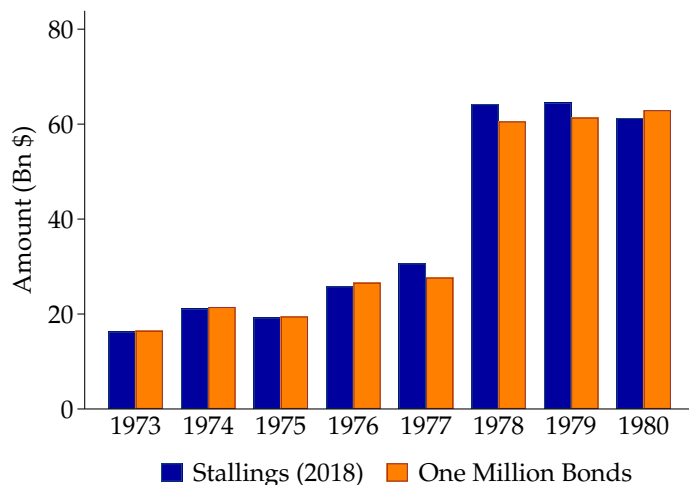


*Notes:* The bar plots compare the aggregated amount issued in million US dollar between 1920 and 1939, inclusive, for countries that are available in both our dataset and End et al. (2019). Although the two datasets have different foci, i.e. our dataset focuses on external issuances, End et al. (2019) primarily covers bonds outstanding during the interwar period of underlying data sources that are skewed towards domestic issuances, we find that our data indeed comes very close to the aggregated data from End et al. (2019).

**Figure A.5:** Our sovereign bond data vs. data from the BIS

*Notes:* The bar plot compares the aggregated amount issued in billion US dollars between 1990 and 2018, inclusive, for both our dataset and the BIS. We find that our data comes very close to the aggregated data with few exceptions. One example is the case of Tunisia which we could not find an explanation for even after cross-checking our data with available online sources and official listings.

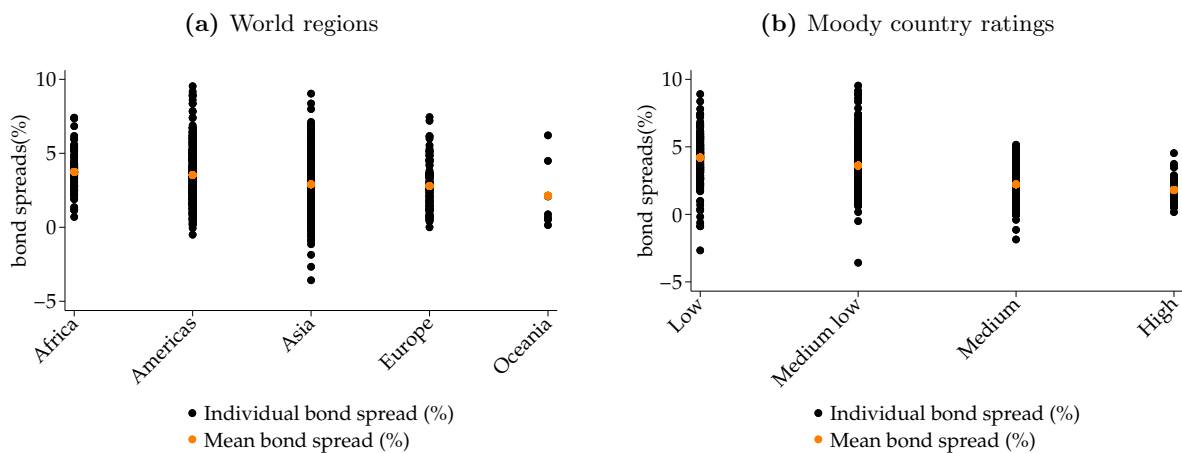
**Figure A.6:** Our syndicated loan data vs. data from Stallings (2018)



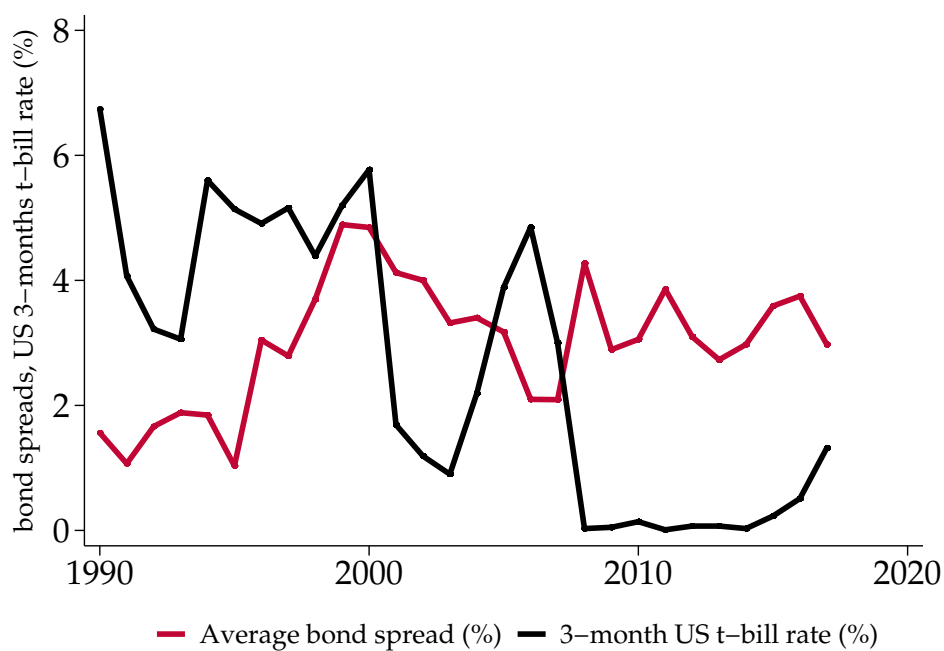
*Notes:* The bar plot compares the aggregated amount issued in billion US dollars between 1973 and 1980, inclusive, for both our dataset and Stallings (2018). We find that our data indeed comes very close to the aggregated data from Stallings (2018).

### A.3.2 Stylized Fact 2: Coupon and spreads

**Figure A.7:** Distribution of bond spreads across regions and ratings

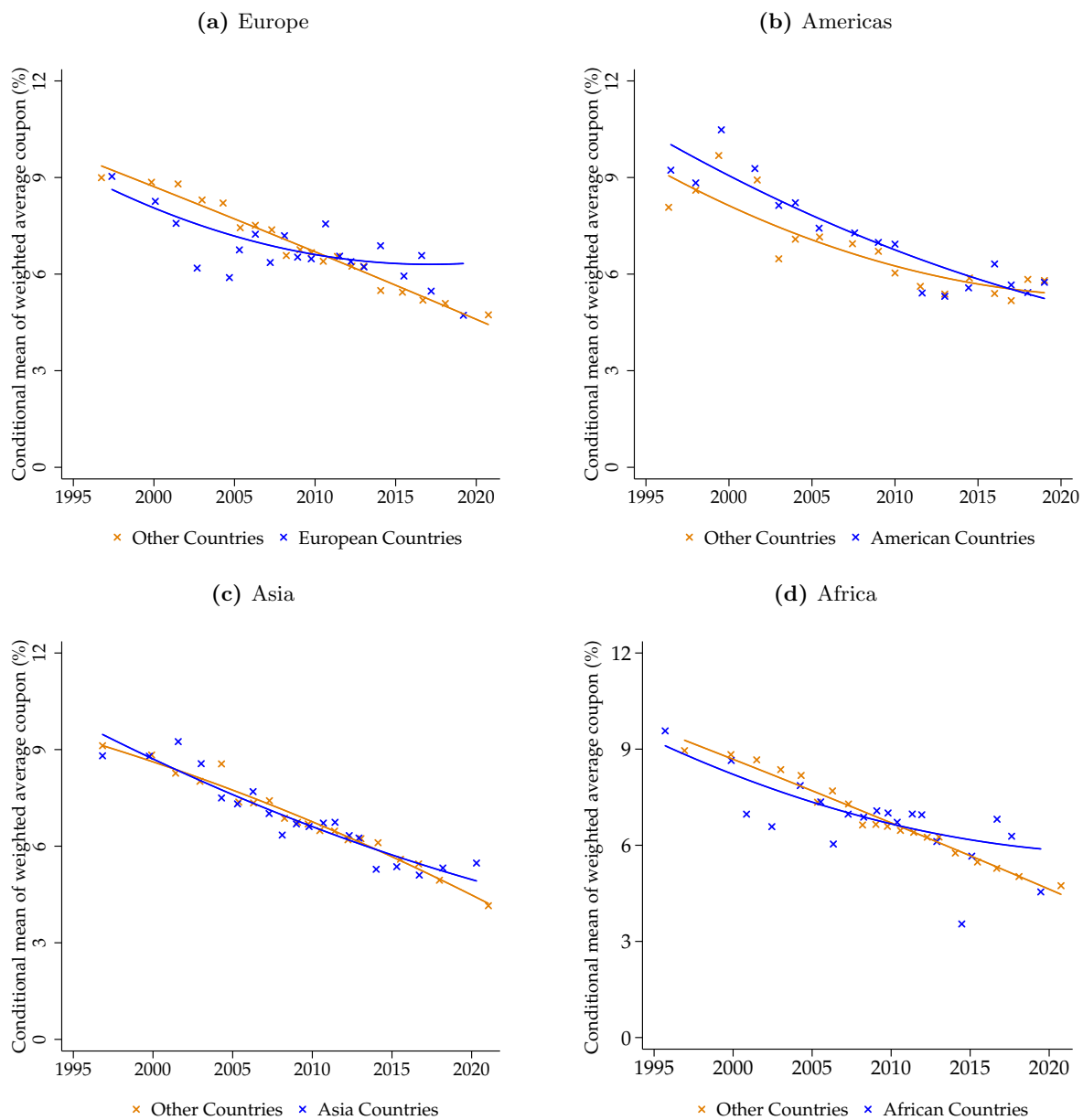


*Notes:* The left graph shows the bond spreads across the world regions Africa, Americas, Asia, Europe and Oceania for the period 1990 to 2019, inclusive. The right graph plots the bond spreads and mean bond spreads across rating groups according to Moody’s average rating by country for the period 1995-2019 (low: 2-6, medium low: 7-10, medium: 11-15, high:16-20).

**Figure A.8:** Average bond spreads and US 3-month t-bill rate

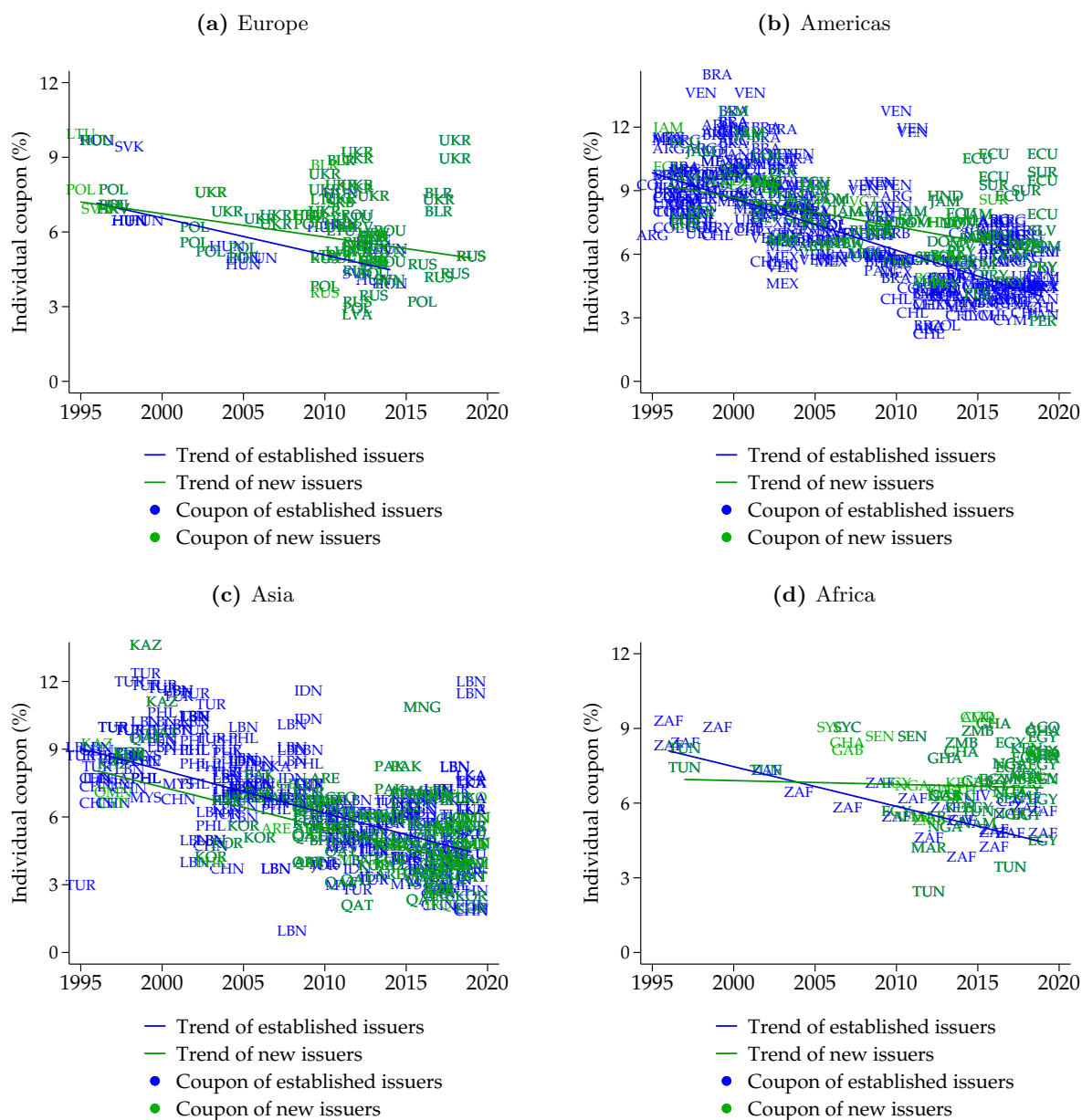
*Notes:* The plot shows the evolution of the average bond spread (red line) vs. the 3-month US t-bill rate (black line, both in percent).

**Figure A.9:** Conditional mean of weighted coupon by region since 1995



*Notes:* The four graphs show the weighted average hard-currency coupons over time since 1995. To control for time-invariant country-pair characteristics, the graph shows the residuals resulting from a regression of each respective series on country-pair fixed effects. The observations have been grouped into equally sized bins and the scatter plots shows the corresponding conditional means.

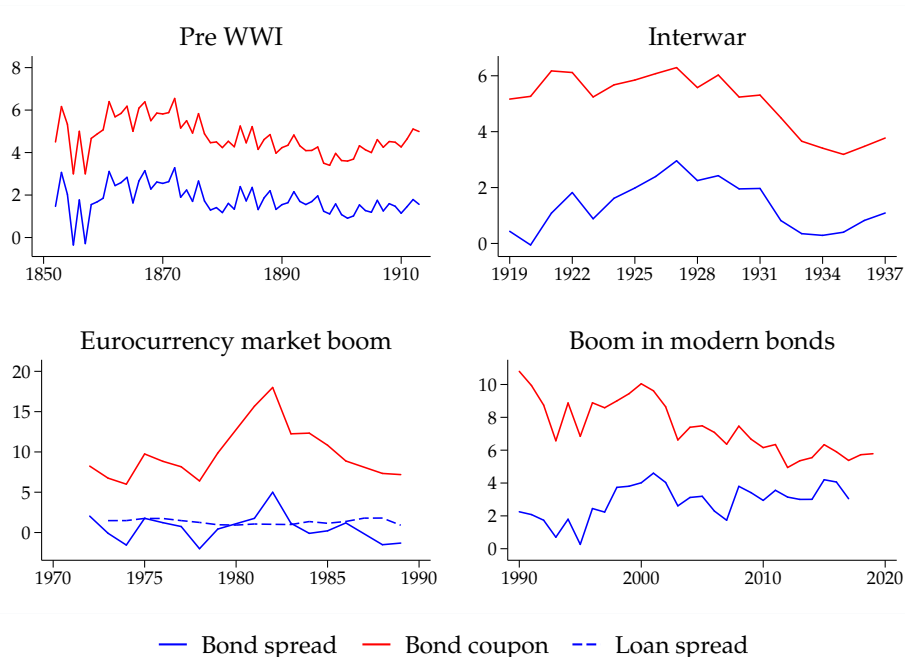
**Figure A.10:** Individual coupons of old and new issuer by regions



*Notes:* The four graphs show the coupons of hard-currency external sovereign bonds issued since 1995 by world regions. Coupons of established issuers, i.e. issuers that have issued bonds between 1969 and 1995 are given in blue. Coupons of new issuers, i.e. those that, in the period since 1970, only started issuing bonds after 1994, are given in green. The blue and green lines show the trend lines for established and new issuers, respectively.

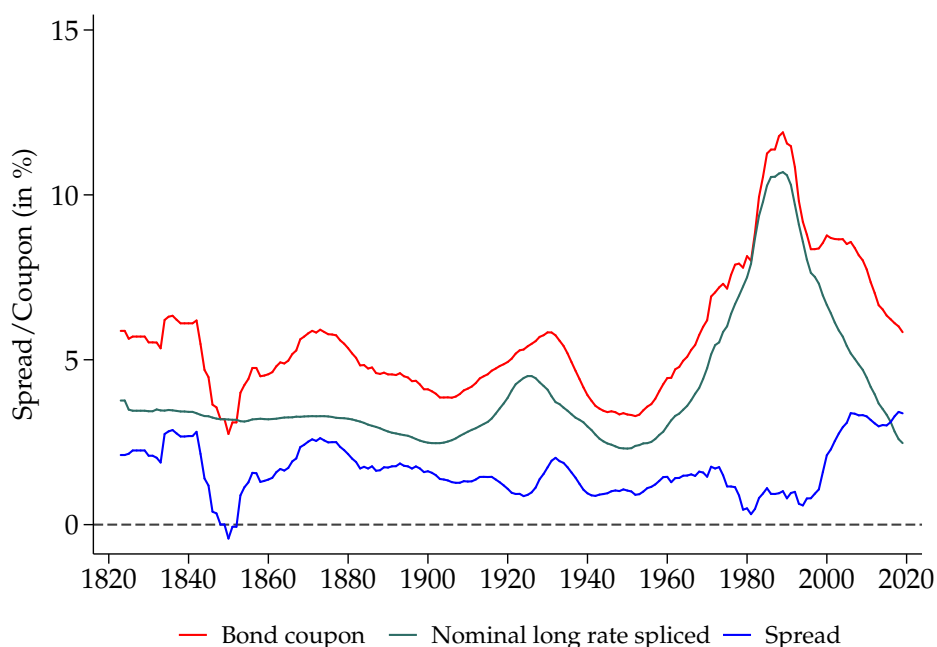


**Figure A.11:** Coupons and spreads



*Notes:* The four graphs show bond spreads (blue solid line) loan spreads (blue dashed line) and bond coupons (red solid line) split into the pre World War I period, the interwar era, the time of the eurocurrency market boom and and the modern bond era.

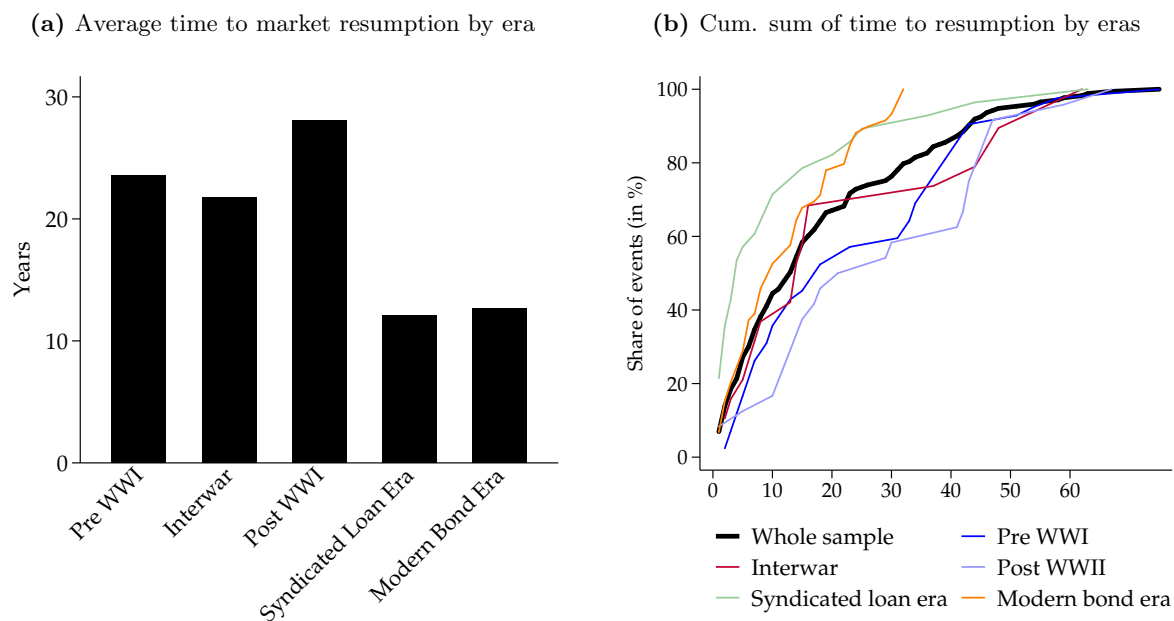
**Figure A.12:** Coupons, the global interest rate, and spreads



*Notes:* The graph shows bond spreads (blue line), bond coupons (red line) and the nominal long run interest rate (green line) from Reinhart et al. (2016) which is given by the UK consol yield until 1919 and as the yield on long-term United States bonds from there on.

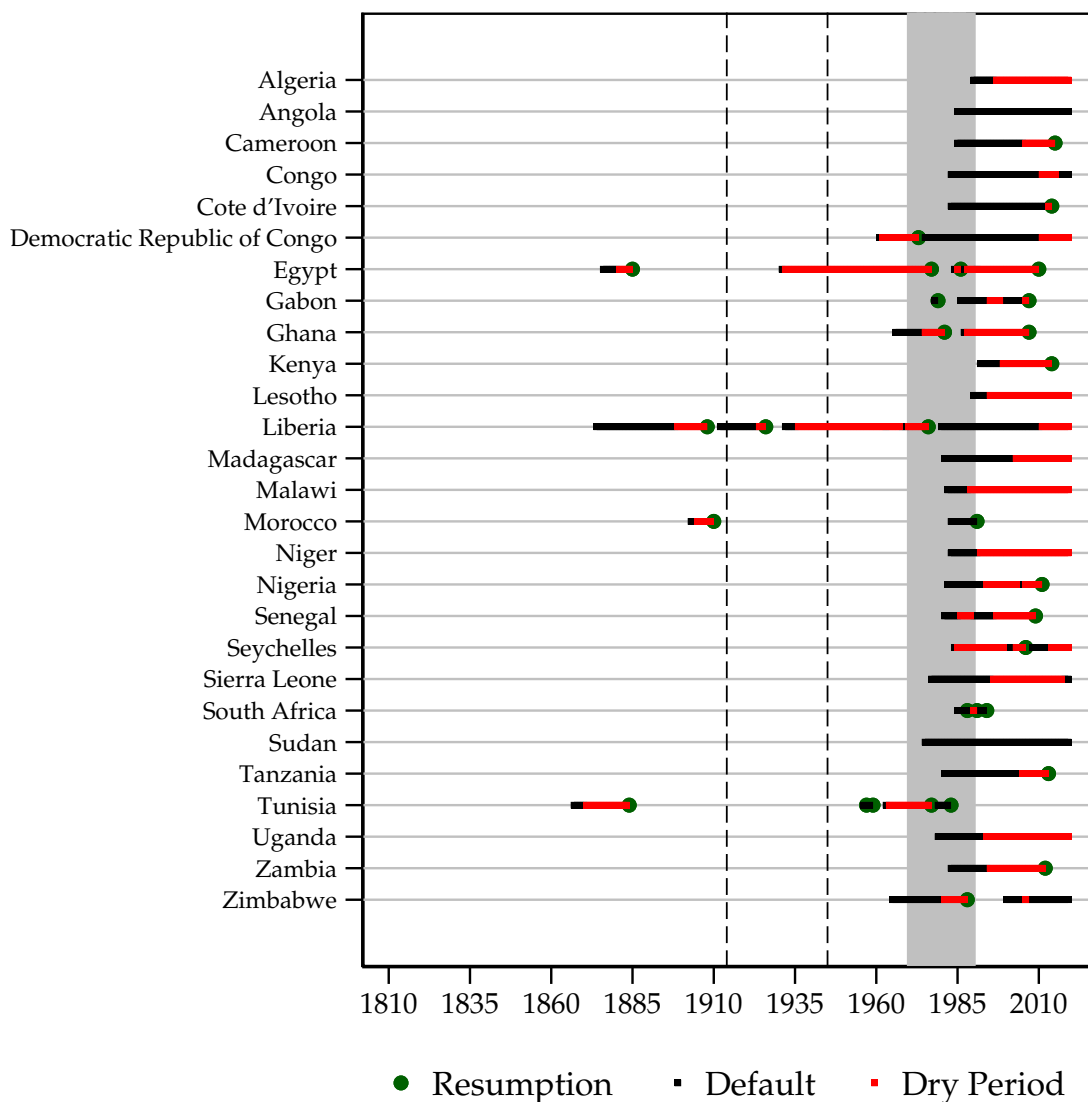
### A.3.3 Stylized fact 3: Time to resumption

**Figure A.13:** Average time to resumption across eras and world regions, counting resumption from first year of default



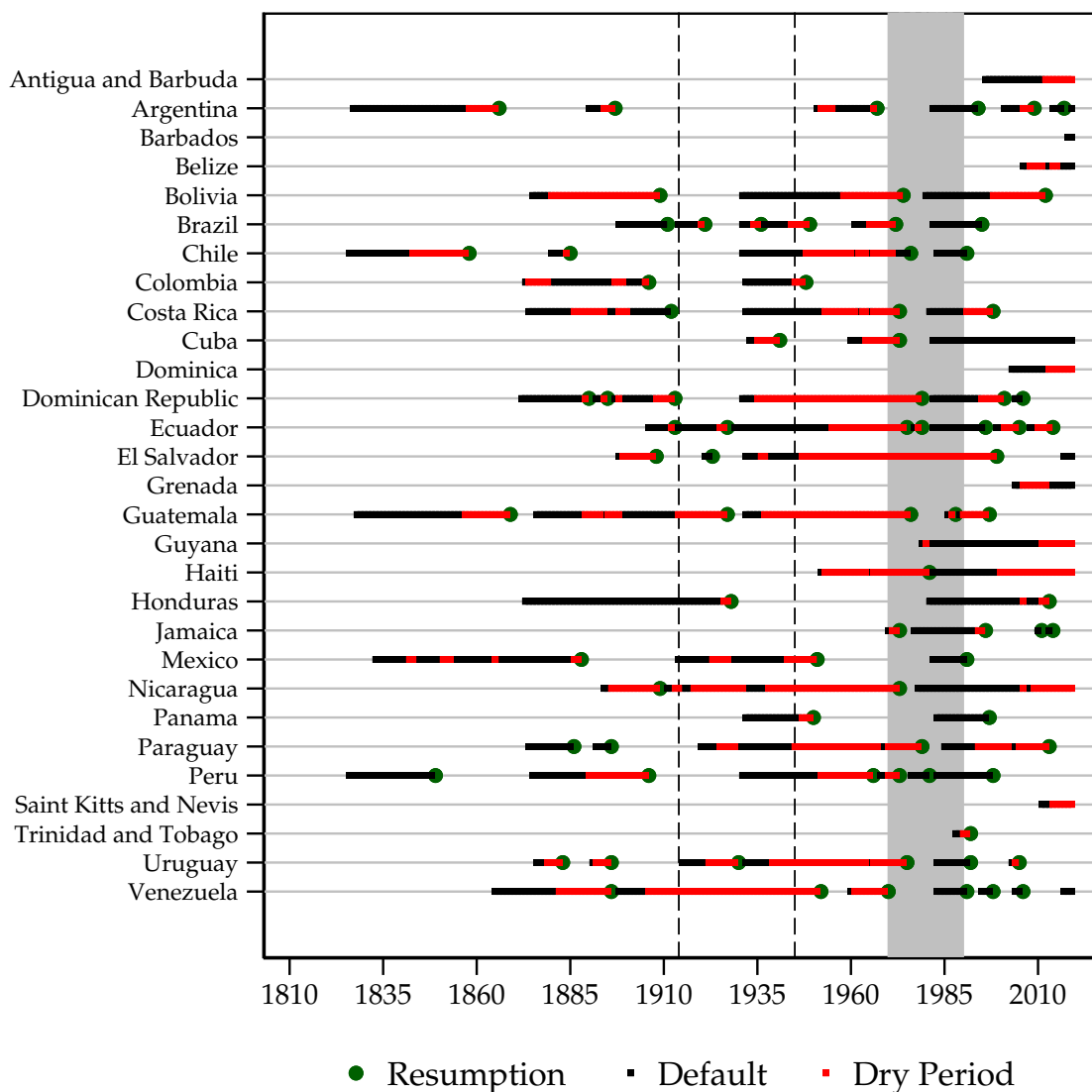
*Notes:* The left plot shows five bars that represent the average time to market access after default split by five eras: Pre WWI, interwar, post WWII, syndicated loan period, and modern bond period. Time to resumption during the syndicated loan era includes the issuance of syndicated bank loans. The first year of a default episode was used as a reference year for era allocation. The right plot shows the cumulative number of resumptions by time to resumption for the whole sample (thick black line) and the five eras pre WWI, interwar, post WWII, syndicated loan period, and modern bond period.

Figure A.14: Africa: Default, resumption, and market exclusion periods



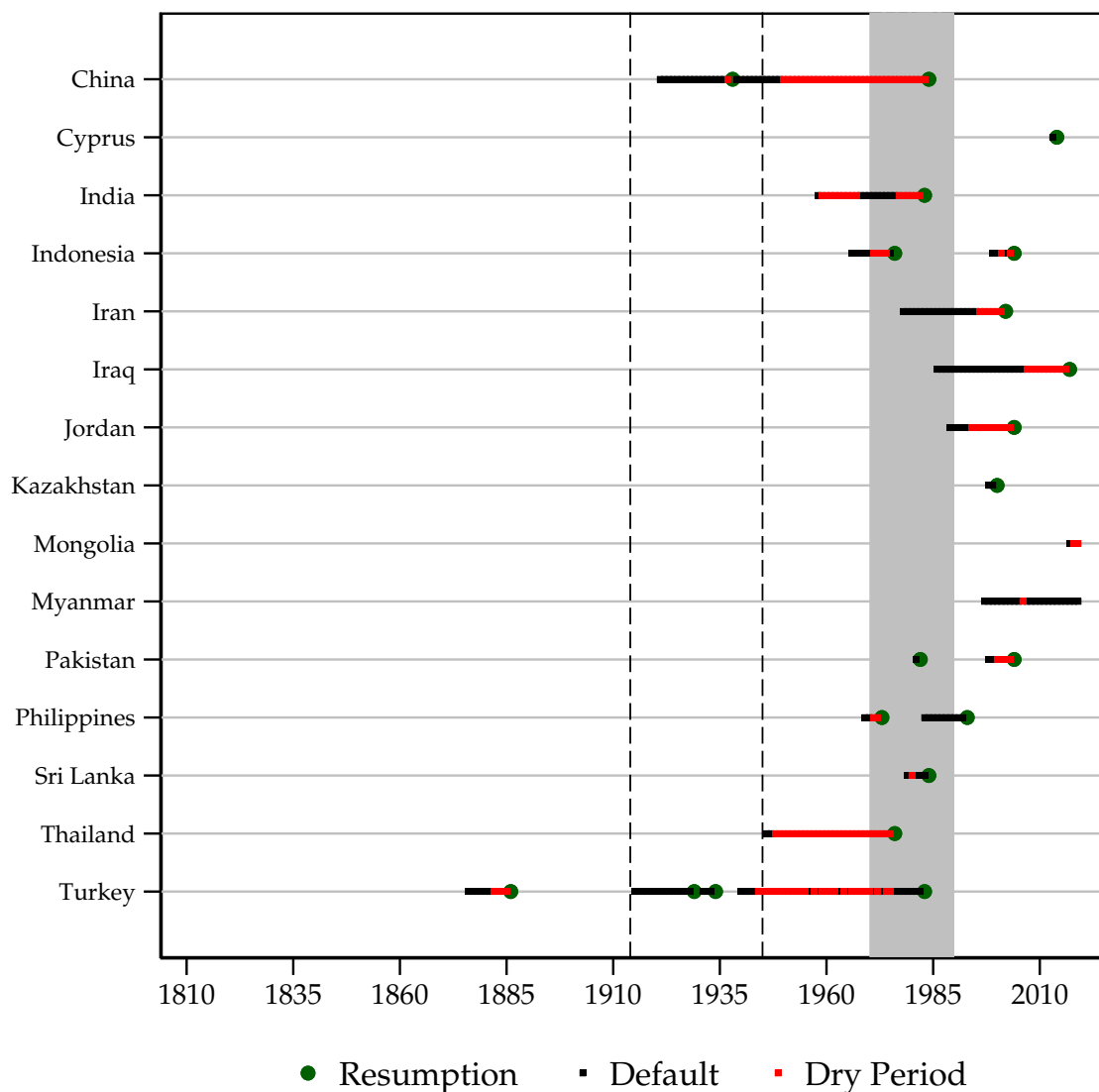
Notes: The grey shaded area bar represents the 1970s and 1980s which are mainly dominated by syndicated loan issuances. Dashed vertical lines divide the sample into the periods pre WWI, interwar, post WWII and the modern bond period. The green circle represents the year of market resumption, the dark square represent periods of sovereign default and the red squares show periods of no issuances. We have excluded all issuances that took place during default events that did not match our data, e.g. a default was reported before the first issuance occurred.

Figure A.15: Americas: Default, resumption, and market exclusion periods



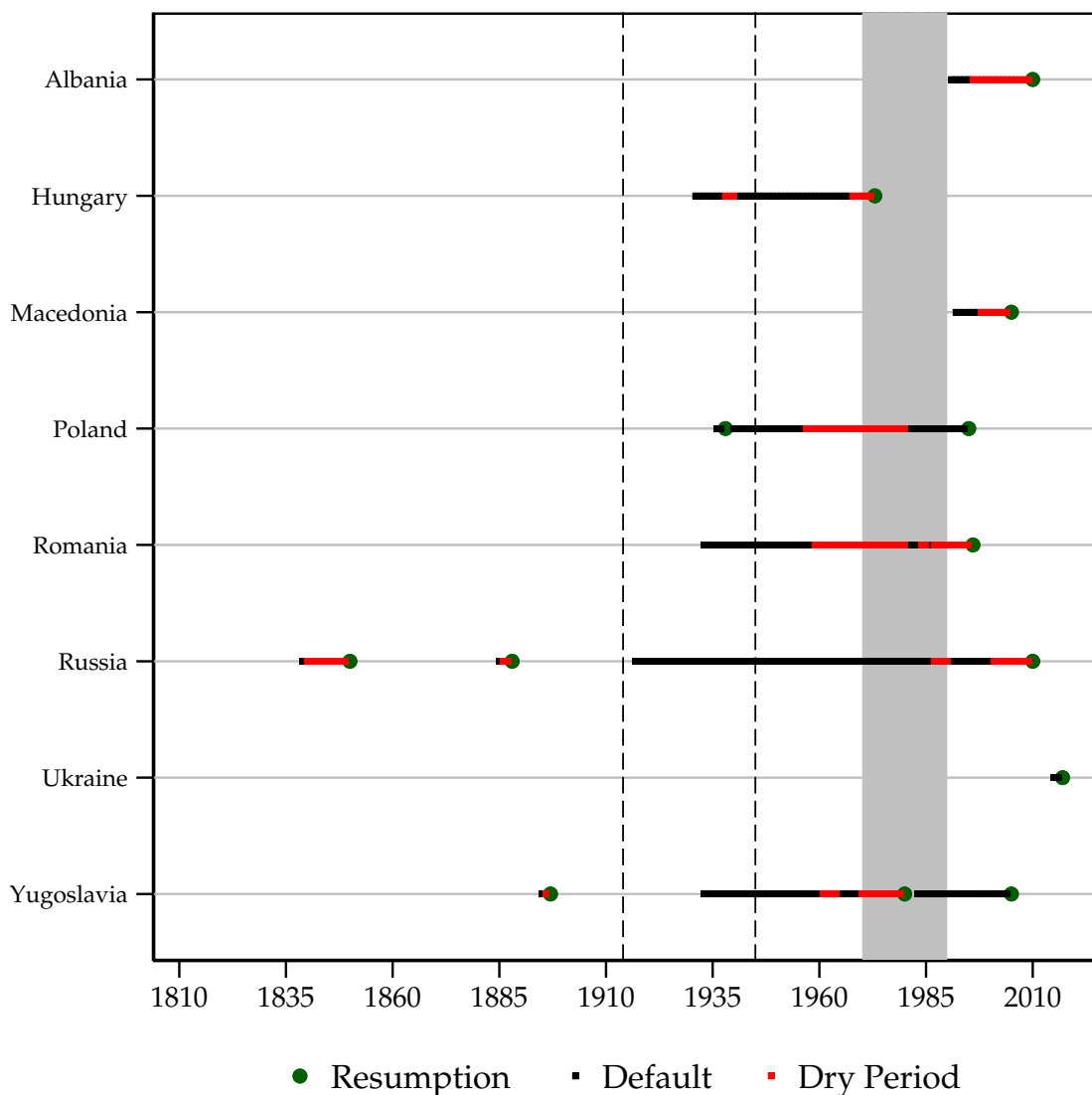
Notes: The grey shaded area bar represents the 1970s and 1980s which are mainly dominated by syndicated loan issuances. Dashed vertical lines divide the sample into the periods pre WWI, interwar, post WWII and the modern bond period. The green circle represents the year of market resumption, the dark square represent periods of sovereign default and the red squares show periods of no issuances. We have excluded all issuances that took place during default events that did not match our data, e.g. a default was reported before the first issuance occurred.

Figure A.16: Asia: Default, resumption, and market exclusion periods



Notes: The grey shaded area bar represents the 1970s and 1980s which are mainly dominated by syndicated loan issuances. Dashed vertical lines divide the sample into the periods pre WWI, interwar, post WWII and the modern bond period. The green circle represents the year of market resumption, the dark square represent periods of sovereign default and the red squares show periods of no issuances. We have excluded all issuances that took place during default events that did not match our data, e.g. a default was reported before the first issuance occurred.

Figure A.17: Europe: Default, resumption, and market exclusion periods



Notes: The grey shaded area represents the 1970s and 1980s which are mainly dominated by syndicated loan issuances. Dashed vertical lines divide the sample into the periods pre WWI, interwar, post WWII and the modern bond period. The green circle represents the year of market resumption, the dark square represent periods of sovereign default and the red squares show periods of no issuances. We have excluded all issuances that took place during default events that did not match our data, e.g. a default was reported before the first issuance occurred.

**Table A.4:** Pre World War I: Resumption by region

World region	Mean	Median	<i>#Resumptions</i>
Western Africa	9	9	1
Northern Africa	7.3	5	3
Central America	7.5	6	17
Caribbean	5.5	3	4
South America	8.5	3	25
Southern Europe	1	1	1
Eastern Europe	5	5	2
Full Sample	7.6	4	53

*Notes:* The table lists the mean and median time to resumption (in years) by world regions for the pre World War I era. Resumption is defined as the time from the first year after the end of a default or a restructuring period until the year of the first new issuance in international capital markets.

**Table A.5:** Interwar period: Resumption by region

World region	Mean	Median	<i>#Resumptions</i>
Western Africa	2	2	1
South America	1.8	2	5
Central America	1	1	4
Caribbean	6	6	1
Eastern Asia	1	1	1
Full Sample	1.8	2	12

*Notes:* The table lists the mean and median time to resumption (in years) by world regions for the interwar period. Resumption is defined as the time from the first year after the end of a default or a restructuring period until the year of the first new issuance in international capital markets.

**Table A.6:** Syndicated loan period: Resumption by region

World region	Mean	Median	<i>#Resumptions</i>
Middle Africa	0	0	1
Eastern Africa	3.3	3	3
Northern Africa	.5	.5	2
Southern Africa	0	0	1
Western Africa	6	6	1
South America	1.4	1	5
Central America	1	1	1
Southern Asia	2.8	4	5
South-Eastern Asia	0	0	1
Full Sample	2	1	20

*Notes:* The table lists the mean and median time to resumption (in years) by world regions for the syndicated loan era. Resumption is defined as the time from the first year after the end of a default or a restructuring period until the year of the first new issuance in international capital markets.

**Table A.7:** Modern bond period: Resumption by region

World region	Mean	Median	<i>#Resumptions</i>
Middle Africa	1	1	1
Northern Africa	18	18	2
Southern Africa	0	0	1
Eastern Africa	10.7	14	6
Western Africa	10.5	10.5	3
Central America	2	2	4
South America	2.5	2	10
Caribbean	0	0	8
Western Asia	5.3	3	1
Central Asia	3.7	1	3
South-Eastern Asia	3	3	2
Southern Asia	4	4	1
Southern Europe	13.7	14	3
Eastern Europe	4	2	3
Full Sample	5.3	3	48

*Notes:* The table lists the mean and median time to resumption (in years) by world regions for the modern bond era. Resumption is defined as the time from the first year after the end of a default or a restructuring period until the year of the first new issuance in international capital markets.



**Table A.8:** Number of defaults and average time to resumption I

Country	Period	Number of defaults	Average time to resumption
<b>Africa</b>			
Cameroon	Modern bond era	1	9
Cote d'Ivoire	Modern bond era	1	1
Egypt	Pre WWI	1	4
Egypt	Syndicated loan era	2	1
Egypt	Modern bond era	1	18
Ethiopia	Modern bond era	1	14
Gabon	Syndicated loan era	2	0
Gabon	Modern bond era	2	7
Ghana	Syndicated loan era	2	6
Kenya	Modern bond era	2	14
Liberia	Pre WWI	2	9
Liberia	Interwar	2	2
Morocco	Pre WWI	1	5
Morocco	Modern bond era	1	0
Nigeria	Modern bond era	3	11
Senegal	Modern bond era	1	12
Seychelles	Syndicated loan era	3	2
Seychelles	Modern bond era	2	3
South Africa	Modern bond era	1	0
Tanzania	Modern bond era	1	8
Tunisia	Pre WWI	1	13
Tunisia	After WWII	3	0
Tunisia	Syndicated loan era	1	0
Zambia	Modern bond era	1	17
Zimbabwe	Syndicated loan era	1	7
<b>Americas</b>			
Argentina	Pre WWI	2	6
Argentina	After WWII	2	7
Argentina	Modern bond era	4	1

*Notes:* The table lists the start date of a default, the first year after its end, the years until the end of default, the year of resumption and the years till resumption for each default period of American countries. Resumption is defined as the time from the first year after the end of a default or a restructuring period until the year of the first new issuance in international capital markets.

**Table A.9:** Number of defaults and average time to resumption II

Country	Period	Number of defaults	Average time to resumption
<b>Americas</b>			
Bolivia	Pre WWI	1	29
Bolivia	Modern bond era	1	14
Brazil	Pre WWI	1	0
Brazil	Interwar	3	1
Brazil	Modern bond era	1	0
Chile	Pre WWI	2	8
Chile	After WWII	4	0
Chile	Syndicated loan era	2	0
Chile	Modern bond era	1	0
Colombia	Pre WWI	5	12
Costa Rica	Pre WWI	4	11
Costa Rica	After WWII	3	0
Costa Rica	Modern bond era	1	7
Cuba	Interwar	1	6
Dominican Republic	Pre WWI	4	6
Dominican Republic	Modern bond era	2	3
Ecuador	Pre WWI	4	10
Ecuador	Interwar	2	2
Ecuador	Syndicated loan era	2	1
Ecuador	Modern bond era	3	3
El Salvador	Pre WWI	2	6
El Salvador	Interwar	3	0
Guatemala	Pre WWI	4	6
Honduras	Pre WWI	2	1
Honduras	Interwar	1	2
Honduras	Modern bond era	2	5
Jamaica	Modern bond era	3	1
Mexico	Pre WWI	5	6
Mexico	Modern bond era	1	0
Nicaragua	Pre WWI	3	12
Nicaragua	Interwar	2	1
Panama	After WWII	1	3
Panama	Modern bond era	1	0

*Notes:* The table lists the start date of a default, the first year after its end, the years until the end of default, the year of resumption and the years till resumption for each default period of American countries. Resumption is defined as the time from the first year after the end of a default or a restructuring period until the year of the first new issuance in international capital markets.

**Table A.10:** Number of defaults and average time to resumption III

Country	Period	Number of defaults	Average time to resumption
<b>Americas</b>			
Paraguay	Pre WWI	2	0
Paraguay	Modern bond era	2	14
Peru	Pre WWI	2	8
Peru	After WWII	2	0
Peru	Syndicated loan era	4	2
Peru	Modern bond era	1	0
Uruguay	Pre WWI	2	2
Uruguay	Interwar	2	4
Uruguay	Modern bond era	2	1
Venezuela	Pre WWI	5	10
Venezuela	Modern bond era	4	0
<b>Asia</b>			
China	Interwar	2	1
India	Syndicated loan era	1	6
Indonesia	Syndicated loan era	1	0
Indonesia	Modern bond era	2	2
Iran	Modern bond era	1	6
Iraq	Modern bond era	1	10
Jordan	Modern bond era	1	10
Kazakhstan	Modern bond era	2	1
Pakistan	Syndicated loan era	2	2
Pakistan	Modern bond era	1	4
Philippines	Modern bond era	1	0
Sri Lanka	Syndicated loan era	2	2
Tajikistan	Modern bond era	2	7
Vietnam	Modern bond era	1	6
<b>Europe</b>			
Albania	Modern bond era	1	14
Bosnia and Herzegovina	Modern bond era	1	20
Macedonia	Modern bond era	1	7
Russia	Pre WWI	2	6
Russia	Modern bond era	1	9
Ukraine	Modern bond era	2	2
Yugoslavia	Pre WWI	1	1
Yugoslavia	Modern bond era	1	0

*Notes:* The table lists the start date of a default, the first year after its end, the years until the end of default, the year of resumption and the years till resumption for each default period of American, Asian and European countries. Resumption is defined as the time from the first year after the end of a default or a restructuring period until the year of the first new issuance in international capital markets.

## A.3.4 Market resumption by region

Table A.11: Americas: Sovereign default and resumption of market access I

Country	Default start	Year after default	Years till default end	Year of resumption	Years till resumption
Argentina	1827	1858	31	1866	8
Argentina	1890	1894	4	1897	3
Argentina	1951	1952	1	1966	14
Argentina	1956	1966	10	1966	0
Argentina	1982	1994	12	1994	0
Argentina	2001	2006	5	2009	3
Argentina	2014	2017	3	2017	0
Argentina	2019	-	-	-	-
Antigua and Barbuda	1996	2012	16	-	-
Belize	2006	2008	2	-	-
Belize	2012	2014	2	-	-
Belize	2017	-	-	-	-
Bolivia	1875	1880	5	1909	29
Bolivia	1931	1958	27	2012	54
Bolivia	1980	1998	18	2012	14
Brazil	1898	1911	13	1911	0
Brazil	1914	1920	6	1921	1
Brazil	1931	1934	3	1936	2
Brazil	1937	1944	7	1944	0
Brazil	1961	1965	4	1972	7
Brazil	1983	1995	12	1995	0
Barbados	2018	-	-	-	-
Chile	1826	1843	17	1858	15
Chile	1880	1884	4	1885	1
Chile	1931	1948	17	1948	0
Chile	1961	1962	1	1991	29
Chile	1963	1964	1	1991	27
Chile	1965	1966	1	1991	25
Chile	1972	1976	4	1991	15
Chile	1983	1991	8	1991	0
Colombia	1826	1846	20	1863	17
Colombia	1850	1862	12	1863	1
Colombia	1873	1874	1	1906	32
Colombia	1880	1897	17	1906	9
Colombia	1900	1905	5	1906	1
Colombia	1932	1945	13	1948	3
Costa Rica	1828	1841	13	1871	30
Costa Rica	1874	1886	12	1886	0
Costa Rica	1895	1898	3	1912	14
Costa Rica	1901	1912	11	1912	0
Costa Rica	1932	1953	21	1953	0
Costa Rica	1962	1963	1	1980	17
Costa Rica	1965	1966	1	1980	14
Costa Rica	1981	1991	10	1998	7

*Notes:* The table lists the start date of a default, the first year after its end, the years until the end of default, the year of resumption and the years till resumption for each default period of American countries. Resumption is defined as the time from the first year after the end of a default or a restructuring period until the year of the first new issuance in international capital markets.

**Table A.12:** Americas: Sovereign default and resumption of market access II

Country	Default start	Year after default	Years till default end	Year of resumption	Years till resumption
Cuba	1933	1935	2	1941	6
Cuba	1960	1964	4	-	-
Cuba	1982	-	-	-	-
Dominica	2003	2013	10	-	-
Dominican Republic	1872	1889	17	1890	1
Dominican Republic	1892	1894	2	1895	1
Dominican Republic	1897	1898	1	1913	15
Dominican Republic	1899	1908	9	1913	5
Dominican Republic	1931	1935	4	2001	66
Dominican Republic	1982	1995	13	2001	6
Dominican Republic	2004	2006	2	2006	0
Ecuador	1826	1856	30	1891	35
Ecuador	1868	1891	23	1891	0
Ecuador	1894	1899	5	1901	2
Ecuador	1906	1912	6	1913	1
Ecuador	1914	1925	11	1927	2
Ecuador	1929	1955	26	1996	41
Ecuador	1977	1978	1	1996	18
Ecuador	1982	1996	14	1996	0
Ecuador	1999	2001	2	2005	4
Ecuador	2008	2010	2	2014	4
Grenada	2004	2006	2	-	-
Grenada	2013	-	-	-	-
Guatemala	1828	1857	29	1869	12
Guatemala	1876	1889	13	1895	6
Guatemala	1894	1895	1	1895	0
Guatemala	1899	1914	15	1927	13
Guatemala	1932	1937	5	1988	51
Guatemala	1986	1987	1	1988	1
Guatemala	1989	1990	1	1997	7
Guyana	1979	1980	1	-	-
Guyana	1981	2011	30	-	-
Honduras	1828	1868	40	1869	1
Honduras	1873	1926	53	1928	2
Honduras	1981	2006	25	2013	7
Honduras	2007	2011	4	2013	2
Haiti	1952	1953	1	-	-
Haiti	1965	1966	1	-	-
Haiti	1982	2000	18	-	-
Jamaica	1970	1971	1	1996	25
Jamaica	1978	1994	16	1996	2

*Notes:* The table lists the start date of a default, the first year after its end, the years until the end of default, the year of resumption and the years till resumption for each default period of American countries. Resumption is defined as the time from the first year after the end of a default or a restructuring period until the year of the first new issuance in international capital markets.

**Table A.13:** Americas: Sovereign default and resumption of market access III

Country	Default start	Year after default	Years till default end	Year of resumption	Years till resumption
Jamaica	2010	2011	1	2011	0
Jamaica	2013	2014	1	2014	0
Saint Kitts and Nevis	2011	2014	3	-	-
Mexico	1827	1831	4	1831	0
Mexico	1833	1842	9	1851	9
Mexico	1844	1851	7	1851	0
Mexico	1854	1865	11	1886	21
Mexico	1866	1886	20	1886	0
Mexico	1914	1923	9	1951	28
Mexico	1928	1943	15	1951	8
Mexico	1982	1991	9	1991	0
Nicaragua	1828	1875	47	1886	11
Nicaragua	1894	1896	2	1909	13
Nicaragua	1911	1913	2	1920	7
Nicaragua	1915	1918	3	1920	2
Nicaragua	1932	1938	6	1938	0
Nicaragua	1978	2006	28	-	-
Nicaragua	2007	2009	2	-	-
Panama	1932	1947	15	1950	3
Panama	1983	1997	14	1997	0
Peru	1826	1849	23	1849	0
Peru	1875	1890	15	1906	16
Peru	1931	1952	21	1952	0
Peru	1968	1970	2	1974	4
Peru	1976	1977	1	1998	21
Peru	1978	1979	1	1998	19
Peru	1980	1981	1	1998	17
Peru	1983	1998	15	1998	0
Paraguay	1874	1886	12	1886	0
Paraguay	1892	1896	4	1896	0
Paraguay	1920	1925	5	2013	88
Paraguay	1930	1945	15	2013	68
Paraguay	1968	1970	2	2013	43
Paraguay	1985	1994	9	2013	19
Paraguay	2003	2005	2	2013	8
El Salvador	1828	1861	33	1863	2
El Salvador	1898	1899	1	1908	9
El Salvador	1921	1923	2	1923	0
El Salvador	1932	1936	4	1999	63
El Salvador	1938	1947	9	1999	52
El Salvador	2017	-	-	-	-
Trinidad and Tobago	1988	1990	2	1992	2

*Notes:* The table lists the start date of a default, the first year after its end, the years until the end of default, the year of resumption and the years till resumption for each default period of American countries. Resumption is defined as the time from the first year after the end of a default or a restructuring period until the year of the first new issuance in international capital markets.

**Table A.14:** Americas: Sovereign default and resumption of market access IV

Country	Default start	Year after default	Years till default end	Year of resumption	Years till resumption
Uruguay	1876	1879	3	1883	4
Uruguay	1891	1892	1	1892	0
Uruguay	1915	1922	7	1926	4
Uruguay	1932	1939	7	1992	53
Uruguay	1965	1966	1	1992	26
Uruguay	1983	1992	9	1992	0
Uruguay	2003	2004	1	2005	1
Venezuela	1826	1841	15	1863	22
Venezuela	1848	1863	15	1863	0
Venezuela	1865	1882	17	1896	14
Venezuela	1892	1893	1	1896	3
Venezuela	1898	1906	8	1952	46
Venezuela	1960	1961	1	1970	9
Venezuela	1983	1991	8	1991	0
Venezuela	1995	1998	3	1998	0
Venezuela	2004	2006	2	2006	0
Venezuela	2017	-	-	-	-

*Notes:* The table lists the start date of a default, the first year after its end, the years until the end of default, the year of resumption and the years till resumption for each default period of American countries. Resumption is defined as the time from the first year after the end of a default or a restructuring period until the year of the first new issuance in international capital markets.

**Table A.15:** Africa: Sovereign default and resumption of market access I

Country	Default start	Year after default	Years till default end	Year of resumption	Years till resumption
Angola	1985	-	-	-	-
Benin	1983	1990	7	2019	29
Cote d'Ivoire	1983	2013	30	2014	1
Cameroon	1985	2006	21	2015	9
Democratic Republic of Congo	1961	1962	1	1973	11
Democratic Republic of Congo	1975	2011	36	-	-
Congo	1983	2011	28	-	-
Congo	2016	-	-	-	-
Algeria	1991	1997	6	-	-
Egypt	1876	1881	5	1885	4
Egypt	1931	1932	1	1977	45
Egypt	1984	1985	1	1986	1
Egypt	1987	1988	1	2010	22
Egypt	1991	1992	1	2010	18
Ethiopia	1990	2000	10	2014	14
Gabon	1978	1979	1	1979	0
Gabon	1986	1995	9	2007	12
Gabon	1999	2006	7	2007	1
Ghana	1966	1975	9	1981	6
Ghana	1987	1988	1	2007	19
Guinea-Bissau	1983	1997	14	-	-
Kenya	1992	1999	7	2014	15
Kenya	2000	2001	1	2014	13
Liberia	1874	1899	25	1908	9
Liberia	1912	1924	12	1926	2
Liberia	1932	1936	4	1976	40
Liberia	1963	1964	1	1976	12
Liberia	1968	1970	2	1976	6
Liberia	1980	2011	31	-	-
Lesotho	1990	1995	5	-	-
Morocco	1903	1905	2	1910	5
Morocco	1983	1984	1	1991	7
Morocco	1986	1991	5	1991	0
Madagascar	1981	2003	22	-	-
Mozambique	1980	1981	1	-	-
Mozambique	1983	1993	10	-	-
Mozambique	2016	-	-	-	-
Malawi	1982	1989	7	-	-
Niger	1983	1992	9	-	-
Nigeria	1982	1994	12	2011	17
Nigeria	2001	2002	1	2011	9
Nigeria	2004	2006	2	2011	5
Sudan	1975	-	-	-	-
Senegal	1981	1986	5	2009	23
Senegal	1990	1997	7	2009	12

*Notes:* The table lists the start date of a default, the first year after its end, the years until the end of default, the year of resumption and the years till resumption for each default period of African countries. Resumption is defined as the time from the first year after the end of a default or a restructuring period until the year of the first new issuance in international capital markets.



**Table A.16:** Africa: Sovereign default and resumption of market access II

Country	Default start	Year after default	Years till default end	Year of resumption	Years till resumption
Sierra Leone	1977	1996	19	-	-
Sierra Leone	2018	-	-	-	-
Seychelles	1977	1978	1	1981	3
Seychelles	1980	1981	1	1981	0
Seychelles	1984	1985	1	2006	21
Seychelles	2000	2003	3	2006	3
Seychelles	2008	2014	6	-	-
Tunisia	1867	1871	4	1884	13
Tunisia	1956	1957	1	1957	0
Tunisia	1958	1959	1	1959	0
Tunisia	1963	1964	1	1977	13
Tunisia	1979	1983	4	1983	0
Tanzania	1981	2005	24	2013	8
Uganda	1979	1994	15	-	-
South Africa	1985	1988	3	1991	3
South Africa	1989	1990	1	1991	1
South Africa	1993	1994	1	1994	0
Zambia	1983	1995	12	2012	17
Zimbabwe	1965	1981	16	1988	7
Zimbabwe	2000	2006	6	-	-
Zimbabwe	2007	-	-	-	-

*Notes:* The table lists the start date of a default, the first year after its end, the years until the end of default, the year of resumption and the years till resumption for each default period of African countries. Resumption is defined as the time from the first year after the end of a default or a restructuring period until the year of the first new issuance in international capital markets.

**Table A.17:** Asia: Sovereign default and resumption of market access

Country	Default start	Year after default	Years till default end	Year of resumption	Years till resumption
China	1921	1937	16	1938	1
China	1939	1950	11	1987	37
Indonesia	1966	1971	5	1979	8
Indonesia	1975	1976	1	1979	3
Indonesia	1999	2001	2	2004	3
Indonesia	2002	2003	1	2004	1
Iran	1978	1996	18	2002	6
Iraq	1986	2007	21	2017	10
Jordan	1989	1994	5	2004	10
Kazakhstan	1993	1995	2	1996	1
Kazakhstan	1998	2000	2	2000	0
Laos	1975	1988	13	2019	31
Lebanon	2020	-	-	-	-
Sri Lanka	1979	1980	1	1994	14
Sri Lanka	1981	1984	3	1994	10
Myanmar	1997	2006	9	-	-
Myanmar	2007	-	-	-	-
Pakistan	1971	1976	5	1996	20
Pakistan	1981	1982	1	1996	14
Pakistan	1998	2000	2	2004	4
Philippines	1969	1971	2	1978	7
Philippines	1983	1993	10	1993	0
Thailand	1946	1948	2	1984	36
Tajikistan	1994	2007	13	2017	10
Tajikistan	2010	2013	3	2017	4
Turkey	1876	1882	6	1886	4
Turkey	1915	1929	14	1929	0
Turkey	1931	1934	3	1934	0
Turkey	1940	1944	4	1987	43
Turkey	1956	1957	1	1987	30
Turkey	1958	1959	1	1987	28
Turkey	1963	1964	1	1987	23
Turkey	1965	1966	1	1987	21
Turkey	1971	1972	1	1987	15
Turkey	1973	1974	1	1987	13
Turkey	1976	1983	7	1987	4
Vietnam	1982	1999	17	2005	6

*Notes:* The table lists the start date of a default, the first year after its end, the years until the end of default, the year of resumption and the years till resumption for each default period of Asian countries. Resumption is defined as the time from the first year after the end of a default or a restructuring period until the year of the first new issuance in international capital markets.

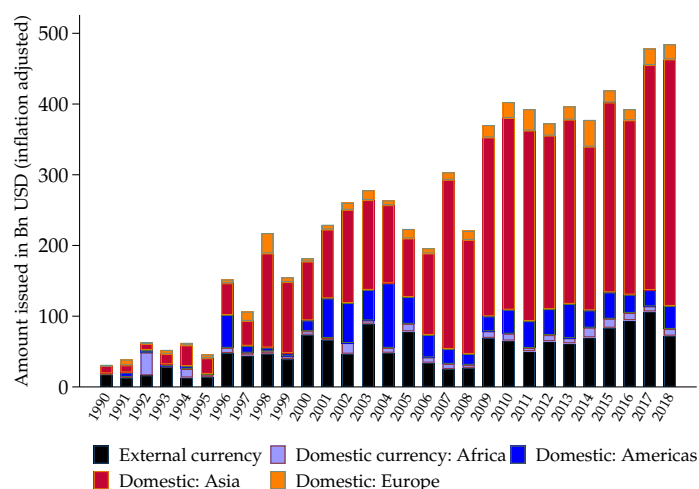
**Table A.18:** Europe: Sovereign default and resumption of market access

Country	Default start	Year after default	Years till default end	Year of resumption	Years till resumption
Albania	1991	1996	5	2010	14
Bulgaria	1915	1921	6	1923	2
Bulgaria	1932	1949	17	2001	52
Bulgaria	1990	1995	5	2001	6
Bosnia and Herzegovina	1992	1998	6	2018	20
Croatia	1992	1997	5	1997	0
Hungary	1931	1938	7	1980	42
Hungary	1941	1968	27	1980	12
Macedonia	1992	1998	6	2005	7
Poland	1936	1938	2	1938	0
Poland	1940	1957	17	1995	38
Poland	1981	1995	14	1995	0
Romania	1933	1959	26	1996	37
Romania	1981	1984	3	1996	12
Romania	1986	1987	1	1996	9
Russia	1839	1840	1	1850	10
Russia	1885	1886	1	1888	2
Russia	1917	1987	70	2010	23
Russia	1991	2001	10	2010	9
Yugoslavia	1895	1896	1	1897	1
Yugoslavia	1933	1961	28	2005	44
Yugoslavia	1965	1970	5	2005	35
Yugoslavia	1983	2005	22	2005	0
Ukraine	1998	2001	3	2003	2
Ukraine	2015	2016	1	2017	1

*Notes:* The table lists the start date of a default, the first year after its end, the years until the end of default, the year of resumption and the years till resumption for each default period of European countries. Resumption is defined as the time from the first year after the end of a default or a restructuring period until the year of the first new issuance in international capital markets.

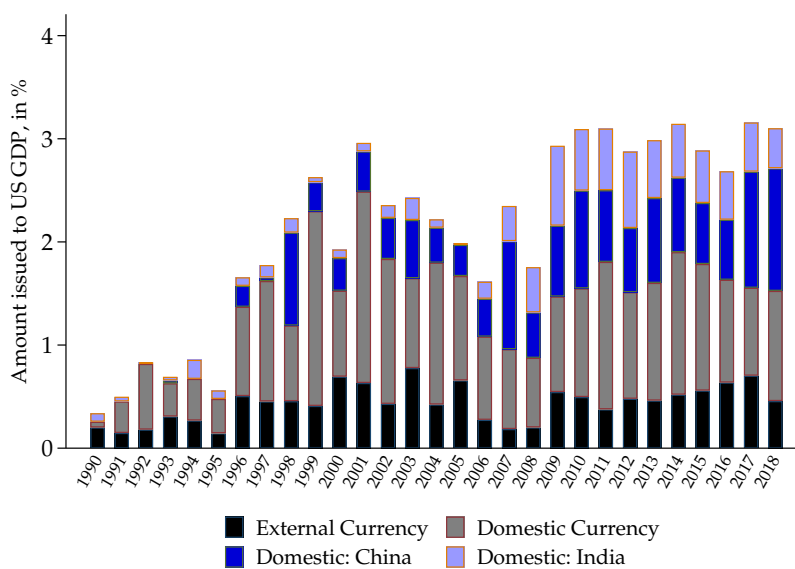
### A.3.5 Stylized fact 4: Domestic bond issuance boom

**Figure A.18:** Domestic bonds of maturity of four years or more by regions

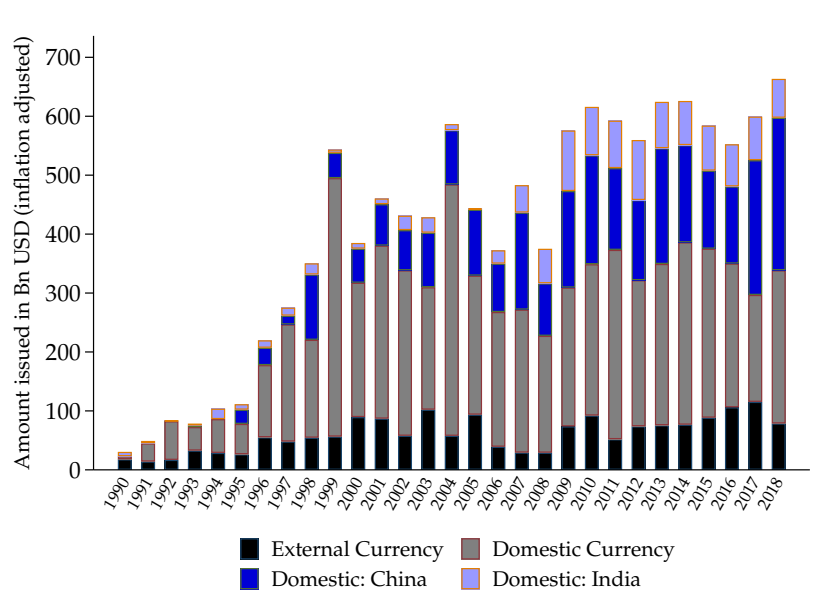


*Notes:* The figure shows the bond issuance volume split by external and domestic currency for all bonds with a maturity of four years or more. The domestic issuances are split across the four major regions: Africa (light blue), Americas (blue), Asia (red), Europe (orange). The graph shows that the strong increase in domestic issuances is driven by issuances from Asia which is line with Figure 1.14. The big spike in 2004 is driven by a large Mexican bond issuance.

**Figure A.19:** Domestic bond issuance volume to US GDP



*Notes:* The figure shows the bond issuance volume split by external and domestic currency as a share of US GDP. Among domestic issuance shares, China and India are plotted separately in dark and light blue, respectively. Similar to Figure 1.14 which plots the real US dollar amount of bond issuances over time, the share of bond issuances relative to US GDP has also seen a strong increase – especially in domestic markets.

**Figure A.20:** Domestic bonds of maturity of two years or more

*Notes:* The figure shows the bond issuance volume split by external and domestic currency for all bonds of maturity of two years or more. Among domestic issuance shares, China and India are plotted separately in dark and light blue, respectively. Similar to Figure 1.14 which plots the real US dollar amount of all bond issuances with a maturity of more than four years, including all issuances with a maturity of two or three years hardly changes the picture of a strong increase in both external and domestic currency issuances.

## Chapter 2

# Global Commodity Markets and Sovereign Risk across 150 Years

This chapter of the dissertation is co-authored with Angélica Domínguez-Cardoza and Josefin Meyer.<sup>1</sup>

**Abstract:** How do commodity price movements affect sovereign default risk over the long-run? Using a novel dataset covering 41 countries and 42 raw commodities, we take a comprehensive long-run view to shed light on this so far understudied relationship between commodity risk and sovereign risk across 150 years. We create a novel country-specific commodity price index that allows us to take advantage of countries' variation in their commodity export compositions. Our results are twofold: first, commodity price fluctuations show a persistent association with sovereign borrowing costs for countries that are commodity export dependent across the last one and a half centuries. Second, historically this relationship was driven by agricultural price movements; today it is driven by mineral and energy price movements.

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<sup>1</sup>We received very helpful comments from Christoph Trebesch, Radost Holler, Menusch Khadjavi, Marcel Peruffo, Carmen Reinhart, Christopher Schang and we thank Alexander Marx, Johannes Moser and Brenton Stefko for their assistance on collecting and cleaning parts of the data.

## 2.1 Introduction

Volatile yield spreads can lead to volatile business cycles, which in turn can lead to volatile economic growth (see Neumeyer and Perri (2005), Uribe and Yue (2006)). We show that sharp drops in commodity prices are associated with surges in yield spreads. This link between commodity price movements and sovereign default risk has not been sufficiently studied; especially in the long-run. We are the first to examine country-specific commodity price movements over 150 years and relate these movements to sovereign default risk. In addition, we examine another dimension of the resource curse phenomenon by focusing on not just the negative impact of resource wealth on economic growth but also on how financial markets value credit risk of commodity rich countries that depend on unstable revenue flows. Using a novel dataset covering 41 countries and 42 raw commodities (abbreviated to “commodities” from here on) we show that there is a persistent relationship between sovereign default risk and commodity price movements across the entire sample period. The only changing factor is the export composition: while historically agricultural price movements were the main driver behind this relationship, today metals/minerals and energy price movements are associated with this relationship.<sup>2</sup>

Across the last 150 years, the relationship between commodity dependence and sovereign risk has revealed itself in several examples. One prime example is the Sub-Saharan African crisis of 2014 that came with a rebound of public debt burdens due to a fall in commodity prices (Shanta Devarajan and Karakülah, 2019). As a result, several indebted commodity exporters suffered from severe debt distress (Shanta Devarajan and Karakülah, 2019).<sup>3</sup> Similarly, the 1930s debt crisis also started with a decline in commodity prices (Marichal, 2000). Examining 150 years of historical commodity price movements, we confirm that while the group of commodities driving default risk has shifted over the years, the general link between commodity price movements and sovereign risk is still present.

The relationship between commodity price movements and sovereign default risk can be explained as follows: the share of countries that are heavily dependent on commodity exports make up for more than 50% of all countries worldwide (UNCTAD, 2019). Commodity dependence has in many cases led to vulnerabilities and poverty among resource-rich economies in which commodity exports are the countries’ main source of income (Fernández et al., 2020). In these countries commodity price fluctuations interrupt the government’s revenue streams. These revenue streams determine whether resource-rich countries are able to make investments, spend money on education, and eventually are able to service their debt. This is the case as the countries’ terms of trade directly contribute to the availability of foreign-currency reserves which in turn affects ability of these countries to service foreign-currency debt and thus their

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<sup>2</sup>We refer to minerals and metals when we speak of minerals from here on.

<sup>3</sup>According to Brahim Sangafowa Coulibaly and Senbet (2019) the median debt-to-GDP rebounded to 53% in 2017 from 31% in 2012 after the debt relief initiative for “heavily indebted poor countries”. Due to the long decline in commodity revenues based on slumps in exports and due to proportionally lower tax collection leading to larger primary deficits, and increasing debt burdens.

default decision (Bulow and Rogoff, 1989*a,b*).

We aim to add to the research canon by capturing the persistent relationship between global commodity markets and sovereign risk across 150 years, adding a country-specific component to global commodity price movements to explain sovereign risk movements. Chen and Rogoff (2003) argue that these price movements can be seen as exogenous as world prices move independently for countries that are price takers, i.e. countries that might export a significant quantity of commodities from a domestic perspective (relative to total GDP output) but a quantity that is relatively small on a global scale and that does not impact global prices. This exogeneity remains even when a country-specific component is added to the analysis (by weighting the price data by each country's export share). Although we do not control for price makers explicitly in our analysis, we are able to provide first evidence on the correlational relationship between commodity price movements and sovereign risk over the long-run.

We base our approach on a novel dataset made up of micro-level country-specific raw commodity export data used to weight global commodity prices given in US dollars. The result is a country-specific commodity index that is time-variant and covers up to 42 globally traded commodities for each commodity dependent country in our sample. By employing time-variant export shares we are able to capture changes in the countries' export structures, which have changed strongly in almost all countries in our sample over the last one and a half decades. To filter out imminent changes in exports that could drive changes in our country-specific price index, we apply moving averages (from  $t - 3$  to  $t - 1$ ) instead of using the ratio in period  $t$ .<sup>4</sup>

Since we analyze 150 years of historical data, our analysis provides us with an advantage over short- and medium-term analyses for which a sufficient number of sharp sovereign yield spread increases are not available.<sup>5</sup> Our paper adds a new angle to established literature that tends to focus on shorter time periods of the more recent past. Additionally, using long-run data also allows us to study periods with different institutional settings and different degrees of global integration and disintegration.

Our regressions outcomes show that a 1% increase in our country-specific commodity price index is associated on average with a decrease in sovereign yield spreads of 0.86 percentage points. In a standardized setup, we find that an increase of the price index by one standard deviation is associated on average with a decrease in sovereign yield spreads of 0.17 percentage points. When comparing this effect to the impact of other global driving forces such as the stock market volatility of leading financial markets, the results highlight that in magnitude the effect is more than double in size. By studying our sample in separation for the historical (pre 1970) and the modern bond era (post 1993), we find that today this relationship is

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<sup>4</sup>Additionally, this allows us to control for abrupt increases/drops in commodity exports in cases for which the splice between commodity export sources is rocky.

<sup>5</sup>We focus on sovereign yield spreads of hard-currency (US dollar and British pound) bonds and we exclude periods of actual default events in our analysis to circumvent spurious results. Given the former, we do not cover countries that have never issued debt on international capital markets.



particularly pronounced for oil-dependent and mineral-dependent exporters. In history, this relationship was pronounced among agricultural exporters.

The granularity of our data allows us to investigate this relationship further by splitting our price index into three major subgroups: energy, agricultural and mineral/metal raw commodities. Additionally, due to the long time horizon that we cover, we are also able to differentiate between time episodes. We find that agricultural commodity price drops had the most profound pass-through effect on sovereign risk in the historical era. This is not surprising as most of the countries were preponderantly rural economies during this time period. Over the course of the second half of the 20th century, this dependence has gradually declined while energy commodity exports have gained ground. In turn, we find that slumps in energy prices increase the default risk of energy-heavy exporters today.

To test the robustness of our results we perform several sensitivity checks. First, we use GDP as a measure for economic performance in weighting our country-specific commodity prices. We do so to allow for comparability with literature that focuses its analysis on the more recent past only (e.g. Bazzi and Blattman (2014)). Second, we employ time-invariant weights when calculating our commodity price index. The use of time-invariant weights guarantees that fluctuations in exports are not hidden driver of changes in our price index. Third, we use two commodity price indices by Gruss and Kebhaj (2019) (one time variant, one time invariant) in our regression setup to further allow for comparability with the literature. All of these specifications support our baseline finding.

To test the robustness in terms of sovereign default risk, we apply an additional measure for sovereign risk, the inverse of the institutional investor index (ICCR). Although the institutional investor index is only available from the late 1970s onwards, it provides comparability with literature where the institutional investor index is a common proxy for sovereign risk (e.g. see Hamann et al. (2018)). It also covers the 1980s during which the largest wave of sovereign defaults of the post World War II era emerged. In that sense, the ICCR is able to measure the risk for countries that were periodically excluded from international capital markets.

To control for specific observations or even entire countries that might drive our results, we run a leave one (country) out regression. Lastly, we repeat our analysis by including additional fixed effects and by including default episodes back into our sample. All of these specifications support the result of our baseline analysis and underpin the importance of commodity price fluctuations for sovereign default risk among commodity dependent countries.

So far, the focus of the literature has primarily been on studying separately the relationship between commodity price movements and macroeconomic performance and the connection between global financial factors and sovereign risk. This paper bridges these two strands of literature by connecting sovereign risk

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to the global commercial channel over the very long-run.

On a general level, our paper adds to the question of what are factors that are associated with sovereign default risk. Ang and Longstaff (2013) as well as Pan and Singleton (2008) show the dependence of sovereign risk to global financial market variables such as global volatility as measured by the VIX. By analyzing a country-specific measure of global commodity price movements with global financial and macroeconomic variables in our regression setups we add an additional layer to the factors associated with sovereign default risk that combines global movements with local conditions.

Our paper also adds to literature that studies movements in commodity prices. A significant portion of literature focuses on boom and bust episodes of commodity cycles. Jacks (2013) studies commodity prices over the long run. He identifies nine booms and busts in real commodity prices between 1900 and 2015. Kilian (2009) studies supply and demand shocks in the oil market using a VAR approach. He shows that disentangling demand from supply shocks is important due to the differences in their implications for the macroeconomy. We go beyond binary measures of global price boom and bust periods and instead introduce country-specific commodity movements captured via our country-specific commodity price index.

Our paper also adds to literature that emphasizes that commodity price fluctuations not only influence the real, but also the financial sector. Work by Lane (2003), Céspedes and Velasco (2012) and Drechsel and Tenreyro (2018) examines how global commercial factors such as global commodity prices are transmitted to emerging markets' business cycles and macroeconomic stability. Mendoza (1995), Spatafora and Tytell (2009), Shousha (2016), Fernández et al. (2017) and Fernández et al. (2018) go one step further by accounting for financial frictions in their analyses. To this literature, knowing what the size of the effect of sovereign risk is on macroeconomic variables such as GDP is extremely important. We add to this by introducing an explicit commodity channel that links commodity price fluctuations and sovereign risk.

Our paper disentangles the relationship between commodity price movements and sovereign default risk not just over the short- but also over the very long-run. Literature that explicitly study the terms of trade as a driving factor for sovereign default risk mostly concentrate around the more recent past. Hilscher and Nosbusch (2010) accounts for country-specific commodity price indices in determining the driving forces of sovereign yield spreads. Based on data for the period 1998 to 2007, the authors find that the volatility in their terms of trade measure drives yield spreads even when controlling for macroeconomic and global factors. Other papers that rest their analyses on the more recent past put exporters and producers of energy commodities in the spotlight. Hamann et al. (2018) examine the link between international oil price movements and sovereign risk for the 30 largest emerging market oil price exporters from 1970 to 2010. In the same vein, Bouri et al. (2019) study the link between oil and gas reserves on sovereign

spreads for 10 emerging oil-exporting countries from 1994 to 2014. They find that oil reserves have an effect on sovereign spreads conditional to the institutional quality in terms of corruption, political stability and democracy of the country. We add to this literature by covering not just energy, but also mineral and agricultural commodity price movements across the last 150 years. On top of that, we confirm the findings by Hamann et al. (2018) that energy price movements are associated with sovereign risk.

Our work provides new insights into the relationship between commodity price movements and sovereign default risk in history, implying that commodity rich countries' finances were once more commodity dependent in history than they are today. Little attention has been attributed to international commodity movements as an explanatory factor for sovereign risk from a historical angle. The only paper that we are aware of that studies the long-run effect of global commercial factors on sovereign risk is Reinhart et al. (2016). They find evidence that changes in global capital flows and commodity price movements correlate negatively with the probability of sovereign default over the last 200 years. However, in contrast to our commodity price index, their measure is based on an international primary commodity price index that does not account for the country-specific exposure to international commodity price movements.

To a lesser extent, our paper also contributes to research that focuses on the impact of resource dependence on developing outcomes e.g. economic growth, conflict or institutions. Such research can be summarized under the term "resource curse"-literature. The "resource curse"-hypothesis says that many resource-rich countries fail to fully benefit from their large commodity shares. It also implies that resource-rich countries tend to see higher rates of conflict, and lower rates of economic stability or economic growth. However, evidence on this hypothesis remains mixed.<sup>6</sup> This is also true in the context of sovereign defaults.<sup>7</sup> Arezki and Brückner (2012) show that an increase in commodity prices reduces external debt levels in democracies but not in autocracies. In contrast to their paper, our setup uses the countries' political regime as a driving factor of sovereign risk, while controlling for the countries' debt to GDP level.

The remainder of the paper is structured as follows. Section 2.2 introduces our data sample and the construction of our two main variables of interest: the country-specific commodity price index and the sovereign bond yield spreads. Section 2.3 provides first descriptive evidences on the relationship between country-specific commodity price movements and sovereign risk as captured by sovereign yield spreads. Section 2.4 builds on this introduction and provides our empirical analysis based on fixed effects regressions. Section 2.5 concludes.

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<sup>6</sup>See for an overview van der Ploeg (2011) and van der Ploeg and Poelhekke (2017).

<sup>7</sup>One major issue with regard to the sovereign risk context is that countries at the very low end of the income spectrum that particularly suffer from the resource curse do not have regular market access which introduces this kind of analysis to sample bias which weakens the relationship.

## 2.2 Methods and data

This section introduces our novel dataset of country-specific commodity price indices and sovereign yield spreads in an unbalanced panel setup covering the last 150 years. With our analysis, we aim to draw an encompassing picture on the relationship between commodity dependence and sovereign risk that is not limited to specific time periods or country groups.

### 2.2.1 Country sample

We assemble our country sample with the goal of covering the most important commodity dependent countries. We start by introducing the term “commodity dependence” to be able to select countries that have exports primarily made up of raw commodities. To measure commodity dependence we begin by following the definition of the UNCTAD’s yearly published state of commodity dependence reports. The UNCTAD classifies every country worldwide for which it has commodity export information as agricultural, energy, or mineral dependent countries. Its classification of commodity dependence is based on a threshold that says that at least 60% of total merchandise exports do need to be composed of commodities (in value terms). We employ our export data to this definition by taking the average of all raw commodities in total exports for every country for the historical era (pre 1970) and define a country as commodity dependent if this share crosses the threshold of 60%. For the modern bond period (post 1993) we have lowered the threshold to 25% as the global economy has broadly shifted from exporting raw commodities to exporting products based on these raw commodities. Based on these criteria, a country is included in our sample if it is able to cross at least one of the thresholds, i.e. if it appears in at least one of the two periods.<sup>8</sup>

Given this definition,<sup>9</sup> we have created a sample of commodity dependent nations for which we were able to collect data on commodity exports, commodity prices and sovereign yield spreads. In total, our country sample covers 41 nations. These countries are: Australia, Argentina, Bolivia, Brazil, Cuba, Chile, Colombia, Costa Rica, Cote d’Ivoire, Dominican Republic, Ecuador, Egypt, El Salvador, Bulgaria, China, Poland, Romania, Ghana, Guatemala, Honduras, Indonesia, Jamaica, Malaysia, Mexico, New Zealand, Nigeria, Pakistan, Panama, Paraguay, Peru, Philippines, Russia, Thailand, Trinidad and Tobago, Uruguay, Venezuela. Additionally, we include Canada, India, Japan, South Africa and Turkey that came with export values in at least one of these commodities that constituted a relatively high share in their total export structure at some point in history. In return, these countries were also strongly exposed to price movements in their specialized commodities at some point in history.

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<sup>8</sup>If the threshold is crossed only in the modern bond era, the country becomes a member of the sample for the entire time period from 1865 to 2015.

<sup>9</sup>To determine the threshold we have applied all available commodity export data and not just the export data of the 42 commodities we eventually use.

## 2.2.2 Commodity sample

To construct our commodity sample, we closely follow Jacks (2013) in the approach that he applies to construct his sample of international commodity market prices. Jacks (2013) collects commodity prices for 40 commodities that together represent a significant share in global economic activity during the period of 1865 to 2015 (Jacks, 2013). Among these commodities are aluminium, barley, bauxite, beef, chromium, coal, cocoa, coffee, copper, corn, cotton, cotton seed, hides, iron, lamb, lead, manganese, natural gas, nickel, palm oil, peanuts, petroleum, phosphate, pork, rice, rubber, rye, silver, sugar, tea, tin, tobacco, wheat, wool and zinc.<sup>10</sup> Additionally, we add jute, opium, olive oil, lumber, meat, butter and nitrate to the commodity group as for some countries these commodities were of prime importance, e.g. historically Chile heavily specialized in exporting nitrate and Turkey heavily exported opium. Taken together, these 42 commodities cover the following three broad categories: agricultural commodities, mineral commodities and energy commodities.

## 2.2.3 A country-specific commodity price index

We create a country-specific commodity price index to study the effect of commodity price movements on sovereign risk for the group of commodity dependent countries. As the effect of global price movements vary across countries due to differences in the countries' respective import and export compositions, it is crucial to link global price movements to the countries' export structures to capture the actual country-specific effect. We do so by constructing a country-specific commodity price index that weights global commodity price movements by each country's share of commodity exports in economic performance.

We calculate our logged country-specific commodity index  $PriceIndex_{i,t}$  by:<sup>11</sup>

$$PriceIndex_{i,t} = \sum_{j=1}^J P_{j,t} \Omega_{i,j,t}, \quad (2.1)$$

with

$$\Omega_{i,j,t} = \frac{1}{3} \sum_{k=1}^3 \frac{Export_{i,j,t-k}}{TotalExports_{i,t-k}}, \quad (2.2)$$

where  $\Omega_{i,j,t-k}$  represents country  $i$ 's export of commodity  $j$  in period  $t-k$  in total exports. The nominator of Equation 2.2 describes total exports and is supposed to measure economic performance. We use total exports instead of GDP as GDP was not yet a commonly used metric globally in the 19th century.<sup>12</sup> The global price  $P_{j,t}$  of each commodity  $j$  in a given year  $t$  is logged and deflated (2000 = 100) using the US

<sup>10</sup>We exclude gold, as we cannot clear cut differentiate between gold as a commodity and gold as a medium of exchange. Additionally, we do not cover potash and sulfur due to missing data. The commodities platinum and steel are already included in COMTRADE's SITC Rev. 1 of silver and iron, respectively. Hence, we do not include them as separate commodities.

<sup>11</sup>By constructing the index we follow closely the methodology of Bazzi and Blattman (2014) and Gruss and Kebhaj (2019).

<sup>12</sup>As a robustness check, we employ GDP as our measure of performance.

Consumer Price Index. We use logs due to large outliers in some price series (such as rubber) and use the US Consumer Price Index to deflate the series as prices are dollar-denominated. We exclude re-exports and employ time-varying weights of lagged average commodity exports for the years  $t - 1$  to  $t - 3$ , which makes the export share predetermined to price changes in period  $t$ . Although the use of time-invariant weights would help to clearly differentiate between price and quantity movements, we choose time-variant export shares as we cover over 150 years of movements in which the composition of major commodity exports as well as the importance of specific export shares in output can change significantly.<sup>13</sup>

To construct the country-specific commodity index, we rely on two main sources for export data: For the time period starting in the 1960s, we have collected export data for our selected group of 42 individual commodities based on the UNCTAD's statistical classification of the commodities entering external trade (SITC 1 and its subcomponents) for each country. For the period before 1960, we rely on commodity data from Mitchell's International Historical Statistics 1750-2010. To construct the final database, we match our commodity data from Mitchell's International Historical Statistics 1750-2010 with the data from UNCTAD. In doing so, we extend the UNCTAD database backwards in history for the 42 raw commodities that are based on the SITC 1 in its subcomponents. Lastly, we fill remaining gaps with raw commodity export data from Moody's Manual of Investments, The Statistical Abstract for British Self-Governing Dominions and Bazzi and Blattman (2014).

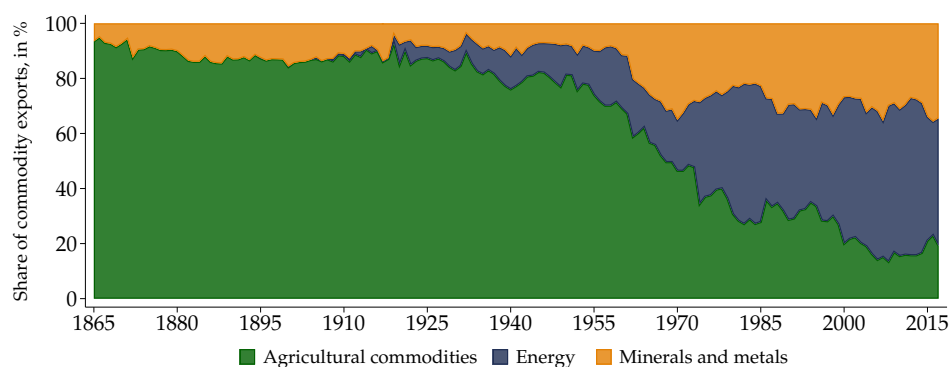
As it can be seen from Figure 2.1, agricultural products have dominated raw commodity exports in history, while energy has become more important over the last couple of decades. The share of mineral exports has been stable over the years and has increased only slightly since the 1960s. In 2015, each of the three commodity export groups made up for approximately one third of the export shares. To account for the evolution of export shares over time, we will include all three export groups in our analysis.<sup>14</sup> Additionally, in Appendix B.6 we plot each country's commodity composition as a share of total exports to allow for a deeper understanding of how the export composition structure of the countries in our sample have evolved (and in part heavily changed) over time.<sup>15</sup>

We use this export data to weight the international market prices of our 42 commodities to eventually create country-specific commodity price indices. We obtain price data from Jacks (2013) (1865-2015), extended using price data from Blattman et al. (2007) (1865-1950) and from Bazzi and Blattman (2014) (1957-2007). In few cases we also applied data from the Global Financial Database (jute and lumber) and from the Financial Reserve (for olive oil in the modern bond period). The individual price series are in US dollars, deflated by the US Consumer Price Index using data from Carmen Reinhart.

<sup>13</sup>As a robustness check, we employ time-invariant weights that are based on the average of commodity exports to total export between 1865 and 2015.

<sup>14</sup>In Appendix B.2 we show the distribution of export shares by these three commodity subgroups.

<sup>15</sup>In some cases, like for Cuba in the 1970s or for Colombia around 1900, data gaps become visible. For these cases the price index shows missings in the data.

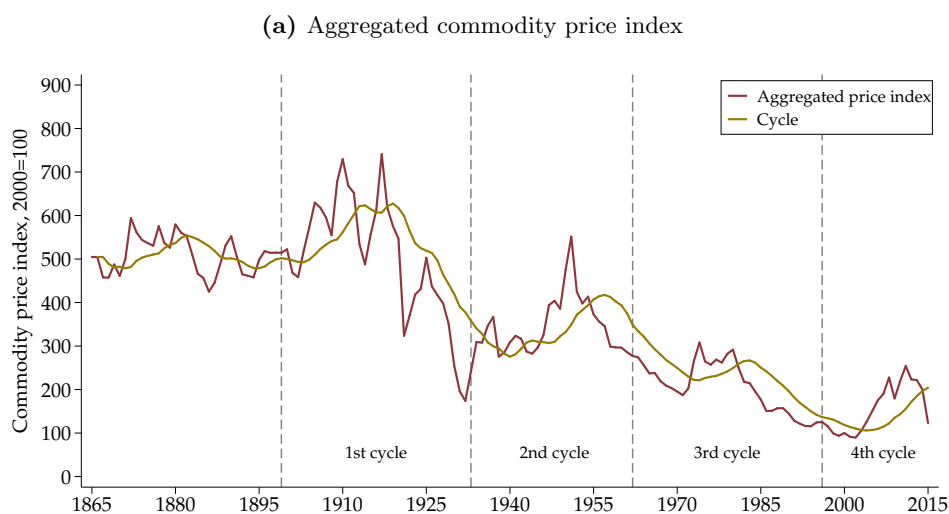
**Figure 2.1:** The evolution of commodity export distribution of commodity dependent countries

Notes: The figure shows the evolution of the share of commodity exports in minerals, agricultural products and energy in percentage points in total exports summarized for all countries in the sample.

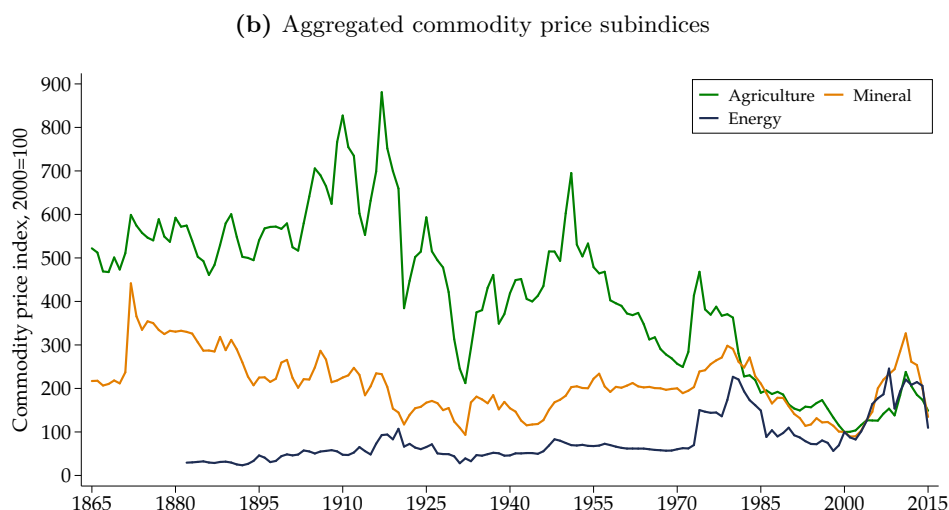
To examine the evolution of our price index over 150 years of time, we present the index in its aggregate over all 41 countries by following the methodology of the IMF Primary Commodity Price Index, using a weighted average of commodity price indices that represent the global market. Our index includes the prices of all 42 commodities in our sample deflated to 2000 = 100 values. Figure 2.2a plots our aggregated price index using prices of real commodity prices between 1865 and 2015 against its 10-year moving average, representing the indexes long run trend.

In total, there have been four cycles of the so called “commodity supercycle” in history (Erten and Ocampo, 2013). The black dashed vertical lines in Figure 2.2a highlight these four cycles. Our aggregated commodity price index, in particular its moving average (black line), fits well into the cycles found in the literature.

Although the second half of the 19th century was characterized by the “railroadization” of major industrial countries (Erten and Ocampo, 2013) and commodities such as coal, iron and wood used to build and maintain railways and steamships were in high demand, the first cycle did not start until 1899 (Erten and Ocampo, 2013). Buyuksahin et al. (2016) describes the beginnings of the four cycles in the following way: the first cycle was driven by the industrialization of the United States at the end of the 19th century. The second cycle started in 1933 due to global rearmament. The third cycle finds its roots in the reindustrialization of Europe and Japan that began in the late 1950s. Finally, the fourth cycle started in 1996 as a response to the urbanization, investment and an ascendant middle class in emerging markets. During this last cycle, China in particular supported the rise of commodity prices due to its surging demand for global metals and oil between 2002 and 2014.

**Figure 2.2:** Long-run trends in our aggregated country-specific commodity price index, 1865-2015

*Notes:* Figure 2.2a shows the total real aggregated price index from 1865 to 2015 and its trend. The price index is deflated to 2000-values and is described by the red solid line. It is a weighted average of the 42 commodities listed above. The weight is calculated based on the global export share over a three-year period, and is normalized to 100 at year 2000 prices. The light green line represents the aggregated price index's 10-year moving average. The grey dashed lines separate the different cycles of the supercycle as based on Erten and Ocampo (2013).



*Notes:* Figure 2.2b shows three aggregated commodity price subindices from 1865 to 2015. The agricultural price index (green line) comprises animal products, grains and soft commodities. The mineral price index (orange line) consists of metals, minerals and precious minerals. The energy price index (blue line) covers commodities such as oil and coal. All price indices are deflated to 2000-values.

The price swings within the supercycle have not all been alike. They affected countries with high export shares in commodities with volatile price dynamics more heavily than countries with low shares.<sup>16</sup> With regard to the four commodity price cycles, our data shows that rubber saw the strongest increase and fall during the first cycle. This was mainly driven by various transformations in this market: Originally, rubber extraction came with high costs (Frank et al., 2002). When low-cost plantations were built in

<sup>16</sup>Figure B.2 in Appendix B.3 plots the evolution of all 42 commodity prices in our sample.



Asia due to rapid commercialization in response to the automobile boom at the beginning of the 20th century the price of rubber began to fall (Frank et al., 2002). At the same time, the demand for tire products dropped due to the introduction of new technologies (Frank et al., 2002).

During the second cycle, the price of jute rose and fell the strongest in this period. The Indo-Pakistan subcontinent was the predominant producer of jute at the time (Pakistan Institute of Development Economics, 1960). In particular, the area which today forms Pakistan had more than 40% of total jute exports up until the 1960s (Pakistan Institute of Development Economics, 1960). The upswing in jute exports was followed by a gradual decline which was driven by the rise of cheaper commodities that served as a substitute for jute in material packaging (Pakistan Institute of Development Economics, 1960).

The third cycle saw a surge in sugar, cocoa and silver prices. Cuba (sugar), Ghana (cocoa) and Bolivia (silver) held the highest US dollar volumes in exports in these three commodities at the time. The cycle came to an end with the bust in oil prices in the 1970s which lasted until the mid 90s (Spatafora and Tytell, 2009). Finally, the fourth cycle drove phosphate, rubber and silver prices up. BRIC economies, and particularly China, had developed large metal- and energy-intensive industries that had driven up the demand for these raw commodities (Humphreys, 2010).

Although prices in agricultural, mineral and energy commodities have moved in synchrony at times in the past, the synchronization of the different commodity price cycles cannot be generalized. Additionally, given that countries do not export commodities at equal shares, it makes sense to look at the movements of subindices. Figure 2.2b breaks down our aggregated country-specific commodity price index into the three major sub-categories agricultural, energy and mineral products. The figure shows a strong fall in our agricultural commodity index over time which can be identified as the main driver behind the downward trend of our aggregated index. In return, the effect on countries that depended on exporting agricultural commodities in the past was immense. In our country sample, several governments heavily relied on export revenues coming from agricultural commodities in history.

Figure 2.2b also shows that the 1986-oil price crisis was followed by negative or stagnating commodity price movements. This period ended at the beginning of the 2000s when commodity prices increased substantially. This increase peaked in 2008 and was followed by a substantial reversal triggered by the Great Recession (Caballero et al., 2008). Although commodity prices rebounded quickly thereafter, they did not return to their pre-2013 levels but followed a downward trend that started in 2011. This commodity downturn covered a high range of commodities ranging from energy to agricultural raw materials and metals.

Having analyzed our country-specific commodity index on the aggregate level, we next study country-level

data. Table 2.1 shows summary statistics for the commodity price index (excluding periods of default).<sup>17</sup> While for most countries the dataset covers data for both the historical and the modern bond period, for some countries only data for the modern bond period is covered due to data limitations. Countries with missing data are Bulgaria, China, Cote d'Ivoire, Pakistan, Panama, Poland, Romania and Russia. We find that the number of data points varies widely from 3 for Cote d'Ivoire to 107 for Australia. Additionally, the distribution across time periods differs in line with a much longer historical bond period.<sup>18</sup>

#### 2.2.4 Sovereign bond yield spreads

We use yield spreads of hard-currency (US dollar and British pound) sovereign bonds to measure sovereign default risk. Sovereign bonds were the major borrowing source both today and before World War II (Fernandez-Ansola and Laursen, 1995). Additionally, sovereign default risk has been determined in international financial markets based on price formation in response to trading activities ever since the 19th century. By using sovereign yield spreads to measure sovereign risk, we are able to compare the historical bond era (pre 1970) with the modern bond era (post 1993).

We employ hard-currency (US dollar and British pound) sovereign bond yield spreads that are based on sovereign bond yield data from Meyer et al. (2019). For the historical era (pre 1970), the authors retrieve yield data from historical newspapers, such as *The Economist*, *Investors Monthly Manual*, *Bank and Quotation Records*, *Financial Times* and *Commercial Financial Chronicle*. As in the 19th and 20th century investors mainly relied on bond prices and regarded sovereign bonds as perpetuities (given that maturities were of 50 years on average compared to seven years in the modern era<sup>19</sup>), the current yield is used for the historical era, i.e. the coupon-market price ratio of a bond. For the modern sample period, foreign-currency yield data is based on stripped yields from the J.P. Morgan Emerging Market Bond Index Global (EMBIG). Based on this data, for each country in our sample we build an annual end of the year yield-spread series by using the 10-year UK bonds for British Pound-denominated bonds and 10-year US Treasury bonds for foreign US dollar-denominated bonds as the risk-free benchmark rate.

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<sup>17</sup>In Appendix B.4 we show the overlap in available data for both the commodity price index and sovereign yield spreads over time for all countries in our sample.

<sup>18</sup>Please note that the country-indices are not normalized at 2000 = 100 which explains why the maximum values for the country price indices are so low.

<sup>19</sup>These numbers refer to the sample employed in this paper.

**Table 2.1:** Summary statistics of commodity price index by country

Country	Total sample period, 1865-2015					Historical period, 1865-1970					Modern period, 1993-2015				
	N	Mean	SD	Min	Max	N	Mean	SD	Min	Max	N	Mean	SD	Min	Max
Argentina	90	3.0	1.2	1.3	4.9	75	3.3	1.1	1.6	4.9	15	1.6	0.2	1.3	1.9
Australia	107	4.0	0.7	2.6	5.7	101	4.0	0.8	2.6	5.7	6	3.9	0.1	3.8	4.0
Bolivia	12	2.4	1.1	1.3	4.0	8	1.7	0.5	1.3	2.6	4	3.8	0.3	3.3	4.0
Brazil	95	3.6	1.2	1.4	6.2	70	4.2	0.8	2.4	6.2	25	2.1	0.7	1.4	4.0
Bulgaria	17	1.8	0.6	1.2	3.5						17	1.8	0.6	1.2	3.5
Canada	104	2.0	0.5	0.9	2.9	101	2.0	0.5	0.9	2.9	3	1.9	0.1	1.9	2.0
Chile	105	2.3	1.5	0.4	4.9	82	2.1	1.5	0.4	4.9	23	3.2	0.9	1.9	4.8
China	22	0.4	0.1	0.3	0.6						22	0.4	0.1	0.3	0.6
Colombia	87	3.5	1.2	1.0	5.8	64	3.7	1.4	1.0	5.8	23	3.2	0.7	2.4	4.4
Costa Rica	51	2.3	0.7	0.2	3.4	47	2.4	0.4	1.7	3.4	4	0.2	0.0	0.2	0.2
Cote d'Ivoire	3	3.7	0.3	3.4	4.0						3	3.7	0.3	3.4	4.0
Cuba	56	4.9	0.7	3.6	6.5	53	4.9	0.7	3.6	6.5	3	5.7	0.7	5.0	6.4
Dominican Republic	36	4.1	0.9	2.2	5.9	22	4.6	0.4	4.1	5.9	14	3.2	0.9	2.2	4.5
Ecuador	17	2.8	0.7	1.8	4.2	1	4.2		4.2	4.2	16	2.7	0.6	1.8	3.4
Egypt	88	4.0	0.9	1.7	5.8	73	4.3	0.7	2.8	5.8	15	2.6	0.5	1.7	3.5
El Salvador	64	3.5	1.6	0.6	5.7	46	4.3	0.8	1.9	5.7	18	1.4	1.2	0.6	3.6
Ghana	46	2.6	1.2	0.3	4.9	38	2.8	1.3	0.3	4.9	8	1.8	0.5	1.1	2.5
Guatemala	35	3.8	1.0	1.4	5.8	31	3.9	1.0	1.4	5.8	4	2.9	0.1	2.7	3.0
Honduras	16	0.6	0.9	0.1	2.5	13	0.1	0.0	0.1	0.2	3	2.3	0.2	2.1	2.5
India	64	1.0	0.3	0.5	1.6	60	0.9	0.2	0.5	1.3	4	1.6	0.1	1.5	1.6
Indonesia	22	3.3	0.9	1.9	4.6	10	4.0	0.6	3.2	4.6	12	2.6	0.4	1.9	3.0
Jamaica	69	1.1	0.7	0.3	3.3	62	1.1	0.7	0.3	3.3	7	1.6	0.2	1.2	1.9
Japan	50	0.5	0.4	0.0	1.1	40	0.3	0.3	0.0	0.9	10	0.9	0.1	0.8	1.1
Malaysia	68	2.1	1.5	0.3	5.4	48	2.4	1.6	0.3	5.4	20	1.2	0.3	0.8	1.7
Mexico	85	2.5	1.2	0.5	4.6	56	3.2	0.8	1.7	4.6	29	1.2	0.7	0.5	2.7
New Zealand	104	4.1	0.6	2.9	6.3	98	4.1	0.6	2.9	6.3	6	4.2	0.2	4.0	4.5
Nigeria	58	4.8	0.5	3.9	5.8	43	4.9	0.5	4.2	5.8	15	4.5	0.4	3.9	5.1
Pakistan	14	0.8	0.3	0.5	1.1						14	0.8	0.3	0.5	1.1
Panama	19	0.9	0.2	0.6	1.5						19	0.9	0.2	0.6	1.5
Paraguay	13	1.9	0.5	1.2	2.4	10	2.1	0.3	1.6	2.4	3	1.2	0.0	1.2	1.3
Peru	78	4.0	1.2	1.8	6.4	53	4.5	0.9	2.9	6.4	25	2.9	0.8	1.8	4.2
Philippines	34	1.3	1.4	0.1	3.8	4	3.0	0.1	3.0	3.1	30	1.1	1.3	0.1	3.8
Poland	21	0.9	0.2	0.7	1.5						21	0.9	0.2	0.7	1.5
Romania	4	0.9	0.1	0.9	1.0						4	0.9	0.1	0.9	1.0
Russia	15	3.7	0.5	2.9	4.3						15	3.7	0.5	2.9	4.3
South Africa	102	1.3	0.9	0.0	3.9	80	1.2	0.9	0.1	3.9	22	1.5	1.0	0.0	2.6
Thailand	55	4.2	1.7	0.5	6.6	46	4.9	0.8	3.5	6.6	9	0.6	0.1	0.5	0.7
Trinidad and Tobago	75	2.5	0.8	1.2	4.1	70	2.4	0.8	1.2	3.9	5	3.4	0.5	2.8	4.1
Turkey	60	1.0	0.5	0.4	2.7	40	1.0	0.6	0.4	2.7	20	0.9	0.1	0.7	1.1
Uruguay	100	3.8	1.0	1.7	5.6	76	4.1	0.7	2.2	5.5	24	2.9	1.2	1.7	5.6
Venezuela	68	3.5	0.9	1.8	4.9	44	3.1	0.8	1.8	4.8	24	4.2	0.5	3.2	4.9
Total	2229	2.8	1.6	0.0	6.6	1665	3.1	1.6	0.0	6.6	564	2.1	1.4	0.0	6.4

*Notes:* The table lists summary statistics by country and time period for the commodity price index for the entire sample period, for the modern bond era (1993-2015) only, and for the historical era (1865-2015) only.

Table 2.2 shows summary statistics by country for sovereign yield spreads, excluding actual default events. In order to control for outlier events, we winsorize our spread variable with cuts at the 1%-level. The table shows that the volatility in spreads was almost four times higher in the historical era than in the modern era. This is not surprising as the historical era is also five times longer than the modern era. Additionally, so called spread crises<sup>20</sup> during which spreads either increase very rapidly, i.e. enter the 99th percentile or surpass 1000 basis points, also contribute to the high volatility in sovereign yield spreads.

We cover spread crises in our table of summary statistics and also in our subsequent analyses but exclude actual default periods to preempt potential spurious results. In response, the table shows that some countries (headed by Turkey and Honduras), have experienced periods with extremely high average yield spreads that are based on long periods of suppressed prices (even outside default events). Turkey, for example, experienced a default period from 1876 to 1881, which caused its spreads to quadruple in size. Similarly, the country's default periods in the early 19th century drove spreads into three-digit territory. The second example is Honduras which was faced with a similar experience. The country's yield spreads surged in the late 19th century and remained exorbitantly high during the interwar period.

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<sup>20</sup>See Mitchener and Trebesch (2021) for more information.

**Table 2.2:** Summary statistics of sovereign yield spreads by country

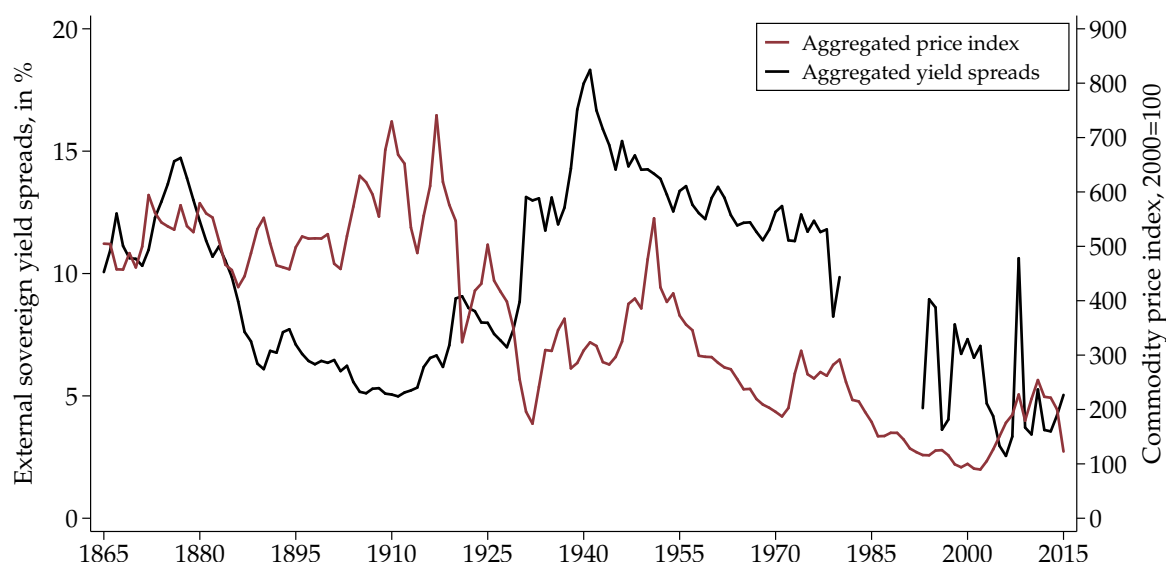
Country	Total sample period, 1865-2015					Historical period, 1865-1970					Modern period, 1993-2015				
	N	Mean	SD	Min	Max	N	Mean	SD	Min	Max	N	Mean	SD	Min	Max
Argentina	90	3.7	2.9	-0.3	17.0	75	2.9	2.1	-0.3	9.5	15	7.4	3.6	2.2	17.0
Australia	107	0.9	1.1	-2.4	4.1	101	1.0	1.0	-2.4	4.1	6	-0.8	0.5	-1.5	-0.2
Bolivia	12	5.2	4.1	2.5	18.0	8	6.3	4.7	4.1	18.0	4	2.9	0.4	2.5	3.5
Brazil	95	3.2	3.3	-2.2	19.5	70	2.8	3.1	-2.2	19.5	25	4.6	3.5	1.4	14.6
Bulgaria	17	4.0	3.4	0.7	12.1						17	4.0	3.4	0.7	12.1
Canada	104	0.4	1.3	-4.7	2.2	101	0.5	1.1	-4.7	2.2	3	-3.5	0.6	-4.0	-2.9
Chile	105	2.2	3.9	-12.4	15.0	82	3.2	2.9	-4.0	15.0	23	-1.2	5.0	-12.4	3.4
China	22	1.3	0.6	0.5	2.8						22	1.3	0.6	0.5	2.8
Colombia	87	3.6	5.5	-4.7	45.3	64	3.7	6.3	-4.7	45.3	23	3.1	1.9	0.6	7.6
Costa Rica	51	3.4	3.2	-4.6	13.2	47	3.4	3.3	-4.6	13.2	4	3.9	1.1	2.8	5.3
Cote d'Ivoire	3	4.4	0.5	3.9	5.0						3	4.4	0.5	3.9	5.0
Cuba	56	2.9	4.4	0.4	26.2	53	1.9	1.0	0.4	4.4	3	20.2	5.4	15.7	26.2
Dominican Republic	36	4.5	3.0	1.3	16.0	22	3.8	2.1	1.3	7.7	14	5.6	3.9	2.0	16.0
Ecuador	17	8.9	3.9	2.3	18.0	1	2.3		2.3	2.3	16	9.4	3.7	5.3	18.0
Egypt	88	1.8	1.7	-0.1	6.1	73	1.6	1.5	-0.1	6.0	15	2.8	1.9	-0.0	6.1
El Salvador	64	2.4	3.1	-4.3	13.7	46	2.4	3.1	-4.3	13.7	18	2.3	3.3	-4.1	8.5
Ghana	46	1.4	2.6	-0.1	14.8	38	0.4	0.3	-0.1	1.0	8	6.1	3.7	3.6	14.8
Guatemala	35	5.4	2.3	2.3	11.8	31	5.7	2.2	2.3	11.8	4	2.6	0.2	2.4	2.9
Honduras	16	57.2	34.9	4.4	120.4	13	69.2	26.2	40.6	120.4	3	5.0	0.8	4.4	5.9
India	64	0.7	0.5	-0.1	2.8	60	0.6	0.3	-0.1	1.6	4	2.1	0.6	1.5	2.8
Indonesia	22	2.2	1.4	0.3	7.6	10	1.5	0.7	0.3	2.9	12	2.9	1.6	1.5	7.6
Jamaica	69	1.3	2.0	-0.2	11.8	62	0.7	0.5	-0.2	1.4	7	6.6	2.7	3.8	11.8
Japan	50	0.6	6.9	-11.9	36.0	40	2.4	6.2	-3.1	36.0	10	-7.0	3.3	-11.9	-1.9
Malaysia	68	1.1	0.9	-0.1	6.2	48	0.9	0.4	-0.1	1.5	20	1.8	1.3	0.5	6.2
Mexico	85	8.8	10.3	-0.0	47.9	56	11.8	11.5	-0.0	47.9	29	2.9	2.4	0.0	10.2
New Zealand	104	0.8	0.9	-1.5	2.3	98	0.9	0.9	-1.5	2.3	6	-0.3	0.7	-0.9	0.8
Nigeria	58	2.7	4.9	-0.2	19.5	43	0.5	0.2	-0.2	0.8	15	9.0	6.5	0.7	19.5
Pakistan	14	6.9	5.2	1.5	21.1						14	6.9	5.2	1.5	21.1
Panama	19	2.9	1.3	1.3	5.4						19	2.9	1.3	1.3	5.4
Paraguay	13	2.5	0.6	1.7	3.5	10	2.4	0.5	1.7	3.5	3	2.9	0.5	2.4	3.4
Peru	78	2.9	7.2	-14.0	26.0	53	4.4	7.1	-2.9	26.0	25	-0.3	6.2	-14.0	6.9
Philippines	34	2.6	1.9	-1.1	6.4	4	2.4	0.8	1.7	3.4	30	2.6	2.0	-1.1	6.4
Poland	21	1.8	1.2	0.5	5.4						21	1.8	1.2	0.5	5.4
Romania	4	2.0	0.3	1.7	2.3						4	2.0	0.3	1.7	2.3
Russia	15	3.2	2.1	1.0	8.0						15	3.2	2.1	1.0	8.0
South Africa	102	1.1	1.1	-0.6	6.5	80	0.7	0.6	-0.6	2.1	22	2.5	1.5	0.8	6.5
Thailand	55	1.0	1.2	-2.2	4.0	46	0.9	1.1	-2.2	3.0	9	1.6	1.2	0.6	4.0
Trinidad and Tobago	75	0.7	1.3	-4.5	6.9	70	0.5	1.0	-4.5	1.7	5	3.6	2.0	2.3	6.9
Turkey	60	27.8	81.0	0.2	396.9	40	39.8	97.4	0.2	396.9	20	3.7	2.1	1.8	8.0
Uruguay	100	2.0	4.3	-12.4	12.3	76	3.1	2.6	-2.9	12.1	24	-1.3	6.4	-12.4	12.3
Venezuela	68	4.1	5.3	-1.6	24.6	44	2.1	2.3	-1.6	7.1	24	7.7	7.0	-1.2	24.6
Total	2229	3.5	15.4	-14.0	396.9	1665	3.7	17.6	-4.7	396.9	564	3.1	4.8	-14.0	26.2

*Notes:* The table lists summary statistics by country and time period for sovereign yield spreads for the entire sample period, for the modern bond era (1990-2015) only, and for the historical period (1865-2015) only.

## 2.3 Descriptive evidence

Figure 2.3 presents first descriptive evidence on the countercyclical relationship between sovereign risk and commodity price movements throughout history. During the Gold Standard period of 1880-1913 commodity prices were quite stable in contrast to the 1870s when world market integration started (Bordo and Schwartz, 2009). The picture changed with the start of World War I in 1914. During 1914 and 1915, world commodity prices dropped sharply and yield spreads increased. Due to the price collapse and the drop in world trade countries that were heavily depended on customs revenues ran large public deficits (Marichal, 2000). However, commodity prices rebounded fast because World War I stimulated an export boom of war-related raw materials and primary products (Litman, 1926). In 1916, a price increase led to an immediate drop in spreads. In effect, most of the countries that were in severe risk of default during this period were able to bridge these years by using previous accumulated foreign reserves to finance the foreign debt service and their public deficits (Marichal, 2000).

**Figure 2.3:** Aggregated commodity price index and sovereign yield spreads, 1865-2015



*Notes:* Figure 2.3 plots the annual, real aggregated commodity price index which is an equally weighted average across the country-specific commodity indices and the aggregated yield spreads that is computed as the annual, equally weighted average spread across all countries in our sample. All prices are deflated to 2000-values. The gap in yield spreads describes the period in the 1980s when syndicated bank loans constituted the main sovereign debt lending instrument.

In the mid-1920s, the World War I boom came to an abrupt end because of a brief post-World War I recession in leading financial centers such as the United States (Hatton et al., 2012). Prices as well as yield spreads, however, remained stable until 1929 when the crash of the New York Stock Exchange introduced the era of the Great Depression (Hatton et al., 2012). The collapse of international export prices and trade reached its trough in 1930 (Hatton et al., 2012). At this time, the United States and Europe imposed protective trade barriers and closed principal commodity markets (for sugar, coffee, beef, wool, copper, tin, silver, and petroleum) that in turn initiated a feedback loop (Madsen, 2001).

This further worsened export prices, trade and also government revenues since most of the default-prone countries heavily depended on trade-related revenues such as custom revenues (Madsen, 2001). Despite the economic downturn, countries aimed to maintain the servicing of their foreign debts in the years of 1929 and 1930. In January 1931, however, Bolivia was the first country that declared formally the suspension of its debt service (Sachs, 2019). This suspension initiated one of the biggest default waves in the pre-World War II era that came with skyrocketing default rates (Sachs, 2019).

By the late 1930s the debt service balance had improved markedly for many countries, yield spreads decreased, and commodity prices recovered. Another downturn began in the aftermath of World War II. At the beginning of the 1970s, a boom period started that resulted in the well-known Latin American debt crisis. Similar to the 1930s crisis, the 1980s Latin American debt crisis was also mainly triggered by external movements including sudden price drops in commodity prices (Sachs, 2019). Although commodity prices slightly recovered in 1985, the next oil-price bust occurred in 1986. The low rate of new defaults in oil producing countries was based on the countries' high financial resources, low sovereign debt ratios, low share of hard currency debt and long maturities. This made them less exposed to sovereign default risk than it was the case in the early 1980s (Sachs, 2019).

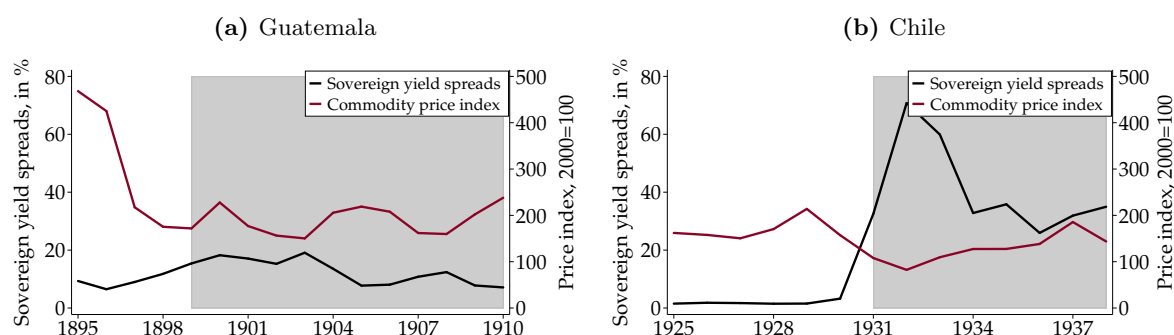
In the run-up of the collapse in commodity prices in 2014/2015, we observe again a countercyclical relationship between global commodity prices and yield spreads suggesting that commodity prices are an important factor when studying sovereign risk.

### **2.3.1 The relationship between commodity prices and sovereign yield spreads on the country level**

So far, we have studied the relationship between commodity price movements and sovereign risk in the aggregate. In this subsection we investigate this relationship on an individual country level with two prime examples: Guatemala and Chile. These examples show a negative link between our country-specific commodity price index and sovereign yield spreads.

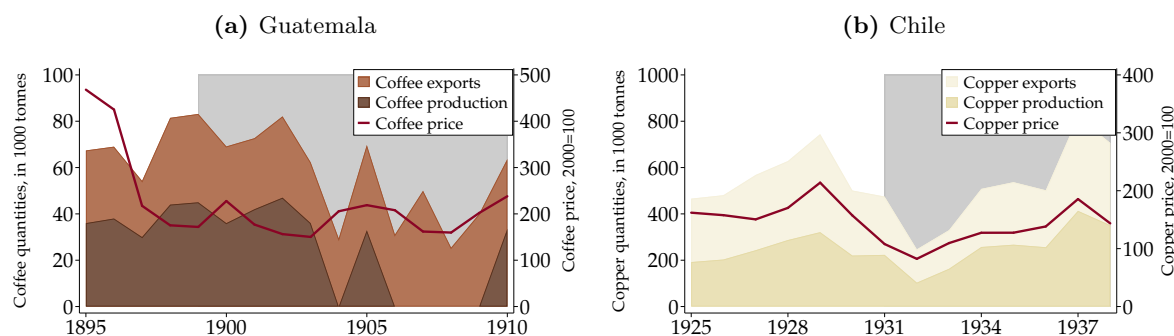
Figure 2.4 highlights the evolution of sovereign yield spreads (black line) vs. the country-specific commodity price index (red line) line for (a) Guatemala and (b) Chile. For the case of Guatemala, we cover the years 1895 to 1910; for Chile, we cover the years 1925 to 1939. During both of these two time periods, the inverse relationship between sovereign yield spreads and the commodity price index is clearly visible. Additionally, in both cases the countries ended up in default.

Figure 2.5 shows the price (red line), production and export volumes of (a) coffee in the case of Guatemala and of (b) copper in the case of Chile as stacked area graphs. According to Wagner et al. (2001), coffee became the prime commodity export for Guatemala in the mid-19th century with Europe as the country's

**Figure 2.4:** Country-specific commodity price index and sovereign yield spreads

Notes: The figures show the evolution of sovereign yield spreads (black line, right axis) and the commodity price index (red line, left axis) around defaults (grey shaded area) for (a) for Guatemala and (b) Chile.

main export destination. Under dictator Justo Rufino Barrios this development was pushed even further with Guatemala's coffee export accounting for more than 90% of the country's total exports by 1890. In the same decade, Brazil's coffee production had risen tremendously, eventually covering more than 50% of the world's total coffee production in 1897. Its harvest led to a drop in the international price for coffee. In return, coffee growers worldwide, and in particular in Guatemala, experienced severe pressure. Being highly indebted when coffee prices fell, many Guatemalan farmers could not service their loans. The combination of a coffee dependency and a currency devaluation triggered a period of not just a coffee crisis but a severe economic crisis. Sovereign spreads rose and eventually Guatemala defaulted on its debt in 1899.

**Figure 2.5:** Commodity prices, export and production values

Notes: The figures show the evolution of (a) coffee production and coffee exports of Guatemala as well as the world coffee price between 1895 and 1910 and (b) the copper production and copper exports for Chile as well as the world copper price between 1925 and 1938. Export and production quantities come as stacked area charts. The production and export quantities come from Mitchell (2010), various reports of The Great Britain Foreign Office, The Statistical Abstract for the Principal and Other Foreign Countries, UN COMTRADE and Minerals UK.

Following Richter (1929), copper had been produced in Chile since colonial times. Over the years the demand grew and Great Britain became the most important copper export market for Chile. By 1927, world consumption of copper had risen to record amounts, stimulating the rise in world copper production which eventually resulted in a fall in copper prices as supply ultimately outstripped demand. When the Great Depression hit two years later, the international copper prices dropped even further. Chile was hit



particularly hard; the demand for the country's copper plummeted and their copper exports collapsed. Although Chile's default in 1932 was not directly related to the collapse in copper prices, the fall in prices had a significant negative impact on the country's ability to service its debt.

## 2.4 Econometric approach

To study the link between country-specific commodity price movements and sovereign risk, we run a panel fixed effects regression with our country-specific commodity price index from Section 2.2.3 as the main variable of interest. Following standard frameworks of the sovereign debt literature (such as Cruces and Trebesch (2013)), our regression equation writes as follows:

$$Spread_{i,t} = \gamma_1 PriceIndex_{i,t-1} + \gamma_2 \mathbf{X}_t + \gamma_3 \mathbf{Z}_{i,t-1} + \alpha_i + \epsilon_{i,t}, \quad (2.3)$$

where  $Spread_{i,t}$  is the real foreign currency bond yield spread for country  $i$  in year  $t$  given in percentage points.  $PriceIndex_{i,t-1}$  describes our variable of interest the country-specific commodity price index. To account for potential frequency issues with regard to price and yield spread changes, the price index enters our regression with a one period lag. Additionally, we control for global factors ( $\mathbf{X}_t$ ) and country-specific driving forces ( $\mathbf{Z}_{i,t-1}$ ) and also add country fixed-effects ( $\alpha_i$ ). The inclusion of country fixed effects allows us control for time invariant or slow-moving country characteristics which help to minimize omitted variable bias.  $\epsilon_{i,t}$  describes the error term.

For the global factors comprised in  $\mathbf{X}_t$ , we study the following variables: We include the world interest rate to control for global factors that measure overall risk perception. We use a spliced series to account for the transformation of the USA to the leading financial market after World War I. For pre-World War I, we use the 3-month UK t-bill rate. For post-World War I, we employ the 3-month US t-bill rate. To approximate overall market sentiment, we compute a stock market volatility index in the spirit of the CBOE US VIX index based on monthly observations of the FTSE and S&P index. To capture global shocks to growth we include world imports. To measure international trade activity we use the variable world imports from Federico and Tena-Junguito (2017) for the period 1865-1938 which we complement with data from the IMF's World Economic Outlook Database for the years 1960-2015. To fill the gap between 1938 and 1960, we construct our own world import series as the sum of all available imports in a given year by using data from the World Bank's World Development Indicators and from the UN ComTrade-Database.

To account for macroeconomic fundamentals, we include the following variables in  $\mathbf{Z}_{i,t-1}$ : To approximate debt sustainability we include the countries' debt to GDP ratios in our regression with data coming from Reinhart and Rogoff (2009) and the IMF's Global Debt Database. In order to account for authority

characteristics of states, we include the Polity IV variable from Marshall and Gurr (2020). It allows us to capture the regime type under which the government is operating ranging from -10 (hereditary monarch) to +10 (consolidated democracy). We expect a higher polity score to translate into lower yield spreads.<sup>21</sup> Lastly, to capture the countries' dependence on the world market, we calculate a country-specific measure of trade openness as the sum of imports and export to GDP (in percent). The import data is compiled from four different sources: the Correlates of War Project, the IMF's Direction of Trade Statistics, Federico and Tena-Junguito (2017), and the Historical Bilateral Trade and Gravity Data set (TRADHIST). A detailed description on the compilation of the export and GDP series can be found in Appendix B.1.

In our setup, we exclude default years to account for abnormally high yield spreads that are driven by the actual default event rather than commodity price swings. Additionally, to allow for comparability of the effect that the dependent variables have on sovereign yield spreads, we standardize all variables. The coefficients reported in the regression tables report the outcome of running regressions on standardized variables.

Table 2.3 provides the results for the regression of sovereign yield spreads on commodity price movements for the entire sample period. In column (1) we only include the lagged price index as explanatory variable. In the next step, we introduce our three global variables that simultaneously affect all countries in our sample (column 2), before we add country-specific factors (column 3-6). The last column shows the same setup as column (5) but without country fixed effects. To rule out risk of default events being the driver behind the rise in sovereign yield spreads, we run our regression of the lagged commodity price index and sovereign spreads excluding defaults.

We find that the negative relationship between the one year lagged country-specific price index and sovereign yield spreads holds with the inclusion of global and domestic variables as well as fixed effects. The results of all of these specifications are robust at the 1% level. As we are showing standardized regression outcomes, our results can be read as follows: a one standard deviation increase in the lagged country-specific price index translates into a decrease of 0.17 percentage points in sovereign yield spreads (Table 2.3, column (5)). From the unstandardized version of the output presented in column (5) of Table 2.3 we find that sovereign yield spreads increase by 0.86 percentage points in response to a 1% drop in the lagged commodity price index. Besides the significance of our country-specific price index, the results show that the magnitude of the the impact of the price index on sovereign risk lies above the size of the effect of the other global variables such as stock market volatility of leading financial markets and world interest rates.<sup>22</sup>

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<sup>21</sup>A big advantage of the Polity IV variable is its long time span going all the way back to the mid 19th century.

<sup>22</sup>When repeating the exercise using level changes instead of fixed effects, the direction of the relationship remains.

**Table 2.3:** Comovement of commodity prices and sovereign bond yield spreads, 1865-2015

	(1)	(2)	(3)	(4)	(5)	(6)
Price index[t-1]	-0.118*** (0.160)	-0.166*** (0.213)	-0.166*** (0.258)	-0.167*** (0.245)	-0.167*** (0.245)	-0.184*** (0.241)
World interest rate[t, %]		-0.113*** (0.075)	-0.113*** (0.073)	-0.114*** (0.077)	-0.115*** (0.078)	-0.178*** (0.084)
World imports[t, logged]		-0.183*** (0.126)	-0.183*** (0.138)	-0.181*** (0.163)	-0.180*** (0.163)	-0.060 (0.125)
Global volatility index[t]		0.072*** (0.084)	0.072** (0.092)	0.072** (0.093)	0.071** (0.093)	0.148*** (0.174)
Debt to GDP[t-1, %]			0.000 (0.000)	0.000 (0.000)	-0.001 (0.000)	-0.076** (0.000)
Polity IV[t-1]				-0.004 (0.040)	-0.005 (0.041)	-0.107*** (0.038)
Trade openness[t-1, %]					0.010 (0.000)	0.055*** (0.000)
Observations	1430	1430	1430	1430	1430	1430
Countries	41	41	41	41	41	41
Country FE	Yes	Yes	Yes	Yes	Yes	No
R <sup>2</sup>	0.60	0.63	0.63	0.63	0.63	0.10

Notes: Robust standard errors clustered on country level. Significance levels represent  $*p < 0.1$ ,  $**p < 0.05$ ,  $***p < 0.01$ , respectively. Dependent variable: sovereign yield spreads. The regression table includes the results for the lagged country-specific price index and sovereign yield spreads excluding sovereign default events. Variables are standardized.

In Table 2.3 all control variables have the expected sign. In the case of the world interest rate, we find that a higher world interest rate lowers yield spreads. This is in line with Uribe and Yue (2006) who show that US interest rates are a driving force for sovereign risk and business cycles in emerging markets in the long run. However, the authors also find that spreads drop initially before they begin to rise.

Regarding the stock market volatility of leading financial markets, our results go in line with literature that studies the relationship between global volatility and sovereign default risk as proxied by CDS spreads. Longstaff et al. (2011) and Pan and Singleton (2008) show that stock market returns and changes in the VIX index explain a large part of the variation in sovereign risk.

Lastly, we find that world imports have a strong and negative impact on sovereign risk. In a similar vein, Kaminsky and Vega-Garcia (2016) also capture shocks to growth by including world imports (by including total imports of France, the United Kingdom and the United States in their regression setup). They find indication that a collapse in world growth can help predict defaults.

With regard to macroeconomic fundamentals our results show that neither the Debt to GDP ratio, nor the

policy regime as captured by the Polity IV variable, nor trade openness significantly influence sovereign yield spreads when controlling for country fixed effects.

### **Commodity export composition and sovereign risk**

The last 150 years of commodity trade have been accompanied by changes in institutional settings, inventions, technological progress and shifts in global export chains. In return, commodity dependent countries differ in the export of their raw products and their revenue structures and therefore also differ in terms of the impact that commodity prices have on them. These relationships differ over time in each country due to the way that each respective economy has developed historically. To account for this heterogeneity, we study whether we can confirm the impact of commodity prices for all kind of commodity exports and eras. We explicitly account for the export structure of dependent countries by running regressions for an agricultural, a mineral and an energy index in separation.

To study the variation of commodity prices on sovereign risk within the group of resource-rich countries, we analyze the countries' export composition as a potential driver of this relationship. We rely on the three commodity subgroups as introduced in Section 2.2: agricultural, mineral, and energy commodities. Additionally, we split our sample into an historical (pre 1970) and a modern bond period (post 1993) to see if the relationships are particularly pronounced during one of the two periods. We do not align observations as several countries have not exported both energy, agricultural, and mineral simultaneously throughout history. Aligning observations would reduce the sample size to a minimum, leaving us with outcomes of low power and difficult interpretability.<sup>23</sup>

Table 2.4 provides the results. Column (1) shows again the results of Table 2.3 for the entire index and the entire sample period. Column (2) and (3) show the results for the total index split into the modern bond and the historical era, respectively. We find that once we split the sample into different eras the statistical significance of the price index decreases (historical era) and even vanishes for the modern bond era. We believe that the reason behind this change in significance and sign comes from the vanishing importance of agricultural commodity price movements in driving sovereign yield spreads.

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<sup>23</sup>If we run the regressions for each price index separately but for the entire time period all price index coefficients are negative and significant at the 1% level.

**Table 2.4:** Regression outcomes of commodity price subindices and sovereign yield spreads

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Total period	Historical period	Modern period	Historical period	Modern period	Historical period	Modern period	Historical period	Modern period
	1865-2015	1865-1970	1993-2015	1865-1970	1993-2015	1865-1970	1993-2015	1865-1970	1993-2015
Price index[t-1]	-0.167*** (0.245)	-0.061* (0.349)	0.113 (0.540)						
Price index agric[t-1]				-0.115*** (1.187)	-0.001 (0.641)				
Price index mineral[t-1]						-0.055 (4.004)	-0.209*** (1.294)		
Price index energy[t-1]								-0.025 (5.085)	-0.162** (0.988)
Observations	1430	512	895	947	512	399	512	258	505
Countries	41	35	19	22	35	16	35	15	35
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R <sup>2</sup>	0.63	0.46	0.49	0.42	0.46	0.45	0.48	0.54	0.47

Notes: Robust standard errors clustered on country level. Significance levels represent \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ , respectively. Dependent variable: sovereign yield spreads. The regression table includes the results between the lagged commodity group price indices and sovereign yield spreads split into the historical (pre 1970) period and the modern bond era (post 1990). Variables are standardized.

When studying the subindices across eras in separation (column 4 to 9), our regression outcomes show that agricultural commodity price movements were a major driver of sovereign yield spreads in history. For the modern bond period, the picture looks different. Now we find significant results for energy and mineral price movements. These results do not come as a surprise as the share of agricultural commodity exports as a percentage of total exports has been falling strongly since the 1950s and has been taken over by a forceful growth in energy and also mineral shares (see Figure 2.4). Another insight of Table 2.4 is that the price impact of commodity dependence exists both today and throughout the historical dataset. This reinforces our results of Table 2.3 of the last Section.

We can conclude that the relationship between export weighted commodity prices and sovereign risk has been persistent over the last 150 years. The structural differences between the two eras are reflected by differences across commodity classes. In particular, we find that the impact of energy-related commodity export prices today is even more pronounced than for agricultural products in history if we consider a one standard deviation change in the respective price index.

### 2.4.1 Robustness checks

#### Alternative specifications of commodity price indices

To control for spurious effects, we employ four additional price indices: (1) a country-specific commodity index that uses fixed instead of variant weights, (2) a country-specific commodity index that uses GDP as a measure of economic performance and (3) two alternative commodity price indices introduced by Gruss and Kebhaj (2019) (one time variant, one time invariant). Table B.3 provides the results for (1) and (2), and Table B.4 shows the results of our regression that uses the Gruss indices. We find that neither of the different specification of the index, nor the Gruss and Kebhaj (2019) index impact the significance of the relationship.

Our results for the GDP weighted price index come very close to the results obtained using total exports as a measure of GDP, supporting total export as a measure for economic performance in history. The time invariant country-specific commodity price index shows even stronger results. This is not surprising as many countries show higher commodity export shares between 1865 and 1994 in comparison with 1995 to 2015. As a result, these higher export shares can upward bias our results. This reaffirms that using time-variant weight in the baseline regression is a better fit for our analysis.

To rule out our results being driven by specific countries or specific observations in the yield spread or the price data, we run a leave one out regression. Figure B.3 provides the results for the leave one out regression. It shows the coefficient of the lagged country-specific price index for each regression that excludes one country at a time. The confidence bands are at 95%, the results are robust in all scenarios at this confidence level.

### **Alternative measures of sovereign default risk**

Since sovereign yields may be influenced by other factors than default risk (e.g. liquidity risk), we also employ the Institutional Investor's Country Credit Rating Index (ICCR) as another measure of risk perception. The ICCR is the result of a survey of leading international banks that are asked to rate each country on a scale from zero to 100 (where 100 represents the maximum creditworthiness). The Institutional Investor Magazine averages these ratings and assigns greater weights to banks with higher global exposure. The final ratings are then published in the March and September issues of the institutional investor. The time span the index covers 1979 to 2016 for a maximum of 179 countries. In our analysis, we use the inverse of the ICCR ( $100 - \text{ICCR}$ ) so that a positive change in the inverse ICCR reflects a higher risk perception.

Table B.5 in Appendix B.4 provide the results for the ICCR and the sovereign yield spreads. For the ICCR regression we find a negative relationship between the price index in  $t - 1$  and liquidity risk, which confirms the finding of our baseline analysis. Although we cannot reject the null hypothesis for the yield spreads in this regression setup, the relationship between the price index in  $t - 1$  and sovereign risk remains negative.

### **Alternative fixed effects**

To control for additional time and regional effects that might influence the results, we run two additional regressions. The first includes year fixed effects instead of global variables. The second includes country, decade and regional fixed effects in different combinations. Table B.1 and Table B.2 in Appendix B.4 show the results. We find that including year, decade and regional fixed effects in various combinations hardly changes the results. The significance of our results remains robust.

### **Additional control variables**

In Table B.7 we include additional control variables. We add a war dummy to capture the time periods of WWI and WWII, a crisis dummy for the European sovereign debt crisis and FX regime dummy to measure the influence of a fixed exchange rate regime on sovereign yield spreads. All three variables are statistically significant and correlate positively with sovereign yield spreads. The significance of our price index remains robust.

## **2.5 Conclusion**

Commodity dependent countries are vulnerable to sharp commodity price movements. We have created a novel dataset of country-specific commodity price indices consisting of 42 commodities for 41 countries. This dataset has allowed us to study the effect of countries' export composition on the relationship between commodity price movements and sovereign risk across 150 years. By employing fixed-effects

regressions including global and country-specific variables, we found that our country-specific commodity price index is persistently associated with sovereign yield spreads. By examining three different subgroups of commodities (energy, agricultural and mineral products), we have found that in the pre 1970 era agricultural dependent price movements significantly correlate with sovereign yield spreads. Today, this correlation is particularly pronounced for energy and mineral price movements. This finding is in line with the global decrease in agricultural commodity dependence and the rise of mineral and energy commodity exports over the last decades.

We ran several checks to test the robustness of our results. First, we employed different versions of our commodity price index. Instead of using variable weights, we took the average weight over the entire sample period. Second, we employed total exports by GDP as a measure for economic performance. Additionally, we employed two country-specific commodity price indices as provided by Gruss and Kebhaj (2019). The results confirmed the negative relationship between commodity price movements and sovereign default risk uncovered by our country-specific price index. In addition to these checks, we employed a leave one out regression and used the inverse of the institutional investor index as a proxy for sovereign default risk. Lastly, we repeated our baseline regression including year and decade fixed events. All of these adjustments confirmed our findings of the baseline regression.

In future work, we aim to explicitly control for price makers in our sample and differentiate between supply and demand shocks in commodity price movements. This would allow us to filter out endogenous price movements and to shed light on macroeconomic implications and policy advice that go in hand with these two shock types. Additionally, we aim to expand our sample towards countries that have graduated from commodity dependence over time in order to capture better cross-country differences. Lastly, future research should aim to capture the channel of fiscal stability that may contribute to dampening the effect of commodity price movements on sovereign default risk.



# Appendix Chapter 2

## B.1 Additional macroeconomic variables

### Export data

For our export data, we rely on several main sources. For the years 1865-2014, we use export data in British pounds from Fouquin and Hugot (2016) which we complement with data in US dollar from the Correlates of War Project for the period 1865-2014. For the historical era 1865-1938, we additionally employ export data in US dollar from the Federico-Tena World Trade Historical Database and updated our sample for the period 1960-2015 with export data in US dollar from the IMF's Direction of Trade Statistics.

We fill remaining gaps with data in local currency from Montevideo Oxford Latin American Database for Venezuela (1939), El Salvador (1939) and Paraguay (1939-1943), and the Statesman's Yearbook for Turkey (1914, 1917, 1919-1920).

We transform export data given in local currency into US dollar using exchange rate data from the Montevideo Oxford Latin American Database, Fouquin and Hugot (2016), Moody's Manual of investments: American and foreign government securities, Scavo and Reinhart and Rogoff (2011). For data given in British pound we employ the yearly USD/GBP exchange rate from the Bank of England's A Millennium of Macroeconomic Data for the UK dataset.

### GDP data

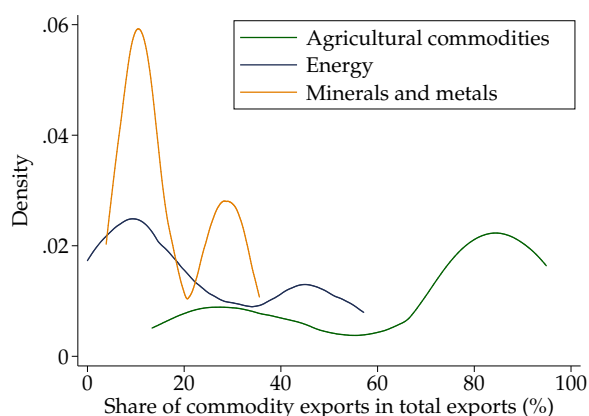
The GDP data is compiled using the following sources: For the historical era 1865-2014, we employ GDP data in British pound from Fouquin and Hugot (2016) which we complement with data in local currencies from the Montevideo Oxford Latin American Database for the period 1900-1979, Mitchell's International Historical Statistics (1913-1990) and Dincecco and Prado (2013) (1865-1988). Data for the modern era (1980-2015) comes from the IMF's International Financial Statistics and from the World Bank's World Development Indicators (1960-2015).

We transform GDP data given in local currency into US dollar using exchange rate data from the

Montevideo Oxford Latin American Database, Fouquin and Hugot (2016), Moody's Manual of investments: American and foreign government securities and Reinhart and Rogoff (2011). For data given in British pound we use the yearly USD/GBP exchange rate from the Bank of England's A Millennium of Macroeconomic Data for the UK dataset.

## B.2 Distribution of commodity exports by subgroup

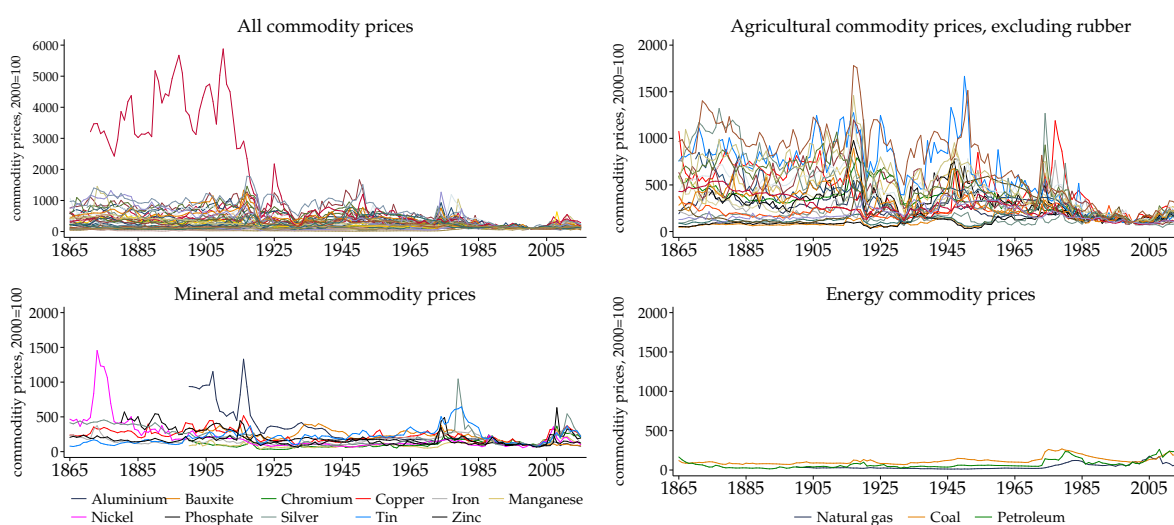
**Figure B.1:** Distribution of commodity exports in total exports by commodity group



Notes: The graph shows the kernel density of commodity exports in total exports by group. Agricultural commodities are represented by the green, energy commodities by the blue and minerals and metals by the orange kernel density function.

## B.3 Commodity prices

**Figure B.2:** Commodity prices



Notes: The four graphs show the evolution of all 42 individual global commodity prices, all in one and split in agricultural, mineral and energy commodity prices. Agricultural prices exclude the evolution of rubber prices to allow for better visualization of all other agricultural commodity prices. The prices are deflated and normalized at 2000 = 100.

## B.4 Robustness checks: regression results

**Table B.1:** Regression including time fixed effects

	(1)	(2)	(3)	(4)
Price index[t-1]	-0.184*** (0.204)	-0.127*** (0.217)	-0.139*** (0.260)	-0.105* (0.302)
Debt to GDP[t-1, %]	-0.023 (0.000)	0.079*** (0.000)	-0.138*** (0.000)	-0.061 (0.000)
Trade openness[t-1, %]	0.043*** (0.000)	0.003 (0.000)	0.045*** (0.000)	0.000 (0.000)
Observations	1430	1430	1430	1430
Countries	41	41	41	41
Country FE	No	Yes	No	Yes
Year FE	No	No	Yes	Yes
R <sup>2</sup>	0.04	0.60	0.17	0.68

Notes: Robust standard errors in parentheses, clustered on country level. Significance levels represent \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ , respectively. The regression table includes the results for the regression by including time and country fixed effects in various combinations. Global variables are not included.

**Table B.2:** Regression including additional fixed effects

	(1)	(2)	(3)	(4)
Price index[t-1, logged ]	-0.184*** (0.241)	-0.134*** (0.249)	-0.290*** (0.338)	-0.255*** (0.349)
World interest rate[t, %]	-0.178*** (0.084)	-0.087** (0.151)	-0.182*** (0.091)	-0.096** (0.155)
World imports[t, logged]	-0.060 (0.125)	-0.143 (0.757)	0.010 (0.097)	-0.106 (0.751)
Global volatility index[t]	0.148*** (0.174)	0.096 (0.222)	0.163*** (0.172)	0.100 (0.214)
Debt to GDP[t-1, %]	-0.076** (0.000)	-0.135*** (0.000)	-0.090* (0.000)	-0.170*** (0.000)
Polity IV[t-1]	-0.107*** (0.038)	-0.074*** (0.040)	-0.166*** (0.041)	-0.148*** (0.040)
Trade openness[t-1, %]	0.055*** (0.000)	0.040*** (0.000)	0.048*** (0.000)	0.034*** (0.000)
Observations	1430	1430	1430	1430
Countries	41	41	41	41
Decade FE	No	Yes	No	Yes
Region FE	No	No	Yes	Yes
R <sup>2</sup>	0.10	0.14	0.14	0.17

Notes: Robust standard errors clustered on country level. Significance levels represent \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ , respectively. Dependent variable: sovereign yield spreads. The regression table includes the results between the lagged country-specific price index and sovereign yield spreads, successively including different combinations of country and regional fixed effects. Coefficients are standardized.

**Table B.3:** Regression of different commodity price indices and sovereign yield spreads

	(1)	(2)	(3)
	Price index	Price index fixed base	Price index GDP base
Price index[t-1, logged]	-0.167*** (0.245)	-0.951*** (0.211)	-0.152*** (0.505)
World interest rate[t, %]	-0.115*** (0.078)	-0.099*** (0.078)	-0.124*** (0.077)
World imports[t, logged]	-0.180*** (0.163)	-0.191*** (0.149)	-0.184*** (0.160)
Global volatility index[t]	0.071** (0.093)	0.066** (0.094)	0.064** (0.091)
Debt to GDP[t-1, %]	-0.001 (0.000)	0.032 (0.000)	0.043 (0.000)
Polity IV[t-1]	-0.005 (0.041)	0.019 (0.047)	0.013 (0.047)
Trade openness[t-1, %]	0.010 (0.000)	0.011 (0.000)	0.007 (0.000)
Observations	1430	1430	1430
Countries	41	41	41
Country FE	Yes	Yes	Yes
R <sup>2</sup>	0.63	0.62	0.63

Notes: Robust standard errors clustered on country level. Significance levels represent \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ , respectively. Dependent variable: sovereign yield spreads. The regression table includes the results for the baseline regression (column 1), using a country-specific price index that employs fixed weights (column 2), and a country-specific price index that uses GDP as a base for weighting the export shares. Coefficients are standardized.

**Table B.4:** Regression of different commodity price indices and sovereign yield spreads

	(1)	(2)	(3)
	Price index	Gross price index floating	Gross price index fixed
Price index[t-1, logged]	-0.028 (0.241)	-0.004** (0.006)	-0.008*** (0.007)
World interest rate[t, %]	-0.098** (0.063)	-0.132*** (0.060)	-0.156*** (0.059)
World imports[t, logged]	0.233*** (0.149)	0.225*** (0.124)	0.287*** (0.114)
Global volatility index[t]	0.169*** (0.084)	0.167*** (0.082)	0.165*** (0.081)
Debt to GDP[t-1, %]	0.340*** (0.000)	0.307*** (0.000)	0.285*** (0.000)
Polity IV[t-1]	0.022 (0.041)	-0.015 (0.041)	-0.010 (0.041)
Trade openness[t-1, %]	-0.005 (0.000)	-0.001 (0.000)	-0.001 (0.000)
Observations	611	611	611
Countries	39	39	39
Country FE	Yes	Yes	Yes
R <sup>2</sup>	0.61	0.61	0.62

Notes: Robust standard errors clustered on country level. Significance levels represent \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ , respectively. Dependent variable: sovereign yield spreads. The three columns use three different country-specific price indices for the period 1960-2015. The Gross price indices enter the regressions with floating export shares (column 2) and fixed export shares (column 3). Coefficients are standardized.

**Table B.5:** Regression outcomes of commodity price indices and different sovereign risk measures

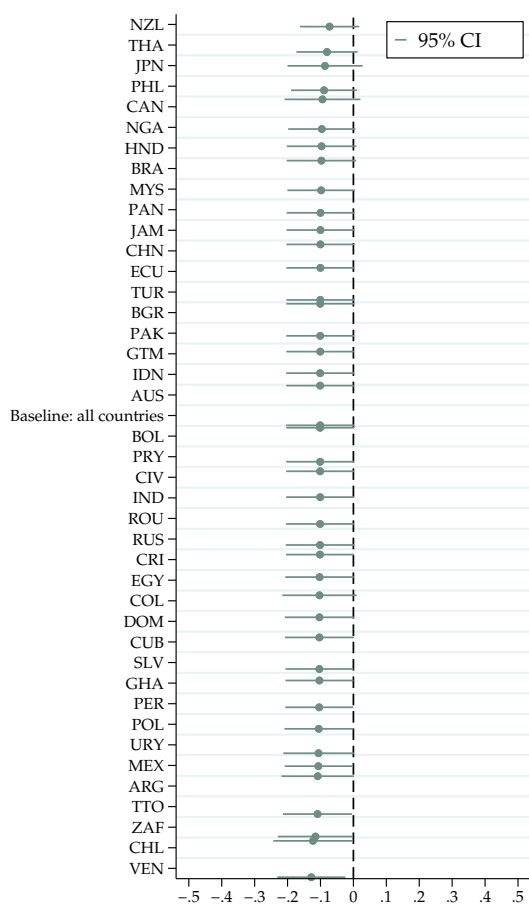
	ICCR aligned	
	Yield spreads	Inverse ICCR
Price index[t-1]	-0.525 (0.621)	-0.035** (0.017)
World interest rate[t, %]	-5.961 (19.381)	-1.007** (0.411)
World imports[t, logged]	0.172 (0.947)	-0.279*** (0.024)
Global volatility index[t]	0.999*** (0.226)	-0.011** (0.004)
Debt to GDP[t-1, %]	0.110*** (0.027)	0.001*** (0.001)
Polity IV[t-1]	0.165 (0.113)	-0.002 (0.004)
Trade openness[t-1, %]	-5.935** (2.360)	-0.049 (0.062)
Observations	418	418
Countries	34	34
Country FE	Yes	Yes
R <sup>2</sup>	0.46	0.86

Notes: Robust standard errors clustered on country level. Significance levels represent \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ , respectively. The regression table includes the results for the baseline regression (column 1) and the log of the inverse ICCR in column (2). To allow for comparability we align the samples to the availability of yield spread data. Coefficients are standardized.

**Table B.6:** Regression including default episodes

	(1)	(2)	(3)	(4)	(5)	(6)
Price index[t-1, logged]	-0.118*** (0.160)	-0.166*** (0.213)	-0.166*** (0.258)	-0.167*** (0.245)	-0.167*** (0.245)	-0.184*** (0.241)
World interest rate[t, %]		-0.113*** (0.075)	-0.113*** (0.073)	-0.114*** (0.077)	-0.115*** (0.078)	-0.178*** (0.084)
World imports[t, logged]		-0.183*** (0.126)	-0.183*** (0.138)	-0.181*** (0.163)	-0.180*** (0.163)	-0.060 (0.125)
Global volatility index[t]		0.072*** (0.084)	0.072** (0.092)	0.072** (0.093)	0.071** (0.093)	0.148*** (0.174)
Debt to GDP[t-1, %]			0.000 (0.000)	0.000 (0.000)	-0.001 (0.000)	-0.076** (0.000)
Polity IV[t-1]				-0.004 (0.040)	-0.005 (0.041)	-0.107*** (0.038)
Trade openness[t-1, %]					0.010 (0.000)	0.055*** (0.000)
Observations	1430	1430	1430	1430	1430	1430
Countries	41	41	41	41	41	41
Country FE	Yes	Yes	Yes	Yes	Yes	No
R <sup>2</sup>	0.60	0.63	0.63	0.63	0.63	0.10

Notes: Robust standard errors in parentheses, clustered on country level. Significance levels represent \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ , respectively. The regression table includes the results for the regression by successively including first global variables (column 2) and country-specific variables (column 3-5). Column 6 shows the same regression as in column 5 without country-fixed effects.

**Figure B.3:** Leave one out regression coefficients by dropped country

Notes: The figure plots the standardized coefficients and their 95%-confidence intervals of a leave one out regression for our main variable of interest the lagged country-specific commodity index. The iso3 codes represent the country that is left out in the regression. The results show that there is no country that actively drives the regression of our country-specific commodity index and sovereign yield spreads. All coefficients lie close to the regression coefficient that incorporates all 41 countries.

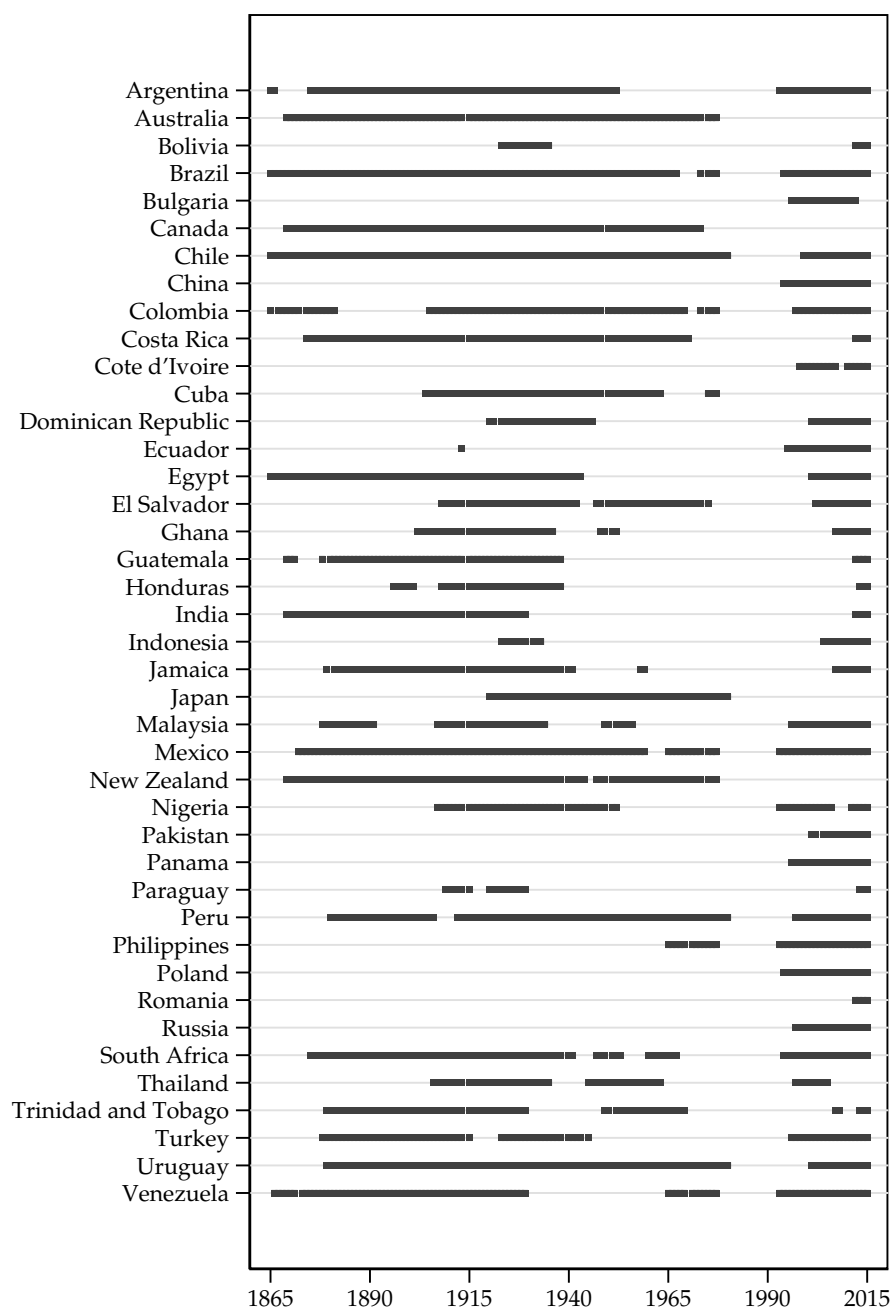
**Table B.7:** Regression including additional control variables

	(1)	(2)	(3)	(4)
Price index[t-1]	-0.131*** (0.108)	-0.158*** (0.132)	-0.149*** (0.137)	-0.060* (0.106)
Debt to GDP[t-1, %]		0.115** (0.000)	0.129*** (0.000)	0.068* (0.000)
Polity IV[t-1]		-0.134*** (0.041)	-0.147*** (0.041)	-0.282*** (0.039)
Trade openness[t-1, %]		0.026 (0.000)	0.042 (0.000)	0.098*** (0.000)
World interest rate[t, %]		-0.271*** (0.071)	-0.263*** (0.070)	-0.274*** (0.077)
World imports[t, logged]		-0.055 (0.085)	-0.005 (0.103)	0.199*** (0.077)
Global volatility index[t]		0.079*** (0.051)	0.073*** (0.054)	0.073*** (0.059)
World War I + II[t]			0.066* (0.842)	0.080** (0.873)
Eurozone crisis[t]			0.057** (0.500)	0.047* (0.538)
FX-regime[t-1]			0.141*** (0.381)	0.113*** (0.342)
Bretton Woods[t]			-0.007 (0.432)	0.041 (0.517)
Colony[t-1]			-0.002 (0.594)	-0.011* (0.775)
Observations	1103	1103	1103	1103
Countries	40	40	40	40
Country FE	Yes	Yes	Yes	No
R <sup>2</sup>	0.30	0.40	0.42	0.18

Notes: Robust standard errors clustered on country level. Significance levels represent  $*p < 0.1$ ,  $**p < 0.05$ ,  $***p < 0.01$ , respectively. The regression table includes the results for the baseline regression (column 1). Column 3 comes with additional control variables and country fixed effects. Column 4 resembles the setup of column 3 but does not come with fixed effects. Coefficients are standardized.

## B.5 Commodity price and yield spread sample

**Figure B.4:** Overlap between commodity price data and sovereign yield spreads

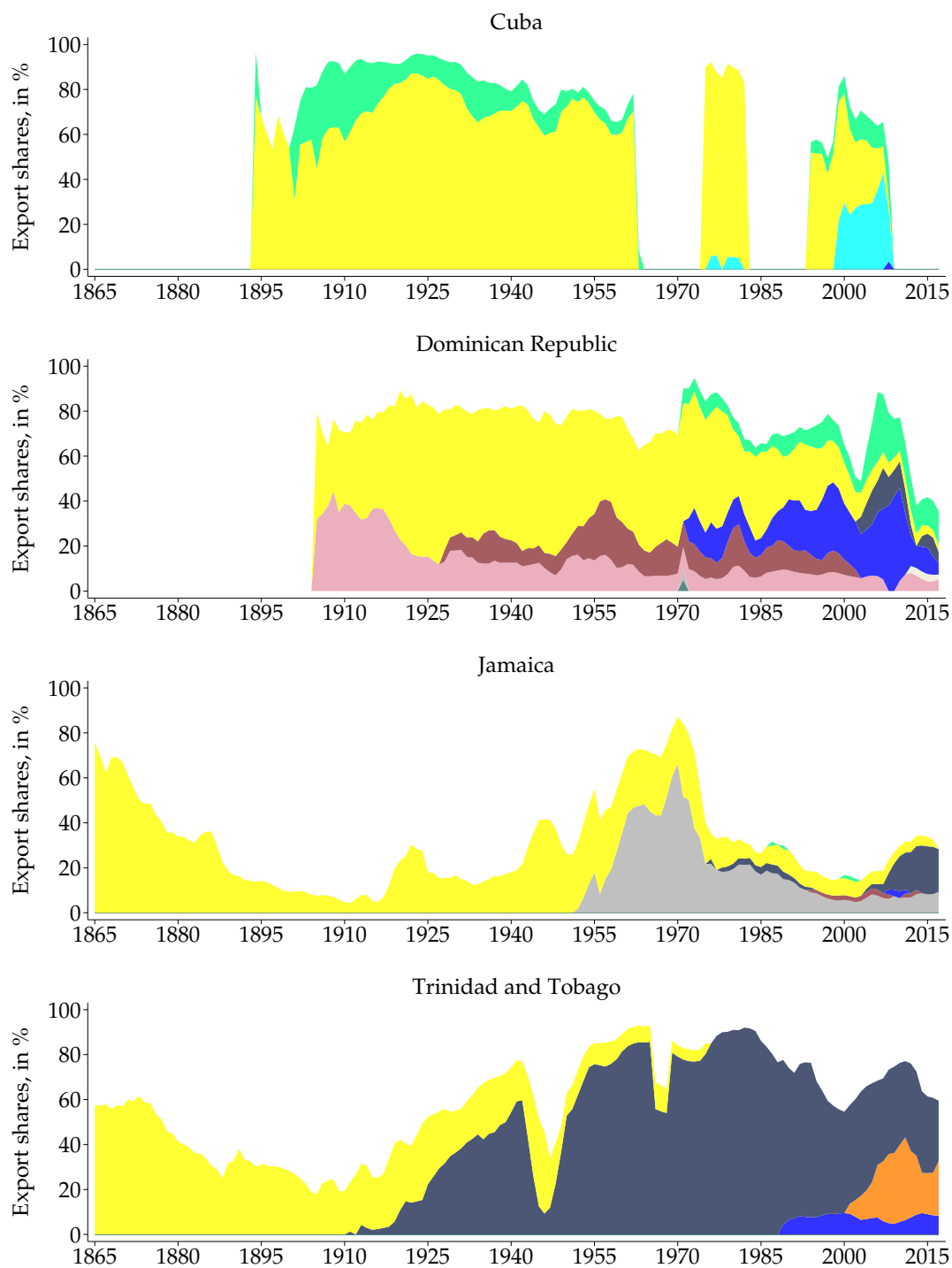


Notes: The stripplot shows the overlap for which commodity prices and sovereign yield spreads are available. The graphic lists all 41 countries in alphabetical order. The gap in the 1970s and 1980s represents the time period during which syndicated loans were the major sovereign lending instrument (among emerging market economies). For Australia, Canada, New Zealand there is only an overlap in history. For Bulgaria, China, Cote d'Ivoire, Pakistan, Panama, Poland, Romania, Russia, the overlap is only given in the modern bond period era. Data for both history and today is given for Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Egypt, El Salvador, Ghana, Guatemala, Honduras, India, Indonesia, Jamaica, Japan, Malaysia, Mexico, Nigeria, Paraguay, Peru, Philippines, South Africa, Thailand, Trinidad and Tobago, Turkey, Uruguay, and Venezuela.

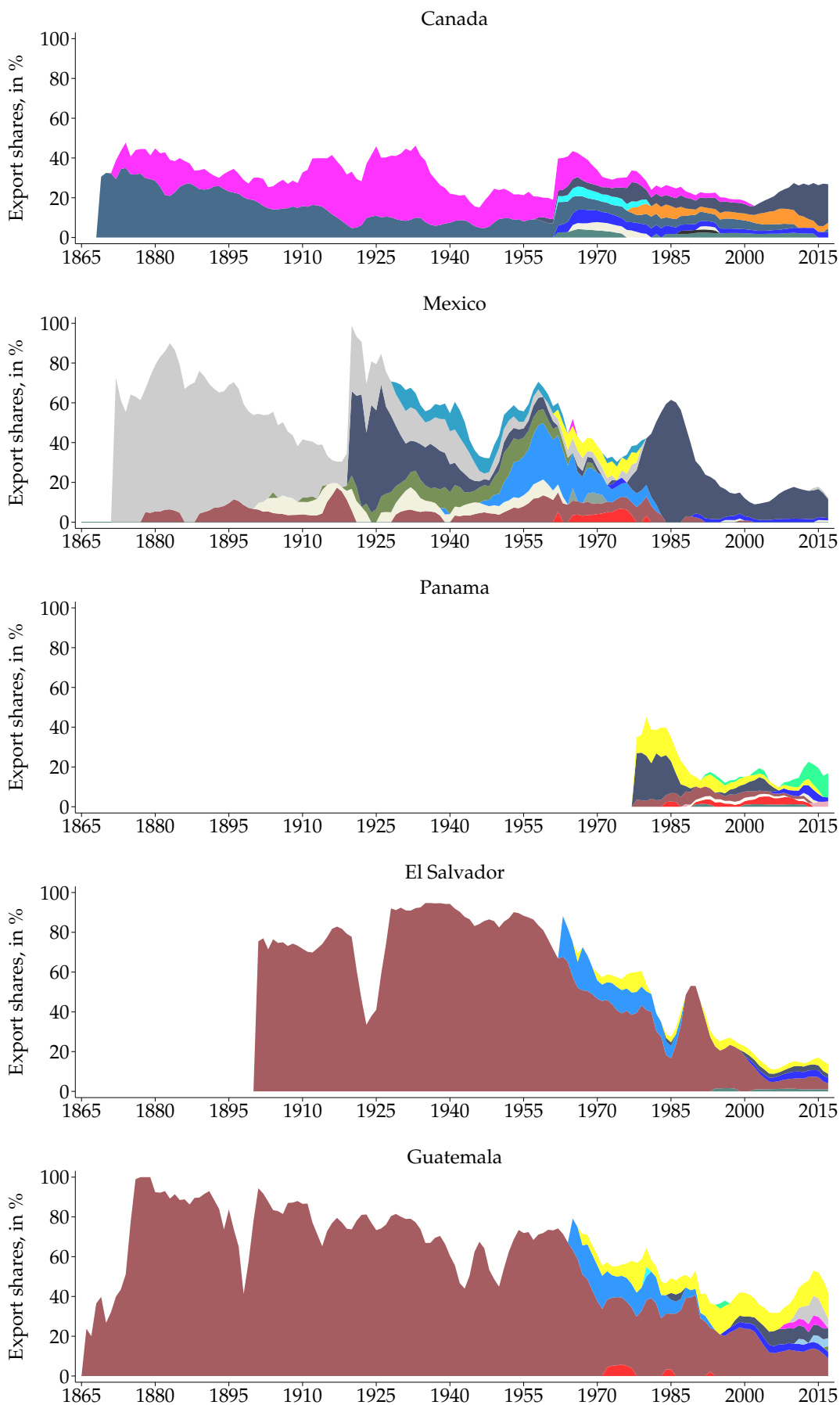


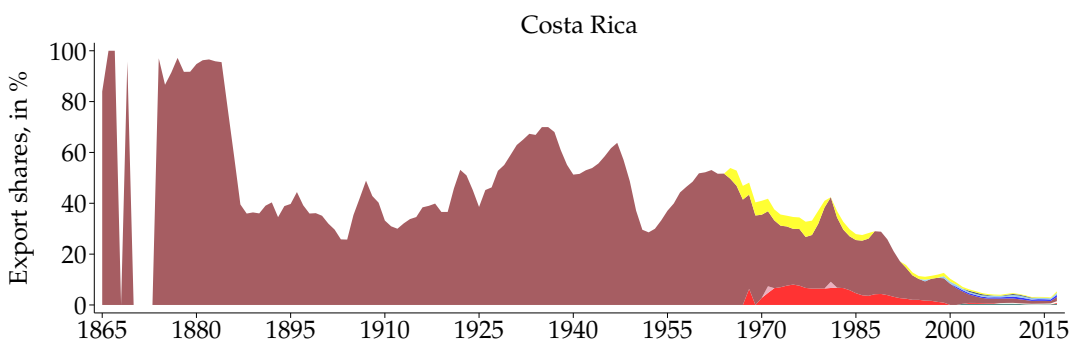
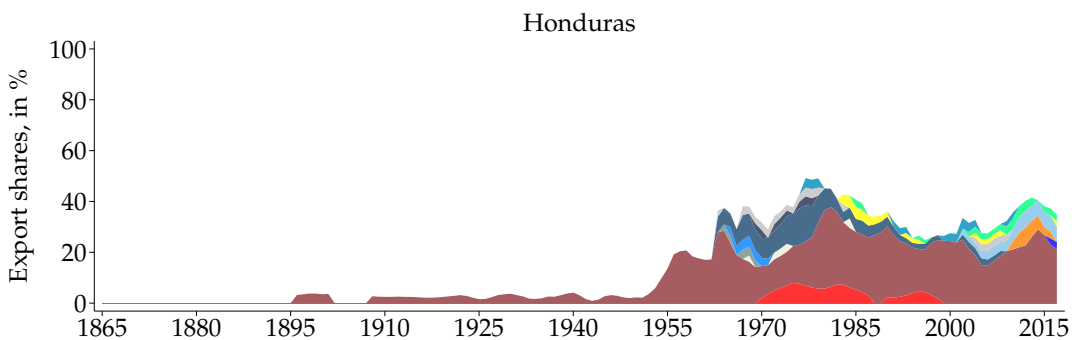
## B.6 Commodity composition

Figure B.5: Caribbean: Commodity export composition

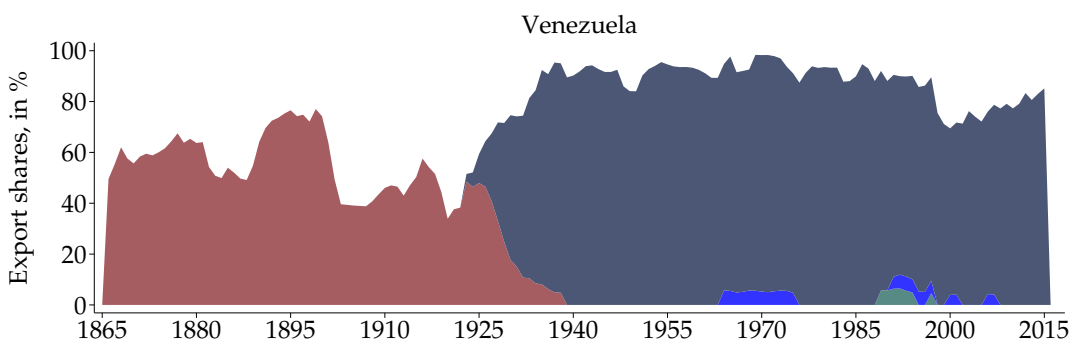
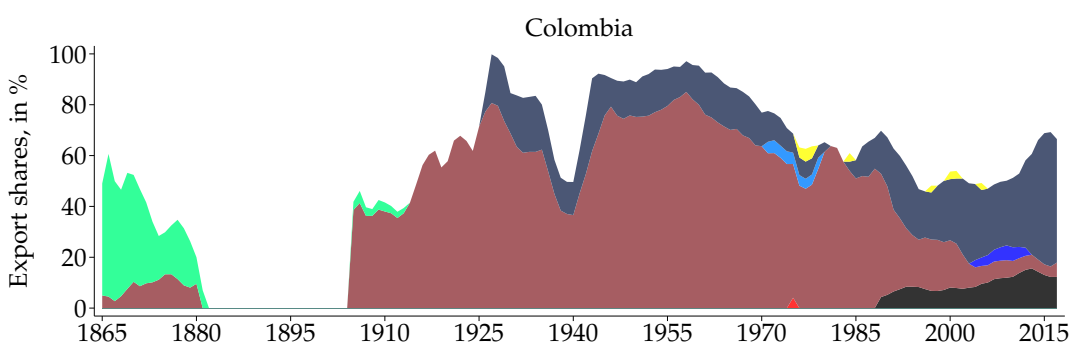
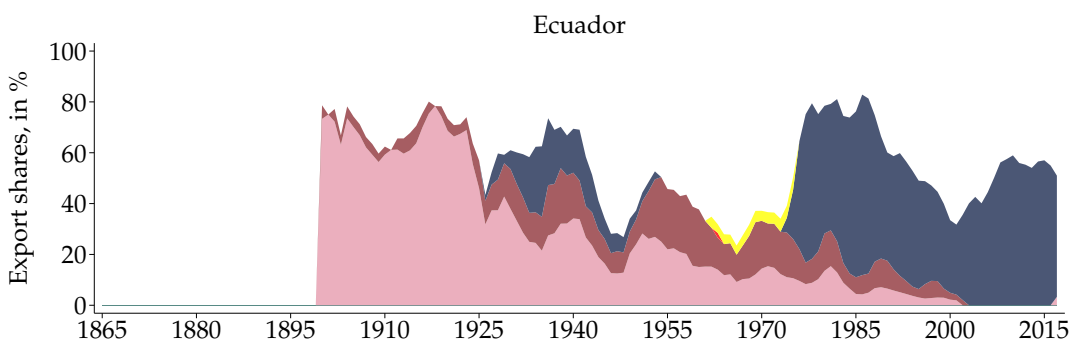


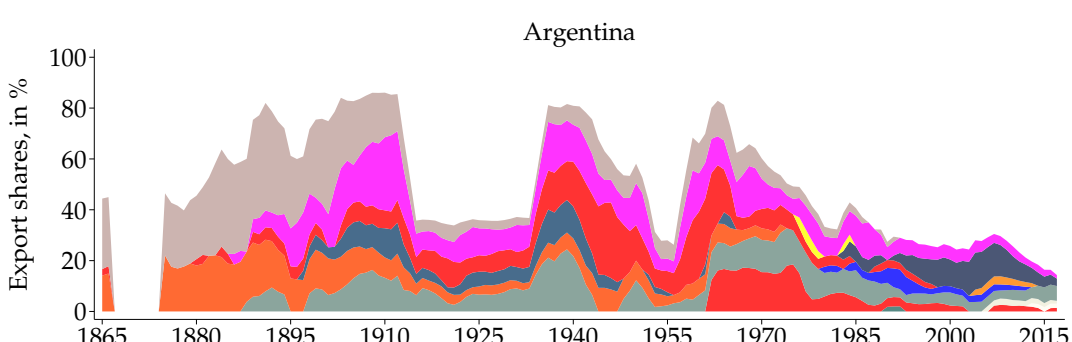
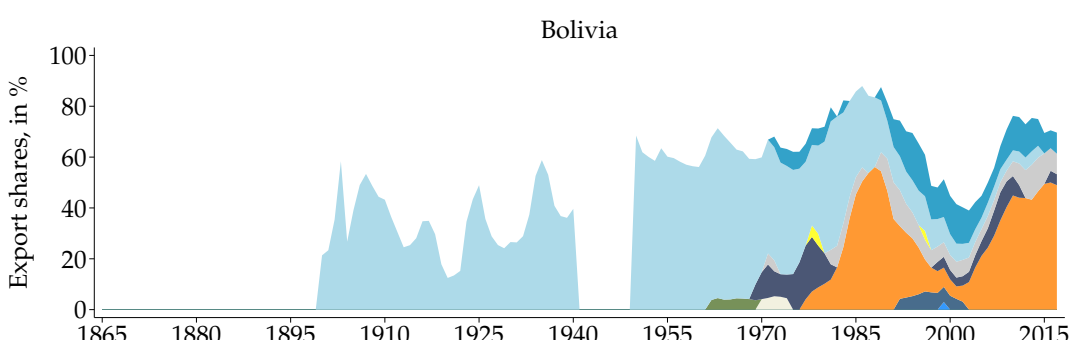
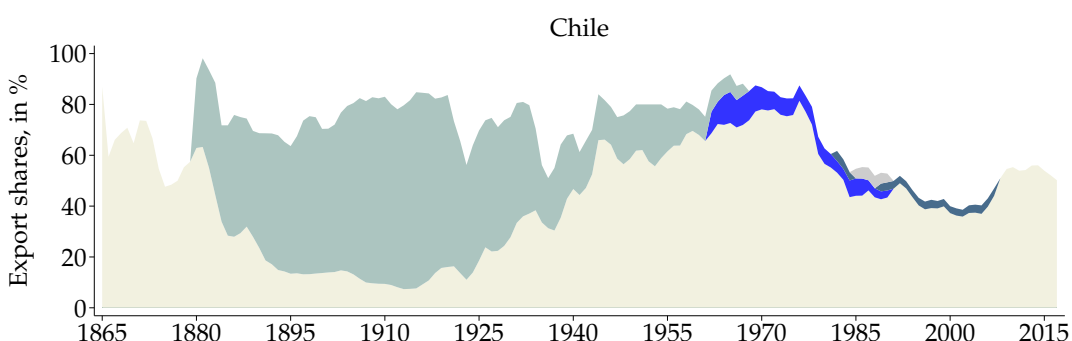
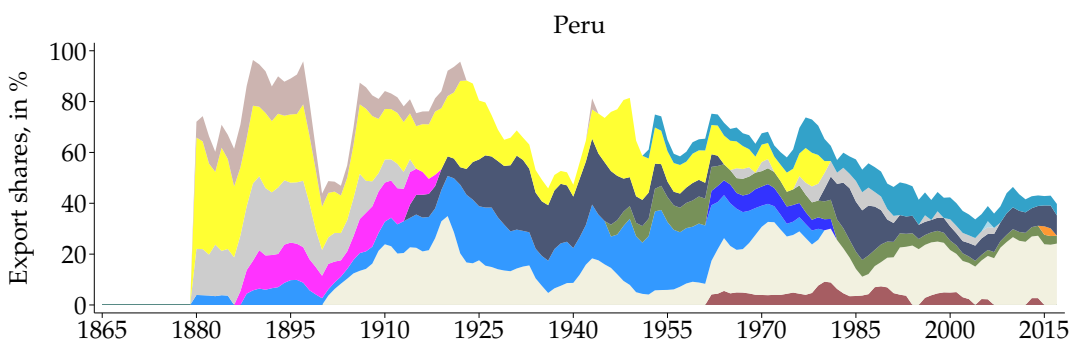
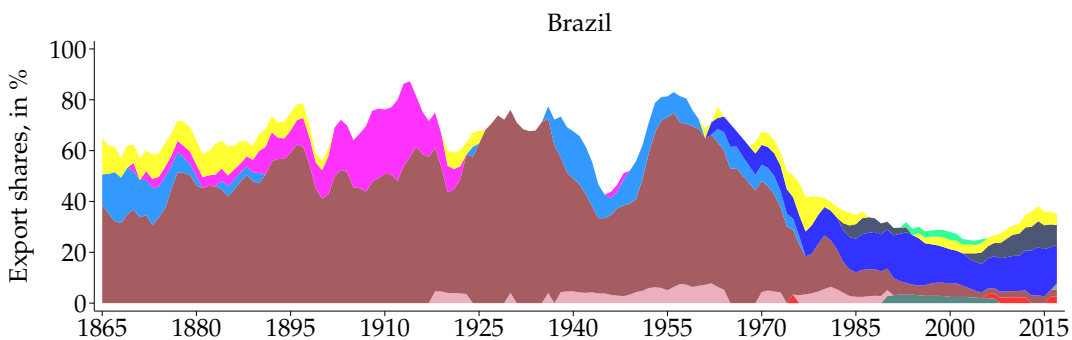
**Figure B.6:** North and Central America: Commodity export composition

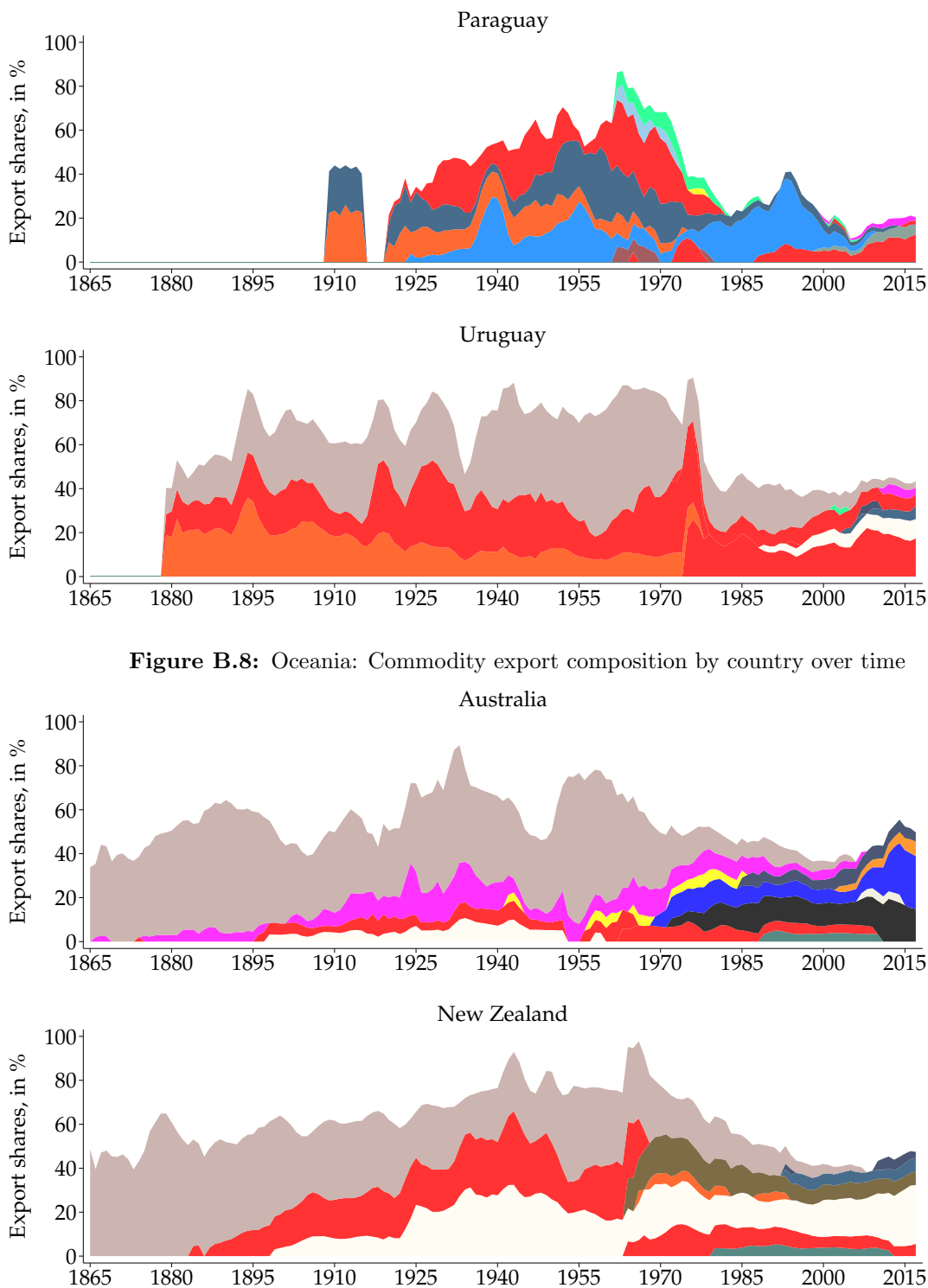




**Figure B.7:** South America: Commodity export composition

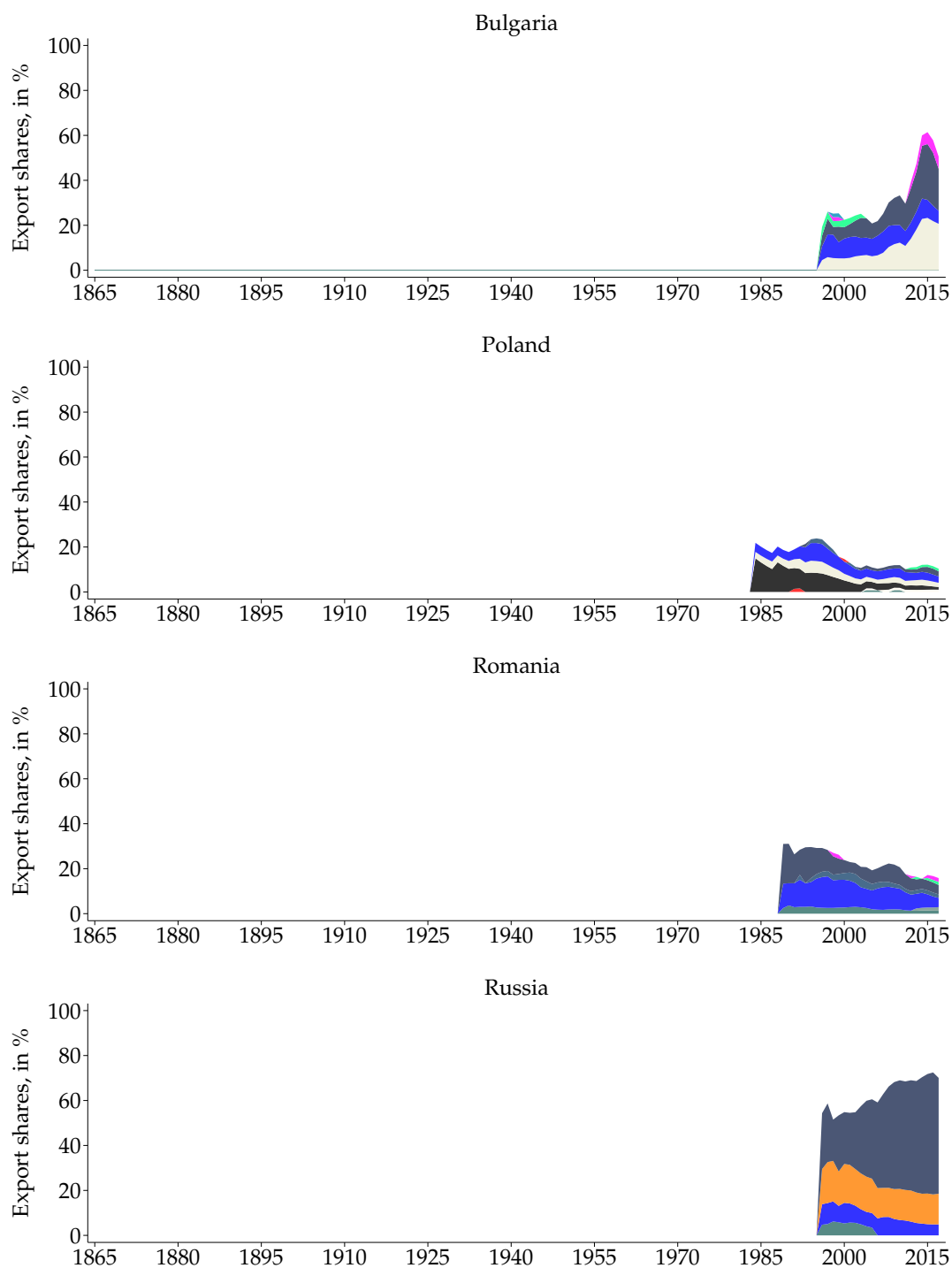




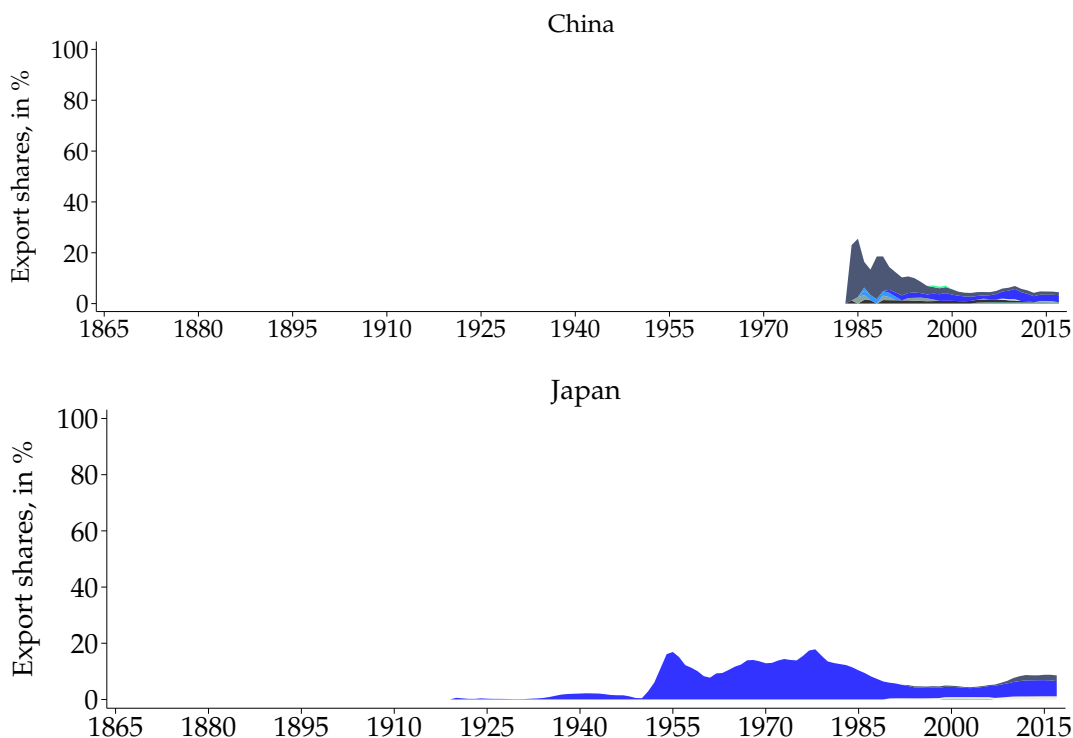


**Figure B.8:** Oceania: Commodity export composition by country over time

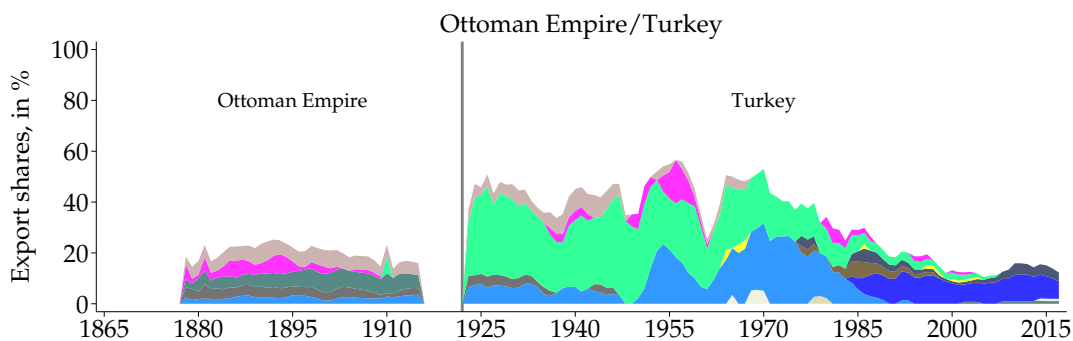
**Figure B.9:** Eastern Europe: Commodity export composition by country over time



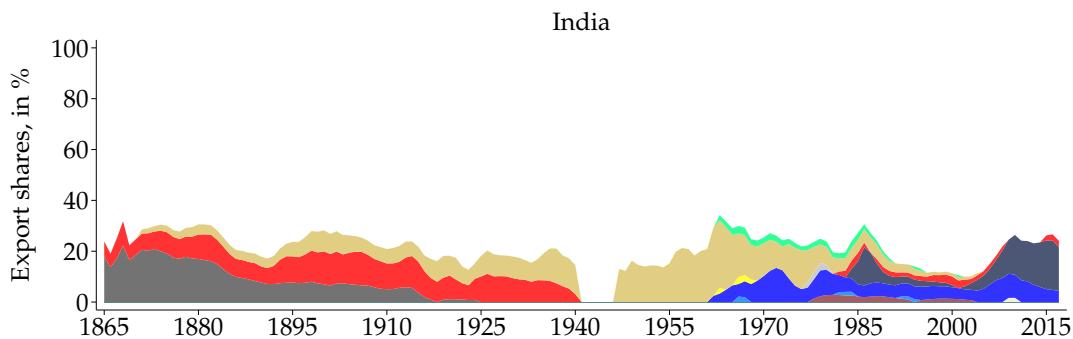
**Figure B.10:** East Asia: Commodity export composition by country over time

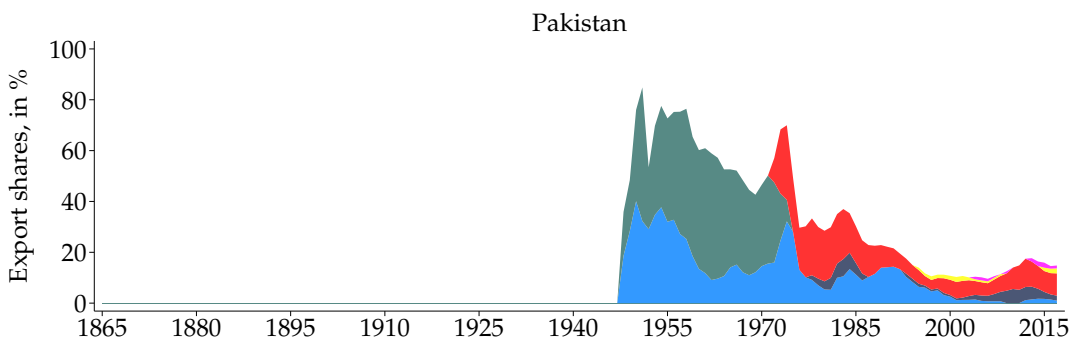


**Figure B.11:** Western Asia: Commodity export composition by country over time

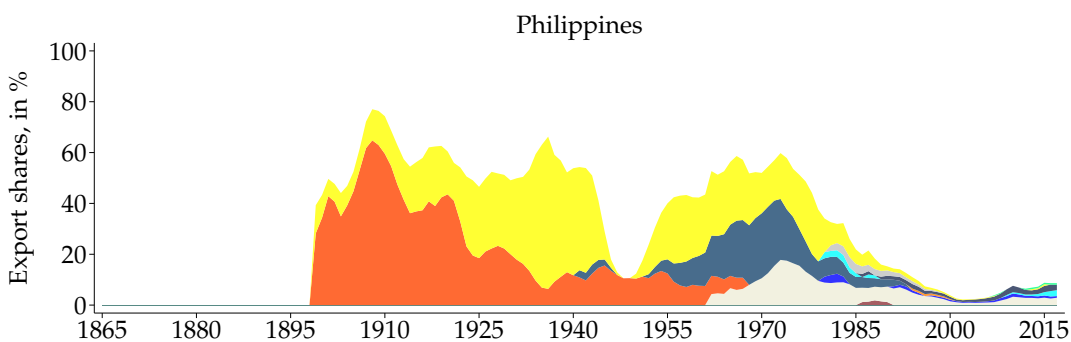
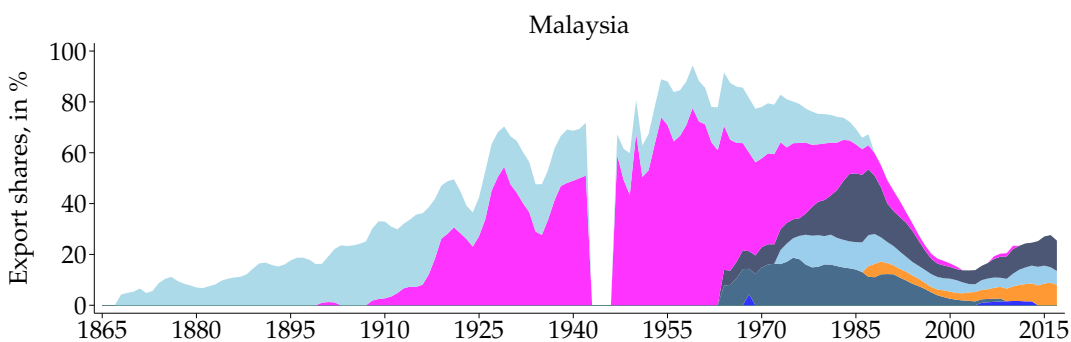
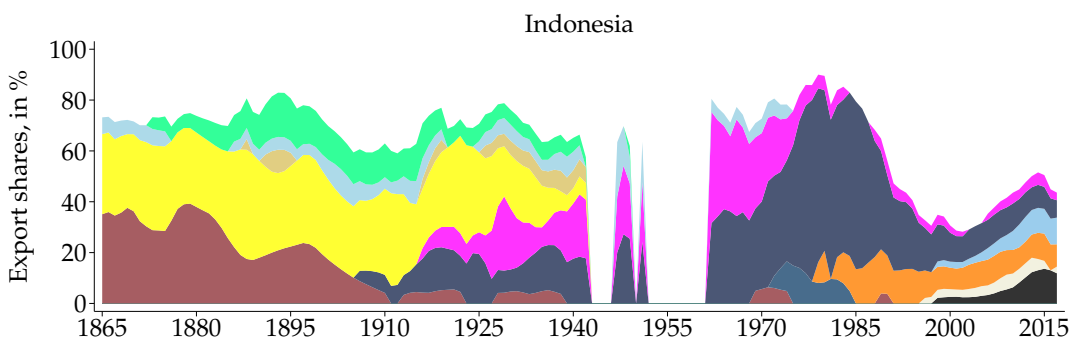


**Figure B.12:** South Asia: Commodity export composition by country over time





**Figure B.13:** South-Eastern Asia: Commodity export composition by country over time





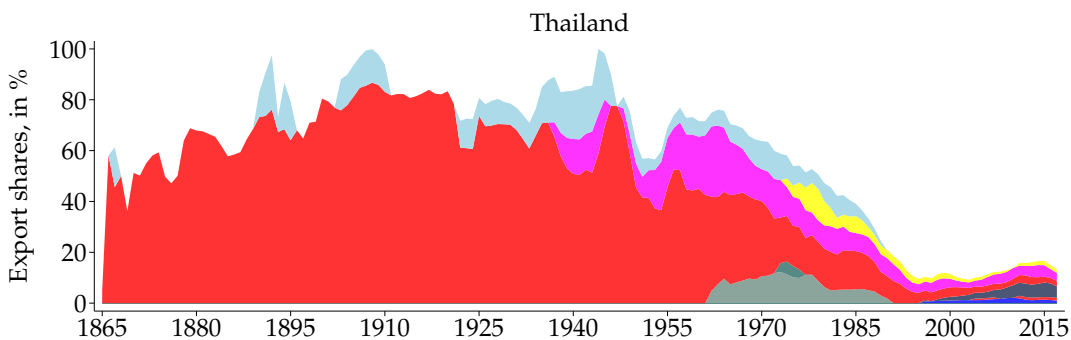


Figure B.14: North and Central Africa: Commodity export composition by country over time

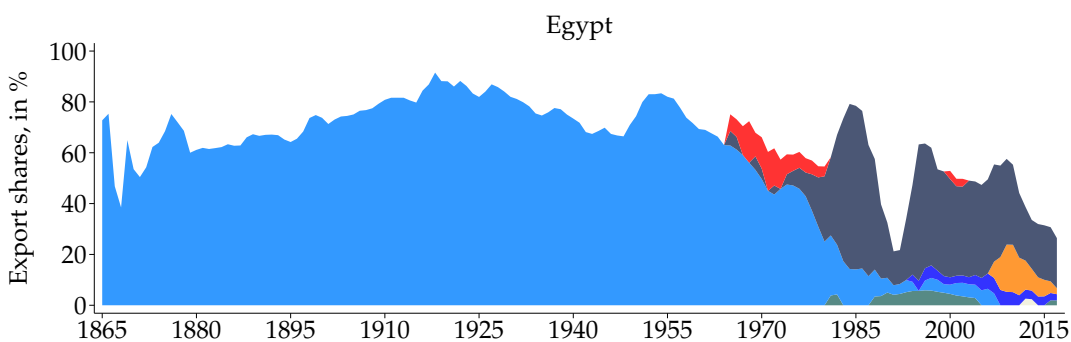
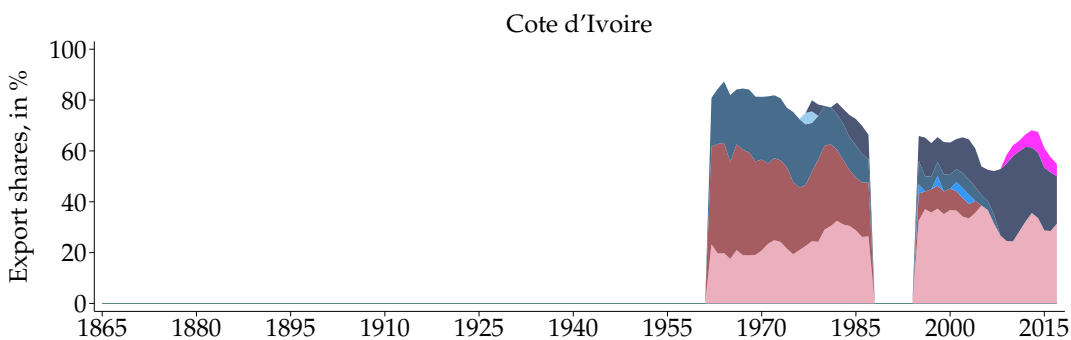
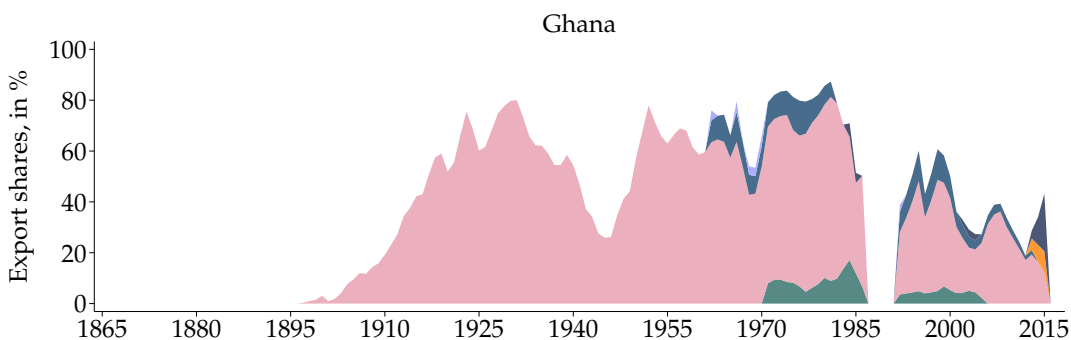


Figure B.15: West Africa: Commodity export composition by country over time



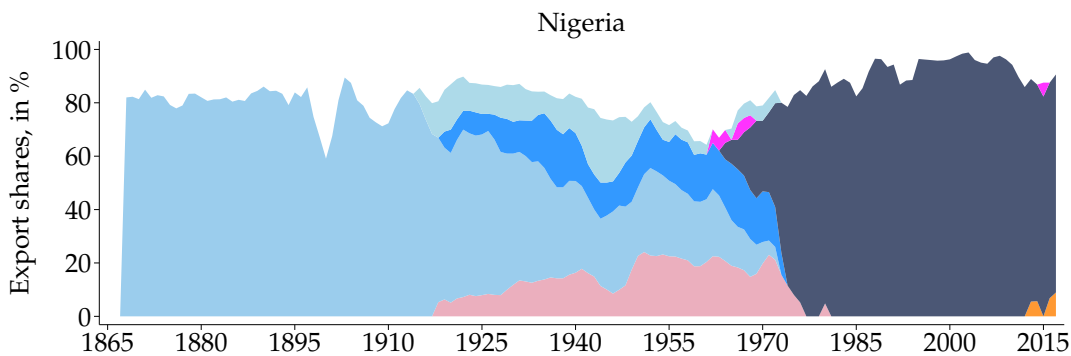
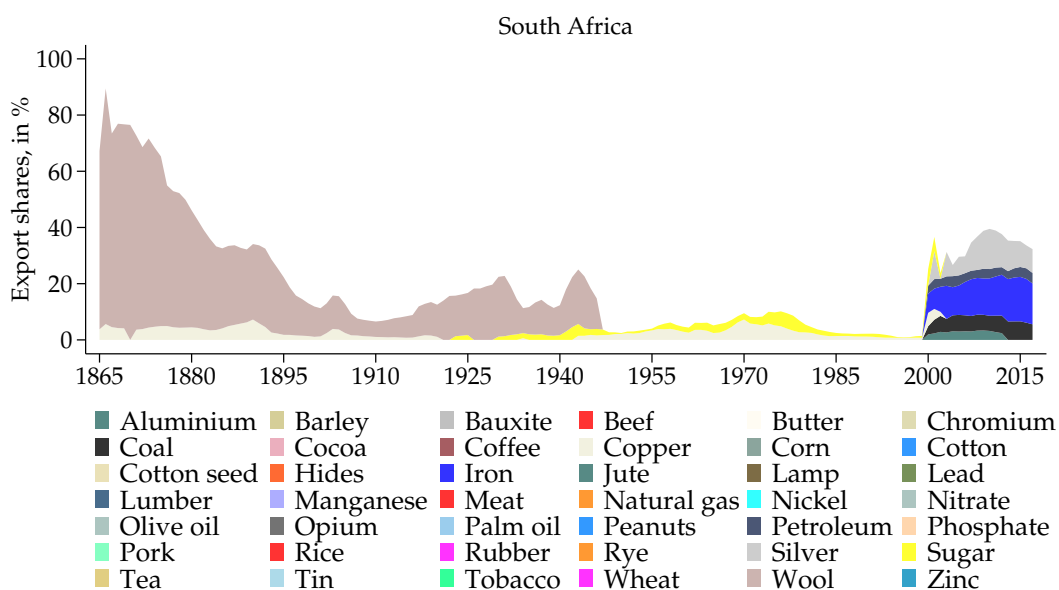


Figure B.16: South Africa: Commodity export composition by country over time



Notes: The figures show the commodity export composition of each country in our sample over the course 1865-2015. As for some countries only data from 1960 onwards is available, several country plots show sharp increases in commodity exports around the 1960s. Gaps in the 1980s, 1990s and 2000s for Ghana, Cuba and Cote d'Ivoire are due to data gaps in UN Comtrade. For Bulgaria, Poland, Romania, Russia, and China, the sample starts in the modern bond period.

## B.7 Commodity price and export sources

**Table B.8:** Overview of major commodity export sources

Country	Source
Argentina	1962-1982: Beef(C); 1888-2015: Corn (C,M); 1865-1961: Hides (M); 1986-1992: Iron (C); 1909-1972: Meat (C,M); 1982-2015: Petroleum (C); 1889-2015: Wheat (C,M); 1865-1968: Wool (C,M);
Australia	1970-1980: Beef (C); 1930-1946: Butter (M,S); 1974-2015: Coal (C); 1968-2015: Iron (C); 1897-1961: Meat (M,S); 2014-2015: Natural gas (C); 1998-2006: Petroleum (C); 1902-1986: Wheat (C,M); 1865-1992: Wool (C,M);
Bolivia	1994-1996: Lumber (C); 1977-2015: Natural Gas (C); 1967-2006: Petroleum (C); 1987-2015: Silver (C); 1900-2002: Tin (C,M); 1988-2015: Zinc (C);
Brazil	1977-1979: Cocoa (C); 1865-2000: Coffee (C,M); 1865-1953: Cotton (M); 1967-2015: Iron (C); 1982-2015: Petroleum (C); 1886-1918: Rubber (M); 1865-2015: Sugar (C,M);
Bulgaria	1996-2015: Petroleum (C); 1996-2011: Iron (C); 1996-2015: Copper (C);
Canada	1968-1971: Copper (C); 1963-1988: Iron (C); 1869-2003: Lumber (C,M,S); 1976-2011: Natural Gas (C); 1968-1971: Nickel (C); 1958-2015: Petroleum (C,M); 1872-1986: Wheat (C,M,S);
Chile	1873-2015: Copper (C,M,Mo); 1885-1950: Nitrate (M,Mo); 1962-1967: Iron (C);
China	2010-2014: Aluminium (C); 1984-2015: Petroleum (C); 1988-2015: Iron (C); 1992-1993: Corn (C); 1995-2005: Coal (C);
Colombia	1989-2015: Coal (C); 1866-2015: Coffee (C,M); 1926-2015: Petroleum (C,M); 1865-1906: Tobacco (M);
Costa Rica	1968-1994: Beef (C); 1865-2015: Coffee (C,M); 2003-2015: Iron (C); 2002-2015: Palm Oil (C); 1966-2015: Sugar (C);
Cote d'Ivoire	1962-2015: Cocoa (C); 1962-1998: Coffee (C); 1962-2015: Lumber (C); 1981-2015: Petroleum (C);
Cuba	2006: Copper (C); 2006: Iron; 1996-2005: Nickel (C); 1894-2005: Sugar (C,M); 1894-2006: Tobacco (C,M);
Dominican Republic	1905-2015: Cocoa (C,M); 1929-1997: Coffee (C,M); 1972-2013: Iron (C); 2000-2014: Petroleum (C); 1905-2011: Sugar (C,M); 1986-2015: Tobacco (C);
Ecuador	1900-1980: Cocoa (C,M); 1920-1996: Coffee (C,M); 1927-2015: Petroleum (C,M); 1962-1971: Sugar (C);
Egypt	1986-1991: Aluminium (C); 1865-2001: Cotton (C,M, Sta); 2004-2013: Natural Gas (C); 1973-2015: Petroleum (C); 1966-1972: Rice (C);
El Salvador	1901-2015: Coffee (C,M); 1963-1983: Cotton (C); 2000-2015: Iron (C); 1999-2015: Petroleum (C); 1973-2015: Sugar(C);

Table B.8 – *Continued*

Country	Source
Ghana	1970-2001: Aluminium (B&B,C); 1897-2013: Cocoa (C,M,B); 1962-2007: Lumber (C); 2010-2011: Natural Gas (C); 2010-2013: Petroleum (C);
Guatemala	1866-2015: Coffee (C,M); 1965-1983: Cotton (C); 2003: Iron (C); 2000-2014: Petroleum (C); 2009-2013: Silver(C); 1972-2015: Sugar (C);
Honduras	1969-1994: Beef (C); 1896-2015: Coffee (C,M); 1963-1984: Lumber (C); 2008-2010: Natural Gas (C); 2004-2015: Palm Oil (C);
India	1977-1980: Coffee (C); 1963-2015: Iron (C); 1865-1912: Opium (M); 1981-2015: Petroleum (C); 1865-2015: Rice (C,M,S); 1874-1993: Tea (C,M,S); 1980: Tobacco (C);
Indonesia	2005-2015: Coal (C); 1865-1905: Coffee (M); 2004-2008: Copper (C); 1971-1975: Lumber (C); 1980-2015: Natural Gas (C); 2004-2015: Palm Oil (C); 1906-2015: Petroleum (C,M); 1916-1973: Rubber (C,M); 1865-1939: Sugar (M); 1933-1939: Tea (M); 1865-1949: Tin (M); 1878-1934: Tobacco (M);
Jamaica	1953-2015: Bauxite (C,M); 1994-2004: Coffee (C); 1983-2015: Petroleum (C); 1865-2011: Sugar (C,M,B);
Japan	1999-2015: Copper (C); 1920-2015: Iron (C,M,S); 2006-2015: Petroleum (C);
Malaysia	1965-1999: Lumber (C); 1995-2015: Natural Gas (C); 1973-2015: Palm Oil (C); 1973-2015: Petroleum (C); 1908-1990: Rubber (C,M,S); 1868-1980: Tin (C,M,S);
Mexico	1969-1974: Beef (C); 1980-1978: Coffee (C,M); 1900-1956: Copper (M); 1945-1977: Cotton (C,M); 1994-2000: Iron (C); 1918-1956: Lead (C,M); 1920-2015: Petroleum (C,M); 1872-1964: Silver (C,M); 1963-1974: Sugar (C); 1927-1950: Zinc (M);
New Zealand	2008-2010: Aluminium (C); 1966-2015: Beef (C); 1900-2007: Butter (C,M); 1964-2015: Lamb (C); 1993-2008: Lumber (C); 1886-1964: Meat (C,M); 2008-2014: Petroleum (C); 1865-1996: Wool (C,M);
Nigeria	1925-1971: Cocoa (C,M,B); 2014: Natural Gas (C); 1868-1966: Palm Oil (C,M,B); 1923-1970: Peanuts (C,M,B); 1963-2014: Petroleum (C,M); 1913-1948: Tin (M,B);
Pakistan	1948-2002: Cotton (C,M); 1948-1972: Jute (M); 1977-2014: Petroleum (C); 1972-2015: Rice (C); 1993-2000: Sugar (C);
Panama	1989-2008: Beef (C); 2013-2015: Cocoa (C); 1982-2000: Coffee (C); 2004-2014: Iron (C); 1978-2004: Petroleum (C); 1979-2009: Sugar (C); 2006-2015: Tobacco(C);
Paraguay	1970-2015: Beef (C); 2001-2015: Corn (C); 1924-2006: Cotton (C,M); 1909-1961: Hides (M); 1909-2005: Lumber (C,M); 1920-1977: Meat (C,M); 1963: Palm Oil (C); 1962-1976: Tobacco (C); 2007-2012: Wheat (C);

Table B.8 – *Continued*

Country	Source
Peru	1977-1997: Coffee (C); 1899-2015: Copper (C,M); 1907-1968: Cotton (C,M); 1966-1971: Iron (C); 1949-1989: Lead (C,M); 1913-2015: Petroleum (C,M); 1886-1913: Rubber (C,M); 1883-1985: Silver (M); 1883-1977: Sugar (C,M); 1883-1904: Wool (M); 1982-2015: Zinc (C,M);
Philippines	1963-2015: Copper (C); 1997-2010: Iron (C); 1951-1989: Lumber (C,M); 2011-2015: Nickel (C); 1989-2015: Petroleum (C); 1980-1988: Silver (C); 1899-1997: Sugar (C,M);
Poland	1984-2011: Coal (C); 1987-2015: Copper (C); 1984-2015: Iron (C); 2011-2015: Petroleum (C);
Russia	1996-2005: Iron (C); 1996-2015: Natural Gas; 1996-2015: Petroleum (C);
South Africa	2000: Aluminium (C); 2000-2015: Coal (C); 1880-1999: Copper (M,S); 2000-2015: Iron (C); 2000-2002: Petroleum (C); 2001-2015: Silver (C); 1930-1999: Sugar (M); 1865-1944: Wool (M,S);
Thailand	1963-1985: Corn (C); 2000-2007: Iron (C); 1997-2015: Petroleum (C); 1865-2015: Rice (C,M); 1935-2015: Rubber (C,M), 1973-2015: Sugar (C); 1867-1983: Tin (C,M);
Trinidad & Tobago	1990-2015: Iron (C); 1999-2015: Natural Gas (C); 2015-2015: Petroleum (M); 1865-1966: Sugar (C,M);
Turkey	1878-1983: Cotton (C,M); 1982-2015: Iron (C); 1980-1988: Lamb (C); 1878-1913: Opium (M); 1982-2015: Petroleum (C); 1919-2000: Tobacco (C,M); 1878-1980: Wheat (C,M); 1878-1943: Wool (M);
Uruguay	1975-2015: Beef (C); 1994-2007: Butter (C); 1879-1973: Hides (C,M); 1879-1976: Meat (C,M, Mo); 1974-2015: Rice (C); 2010-2014: Wheat (C); 1879-2004: Wool (C,M);
Venezuela	1866-1931: Coffee (M); 1921-2013: Petroleum (C,M);

Notes: Table B.8 shows the distribution of the main export goods per country and the corresponding sources. The primary sources were assembled mainly from Mitchell, International Historical Statistics (denoted with a “M”) and the United Nations Commodity Trade Statistics Database (UN Comtrade, denoted with a “C”). For few countries we additionally obtained export shares from Moody’s Manual of Investments labeled as “Mo”, Statistical Abstract for the Principal and Other Foreign Countries, or The Statistical Abstract for British Self-Governing Dominions labeled as “S” and Bazzi and Blattman (2014) labeled as “B&B”. For Jamaica and Nigeria, we also use country-specific sources such as Blue book for the Island of Jamaica, Blue book of Northern Nigeria and Blue book of Southern Nigeria, and Blue book for Lagos which we label as “B”.

**Table B.9:** Overview on commodity price sources

Commodity	Source	SITC Revision 1 classification
Aluminum	1900-2015 Jacks (2013);	28404, 684
Barley	1865-2015 Jacks (2013);	043
Bauxite	1900-2015 Jacks (2013);	2833
Beef	1865-2015 Jacks (2013);	0011, 0111
Butter	1865-1950 Blattman et al. (2007); 1957-2007 Bazzi and Blattman (2014);	022, 023, 024
Chromium	1900-2015 Jacks (2013);	28391
Coal	1865-2015 Jacks (2013);	32
Cocoa	1865-2015 Jacks (2013);	072, 073
Coffee	1865-2015 Jacks (2013);	071
Copper	1865-2015 Jacks (2013);	2831, 28402, 682
Corn	1865-2015 Jacks (2013);	044
Cotton	1865-2015 Jacks (2013);	263
Cotton seed	1874-2015 Jacks (2013);	2216, 4213
Hides	1865-2015 Jacks (2013);	21, 29195
Iron	1865-1899 Blattman et al. (2007); 1900-2015 Jacks (2013);	27661, 281, 282, 67
Jute	1865-2015 Global Financial Data;	264
Lamb	1865-2015 Jacks (2013);	0112, 0012
Lead	1865-2015 Jacks (2013);	2834, 28406, 685
Lumber	1865-1890 Blattman et al. (2007); 1891-2008 Global Financial Data;	24
Manganese	1900-2015 Jacks (2013);	2837
Meat	1865-2015 Jacks (2013);	012, 013
Natural Gas	1900-2015 Jacks (2013);	34
Nickel	1865-2015 Jacks (2013);	2832, 28403, 683
Nitrate	1865-1950 Blattman et al. (2007);	2712, 51425
Olive Oil	1865-1950 Blattman et al. (2007); 1957-2007 Bazzi and Blattman (2014); 2008-2015 Federal Reserve;	4215
Opium	1865-1950 Blattman et al. (2007);	No SITC code
Palm Oil	1865-2015 Jacks (2013);	2213, 4222, 4224
Peanuts	1870-2015 Jacks (2013);	2211, 4214
Petroleum	1865-2015 Jacks (2013);	33
Phosphate	1880-2015 Jacks (2013);	2713
Pork	1865-2015 Jacks (2013);	0013, 0113
Rice	1865-2015 Jacks (2013);	042
Rubber	1871-1889 Blattman et al. (2007); 1890-2015 Jacks (2013);	23
Rye	1865-2015 Jacks (2013);	0451
Silver	1865-2015 Jacks (2013);	285, 681
Sugar	1865-2015 Jacks (2013);	0611, 0612, 0615, 0619, 062
Tea	1865-2015 Jacks (2013);	074, 09902
Tin	1865-2015 Jacks (2013);	2836, 28409, 687
Tobacco	1865-2015 Jacks (2013);	12
Wheat	1865-2015 Jacks (2013);	041, 046
Wool	1865-2015 Jacks (2013);	262
Zinc	1865-2015 Jacks (2013);	2835, 686

*Notes:* This Table lists the sources of real commodity prices which we use throughout the paper. Export prices are quoted on international stock exchanges. Blattman et al. (2007) use export prices quoted in UK. Bazzi and Blattman (2014) take export prices from world markets, mainly from the US and if not available from the UK. Table B.9 also states the corresponding SITC Revision 1 classification of the UN ComTrade-Database which we use to link international commodity prices with the export data.

## Chapter 3

# Sovereign Bond Maturity: The Rise of (Ultra-)Long Bonds

**Abstract:** (Ultra-)long sovereign bonds are on the rise. This paper investigates the emergence of sovereign (ultra-)long bond issuances and major factors associated with this trend. Building on Stoppok and Trebesch's (2021) unique instrument-level sovereign bond database which covers more than 50,000 sovereign domestic (1990-2018) and external bonds (1815-2019), I show that the number of governments issuing long maturity bonds of at least 10 years to maturity has increased from 75 in the 1990s to a total of 115 after 2010 in domestic markets. The number of governments issuing ultra-long bonds, i.e. bonds of more than 30 years to maturity has increased from 3 in the 1990s to 14 since 2010 in external bond markets. My regression results indicate that the countries' financial development as well as their ability to have issued (ultra-)long bonds in the past are associated with (ultra-)long issuances. While financial development is negatively correlated with ultra-long bond issuances in external bond markets, having issued (ultra-)long bonds in history is positively correlated with (ultra-)long-bond issuances in both bond markets. The adverse effect of financial development might be driven by substitution effects of long maturity bonds between external and domestic markets.

### 3.1 Introduction

For decades, macroeconomists have argued that sovereigns should lengthen their maturity profiles (e.g. see Angeletos (2002), Barro (1997) and Buera and Nicolini (2004)) based on two strands of theory: While the proponents of the macro general equilibrium approach target fiscal insurance, the proponents of the micro portfolio approach focus on a cost vs. risk trade-off. The former argue that long-term debt helps to hedge against fiscal shocks and to smooth tax profiles (see Faraglia et al. (2019), Chatterjee and Eyigungor (2012)). The latter suggest that sovereigns that are prone to rollover crises should lengthen maturity (see Cole and Kehoe (2000) and Conesa and Kehoe (2017)). For long, however, (ultra-)long issuances, i.e. issuances of at least ten years to maturity in domestic and more than 30 years to maturity in external markets, were centered around few countries despite falling interest rates. This picture has finally changed. I show that a rising number of sovereigns issue (ultra-)long bonds today. In the data, a slight increase in the maturity structure of sovereigns' newly issued debt becomes visible.

In my analysis, I first demonstrate that the average sovereign bond maturity has been surprisingly slow moving in both external and domestic capital markets over the last 30 years.<sup>1</sup> This slow trend is impelled by movements in the upper tail of the maturity distribution, namely that more and more countries have started to issue bonds at the very long end of the maturity spectrum. The distribution of maturity has widened overall. The actual share of long bonds in the total number of new bond issuances, however, remains small.

Second, I explore two important mechanisms behind the rise in (ultra-)long bond issuances. Financial systems have developed rapidly since the late 1990s on a global scale (Calvo et al., 1994). Countries that develop their financial systems attract investors that request bonds of long maturities such as pension funds or life insurance companies (Meng et al., 2010). Running regressions with the share of new (ultra-)long issuances as a percentage of total new issuances as the dependent variable, I show that financial development (as measured by private credit by deposit money banks to GDP) is positively associated with long bond issuances in domestic markets. In external markets, where I study ultra-long issuances, financial development has a negative effect. One explanation for this finding might be that governments prefer issuing long bonds in domestic markets rather than issuing ultra-long bonds in external markets once their financial systems have developed.

In addition to financial development, having been able to issue (ultra-)long bonds in the past is positively correlated with a rise in the share of (ultra-)long bond issuances today.<sup>2</sup> This is the case in both

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<sup>1</sup>This finding holds for a majority of countries.

<sup>2</sup>The variable “(ultra-)long issuances in history” is a dummy variable that turns one as soon as a (ultra-)long bond issued for the first time and zero otherwise. In domestic markets, this refers to bonds of at least 10 years to maturity and in external markets this refers to bonds of more than 30 years to maturity. The time frame considered ranges from 1990 to 2018.



domestic and external bond markets. In external bond markets, ultra-long issuances are indeed not a new phenomenon. By going 200 years back in history, we can see that maturities of more than 30 years were a common phenomenon before World War II.

This paper is, to the best of my knowledge, the first broad-based and systematic empirical analysis on (ultra-)long sovereign bond maturity. Very few papers have tried to analyze (ultra-)long sovereign debt because granular data on maturity is hard to come by. Paluszynski (2020) studies the emergence of century bonds in a theoretical setup studying the effect of such bonds on sovereign default risk. However, Paluszynski's (2020) analysis is limited to Mexico only. I build on Stoppok and Trebesch's (2021) granular sovereign bond database of bonds issued in both domestic (1990-2018) and external (1815-2019) markets. This allows me to study changes in maturity distribution that only become visible on the granular level. Other advantages of this dataset over other data providers<sup>3</sup> are its time span, its encompassing country coverage, its granularity, and its focus on not just external but also domestic capital markets.

I create two datasets to study sovereign bond maturity. First, one dataset that presents the data on their most granular level. It provides information on the time between issuance and maturity in years for each government bond. Overall, this dataset comes with more than 50,000 bond-year observations for 160 advanced (AEs) and emerging and developing countries (EMDEs). Second, a dataset that contains an unbalanced panel of volume weighted initial maturity, i.e. the sovereigns' maturity of newly issued bonds weighted by the bonds' issuance amounts. 143 of these sovereigns have at least one bond issued during the modern bond period (1990-2018) in case of domestic markets and 119 have at least one bond issued for the entire period of international borrowing (1815-2019) for external markets. This two-staged approach allows me to analyze sovereign bond maturity both in aggregate and on a micro level.

My analysis focuses on bond markets which are major lending platforms for sovereigns.<sup>4</sup> Within the bond market, governments can issue internationally or domestically.<sup>5</sup> International bond markets have been a major source for sovereign financing ever since the early 19th century (Fernandez-Ansola and Laursen, 1995). They have been studied extensively – especially with regard to crises that have hit EMDEs: Perez (2017) studies optimal sovereign debt maturity structures under the presence of asymmetric information. He finds that during periods of financial stress, borrowers issue more short-term debt in external capital markets. Aguiar et al. (2019) confirm this finding and show that it is optimal for the sovereign to finance short-term borrowing around debt crises. Arellano and Ramanarayanan (2012) and Broner et al. (2013) investigate why EMDEs borrow mostly via short-term debt during crises. Broner et al. (2013) find that

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<sup>3</sup>See the IMF's debt statistics, the BIS' Debt securities statistics or the OECD's data on maturity from its Central Government Debt Database and its Sovereign Borrowing Outlook.

<sup>4</sup>This exclude countries of political instability and/or low creditworthiness that are entirely dependent on official financial lending.

<sup>5</sup>Restrictions can keep sovereigns from issuing domestically and internationally. If the own domestic market is underdeveloped, the sovereign might not be able to issue bonds in its own home market. If investors do not believe in the sovereign's ability to repay its debt, the government can suffer from international capital market exclusion.

the high risk premia charged by bondholders on long-term debt drives this movement. In a similar vein, Bai et al. (2017) explore the relationship between sovereign spreads and back-loaded payments, i.e. small size payments are repaid before large size repayments, which are repaid closer to the actual maturity date. They argue that during recessions new issuances come with shorter maturities as this helps to decrease borrowing costs. My contribution to this literature is that I go beyond studying maturity only around crises of the last 30 years. I document the evolution of maturity over the last 200 years (from 1815 to 2019) in external bond markets, highlighting that the recent rise in ultra-long bonds is a return to long maturities that were a common phenomenon before World War II. Additionally, I confirm the finding from the literature that long-term sovereign yields correlate negatively with (ultra-)long bond issuances.

Despite their rapid growth in volume since the mid 1990's, domestic bond markets have received less attention than external bond markets. Well-developed domestic bond markets are important to sovereigns as they help reduce currency mismatches (if the bond is issued in local currency) (Burger and Warnock, 2006). The literature on domestic debt, however, points out that domestic bond markets still suffer from domestic original sin, i.e. sovereigns are not able to issue long bonds in their own currencies in domestic markets (Hausmann and Panizza, 2003). This exposes sovereigns to rollover risk in their own domestic markets.

So far, literature on factors that are positively associated with long sovereign bond issuances in domestic bond markets remains scarce due to data limitations. Few studies analyze domestic bond markets with regard to maturity in detail. Chen et al. (2019) study the evolution of sovereign bond maturity in the aggregate. They find that domestic maturity is still significantly lower than external maturity among EMDEs. My paper extends their analysis. I confirm that the average EMDE maturity in domestic markets still lies below the average maturity in external bond markets. However, by going granular, I highlight that since 1990 107 EMDE sovereigns have been able to issue long bonds in domestic bond markets. The relative share of these issuances is nevertheless too small to influence the aggregate significantly.

The remainder of this paper is structured as follows. Section 3.2 introduces the database on sovereign bond maturity and explains differences between external and domestic sovereign bond markets. Section 3.3 provides stylized facts on both the domestic and the external bond markets' maturities. Section 3.4 introduces the empirical analysis that studies factors associated with (ultra-)long bond issuances. Section 3.5 concludes.

## 3.2 Database

I employ external and domestic bond-by-bond level data from Stoppok and Trebesch (2021). In total, their database comprises 55,852 bonds issued by 160 emerging market and advanced economies.<sup>6</sup> The authors use data from a wide range of sources, including Refinitive Eikon (2019 version), Bloomberg (2019 version), and Dealogic (2013 version) for the years covering 1970 to 2019 (external and domestic markets) and Moody's Manual of Investments, the London Stock Exchange Yearbooks, Meyer et al. (2019), and Fenn's Compendium for the historical era (1815-1970, external markets).<sup>7</sup> Based on the authors' dataset, I construct a large unbalanced panel of individual sovereign bond maturities for 160 sovereigns that have at least one bond issued since the onset of the modern bond period in 1990 with regard to domestic markets and since 1815 for external markets.

During the cleaning procedure, I exclude bonds with maturities of less than one year and instruments that have explicitly been classified as bills, as debt managers differentiate between bond and bill issuances when deciding on the maturity structure for their country. Additionally, these instruments are mainly used to protect sovereigns against unexpected funding needs that lie outside the scope of debt managers' long-term maturity strategies. To avoid additional data bias, I exclude bonds that were issued due to restructurings, e.g. Brady Bonds, as they would artificially lengthen the average maturity in the dataset. Further, I focus on sovereign bonds issued by the the central government or the central bank but exclude publicly guaranteed bonds to avoid issues with differences in credit risk.

Whether a bond is placed externally or internally is not just dependent on the debt managers' choice and investors' demand, but also on the actual definition of external and domestic markets. I follow Stoppok and Trebesch (2021) in defining external and domestic capital markets by applying the following methodology: I classify a bond as domestic if the data provider states that the bond was issued domestically and if at least one of the following three criteria are fulfilled: (1) The first two letters of the ISIN are domestic, (2) the governing law is domestic, (3) the currency is domestic.<sup>8</sup>

Table 3.1 shows summary statistics for external and domestic sovereign bond maturity of AEs and EMDEs in the modern bond period (1990-2018). For maturity, I use the weighted initial maturity which is calculated as the maturity of newly issued bonds weighted by issuance amounts. In line with Chen et al. (2019), the data shows that the average maturity of bonds issued by EMDEs in external bond markets exceeds the average maturity of those issued by advanced economies (Panel B, column "Mean").<sup>9</sup> This finding is driven by countries from Latin America such as Mexico, the Philippines and Peru that have

<sup>6</sup>In their paper, the authors analyze EMDE sovereign bonds and syndicated loans. Their entire database, however, also covers AE sovereign bonds.

<sup>7</sup>See Stoppok and Trebesch (2021) for more details on the data sources and the compilation of the dataset.

<sup>8</sup>For more information on the classification into external and domestic capital markets see Stoppok and Trebesch (2021).

<sup>9</sup>I follow Stoppok and Trebesch (2021) in classifying countries into advanced and emerging and developing countries.

been able to issue bonds of very long maturities in the last 30 years.

**Table 3.1:** Summary Statistics for external and domestic weighted sovereign bond maturity

External and domestic markets								
Panel A	Years active	#Countries	Obs	Mean	Median	Std.Dev.	Min	Max
Advanced economies	1990-2018	19	9516	8.5	3.1	8.4	1	30.5
Emerging and developing economies	1990-2018	141	38953	7.9	5.1	6.8	1	65.5
External markets								
Panel B	Years active	#Countries	Obs	Mean	Median	Std.Dev.	Min	Max
Advanced economies	1990-2018	15	1672	7.9	4.8	7.3	2	100
Emerging and developing economies	1990-2018	104	2056	10.6	6.3	9.5	1	99
Domestic markets								
Panel C	Years active	#Countries	Obs	Mean	Median	Std.Dev.	Min	Max
Advanced economies	1990-2018	19	7844	8.7	3.2	8.4	1	35.5
Emerging and developing economies	1990-2018	124	36906	7	5	5.6	1	68.9

Notes: The table shows summary statistics of the weighted initial maturity, i.e. the sovereigns' maturity of newly issued bonds weighted by issuance amounts. The sample is split into advanced and emerging and developing economies as based on the definition introduced by Stoppok and Trebesch (2021). Panel A reports summary statistics of weighted initial maturity for both external and domestic bond markets taken together. Panel B provides summary statistics for the weighted initial maturity of the external bond markets only, while panel C does so for the domestic bond markets only.

Panel C shows that the average maturity in domestic bond markets does not differ significantly between advanced and emerging and developing countries. The maximum maturity of EMDEs even exceeds the maximum maturity of advanced countries by 33.4 years. This results from the fact that advanced countries issue ultra-long bonds, however, these are rarely longer than 40 years to maturity.

While advanced countries issue bonds of similar maturities in both markets (Panel B vs. Panel C, column "Mean"), the maturity of emerging market bonds is on average 3.6 years below the bond maturity issued in external markets averaged over the last 30 years. This goes line with the literature on domestic original sin which states that emerging market economies still struggle to place bonds with longer maturities in domestic capital markets (see Hausmann and Panizza (2011)).

Overall, the data shows that maturity in domestic and external markets structurally differ. This is based on general differences between external and domestic bond markets across EMDEs and AEs. In the next subsection, I will outline factors behind these differences in detail.

### 3.2.1 Why to study external and domestic maturity separately

In the 1980s, the largest sovereign default wave since World War II hit international capital markets (Meyer et al., 2019). During this period, hardly any international bonds were issued by EMDEs (Fernandez-Ansola and Laursen, 1995). At the beginning of the 1990s sovereigns returned to external bond markets (Meyer et al., 2019). Alongside external bond market tapping, domestic bond markets began to develop and increased in issuance size in the mid 1990s. They expanded even more strongly in response to the global

financial crisis that went along with structural changes such as fiscal deficits (Burger and Warnock, 2006).

Institutions like the IMF highlight the importance of domestic debt markets due to their many advantages, ranging from low currency risk to low vulnerability to capital flow reversals and their high shock resilience. However, domestic bond markets are not perfect either. Foreign investors that operate in these markets can be fickle, i.e. they flee domestic (currency) markets as soon as signs of trouble arise (e.g. if inflation rises sharply). This can lead to widening yield spreads and increased default risk (Hofmann et al., 2020).

To understand how external and domestic sovereign bond markets differ and how this eventually affects sovereign bond maturity, I provide insights into external and domestic bond markets with regard to placement history, market size, issuance place, currencies and shock resistance.

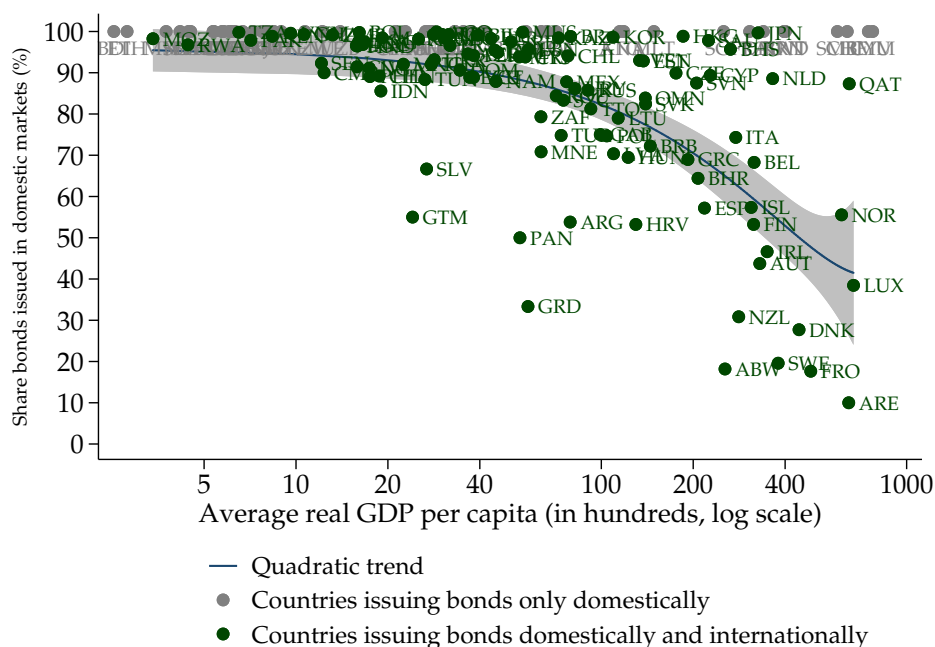
**Placement history.** Sovereign borrowing has historically been dominated by bond issuances in external capital markets. The 1970s and 1980s marked a break from this trend. This period was dominated by syndicated bank lending. External markets regained their importance at the beginning of the modern bond period after the end of the default wave on syndicated loans that ended in the Brady restructurings (Fernandez-Ansola and Laursen, 1995), which resulted in more and more emerging economies tapping international capital markets.

While external bond markets have been a major source for funding among governments ever since their development in the early 19th century, domestic bond markets began to gain significance on a large scale only during the last 30 years; the so called “modern bond period”. This period is associated with the efforts of emerging economies to protect themselves against capital flow reversals first in the 1990s and later in the global financial crisis. By deepening their domestic markets, they widened their opportunities for additional funding and tackle currency and maturity mismatches that would otherwise expose them to crises (Mehl and Reynaud, 2005). The global low yield environment has pushed international investors to tap domestic capital markets in search of higher returns. The reform of many domestic pension systems additionally contributed to the markets’ accelerating development (Mehl and Reynaud, 2005).

Figure 3.1 highlights the distribution of issuances across domestic and external capital markets for each country over last 30 years. It plots the share of bonds issued in domestic market (y-axis) by country against the average real GDP per capita between 1990 and 2018 (in hundreds, log scale). Figure 3.1 shows that there are 51 countries that issue solely in domestic bond markets. These countries cover the whole range of income level. Among countries that issue in external markets, there is a negative relationship between domestic market participation and average real GDP per capita. Although domestic markets have traditionally been dominated by advanced economies (e.g. see Germany with only domestic

market issuances over the last 30 years), this began to change in the 1990's with the vast development of emerging market economies.

**Figure 3.1:** Share of bonds issued in domestic capital markets, 1990-2018



Notes: The figure plots the total share of bonds issued in domestic capital markets vs. the number of bonds issued in external bond markets between 1990 and 2018 inclusive by average real GDP per capita (given in hundreds and on log scale). 100% corresponds to only issuances in domestic bond markets (e.g. Germany) on average in the last 29 years. These data points are highlighted in grey. The black thick line shows the quadratic relationship between the share of number of bonds issued in domestic capital markets and the share on the average log real GDP per capita for all countries that have issued in both markets. The line retains its downward slope even when using the max/min/1990/2018 version of the average real GDP per capita.

**Size.** Overall, the volume of bonds issued in both external and domestic bond markets has largely increased over the last 30 years.<sup>10</sup> In domestic markets, issuance has increased from 663 Billion US dollar issued in 1990 to 2.4 Trillion US dollar issued in 2018. External markets have seen a smaller increase, from 30.7 to 84.3 Billion US dollar issued in 2018 (inflation adjusted with base 2015). This trend is the result of the before mentioned market tapping of countries on the lower end of the income spectrum. While external bond markets are tapped on a much lower frequency, domestic bond markets are valued for their liquidity. In return, maturities in domestic markets are for most countries lower than what we see in external capital markets.

**Currency.** While international capital markets are ruled by issuances in hard currencies, headed by the US dollar and followed by the euro, domestic bonds are predominantly issued in local currencies with the exception of a few countries that carry a notable share of US dollar domestic bonds. Among these countries are low rated countries and serial defaulters like Argentina, Lebanon or Turkey, which have struggled with exchange rate crises many times in the last 30 years. Domestic currency issuances address

<sup>10</sup>See Stoppok and Trebesch (2021) for more details.

a different investor base from those buying hard currency bonds. These investors are most of the time domestic investors themselves or else speculative investors from abroad that more quickly offload their holdings when market conditions worsen (Hofmann et al., 2020).

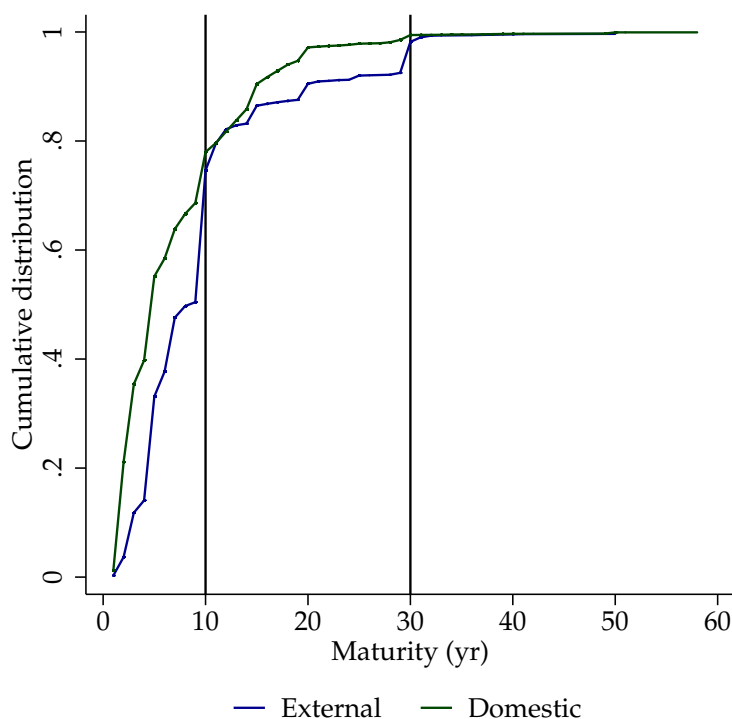
**Shock resistance.** Starting with the global financial crisis, domestic bond markets have gained increasing recognition in helping immunize countries from international crises. One major reason for this development is the low dependence on foreign currencies in domestic bond markets. Conversely, countries without developed domestic debt markets have moved up the list of currency mismatched countries and in return have had to take deflationary measures in times when the demand for their bonds crumbled (e.g. in the case of Hungary or Latvia).

Given that domestic and external bond issuance markets differ in characteristics such as currency and size, it comes to no big surprise that aggregate maturities differ between external and domestic bond markets. In this next section, I will analyze domestic and external sovereign bond maturity descriptively.

### 3.3 Stylized facts

While issuing long in external bond markets is less difficult for sovereigns as these bonds are in most cases issued in hard currencies (Kahn, 2005), issuing long in domestic bond markets on a regular basis is not yet common among all EMDEs. Figure 3.2 highlights the difference in maturity distribution between domestic and external capital markets for EMDE sovereigns between 1990 and 2018. The plot shows that the cumulative distribution of EMDE sovereign bond maturity in external markets always lies below the cumulative distribution of EMDE sovereign bond maturity in domestic markets. While issuing bonds of 10 years or more comes with a probability of 22%, in external bond markets the probability is at 36%.

When it comes to external bond markets, ultra-long bonds have received increased attention as they have been issued with rising frequency over the last 10 years (World Today News, 2021). Although their share in overall bond issuances is still small (they make up for less than 1% of external issuances between 2010 and 2018), ultra-long bonds attract institutional investors such as pension funds and life insurance companies that seek long instruments (World Today News, 2021). At the same time, they allow sovereigns to lock in on ultra-low interest rates (World Today News, 2021). Before diving into ultra-long bonds in external bond markets, however, I will outline the rise of long maturity bonds in domestic markets.

**Figure 3.2:** Cumulative distribution of EMDE sovereign bond maturity

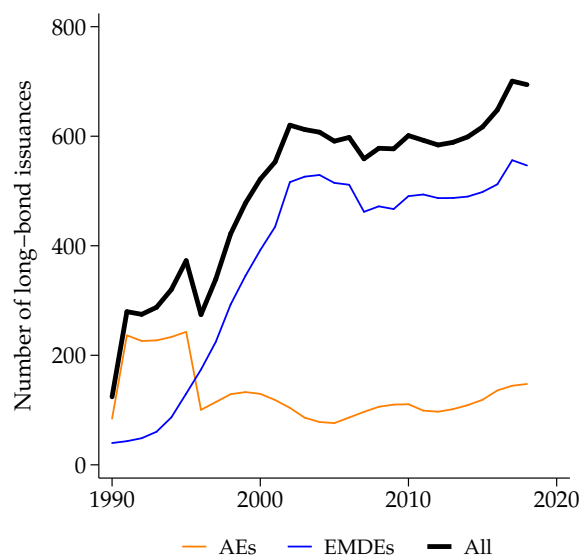
Notes: The plot shows the difference in cumulative distribution of sovereign bond initial maturity between external and domestic capital markets. The blue line represents the cumulative distribution of maturity in external markets, while the green line represents the cumulative distribution of maturity in domestic markets. To ease illustration, the x-axis (maturity in years) has been capped at 60. The two black vertical lines at maturities 10 and 30 represent the threshold for long bonds in domestic and ultra-long bonds in external markets.

### 3.3.1 The rise of long bonds in domestic markets

When have countries started to issue long bonds in domestic markets? To answer this question, I plot the 5-year moving average of all long bonds issued in domestic markets since 1990 over time. Figure 3.3 shows that the number of long bonds issued by EMDEs has risen strongly since 1990, from 129 in 1990 to 739 in 2018. There is a general upwards trend in long bond issuances since the onset of the modern bond period in 1990.

On the country-level this finding can be confirmed. I show four examples, covering small and large economies, advanced and emerging nations: Ghana, Japan, Austria and China. Figure 3.4 shows a combined line and scatter plot for each of the countries. A scatter is shown in case at least one bond was issued at a specific maturity in a given year. This means that even if 100 bonds of the same maturity were issued in one year, only one scatter appears. The black line describes the weighted initial maturity. It becomes clear that all four countries nowadays issue bonds at the longer end of the maturity spectrum in domestic markets. However, while Austria and Japan have been issuing long (even ultra-long) over the last 30 years, China only started issuing long bonds in 1996; Ghana in 2016.



**Figure 3.3:** 5-year moving average of number of long-bonds issued in domestic markets

Notes: The graph shows the 5-year moving average of the number of long-bonds, i.e. bonds of at least 10 years to maturity, issued in domestic bond markets (black line). For EMDEs and AEs the number of long bonds are given separately as blue and orange lines, respectively.

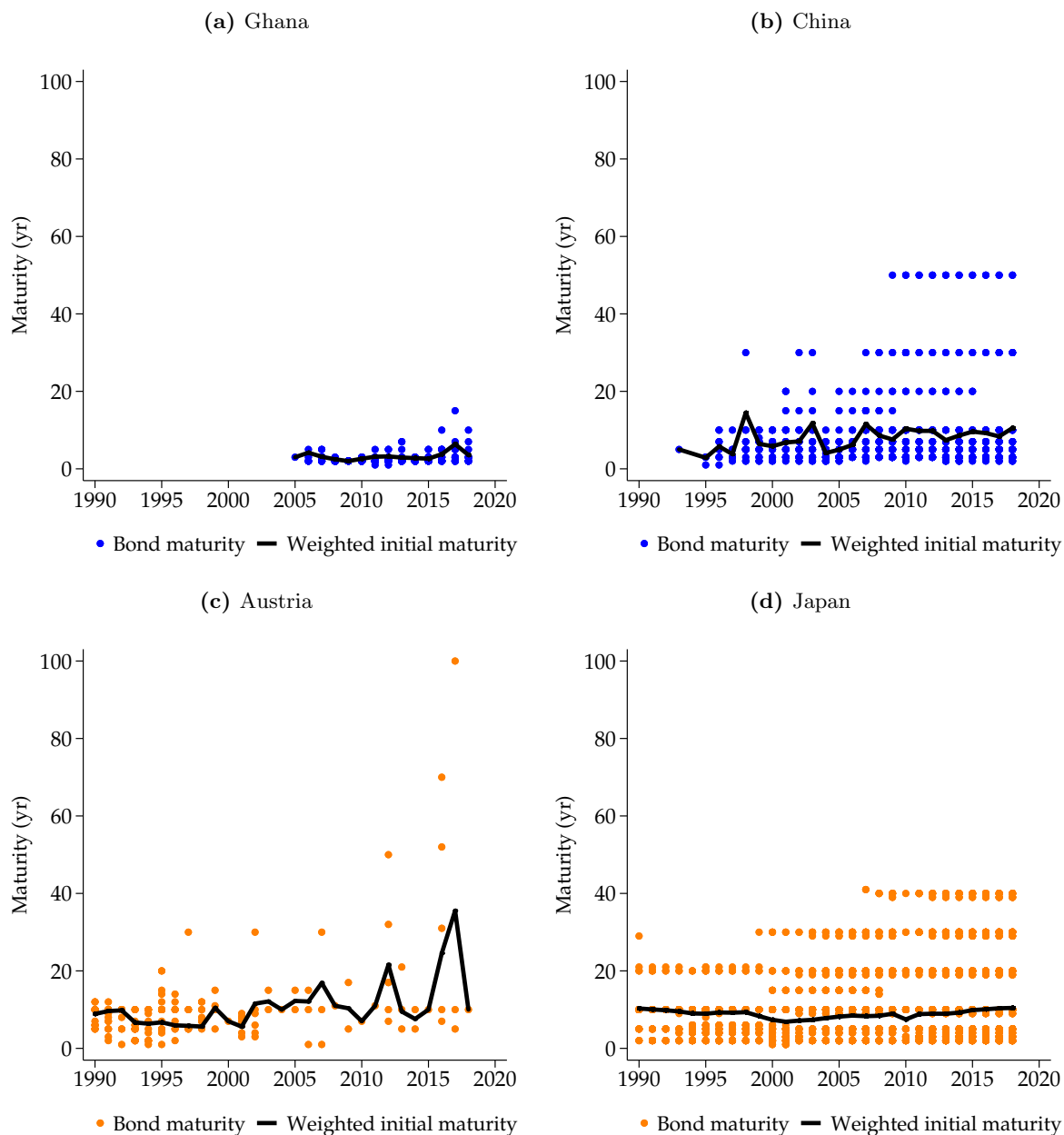
The country plots highlight that once a country has issued a long bond once, it does so again. This goes in line with the trend of maturity becoming a commodity. While few sovereigns focus on solely taking advantage of low interest rates, issuing bonds with maturities that allows them to place debt as cheaply as possible, many, in particular countries with profound debt management strategies in place, aim to please investors by offering the same product on a regular basis mostly irrespective of the current interest rate environment. This term can be summarized under the Modigliani and Sutch (1966)'s coined term preferred-habitat theory which states that investors are specialized in buying bonds with specific maturities. They only buy bonds of maturity other than their preferences if these are offered to them at a risk premium.<sup>11</sup>

While the subplots in Figure 3.4 highlight a rising spread in maturities, they also point out that maturities in the aggregate have not moved strongly in the last 30 years. Figure 3.5 shows the maturity distribution for all EMDEs in domestic markets since 1990 using boxplots. The figure confirms that emerging economies have indeed been able to place bonds of maturities with ten years or longer in domestic markets not just over the last ten but also over the last 20 to 30 years. Out of 124 emerging countries, 85% have issued bonds with maturities of at least 10 years – some even with bonds of at least 20 years. Figure C.1 in Appendix C.2.1 confirms this finding on the country level. China and Bolivia are among the few EMDEs that have issued ultra-long (maturity > 30 years) domestic bonds on a yearly basis since 2010. China is particularly interested in offering its investors bonds at long maturities to meet demand coming

<sup>11</sup>This stands in contrast to the market segmentation theory which claims that investors care about yields, not maturity.

from insurers and pension funds (Kim et al., 2003). In Bolivia, the maturity lengthening went in line with policy implementations, relief programs, and an increase in investors' confidence in Bolivia's domestic bond markets.

**Figure 3.4:** Four examples of domestic maturity on the bond level and in the aggregate



Notes: The four plots represent examples of small (Ghana), large (Japan), advanced (Austria) and emerging (China) nations. A blue (orange) scatter confirms that at this year at least one bond was issued at a given maturity. The black solid line represents the weighted initial maturity as calculated using the individual maturities of bonds issued in a given year by a given country weighted by their issuance amount in US dollar.

**Figure 3.5:** Boxplots of maturities in domestic bond markets for EMDEs

Notes: The plot shows boxplots over all maturities issued in domestic bond markets between 1990 and 2018 on a yearly basis for all emerging and developing countries in the sample.

### 3.3.2 The return of ultra-long bonds in external bond markets

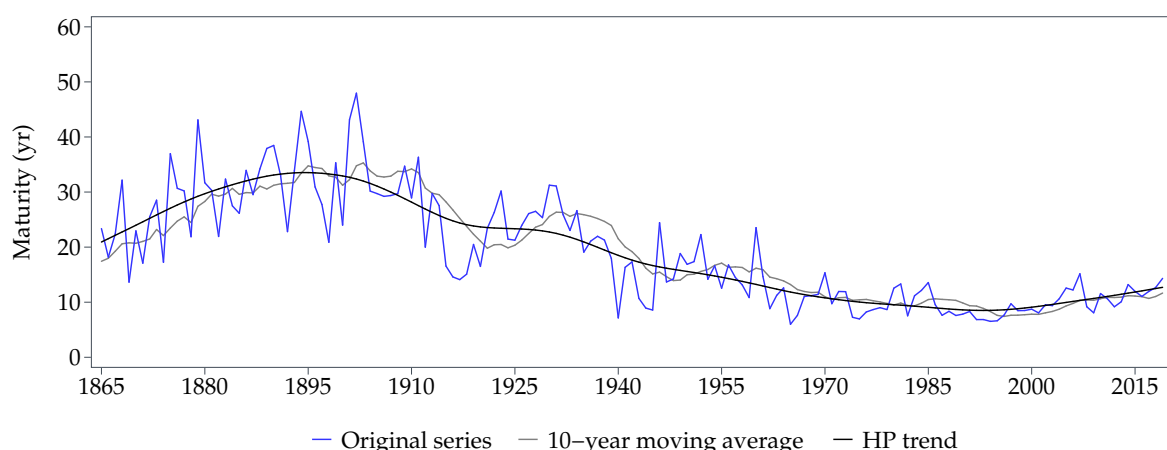
In the last subsection, we studied maturity in domestic bond markets where we saw that EMDEs can issue bonds of at least 10 years to maturity. Next, we move to maturity in external bond markets. Here, the focus rests on ultra-long bonds.

Issuing bonds with ultra-long maturities is not new to most sovereigns in respect to external bond markets. Perpetuities, i.e. debt without any payback dates, were common up until two centuries ago in countries such as the UK. During the interwar period, issuing ultra-long bonds was a standard procedure, not an exception. Even in the aggregate, the average maturity profile has been much longer during the interwar period than in the last 30 years.

Figure 3.6 shows the evolution of the average initial sovereign bond maturity weighted by the individual bonds' issuance amounts (in US dollar). The graph shows the weighted initial maturity as a blue line, its 10-year moving average in gray and the trend line generated using the Hodritt-Prescott filter as black line. The curve shows a clear trend towards shorter maturities since the end of the 19th century – a trend that started to reverse in form of a slight uptake since the mid 1990s.

Figure 3.6 reveals a picture that at first might come as a surprise: Before World War II the average bond maturity was higher than what we see today. However, the average bond repayment structure was also different at this time as most bonds had as sinking fund structure. Such sinking funds allow governments to repay debt before maturity. In doing so, repayments are split over time rather than made fully on the day of maturity. This reduces the default probability of the bond, as the reduction in outstanding principal makes the bond less risky. Longer maturity sinking fund bonds have a similar risk profile to bullet bonds with shorter maturities.<sup>12</sup>

<sup>12</sup>Figure C.3 in Appendix C.2.4 plots the share of sinking funds among all bond issuances since 1860 with regard to volume and share. The data shows that the number of sinking funds climbed from 44% in 1876 to a maximum of 85% in 1876, followed by a gradual downfall in both volume and number that has leveled off since the 1970s at an average of 6.3%.

**Figure 3.6:** The evolution of sovereign debt maturity in external bond markets

Notes: The figure plots the weighted initial maturity of external bonds as its original series (blue line), its 10-year moving average (gray line) and as smoothed trend using the HP-filter (black line). Missing values have been approximated by the respective 9- to 2-year moving averages.

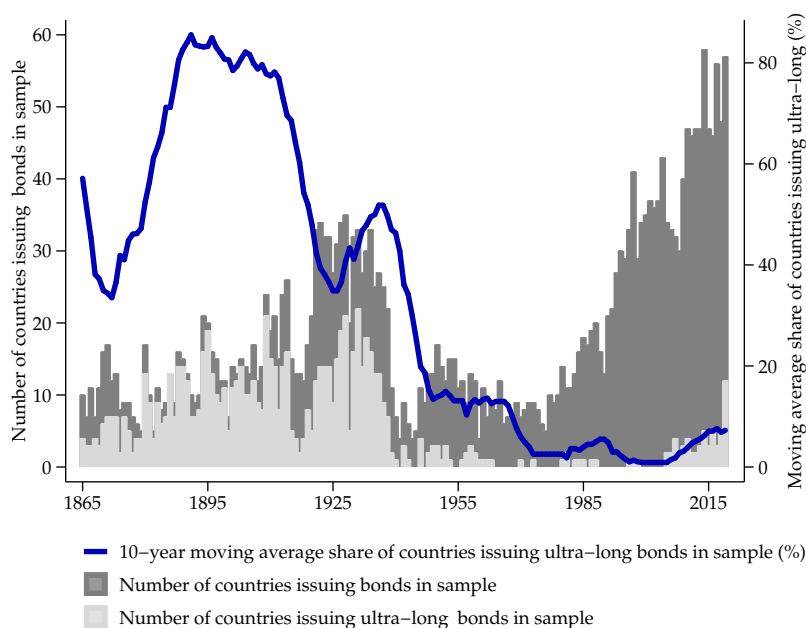
Although Figure 3.6 does not show a steeply rising upward trend in average maturity in the last 20 years, governments have indeed shown ambition to extend their maturity profiles (Chen et al., 2019). Figure 3.7 confirms this trend. Additionally, the plot provides descriptive evidence that the number of countries issuing ultra-long bonds has increased.<sup>13</sup> The plot shows the number of countries issuing ultra-long bonds in external capital markets every year since 1865. The graph differentiates between bonds of maturity of 30 years or less and bonds come with ultra-long maturities (i.e. maturities of more than 30 years.). The blue line highlights that more countries have issued ultra-long bonds in external capital markets (again) since the early 2000s. This trend is global, i.e. not limited to advanced economies only.<sup>14</sup>

Where does this increase come from? US long-term bond rates have been falling since the early 1980s (see Figure 3.8). With the fall in US long-term bond rates, hard-currency long-term bond rates of EMDEs have been falling as well. Nowadays, the trend towards ultra-long issuances can also be seen in other parts of the debt market (e.g. the corporate sector) where companies lock in on historically low interest rates.

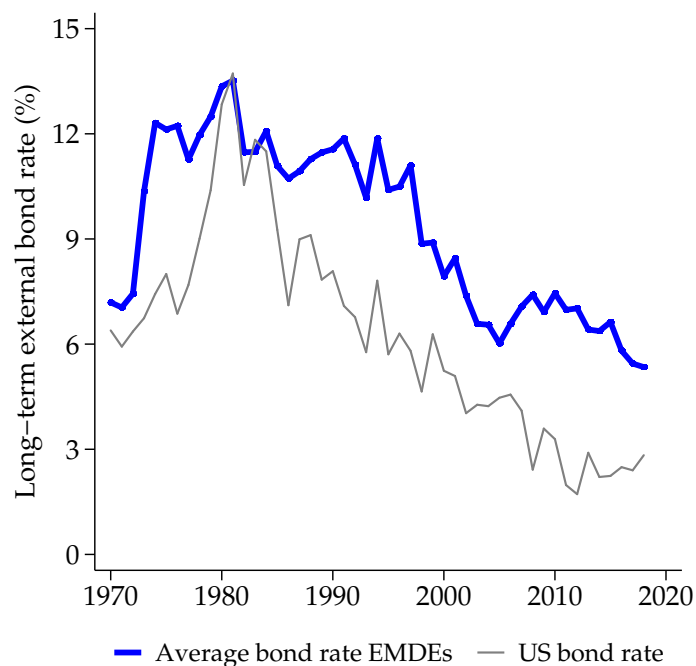
Analyzing the data on a granular level demonstrates a trend towards ultra-long issuances that are not yet well captured in the aggregate. Table C.5 in Appendix C.2.3 depicts all bonds that have been issued with maturities of more than 30 years since 1990. The table shows that it is not just advanced but also emerging economies, even serial defaulters like Venezuela, that have been able to place ultra-long bonds in international capital markets in the last 30 years.

<sup>13</sup>E.g. see Argentina's 100 year bond issuance in 2017: <https://www.ft.com/content/5ac33abc-551b-11e7-9fed-c19e2700005f>

<sup>14</sup>See Appendix C.2.2 for more information.

**Figure 3.7:** Number and share of countries issuing ultra-long bonds, 1865-2019

Notes: The figure plots the number and the share of countries issuing ultra-long bonds, i.e. bonds of more than 30 years to maturity, in external capital markets in a given year. The dark grey bars describe the number of countries issuing bonds in external capital markets as a stacked bar plot (left y-axis). The light grey bars show the number of countries issuing ultra-long bonds. The bold dark blue line refers to the share of countries issuing ultra-long bonds in the entire sample of countries (% , right y-axis).

**Figure 3.8:** Long-term bond yields US vs. EMDE average, 1970-2018

Notes: The figure plots the US long-term bond rate (grey line) vs. the average EMDE long-term bond rate (blue line) between 1970 and 2018. The data on long-term bond rates comes from the IMF's IFS.

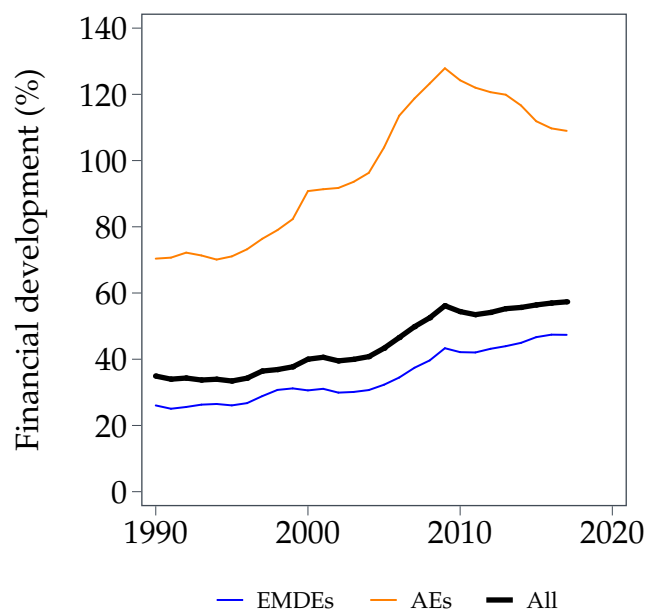
(Ultra-)long bonds are on the rise. Over the last three decades, there has been a movement in the upper tail of sovereign bond maturity distribution. More and more countries issuing (ultra-)long bonds. The number of governments issuing bonds of at least 10 years to maturity has increased from 75 in the 1990s to a total of 115 after 2010 in domestic markets. The number of governments issuing ultra-long bonds has increased from 3 in the 1990s to 14 since 2010 in external bond markets. What are the factors associated with this movement?

### 3.4 Factors associated with (ultra-)long sovereign bond issuances

In the last section, I presented stylized facts on bond maturity in domestic and external capital markets with a focus on (ultra-)long bonds. Next, I unravel factors that are associated with (ultra-)long bond issuances. According to Blommestein (2007) and Greenwood and Vissing-Jorgensen (2018), an important factor is the financial development of a country, which due to the rise of pension funds has led to an increase in investor demand at the very long end of sovereign bond maturity. Do we also see this relationship in the data?

First, I plot the evolution of average financial development since 1990. I proxy financial development following King and Levine (1993) by using data on private credit by deposit money banks to GDP (in %). Figure 3.9 shows that the average financial development has increased steadily since the mid 1990s from a low of 33 percentage points in 1995 to a maximum of 57 percentage points in 2018 (thick black line). While advanced countries have seen a vast rise in the early 2000s, the trend has been reversed since the end of the European sovereign debt crisis. Given that EMDEs account for the largest share of countries in the sample, their financial development heavily shapes the average financial development of all countries in the sample.

To unravel the relationship between financial development and (ultra-)long bonds, Figure 3.10 plots the conditional mean of the share of newly issued long bonds in percent of total bonds in external capital markets (% , x-axis) and financial development as proxied using data on private credit by deposit money banks to GDP (% , y-axis). To control for time invariant country-pair characteristics, the graph shows residuals after a regression of both series on country-pair fixed effects. Additionally, the observations have been grouped into equally sized bins.

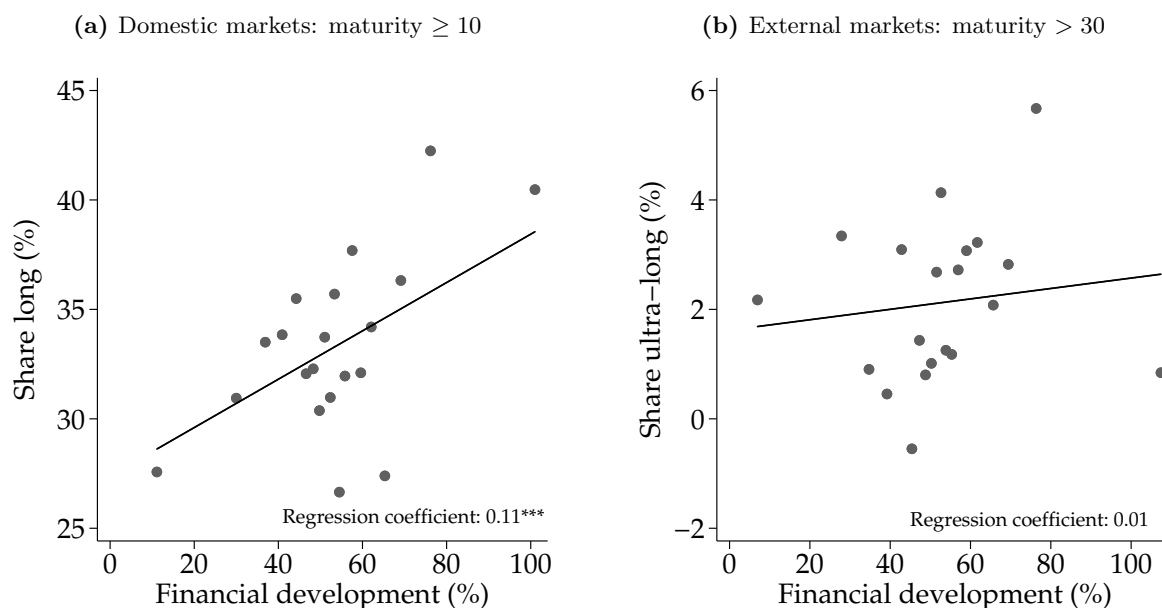
**Figure 3.9:** Average financial development since 1990

Notes: The plot shows the evolution of the average financial development (for which data is available) between 1990 and 2018, inclusive. The black line shows the average for all countries. The blue line shows the average for emerging and developing countries only and the orange line shows the average for advanced countries only. The financial development variable is proxied by private credit by deposit money banks to GDP (%) and comes from the World Bank's Global Financial Development Database.

I split the analysis for bonds with at least ten years to maturity for domestic bond markets (left panel) and with more than 30 years to maturity for external bond markets (right panel). The plots show a positive relationship that is particularly pronounced among long bonds (left panel) in domestic markets, controlling for creditor fixed effects.<sup>15</sup> The plots show that while financial development is statistically significantly associated with the share of long bond issuances as a percent of total new issuances in a given year in the domestic market, there is no statistically significant relationship in the external bond market. The regression coefficient of 0.01 remains insignificant.

Financial development attracts investors that come with a demand for long-term assets. According to the preferred-habitat theory, an establish demand for (ultra-)longs bonds can only fulfilled by governments if they issue long-term assets on a regular basis. As a result, having issued long-term assets in the past should be a good predictor for future long-term issuances. The variable “(ultra-)long issuances in history” captures this effect. It indicates when a (ultra-)long bond is issued for the first time via a dummy variable that is one if a (ultra-)long bond was issued before and zero otherwise. In domestic markets, this refers to bonds of at least 10 years to maturity and in external markets this refers to bonds of more than 30 years to maturity. The time frame considered ranges from 1990 to 2018.

<sup>15</sup>The relationship also hold when excluding creditor fixed effects.

**Figure 3.10:** Correlation between financial development and share of (ultra-)long bonds

Notes: The two plots show the relationship between financial development as measured by private credit by deposit money banks to GDP (%) and the share of (ultra-)long bonds in among all bonds of a given country in a given year (%). The latter is given by the following thresholds (from left to right): maturity  $\geq 10$  and maturity  $> 30$ . The graph shows the correlation between the residuals of both series after regressing each series on country fixed effects. The black line shows the fitted values from a univariate OLS regression of both series. The data on private credit by deposit money banks to GDP (%) comes from the World Bank.

Both financial development and (ultra-)long issuances in history show a positive relationship with the rise of (ultra-)long bond issuances when analyzed descriptively. Financial development leads to a deepening of financial markets. Investor interest widens and the demand for long-term assets increases. According to the preferred-habitat theory, investors specialize in assets of specific maturities. To fulfill the demand, governments issue more long-term debt. To test this relationship, I set up a regression analysis with financial development and the sovereigns' ability to have issued (ultra-)long before as the two main variables associated with an increase in the share of new (ultra-)long bonds in total new issuances.

### 3.4.1 Empirical analysis

In this subsection, I empirically assess the factors associated with the share of (ultra-)long domestic and external bond issuances as a % of total issuances, building on the insights derived in the last subsections. First, I analyze the relationship between the share of new (ultra-)long bond issuances, using financial development and (ultra-)long issuances in history as the main dependent variables of interest. Afterwards, I analyze the relationship of financial development, (ultra-)long bond issuances in history and the share of new (ultra-)long bond issuances in a joint regression setup including control variables. The variable “(ultra-)long issuances in history” is one as soon as a (ultra-)long bond issued for the first time and zero otherwise. In domestic markets, this refers to bonds of at least 10 years to maturity and in external markets this refers to bonds of more than 30 years to maturity. The start year for this variable is 1990,



i.e. issuances before 1990 are not considered. Financial development is measured by private credit by deposit money banks to GDP (%).

Table 3.2 provides the results split across two separate panels. No control variables are included yet. For domestic bond markets, I find a positive relationship between last year's financial development and today's share of long bond issuances (Panel A). The picture for external bond markets is less definitive; only when including fixed year effects does a negative relationship become significant. One explanation for this finding might be a substitution effect between external and domestic bond markets. If a country comes with good financial systems, it shifts long issuances from external to domestic bond markets.

The relative importance of financial development for long domestic bond issuances becomes present from this exercise. A one standard deviation increase in financial development is associated with an increase of 5.37 percentage points in the share of long bonds in total bond issuances in domestic markets. The coefficient of the financial development variable is statistically significant at the 1%-level (5%-level if both debtor and time fixed effects are included). The mean share of long in total issuances for the domestic market is at 32.5%, whereas the mean of financial development is at 40.6%. Hence, a 1 percentage point increase in financial development is associated with a 5.85 percentage point increase in the share of long issuances as a percent of total issuances (column 4). For the case of external bond markets, a 1 percentage point increase in financial development is associated with a decrease in the share of ultra-long issuances of total issuances of -4.1 percentage points.

**Table 3.2:** Correlation between share (ultra-)long issuances and main factors

	Dependent variable:							
	Share long issuances in total issuances (%)				Share ultra-long issuances in total issuances (%)			
	Domestic markets				External markets			
<b>Panel A</b>								
Financial Development[t-1, %]	0.243*** (0.040)	0.161*** (0.049)	0.246*** (0.040)	0.144** (0.060)	-0.019 (0.012)	0.001 (0.015)	-0.027* (0.016)	-0.101** (0.045)
<b>Panel B</b>								
(Ultra-)long issuance in history[t-1, dummy]	26.428*** (2.605)		26.370*** (2.580)		4.678*** (1.478)		4.327*** (1.350)	
Observations	2155	2155	2155	2155	990	990	990	990
Countries	124	124	124	124	101	101	101	101
Country FE	No	Yes	No	Yes	No	Yes	No	Yes
Time FE	No	No	Yes	Yes	No	No	Yes	Yes
R <sup>2</sup>	0.04	0.01	0.06	0.04	0.00	0.00	0.04	0.06

Notes: Standard errors clustered on country level. Significance levels represent \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ , respectively. Dependent variable: share of new long bond issuances (maturity  $\geq 10$  years) in total number of new bond issuances by country and year (in %) in the case of domestic bond markets and share of new ultra-long bond issuances (maturity  $> 30$  years) in total number of new bond issuances by country and year (in %) in external markets. The regression table includes the results for the main explanatory variables financial development (Panel A) and the dummy for (ultra-)long issuance in history (Panel B). In domestic markets, long issuances in history (post 1990) are used while in external markets ultra-long issuances are used. Financial development is measured by private credit by deposit money banks to GDP (%). The (ultra-)long issuance dummy in history is one as soon as the country has issued its first (ultra-)long bond and zero otherwise (maturity  $\geq 10$  years in the case of domestic markets and maturity  $> 30$  years in the case of external markets).

Panel B reports the results for the regression of the dummy variable (ultra-)long issuance in history. The dummy turns one as soon as the sovereign issues a bond of at least ten years to maturity for the first time in domestic markets. In external markets, the dummy turns one as soon as the sovereign issues a bond of more than 30 years to maturity. As the variable provides little variation within countries, I run the regressions without debtor fixed effects.

The coefficient of the variable (ultra-)long issuances in history is statistically significant at the 1%-level in all specifications across domestic and external bond markets. Having issued (ultra-)long bonds in the past is positively associated with a higher share of (ultra-)long bond issuances of total issuances today. This regression outcomes goes in line with the preferred-habitat effect as described in Section 3.3.1. Based on pricing and regulatory issues, once issued at a specific maturity (in this case (ultra-)long), the country is more likely to do so again.

As a next step, I test if the results of Table 3.2 hold when bringing the setup together in one regression that also includes control variables. To control for country-specific driving forces, I include the additional control variables with a one year lag in my analysis. First, I include debt to GDP (in %) to account for debt sustainability. The data comes from Reinhart and Rogoff (2011) and the IMF's Global Debt Database. Missale and Blanchard (1994) show that in the case of OECD countries, for high debt to GDP levels the relationship with maturity is negative. Cole and Kehoe (1996) confirm this finding for Mexico. On the other hand, Greenwood, Hanson, Rudolph and Summers (2015) describe a positive relationship between debt levels and debt maturity in the case of the US.

Additionally, to capture potential substitution effects, I include a dummy variable as a measure for international capital market access. Sachs et al. (1996) show that during the Mexican crisis of 1994 to 1995 the government switched from local currency to foreign currency debt. In external debt markets, Broner et al. (2013) show that governments switch from issuing long-term to issuing short-term debt during crises. Similarly, there might be substitution from external to domestic bond markets with regard to long bond issuances when the government has access to international capital markets. With regard to the variable construction, the dummy turns one if the sovereign has issued a bond in international capital markets and zero otherwise. The dummy is constructed using external sovereign bond data from Stoppok and Trebesch (2021).

Lastly, I aim to control for the effect of institutional quality on (ultra-)long bond issuances. Acemoglu et al. (2008) show that institutions matter for growth and development of EMDEs. Reinhart et al. (2003) highlight that countries with weak institutions are prone to increased default risk. For governments, a higher political score increases investor confidence in the country's domestic market. As a result, the government should be able to place long bonds more easily. To capture the effect of changes in the

countries' institutional quality on (ultra-)long issuances, I include the variable Polity V (labeled "Political regime") from the Polity Project. The observations range from -10 (autocracy) to +10 (democracy).

Although the literature shows that long-term interest rates are a driver of sovereign debt maturity (see for example Goudswaard (1990)), I do not include long-term interest rates in the main regression setup due to the limitations this would impose on the country sample. Instead, I repeat the analysis of the main regressions including long-term bond rates in Appendix C.1. The data on long-term interest rates come from the IMF's IFS.

Table 3.3 provides the results for the main regression setup including control variables in domestic markets. As before, I successively add different combinations of debtor and year fixed-effects. I find that the variable financial development remains positively associated with the share of long-bond issuances even after controlling for additional country-specific variables and debtor and time fixed effects. The indicator long issuances in history also remains statistically significant at the 1%-level. The effect, however, falls from a 26.4 percentage point increase to a 19.1 percentage point increase.<sup>16</sup>

Two out of three additional control variables are also highly significant at the 1%-level. The indicator for access to international capital markets is negatively correlated with the share of new long bond issuances. Again, substitution from the domestic to the external bond market and vice versa might be able to explain this finding. The debt to GDP ratio is negatively associated with long bond issuances. However, the coefficients are not significant. This is in line with the literature that remains inconclusive about debt sustainability and its effect on maturity (e.g. see Missale and Blanchard (1994) or Greenwood, Hanson and Stein (2015)). Lastly, the coefficient of the political regime variable switches from positive to negative when including country fixed effects. This result indicates that when countries with autocratic regimes become more autocratic (e.g. in the case of China), they can be considered as more stable and are able to still attract enough interest on long-issuances from investors.

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<sup>16</sup>The results are similar when including the indicator with a five or a ten year lag.

**Table 3.3:** Correlations in domestic bond markets including control variables

	<b>Dep. var:</b> Share long issuances in total issuances (%)			
	(1)	(2)	(3)	(4)
Long issuance in history[t-1, dummy]	19.194*** (2.965)		19.118*** (2.938)	
Debt to GDP ratio[t-1, %]	-0.030 (0.038)		-0.048 (0.039)	
Financial Development[t-1, %]	0.203*** (0.040)	0.187*** (0.049)	0.209*** (0.040)	0.139** (0.055)
Political regime[t-1]	0.836*** (0.245)	-1.163** (0.507)	0.804*** (0.247)	-1.316** (0.544)
Access to internatl. cap markets[t-1, dummy]	-5.824** (2.807)	-3.177 (2.042)	-6.062** (2.851)	-3.824* (2.123)
Observations	1909	1909	1909	1909
Countries	112	112	112	112
Country FE	No	Yes	No	Yes
Time FE	No	No	Yes	Yes
R <sup>2</sup>	0.16	0.02	0.18	0.06

Notes: Standard errors clustered on country level. Significance levels represent \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ , respectively. Dependent variable: share of new long bond issuances (maturity  $\geq 10$  years) in total number of new bond issuances by country and year (in %). The regression table includes the results for domestic bond markets only. Financial development is measured by private credit by deposit money banks to GDP (%). The long issuance dummy in history is one as soon as the country has issued its first long bond and zero otherwise (maturity  $\geq 10$  years).

Table 3.4 provides the results for external bond markets. Again, I successively add different combinations of debtor and year fixed-effects. The main variables financial development and ultra-long issuance in history remain robust in their size and in significance. When further adding also long-term interest rates on sovereign bonds (external interest rates for external markets and domestic interest rates for domestic markets), the results hardly change (see Table C.1 and Table C.2 in Appendix C.1). However, the number of countries included in the regressions drops from 100 to 55 in domestic and from 89 to 37 in external bond markets due to data limitations. In both markets, long-term bond rates have a negative effect on (ultra-)long issuances within countries. This is in line with the global trend of falling interest rates over the last 30 years.

**Table 3.4:** Correlations in external bond markets including control variables

	<b>Dep. var:</b> Share ultra-long issuances in total issuances (%)			
	(1)	(2)	(3)	(4)
Ultra-long issuance in history[t-1, dummy]	5.363*** (1.686)		4.767*** (1.472)	
Debt to GDP ratio[t-1, %]	0.009 (0.017)		0.010 (0.018)	
Financial Development[t-1, %]	-0.037*** (0.013)	-0.001 (0.017)	-0.047*** (0.018)	-0.104** (0.048)
Political regime[t-1]	0.089 (0.074)	0.256 (0.254)	0.166* (0.096)	0.116 (0.212)
Observations	883	883	883	883
Countries	89	89	89	89
Country FE	No	Yes	No	Yes
Time FE	No	No	Yes	Yes
R <sup>2</sup>	0.04	0.00	0.08	0.09

Notes: Standard errors clustered on country level. Significance levels represent \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ , respectively. Dependent variable: share of new ultra-long bond issuances (maturity > 30 years) in total number of new bond issuances by country and year (in %). The regression table includes the results for external bond markets only. Financial development is measured by private credit by deposit money banks to GDP (%). The ultra-long issuance dummy in history is one as soon as the country has issued its first ultra-long bond and zero otherwise (maturity > 30 years).

### 3.4.2 Robustness checks

In the literature, there is a debate on how to measure financial development. Hence, to test for the robustness of my results, I repeat the exercise using different proxies for financial development. I use the IMF's variable Financial Development and the IMF's variable Financial Institutions as additional proxies for financial development. Table 3.5 provides the regression outcomes for these tests. In each column, a different financial development proxy is used. Fin. Dev. represents the baseline analysis; FD IMF represents the IMF variable for financial development, and FI IMF represents the IMF variable for financial institutions. The regression results shows that all proxies for financial development have the expected sign in domestic bond markets. In external bond markets the negative effect is only statistically significant for the setup that uses the original financial development variable. The direction of the effect, however, is negative in all three regression outcomes.

**Table 3.5:** Correlations using alternative measures for financial development

	<b>Dependent variable:</b> Share (ultra-)long issuances in total issuances (%)					
	Domestic markets			External markets		
	Fin. Dev.	FD IMF	FI IMF	Fin. Dev.	FD IMF	FI IMF
Financial Development proxies[t-1]	0.150*** (0.057)	48.602** (21.436)	26.111 (21.514)	-0.098** (0.046)	-14.799 (13.817)	-20.836 (19.433)
Long issuance in history[t-1, dummy]	0.701 (4.166)	1.093 (4.140)	0.776 (4.167)	5.560* (2.894)	6.525** (3.184)	6.712** (3.185)
Debt to GDP ratio[t-1, %]	0.026 (0.064)	-0.016 (0.062)	0.012 (0.063)	-0.001 (0.032)	0.014 (0.034)	0.004 (0.034)
Political regime[t-1]	-1.244** (0.536)	-1.158** (0.570)	-1.240** (0.558)	0.161 (0.207)	0.177 (0.218)	0.241 (0.219)
Observations	1897	1897	1897	875	875	875
Countries	110	110	110	87	87	87
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
R <sup>2</sup>	0.05	0.05	0.05	0.10	0.08	0.09

Notes: Standard errors clustered on country level. Significance levels represent \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ , respectively. Dependent variable: share of new ultra-long bond issuances (maturity  $> 30$  years) in the case of external markets and share of new long bond issuances (maturity  $\geq 10$  years) in total number of new bond issuances in the case of domestic markets by country and year (in %). The regression table includes the results for external bond markets.

### 3.5 Concluding Remarks

Being able to issue (ultra-)long bonds is important to sovereigns as it improves price discovery for these instruments and it helps to minimize rollover risk (Kahn, 2005). In this paper, I have analyzed the trend towards issuing (ultra-)long bonds in domestic and external capital markets (bonds of at least 10 years in domestic and more than 30 years in external capital markets) and the factors associated with this movement. By using novel data on granular maturity profiles for 160 sovereigns, my stylized facts revealed that maturity is extremely slow moving in the aggregate. However, there has been recent movement in the upper tale of the maturity distribution towards very long bond issuances that becomes visible when studying maturity on an instrument-level.

In an empirical setup, I analyzed the factors associated with (ultra-)long bond issuances in more detail. As dependent variable, I used the share of long issuances as a percentage of total issuances. I found that (ultra-)long issuances are positively associated with financial development and a dummy variable indicating previous long issuances in the case of domestic markets. For external markets, I found that the dummy variable for historical ultra-long issuances has a positive impact on ultra-long issuance share but that financial development has the opposite effect: better financial systems are negatively associated with

the share in ultra-long bond issuances. This may be caused by the substitution effects between markets: A country with high financial development may prefer to issue long bonds in domestic markets rather than ultra-long bonds in external bond markets.

Future research could build on my findings in various directions: One could expand my analysis towards other sources of debt such as bank loans or government-to-government lending. Building on investors' holding data, one could also dive into the importance of the preferences of external and domestic investors, their maturity holding response to local and global shocks and how these factors eventually affects the maturity structure of new sovereign debt issuances at the long end.

# Appendix Chapter 3

## C.1 Additional regression results

**Table C.1:** Correlations in domestic bond markets including long-term bond rates

	<b>Dep. var:</b> Share long issuances in total issuances (%)			
	(1)	(2)	(3)	(4)
Long issuance in history[t-1, dummy]	18.145*** (4.193)		18.262*** (5.655)	
Financial Development[t-1, %]	0.231*** (0.062)	0.097 (0.065)	0.255*** (0.063)	0.080 (0.073)
Domestic long-term bond rate[t-1, %]	-0.845** (0.413)	-1.696*** (0.527)	-0.664 (0.470)	-0.896 (0.557)
Debt to GDP ratio[t-1, %]	-0.042 (0.065)		-0.055 (0.066)	
Political regime[t-1]	0.238 (0.443)	0.125 (0.497)	0.232 (0.472)	-0.112 (0.624)
Observations	850	850	850	850
Countries	55	55	55	55
Country FE	No	Yes	No	Yes
Time FE	No	No	Yes	Yes
R <sup>2</sup>	0.18	0.07	0.21	0.11

Notes: Standard errors clustered on country level. Significance levels represent \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ , respectively. Dependent variable: share of new long bond issuances in total number of new bond issuances by country and year (in %). The regression table includes the results for domestic bond markets. From column 1 to column 4 debtor and year fixed effects are included in various combinations. Financial development is measured by private credit by deposit money banks to GDP (%). The long issuance dummy in history is one as soon as the country has issued its first long bond and zero otherwise (maturity  $\geq 10$  years).



**Table C.2:** Correlations in external bond markets including long-term bond rates

	Dep. var: Share ultra-long issuances in total issuances (%)			
	(1)	(2)	(3)	(4)
Ultra-long issuance in history[t-1, dummy]	4.099*		3.569*	
	(2.196)		(2.021)	
Financial Development[t-1, %]	-0.070*	-0.040	-0.073	-0.079
	(0.038)	(0.029)	(0.045)	(0.051)
External long-term bond rate[t-1, %]	-0.493**	-0.964**	-0.350*	-0.738
	(0.218)	(0.422)	(0.190)	(0.490)
Debt to GDP ratio[t-1, %]	0.008		0.016	
	(0.032)		(0.035)	
Political regime[t-1]	-0.176	0.237	0.016	0.604
	(0.198)	(0.349)	(0.212)	(0.514)
Observations	384	384	384	384
Countries	37	37	37	37
Country FE	No	Yes	No	Yes
Time FE	No	No	Yes	Yes
R <sup>2</sup>	0.06	0.06	0.13	0.16

Notes: Standard errors clustered on country level. Significance levels represent  $*p < 0.1$ ,  $**p < 0.05$ ,  $***p < 0.01$ , respectively. Dependent variable: share of new ultra-long bond issuances in total number of new bond issuances by country and year (in %). The regression table includes the results for external bond markets only. Financial development is measured by private credit by deposit money banks to GDP (%). The ultra-long issuance dummy in history is one as soon as the country has issued its first ultra-long bond and zero otherwise (maturity > 30 years).

**Table C.3:** EMDEs only: Correlations in domestic bond markets including control variables

	Dep. var: Share long issuances in total issuances (%)			
	(1)	(2)	(3)	(4)
Long issuance in history[t-1, dummy]	19.785***		20.141***	
	(2.932)		(2.944)	
Debt to GDP ratio[t-1, %]	-0.001		-0.047	
	(0.040)		(0.045)	
Financial Development[t-1, %]	0.121**	0.199**	0.145***	0.187**
	(0.050)	(0.084)	(0.051)	(0.093)
Political regime[t-1]	0.680***	-1.117**	0.693***	-1.096**
	(0.255)	(0.504)	(0.251)	(0.507)
Access to internatl. cap markets[t-1, dummy]	-5.089	-3.567	-5.252	-3.412
	(3.303)	(2.444)	(3.424)	(2.637)
Observations	1498	1498	1498	1498
Countries	95	95	95	95
Country FE	No	Yes	No	Yes
Time FE	No	No	Yes	Yes
R <sup>2</sup>	0.09	0.02	0.14	0.06

Notes: Standard errors clustered on country level. Significance levels represent  $*p < 0.1$ ,  $**p < 0.05$ ,  $***p < 0.01$ , respectively. Dependent variable: share of new long bond issuances in total number of new bond issuances by country and year (in %). The regression table includes the results for EMDE domestic bond markets. From column 1 to column 4 debtor and year fixed effects are included in various combinations. Financial development is measured by private credit by deposit money banks to GDP (%). The long issuance dummy in history is one as soon as the country has issued its first long bond and zero otherwise (maturity  $\geq 10$  years).

**Table C.4:** EMDEs only: Correlations in external bond markets including control variables

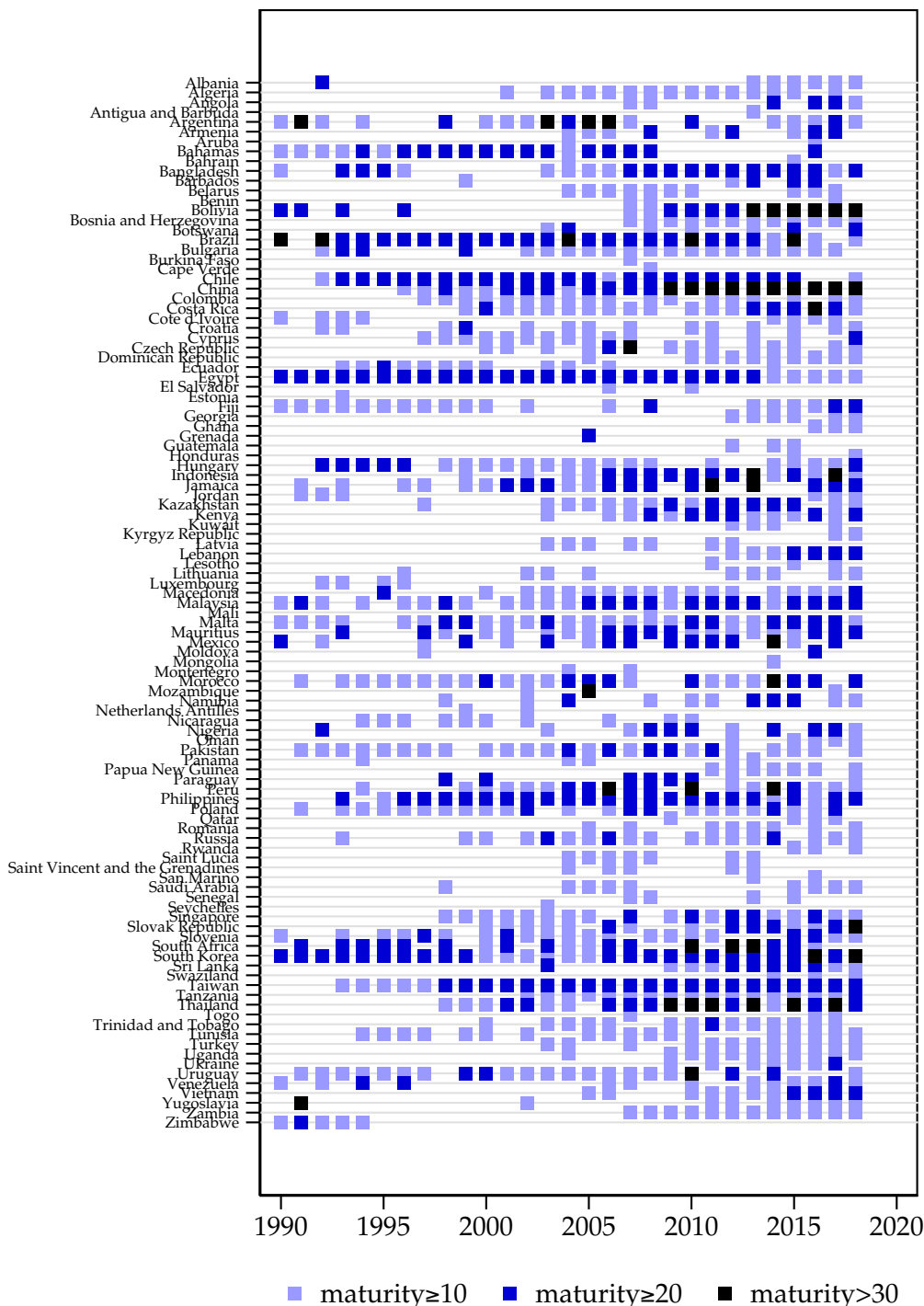
	<b>Dep. var:</b> Share ultra-long issuances in total issuances (%)			
	(1)	(2)	(3)	(4)
Ultra-long issuance in history[t-1, dummy]	3.100*** (0.968)		1.912*** (0.703)	
Debt to GDP ratio[t-1, %]	0.008 (0.018)		0.004 (0.018)	
Financial Development[t-1, %]	-0.053*** (0.019)	0.018 (0.024)	-0.065** (0.028)	-0.121** (0.059)
Political regime[t-1]	0.090 (0.086)	0.303 (0.263)	0.113 (0.089)	0.152 (0.203)
Access to internatl. cap markets[t-1, dummy]	-0.312 (0.828)	-2.038* (1.218)	0.109 (0.737)	-2.177* (1.156)
Observations	658	658	658	658
Countries	72	72	72	72
Country FE	No	Yes	No	Yes
Time FE	No	No	Yes	Yes
R <sup>2</sup>	0.02	0.01	0.06	0.08

Notes: Standard errors clustered on country level. Significance levels represent \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ , respectively. Dependent variable: share of new ultra-long bond issuances in total number of new bond issuances by country and year (in %). The regression table includes the results for EMDE external bond markets only. Financial development is measured by private credit by deposit money banks to GDP (%). The ultra-long issuance dummy in history is one as soon as the country has issued its first ultra-long bond and zero otherwise (maturity > 30 years).

## C.2 Additional graphs and tables

### C.2.1 Countries issuing long bonds in domestic capital markets

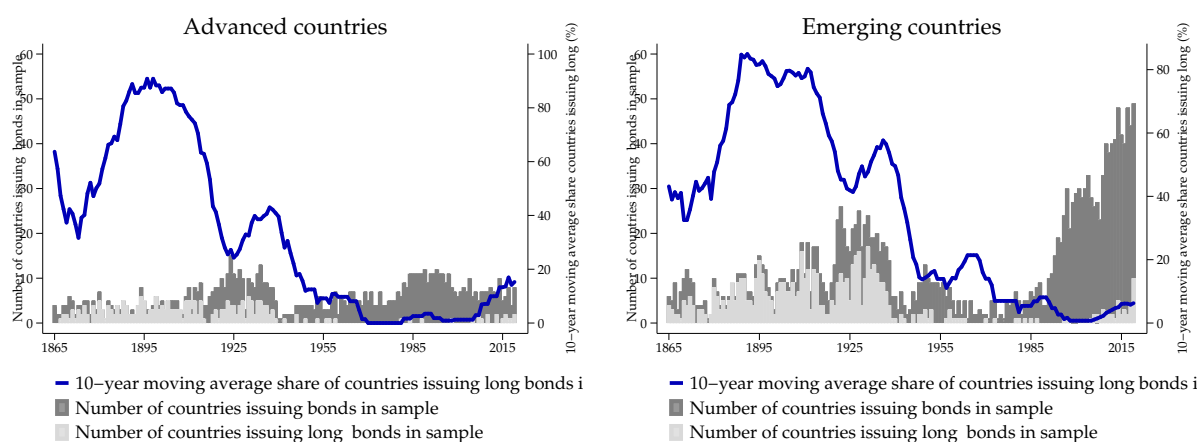
Figure C.1: Long bonds issued in EMDEs' domestic markets, 1990-2018



Notes: The stripplot shows bond issuances with maturities of more than 10 years (light blue), more than 20 years (blue) and more than 30 years (black) across emerging market economies that have issued at least one long bond since 1990 in domestic capital markets.

## C.2.2 Countries issuing ultra-long bonds in external capital markets

**Figure C.2:** Number and share of countries issuing ultra-long bonds in external capital markets



Notes: The figures show the number and share of countries issuing long bonds in external capital markets, i.e. bonds with a maturity of more than 30 years, in a given year, split by advanced (left graph) and emerging and developing (right graph) economies.

## C.2.3 Ultra-long bond issuances in external bond markets

**Table C.5:** External bond issuances with maturity > 30 years since 1990

Country	ISIN	Issue date	Maturity	Term
<b>Advanced economies: seasoned issuer</b>				
Spain	XS0084882587	1998	2029	31
<b>Advanced economies: new issuer</b>				
Austria	XS2050604136	2019	2119	100
Belgium	BE6286271893	2016	2116	100
Belgium	BE6280748953	2015	2115	100
Belgium	BE6254422569	2013	2053	40
Belgium	BE6254706490	2013	2053	40
Belgium	BE6253177727	2013	2058	45
Belgium	BE6209526712	2010	2052	42
Greece	XS0292467775	2007	2057	50
Ireland	XS1389917508	2016	2116	100
Ireland	XS2085883382	2019	2119	100
Ireland	XS1792064047	2018	2075	57
Ireland	XS1639913067	2017	2063	46
Ireland	XS2054064766	2019	2119	100
Ireland	XS1639739876	2017	2064	47
Italy	XS0342993747	2008	2058	50
Italy	IT0003805295	2005	2045	40

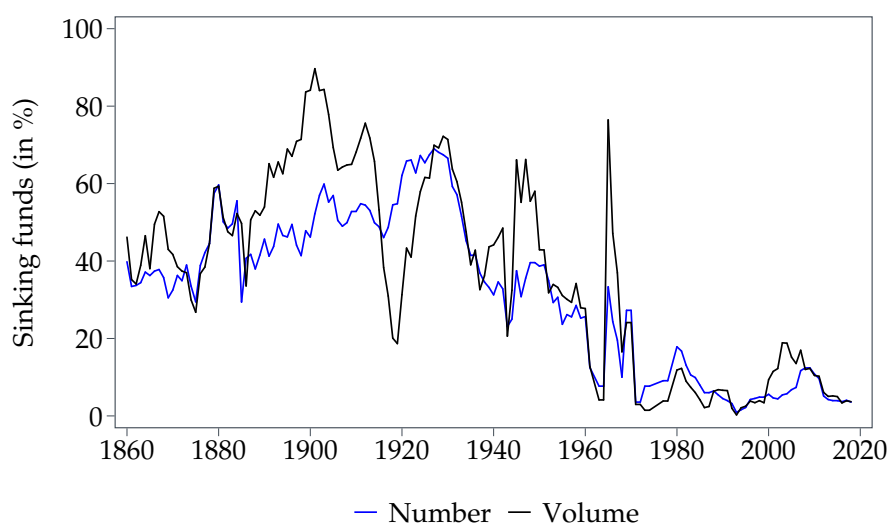
Italy	XS0280146357	2007	2057	50
Italy	XS0293217799	2007	2062	55
Italy	XS0970703772	2013	2053	40
Italy	XS0936805612	2013	2063	50
Italy	IT0003838031	2005	2045	40
Italy	XS0515753183	2010	2060	50
<b>Emerging and developing economies: seasoned issuer</b>				
China	US712219AC86	1996	2096	100
Philippines	US059891AB70	1997	2097	100
<b>Emerging and developing economies: new issuer</b>				
Argentina	US040114GK09	2005	2038	33
Argentina	ARARGE03E659	2005	2038	33
Argentina	XS0205537581	2003	2038	35
Argentina	US040114HN39	2018	2117	99
Argentina	XS0205540536	2003	2038	35
Brazil	US105756BK57	2006	2037	31
Brazil	US105756BW95	2014	2045	31
Brazil	US105756CB40	2019	2050	31
Brazil	US105756BY51	2016	2047	31
Brazil	US105756BR01	2009	2041	32
Chile	US168863DL94	2019	2050	31
Colombia	US195325BM66	2009	2041	32
Colombia	US195325BK01	2006	2037	31
Egypt	XS2079846635	2019	2059	40
El Salvador	USP01012CA29	2019	2050	31
Ghana	XS1968714623	2019	2051	32
Guatemala	USP5015VAJ54	2019	2050	31
Indonesia	US455780BW52	2015	2046	31
Indonesia	US455780CE46	2017	2048	31
Indonesia	US455780CJ33	2018	2049	31
Indonesia	USY20721BR90	2016	2047	31
Jamaica	US470160AV46	2007	2039	32
Mexico	US91086QAV05	2008	2040	32
Mexico	XS1046593908	2014	2114	100
Mexico	US91087BAG59	2019	2050	31
Mexico	US91086QAZ19	2010	2110	100
Mexico	XS1218289103	2015	2115	100
Mexico	XS0694196584	2011	2110	99

Mexico	US91086QBB32	2012	2044	32
Mexico	US91087BAB62	2016	2047	31
Mexico	US91086QBF46	2015	2046	31
Mexico	US91086QBE70	2014	2045	31
Mexico	US91087BAD29	2017	2048	31
Panama	US698299BH68	2018	2050	32
Panama	US698299BB98	2013	2053	40
Panama	US698299BL70	2019	2060	41
Paraguay	US699149AH36	2019	2050	31
Paraguay	USP75744AG08	2019	2050	31
Peru	USP78024AA74	2014	2055	41
Peru	US715638BM30	2010	2050	40
Poland	XS0224427160	2005	2055	50
Qatar	US74727PAR29	2011	2042	31
Qatar	US74727PAL58	2009	2040	31
Saudi Arabia	XS1936302949	2019	2050	31
Saudi Arabia	US80413TAL35	2019	2050	31
Turkey	US900123CG37	2014	2045	31
Uruguay	US760942BA98	2014	2050	36
Uruguay	US760942AY83	2012	2045	33
Uruguay	US760942BD38	2018	2055	37
Venezuela	USP97475AK68	2007	2038	31
Venezuela	USP97475AJ95	2007	2038	31

Notes: The table shows all bonds issued in external capital markets since 1990 that come with a maturity of more than 30 years. The table is further separated into advanced and emerging economies, as well as established and new issuer. Established issuers are defined as having their first ultra-long bond issued before 2000, while new issuers are defined as having their first ultra-long bond issued in 2000 or later. The term is calculated as the difference between the year of maturity minus the year of issuance.

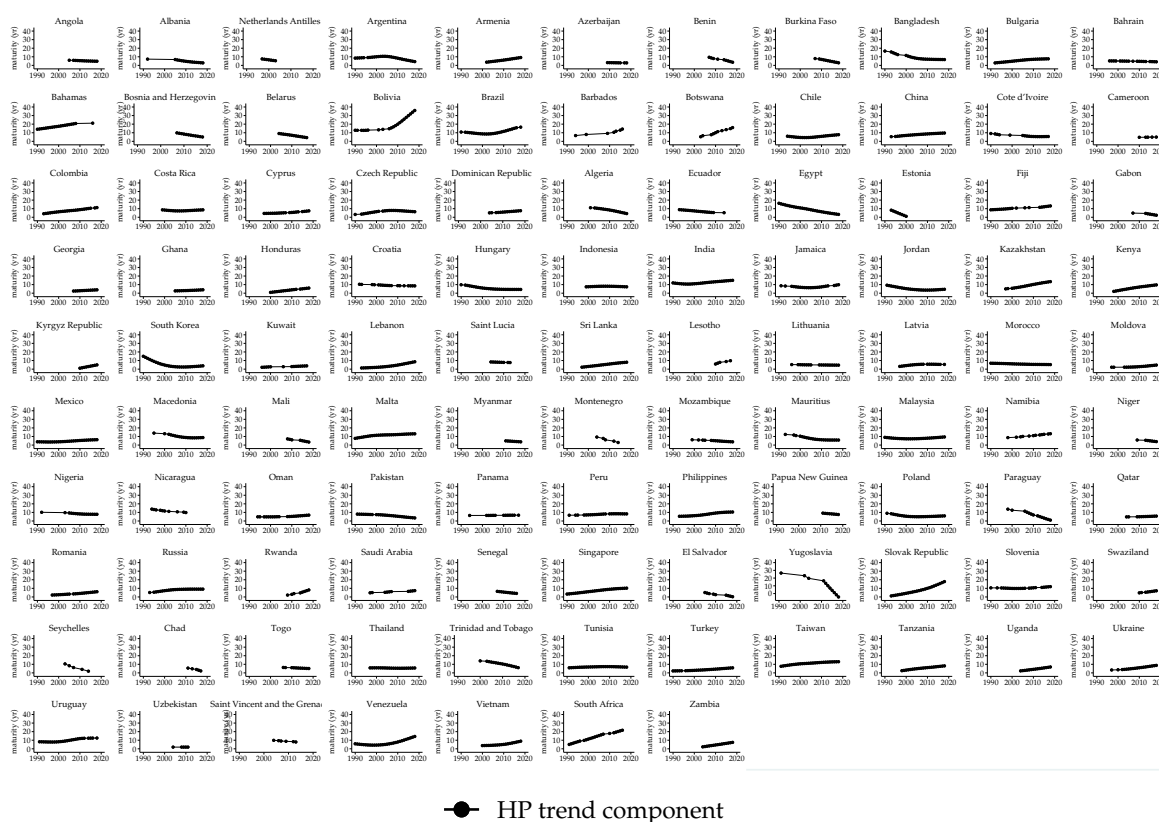
### C.2.4 Sinking funds

Figure C.3: 5-year moving average share of sinking funds



Notes: The plot shows the number (blue line) and volume (black line) as a five-year moving average share in sinking funds (in %) between 1860 and 2019 in the sample

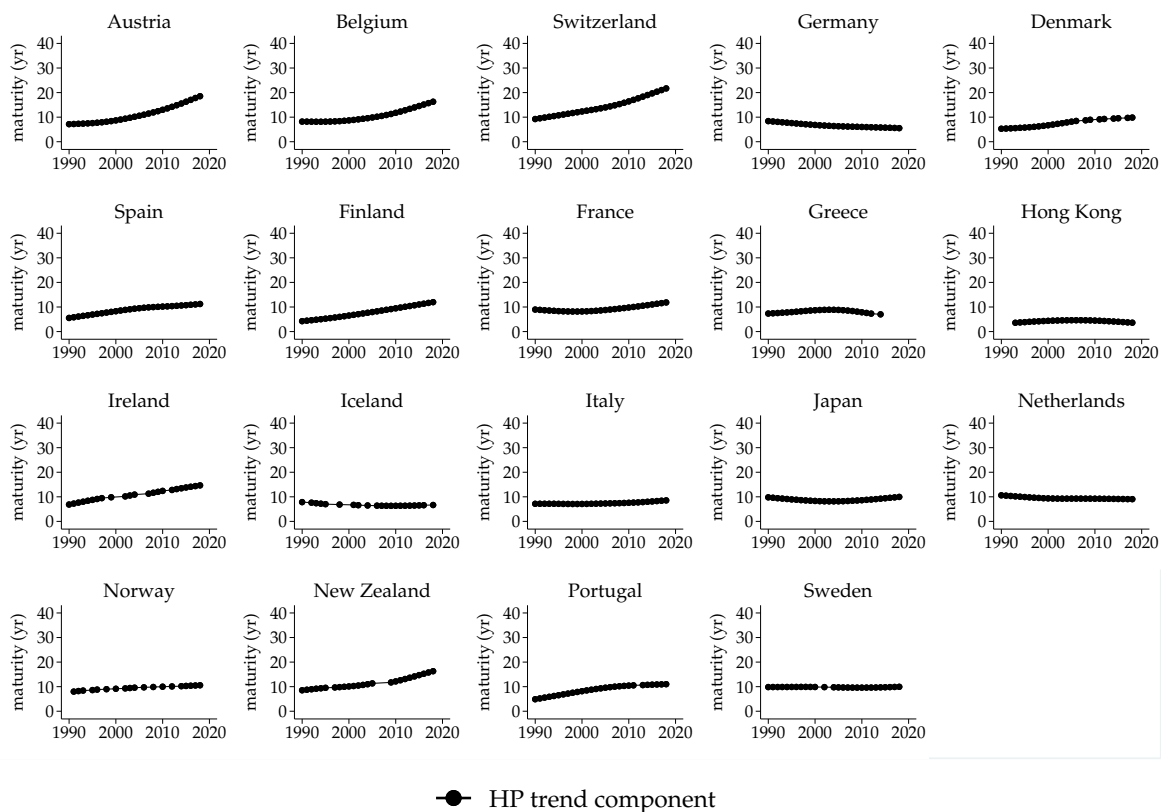
Figure C.4: HP trend component of weighted initial maturity of EMDEs



Notes: The plots show the HP filter trend component (with a smoothing of 1600) of the weighted initial maturity for every emerging economy in the sample that have issued bonds in domestic markets in at least five years between 1990 and 2018.

### C.2.5 Trends in weighted initial maturities

Figure C.5: HP trend component of weighted initial maturity of AEs

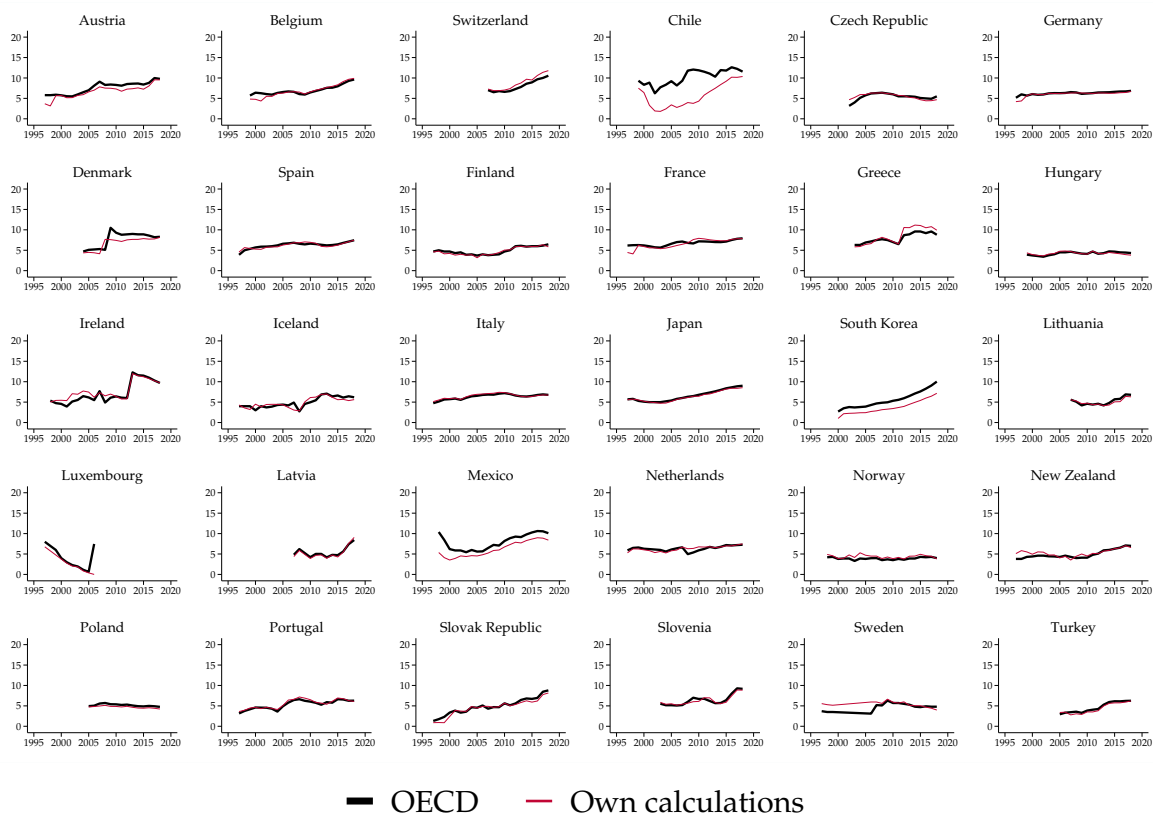


Notes: The plots show the HP filter trend component (with a smoothing of 1600) of the weighted initial maturity for every advanced economy in the sample that have issued bonds in domestic markets in at least five years between 1990 and 2018.



## C.2.6 Comparison with OECD data

Figure C.6: Comparison between OECD and self-calculated residual maturity



Notes: The figure plots the OECD residual (outstanding) maturity of external and domestic bonds between 1997 and 2019 from the OECD Sovereign Borrowing Outlook against my self-calculated weighted average time to maturity for all countries that are given in both samples. The strong difference for Chile results in domestic sovereign bond issuances of 2001 when Refinitive Eikon reports several issuances of shorter maturities.

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# Declaration

I hereby declare that I have written my doctoral thesis “Essays on Sovereign Debt and Commodity Markets” independently and without external assistance, and that I have made a significant contribution as co-author to the scientific articles included in this dissertation. I have identified all word-for-word quotations of other authors, as well as comments based closely on other authors’ ideas, and I have cited the sources according to the guidelines I received.

Kiel, Aug 5, 2021