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DIW Berlin
German Institute for Economic Research
Mohrenstr. 58
10117 Berlin

Tel. +49 (30) 897 89-0
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Global Commodity Markets and Sovereign Risk across 150 Years *

Angélica Domínguez-Cardoza
University of Kiel

Adelina Garamow
DIW Berlin & University of Potsdam

Josefin Meyer
DIW Berlin & CEPR

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.

Keywords: Sovereign Risk, Commodity prices
JEL classification: E44, F41, F34, H63,G12

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Contact: angelica.dominguezcardoza@stu.uni-kiel.de; agaramow@diw.de; jmeyer@diw.de

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 2006a). 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.[1]

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).[2] 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 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

[1] We refer to minerals and metals when we speak of minerals from here on.

[2] According to Brahima 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.

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

We aim to add to the research canton 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.[3]

The dataset of the past 150 years 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. Furthermore, the historical dataset allows us to study periods with different institutional settings and different degrees of global integration and disintegration. Therefore, our paper adds a new angle to established literature with shorter time periods of the more recent past.

Our regressions outcomes show that a 1% increase in our country-specific commodity price index

[3]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.

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 standard deviation decrease in sovereign yield spreads of 0.17. 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) and splitting our price-index into three major subgroups, we find a shift in the group of commodities driving the results. While historically, the relationship was driven by agricultural exporters, today the relationship is driven by oil- and mineral dependent exporters. 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 and a regression that randomly drops 10% of our data points.

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 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 (2013b) 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 (2009a), Shousha (2016), Fernández et al. (2017) and Fernández et al. (2018) go one step further by accounting for financial frictions in their analyses. Understanding 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. (2017) 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.[4] This is also true in the the context of sovereign defaults.[5] 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 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 3 provides first descriptive evidences on the relationship between country-specific commodity price movements and sovereign risk as captured by sovereign yield spreads. Section 4 builds on this introduction and provides our empirical analysis based on fixed effects regressions. Section 5 concludes.

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.

2.1 Country sample

We say that a country is "commodity dependent" when their export primarily consists out of raw commodities. Therefore, we follow UNCTAD's yearly published state of commodity dependence reports. The UNCTAD defines a country to be commodity dependent if at least 60% of total merchandise exports are composed of commodities (in value terms) and classifies every country as agricultural, energy, or mineral dependent countries. 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

[4] See for an overview van der Ploeg (2011) and van der Ploeg and Poelhekke (2017).
[5] 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.

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.[6]

Given this definition,[7] we have created a sample of commodity dependent nations for which we were able to collected 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.

2.2 Commodity sample

To construct our commodity sample, we closely follow Jacks (2013a) in the approach that he applies to construct his sample of international commodity market prices. Jacks (2013a) collects commodity prices for 40 commodities that together represent a significant share in global economic activity during the period of 1865 to 2015 (Jacks, 2013a). 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.[8] 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, mineral and energy commodities.

[6] 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.

[7] 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.

[8] 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.

2.3 A country-specific commodity price index

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. Therefore, we weight global commodity price movements by each country's share of commodity exports in economic performance.

We calculate our country-specific commodity index $PriceIndex_{i,t}$ by:[9]

$$PriceIndex_{i,t} = \sum_{j=1}^{J} P_{j,t}\Omega_{i,j,t}, \tag{1}$$

with

$$\Omega_{i,j,t} = \frac{1}{3}\sum_{k=1}^{3} \frac{Export_{i,j,t-k}}{TotalExports_{i,t-k}}, \tag{2}$$

where $\Omega_{i,j,t-k}$ represents country i's export of commodity j in period $t-k$ in total exports. The denominator of Equation 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.[10] The global price $P_{j,t}$ of each commodity j in a given year t is logged and deflated ($2000 = 100$) using the US 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.[11]

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

[9] By constructing the index we follow closely the methodology of Bazzi and Blattman (2014) and Gruss and Kebhaj (2019).

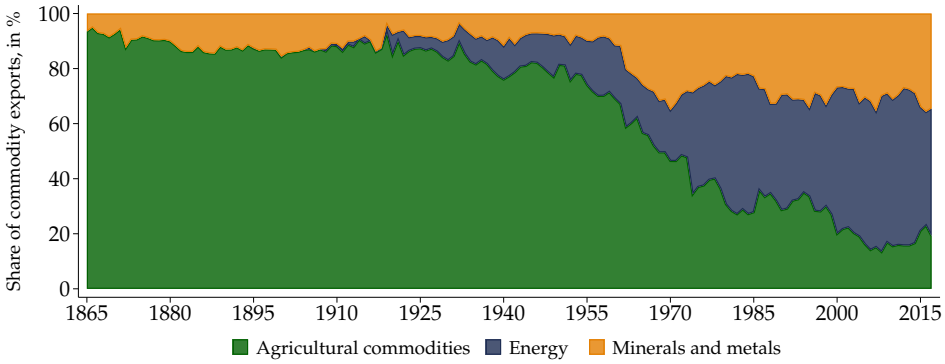
[10] As a robustness check, we employ GDP as our measure of performance.

[11] 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.

period before 1960, we rely on commodity data coming from a new database on *bilateral country-industry-level trade flows*. This database covers among others country-specific trade statistics, aggregated statistics as Mitchell's *International Historical Statistics 1750-2010*, *Moody's Manual of Investments*, *The Statistical Abstract*-Series. To construct the final database, we match the commodity data from the *bilateral country-industry-level trade database* 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 up to the four-digit SITC category.

As it can be seen from Figure 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 considerable 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.[12] Additionally, in Appendix F 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.[13]

Figure 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 of total exports, summarized for all countries in the sample.

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 (2013a) (1865-2015) and extend it 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

[12] In Appendix B we show the distribution of export shares by these three commodity subgroups.

[13] 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.

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.

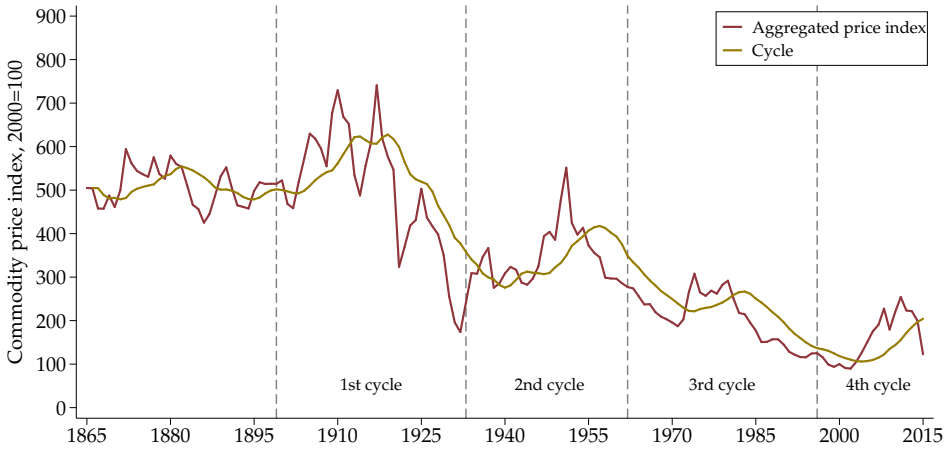
To examine the evolution of our price index over 150 years of time, we present the index in its aggregate over all 41 countries by following the methodology of the *IMF Primary Commodity Price Index*, using a weighted average of commodity price indices that represent the global market. Our index includes the prices of all 42 commodities in our sample deflated to 2000 = 100 values. Figure 2a plots our aggregated price index, using prices of real commodity prices between 1865 and 2015 with 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, 2012). The black dashed vertical lines in Figure 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, 2012) 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, 2012). 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.

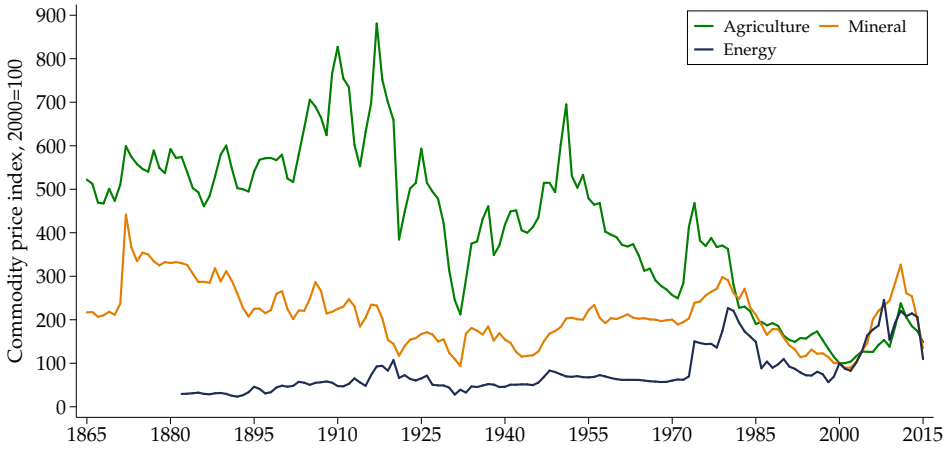
Figure 2: Long-run trends in our aggregated country-specific commodity price index, 1865-2015

(a) Aggregated commodity price index



Notes: Figure 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. The light green line represents the aggregated price index's 10-year moving avearge. The grey dashed lines separate the different cycles of the supercycle as based on Erten and Ocampo (2012).

(b) Aggregated commodity price indices, by commodity groups



Notes: Figure 2b shows aggregate commodity prices indices by commodity groups from 1865 to 2015. The agricultural commodity price index (green line) comprises animal products, grains and soft commodities. The mineral commodity price index (orange line) consists of metals, minerals and precious minerals. The energy commodity price index (blue line) covers commodities such as oil and coal. All price indices are deflated to 2000-values.

Figure 2a shows that price swings differ in each supercycle and were quite volatile, affecting countries with high export shares in commodities more heavily than countries with low shares.[14] 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

[14]Figure A3 in Appendix D plots the evolution of all 42 commodity prices in our sample.

plantations were built in 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, 2009b). 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 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 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 1 shows summary statistics for the commodity price index (excluding periods of default).[15] While for most countries the data set covers both the historical and the modern bond period, some countries only have data for the modern bond period 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 as one would expect with a much longer historical bond period.[16]

[15] In Appendix A4 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.

[16] 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.

Table 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. The overview shows statistics for the entire sample period, for the modern bond era (1993-2015) only, and for the historical era (1865-2015) only.

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. 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 sovereign bond yield spreads that are based on Meyer et al. (2022). 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 [17], 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.

Table 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[18] 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.

[17] According to bond sample used in Meyer et al. (2022) maturities were of 50 years on average compared to seven years in the modern bond era

[18] See Mitchener and Trebesch (2021) for more information.

Table 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

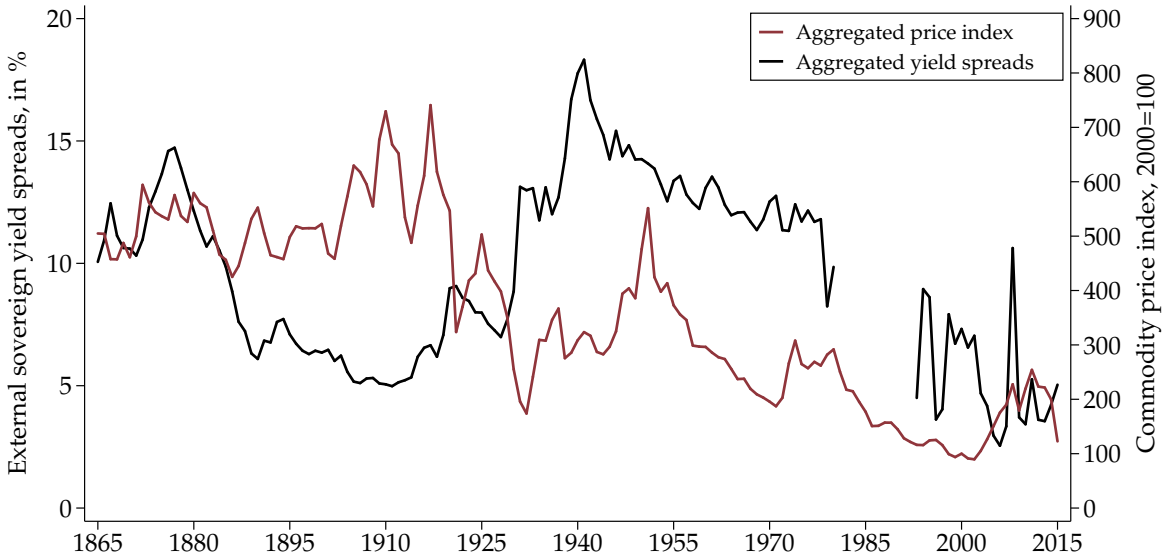
Notes: The table lists summary statistics by country and time period for sovereign yield spreads. The overview shows statistics for the entire sample period, for the modern bond era (1990-2015) only, and for the historical period (1865-2015) only.

3 Descriptive evidence

Figure 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 3: Aggregated commodity price index and sovereign yield spreads, 1865-2015



Notes: Figure 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 ended abruptly 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 deteriorates 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 occured 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.

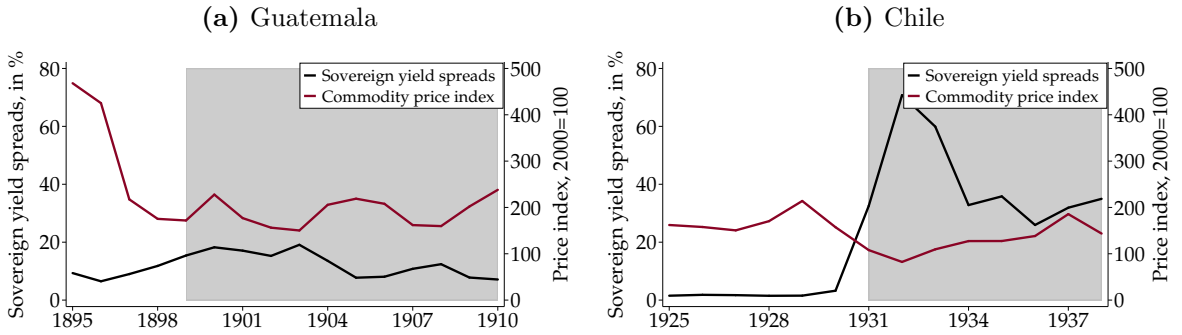
3.1 The relationship between commodity prices and sovereign yield spreads on the country level

In this subsection we investigate this relationship on an individual country level to illustrate the importance of commodity prices movements for sovereign default risk.

Figure 4 highlights this negative link between commodity prices and sovereign yield spreads for two cases, Guatemala for the period 1895 to 1910 and Chile for the period 1925 to 1939. During these time periods the inverse relationship is clearly visible and both countries ended up in default.

Figure 5 shows the price, production and export volumes of the driving commodity in these countries, coffee in the case of Guatemala and copper in the case of Chile. 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 main export destination. Under dictator Justo Rufino Barrios Guatemala's coffee export reached 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. This led to a drop in the international price for coffee. Coffee growers worldwide, and in particular in Guatemala, experienced severe

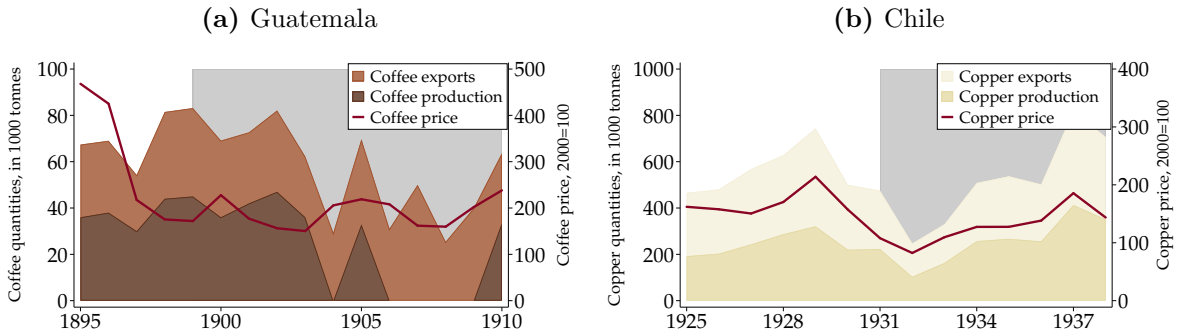
Figure 4: Country-specific commodity price index and sovereign yield spreads



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.

pressure. Guatemalan farmers were highly indebted and with the failing prices they no longer could 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. As a result, sovereign spreads rose and Guatemala defaulted on its debt in 1899.

Figure 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.

According to 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. Eventually, the supply outstripped demand, resulting in falling copper prices. Two years later, when the Great Depression hit, 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.

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 2.3 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:

$$Spread_{i,t} = \gamma_1 PriceIndex_{i,t-1} + \gamma_2 \mathbf{X}_t + \gamma_3 \mathbf{Z}_{i,t-1} + \alpha_i + \epsilon_{i,t}, \tag{3}$$

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 (α_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 country-specific macroeconomic variables, 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 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 et al. (2017). Polity IV allows us to capture the regime type, from hereditary monarchy, -10 to consolidated democracy, +10. We expect a higher polity score to affect yield spreads negatively.[19] 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 A.

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 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.

[19] A big advantage of the Polity IV variable is its long time span, going all the way back to the mid 19th century.

Table 3: Comovement of commodity prices and sovereign bond yield spreads, 1865-2015

	(1)	(2)	(3)	(4)	(5)	(6)
Price index[t-1]	-0.118***	-0.166***	-0.166***	-0.167***	-0.167***	-0.184***
	(0.160)	(0.213)	(0.258)	(0.245)	(0.245)	(0.241)
World interest rate[t, %]		-0.113***	-0.113***	-0.114***	-0.115***	-0.178***
		(0.075)	(0.073)	(0.077)	(0.078)	(0.084)
World imports[t, logged]		-0.183***	-0.183***	-0.181***	-0.180***	-0.060
		(0.126)	(0.138)	(0.163)	(0.163)	(0.125)
Global volatility index[t]		0.072***	0.072**	0.072**	0.071**	0.148***
		(0.084)	(0.092)	(0.093)	(0.093)	(0.174)
Debt to GDP[t-1, %]			0.000	0.000	-0.001	-0.076**
			(0.000)	(0.000)	(0.000)	(0.000)
Polity IV[t-1]				-0.004	-0.005	-0.107***
				(0.040)	(0.041)	(0.038)
Trade openness[t-1, %]					0.010	0.055***
					(0.000)	(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^2	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.

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 standard deviations in sovereign yield spreads (Table 3, column (5)). Running an unstandardized version of the model presented in column (5) of Table 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. The results show that the impact of the price index on sovereign risk is significant and 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.[20]

In Table 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 (2006b) 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.

[20]When repeating the exercise using level changes instead of fixed effects, the direction of the relationship remains.

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 Credit Default Swaps (CDS) spreads. Longstaff et al. (2011) and Pan and Singleton (2008) show that stock market returns and changes in the CBOE Volatility Index (VIX) 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. They find indication that a collapse in world growth can help predict defaults.

With regard to country-specific 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.

4.1 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. 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. To 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: 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. Country coverage in both sample could vary because several countries have not exported energy, agricultural, and mineral commodities simultaneously throughout history. Including only the same countries in history and nowadays observations would reduce the sample size to a minimum, leaving us with outcomes of low power and difficult interpretability.[21]

Table 4 shows again the results of Column 1 of Table 3 for the entire index and the entire sample

[21] 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.

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.

When studying the subindices across eras in separation (column 4 to 9), our regression outcomes show that for the historical bond period agricultural commodity price movements were a major driver of sovereign yield spreads while for the modern bond period energy and mineral price movements affect the sovereign yield spreads. These results do not come as a surprise as the share of agricultural commodity exports of total exports has been falling strongly since the 1950s while the energy and mineral shares have increased (see Appendix F). Table 4 refines our results from Table 3, showing that the structural composition of exports play a role. Energy-related commodities have gained importance in the modern era and their effect of sovereign yield spreads is even more pronounced than for agricultural products in the historical era.

We conclude that the relationship between commodity prices and sovereign risk has been present over the last 150 years and energy-related commodity export prices have overtaken the importance of agricultural products for sovereign debt risk in the modern bond era.

4.2 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 time invariant 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). We find that in all the alternative specifications, the impact of the price index on sovereign bond yield spreads remains significant. The results are presented in the appendix, Table A4 and Table A3.

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

Table 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***	-0.061*	0.113						
	(0.245)	(0.349)	(0.540)						
Price index agric[t-1]				-0.115***	-0.001				
				(1.187)	(0.641)				
Price index mineral[t-1]						-0.055	-0.209***		
						(4.004)	(1.294)		
Price index energy[t-1]								-0.025	-0.162**
								(5.085)	(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^2	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). Column 1 shows the results of column 5 of Table \ref{excldefault} for the entire index and the entire sample period. Variables are standardized.

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. These results reaffirm our baseline approach where we use total export as a measure of economic performance and time variant weighting for the prices.

Additionally, 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 A2 shows the coefficient of the lagged country-specific price index for each regression that excludes one country at a time. The results are robust in all scenarios at a 95% 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's creditworthiness on a scale from zero to 100[22]. 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-ICCR) so that a positive change in the inverse ICCR reflects a higher risk perception.

Table A5 in Appendix C provides the results for the ICCR and the sovereign yield spreads. 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, confirming the relationship from our baseline results.

Alternative fixed effects

To control for additional time and regional effects that might influence the results, we run two alternative regressions. First, we include year fixed effects instead of global variables and secondly, we include country, decade and regional fixed effects in different combinations.Table A1 and Table A2 in Appendix C show the results. We find that the effect of year, decade and regional fixed effects is negligible and our results remain significant.

Additional control variables

In Table A7 we include additional control variables. We add a war dummy to capture the

[22]Where 100 points represents the maximum creditworthiness

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.

5 Conclusion

Commodity dependent countries are vulnerable to sharp commodity price movements. To show this, we have created a novel, historical dataset of country-specific commodity price indices for 41 countries, based on 42 commodities. This historical data set allows us to study the effect of countries' export composition on the relationship between commodity price movements and sovereign risk across 150 years.

Our fixed-effects regressions with global and country-specific variables shows a persistent negative link between our country-specific commodity price index and sovereign yield spreads. We also show that structural change plays an important role. We do so by splitting commodities into three subcategories: energy, agricultural and mineral products and dividing the period into a historical, pre 1970 era and a modern era. We show that the negative relationship is particularly pronounced for energy and mineral price movements as compared to agricultural products in the past. 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 robustness checks. 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 citeGruss2019. The results confirmed the negative relationship between commodity price movements and sovereign default risk uncovered by our country-specific price index. Applying a leave one out regression, we show that the results are not driven by a country specifically. Lastly, we repeated our baseline regression including year and decade fixed events. All of these adjustments confirmed our findings of the baseline regression.

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Appendix

A 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.

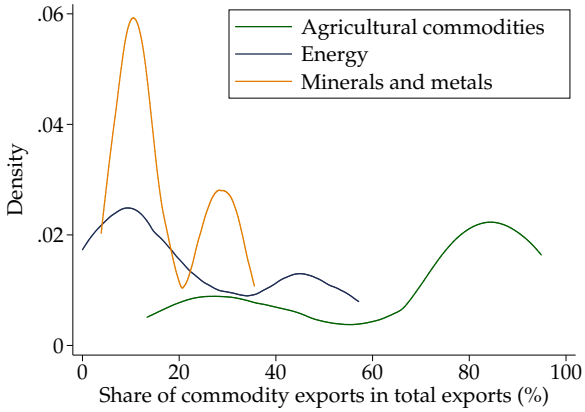
GDP data

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 Mauricio (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 Distribution of commodity exports by subgroup

Figure A1: Distribution of commodity exports in total exports by commodity group



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

C Robustness checks: regression results

Table A1: Regression including time fixed effects

	(1)	(2)	(3)	(4)
Price index[t-1]	-0.184***	-0.127***	-0.139***	-0.105*
	(0.204)	(0.217)	(0.260)	(0.302)
Debt to GDP[t-1, %]	-0.023	0.079***	-0.138***	-0.061
	(0.000)	(0.000)	(0.000)	(0.000)
Trade openness[t-1, %]	0.043***	0.003	0.045***	0.000
	(0.000)	(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^2	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 A2: Regression including additional fixed effects

	(1)	(2)	(3)	(4)
Price index[t-1, logged]	-0.184***	-0.134***	-0.290***	-0.255***
	(0.241)	(0.249)	(0.338)	(0.349)
World interest rate[t, %]	-0.178***	-0.087**	-0.182***	-0.096**
	(0.084)	(0.151)	(0.091)	(0.155)
World imports[t, logged]	-0.060	-0.143	0.010	-0.106
	(0.125)	(0.757)	(0.097)	(0.751)
Global volatility index[t]	0.148***	0.096	0.163***	0.100
	(0.174)	(0.222)	(0.172)	(0.214)
Debt to GDP[t-1, %]	-0.076**	-0.135***	-0.090*	-0.170***
	(0.000)	(0.000)	(0.000)	(0.000)
Polity IV[t-1]	-0.107***	-0.074***	-0.166***	-0.148***
	(0.038)	(0.040)	(0.041)	(0.040)
Trade openness[t-1, %]	0.055***	0.040***	0.048***	0.034***
	(0.000)	(0.000)	(0.000)	(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^2	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 A3: 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***	-0.951***	-0.152***
	(0.245)	(0.211)	(0.505)
World interest rate[t, %]	-0.115***	-0.099***	-0.124***
	(0.078)	(0.078)	(0.077)
World imports[t, logged]	-0.180***	-0.191***	-0.184***
	(0.163)	(0.149)	(0.160)
Global volatility index[t]	0.071**	0.066**	0.064**
	(0.093)	(0.094)	(0.091)
Debt to GDP[t-1, %]	-0.001	0.032	0.043
	(0.000)	(0.000)	(0.000)
Polity IV[t-1]	-0.005	0.019	0.013
	(0.041)	(0.047)	(0.047)
Trade openness[t-1, %]	0.010	0.011	0.007
	(0.000)	(0.000)	(0.000)
Observations	1430	1430	1430
Countries	41	41	41
Country FE	Yes	Yes	Yes
R^2	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 A4: Regression of different commodity price indices and sovereign yield spreads

	(1)	(2)	(3)
	Price index	Gruss price index floating	Gruss price index fixed
Price index[t-1, logged]	-0.028	-0.004**	-0.008***
	(0.241)	(0.006)	(0.007)
World interest rate[t, %]	-0.098**	-0.132***	-0.156***
	(0.063)	(0.060)	(0.059)
World imports[t, logged]	0.233***	0.225***	0.287***
	(0.149)	(0.124)	(0.114)
Global volatility index[t]	0.169***	0.167***	0.165***
	(0.084)	(0.082)	(0.081)
Debt to GDP[t-1, %]	0.340***	0.307***	0.285***
	(0.000)	(0.000)	(0.000)
Polity IV[t-1]	0.022	-0.015	-0.010
	(0.041)	(0.041)	(0.041)
Trade openness[t-1, %]	-0.005	-0.001	-0.001
	(0.000)	(0.000)	(0.000)
Observations	611	611	611
Countries	39	39	39
Country FE	Yes	Yes	Yes
R^2	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 Gruss price indices enter the regressions with floating export shares (column 2) and fixed export shares (column 3). Due to the reduced time period, only 39 countries enter the regression. Coefficients are standardized.

Table A5: Regression outcomes of commodity price indices and different sovereign risk measures

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

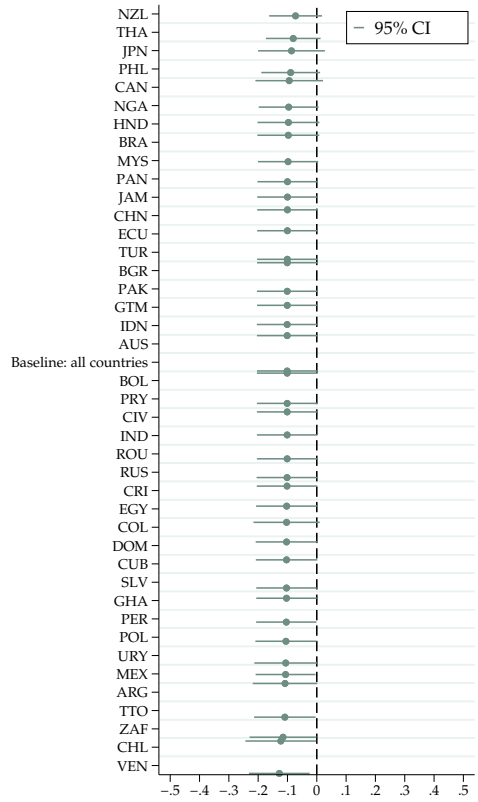
Notes: Robust standard errors clustered on country level. Significance levels represent $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$, respectively. The regression table includes the results for the baseline regression (column 1) and the log of the inverse ICCR in column (2). To allow for comparability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

Table A6: Regression including default episodes

	(1)	(2)	(3)	(4)	(5)	(6)
Price index[t-1, logged]	-0.118***	-0.166***	-0.166***	-0.167***	-0.167***	-0.184***
	(0.160)	(0.213)	(0.258)	(0.245)	(0.245)	(0.241)
World interest rate[t, %]		-0.113***	-0.113***	-0.114***	-0.115***	-0.178***
		(0.075)	(0.073)	(0.077)	(0.078)	(0.084)
World imports[t, logged]		-0.183***	-0.183***	-0.181***	-0.180***	-0.060
		(0.126)	(0.138)	(0.163)	(0.163)	(0.125)
Global volatility index[t]		0.072***	0.072**	0.072**	0.071**	0.148***
		(0.084)	(0.092)	(0.093)	(0.093)	(0.174)
Debt to GDP[t-1, %]			0.000	0.000	-0.001	-0.076**
			(0.000)	(0.000)	(0.000)	(0.000)
Polity IV[t-1]				-0.004	-0.005	-0.107***
				(0.040)	(0.041)	(0.038)
Trade openness[t-1, %]					0.010	0.055***
					(0.000)	(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^2	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 A2: 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.

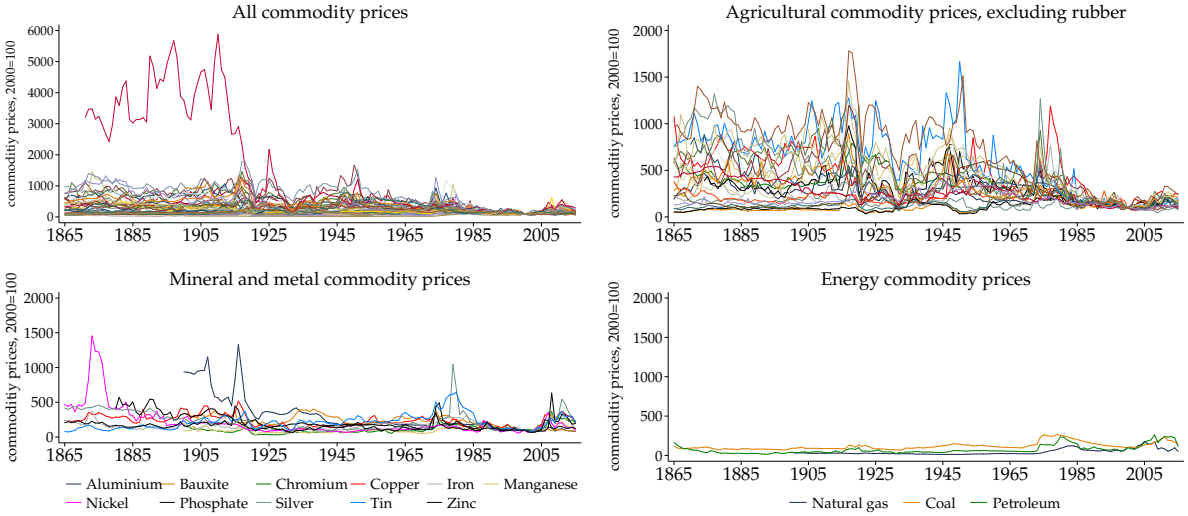
Table A7: Regression including additional control variables

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

D Commodity prices

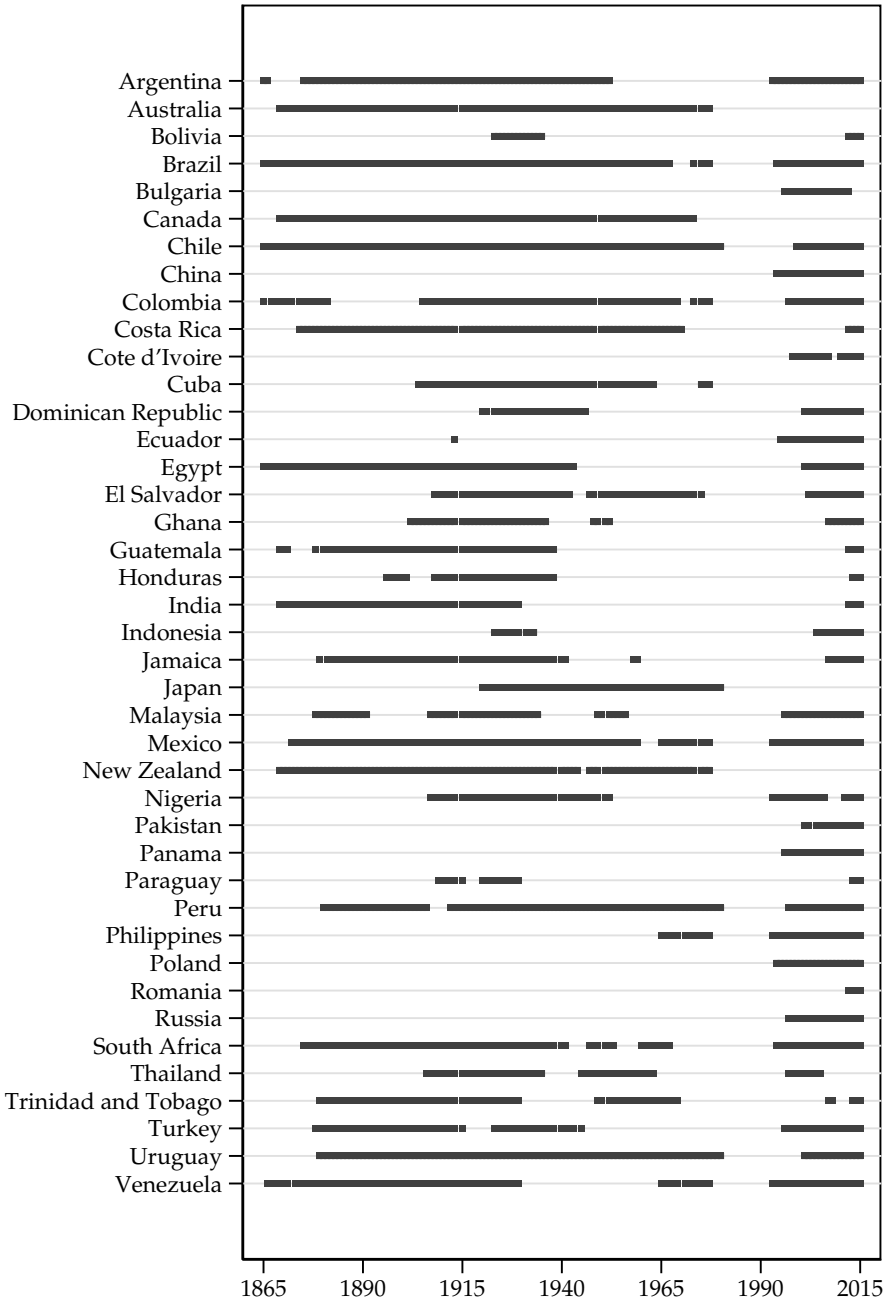
Figure A3: Commodity prices



Notes: The four graphs show the evolution of all 42 individual global commodity prices, first in one graph and then split in agricultural, mineral and energy commodity prices. Agricultural commodity 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.

E Commodity price and yield spread sample

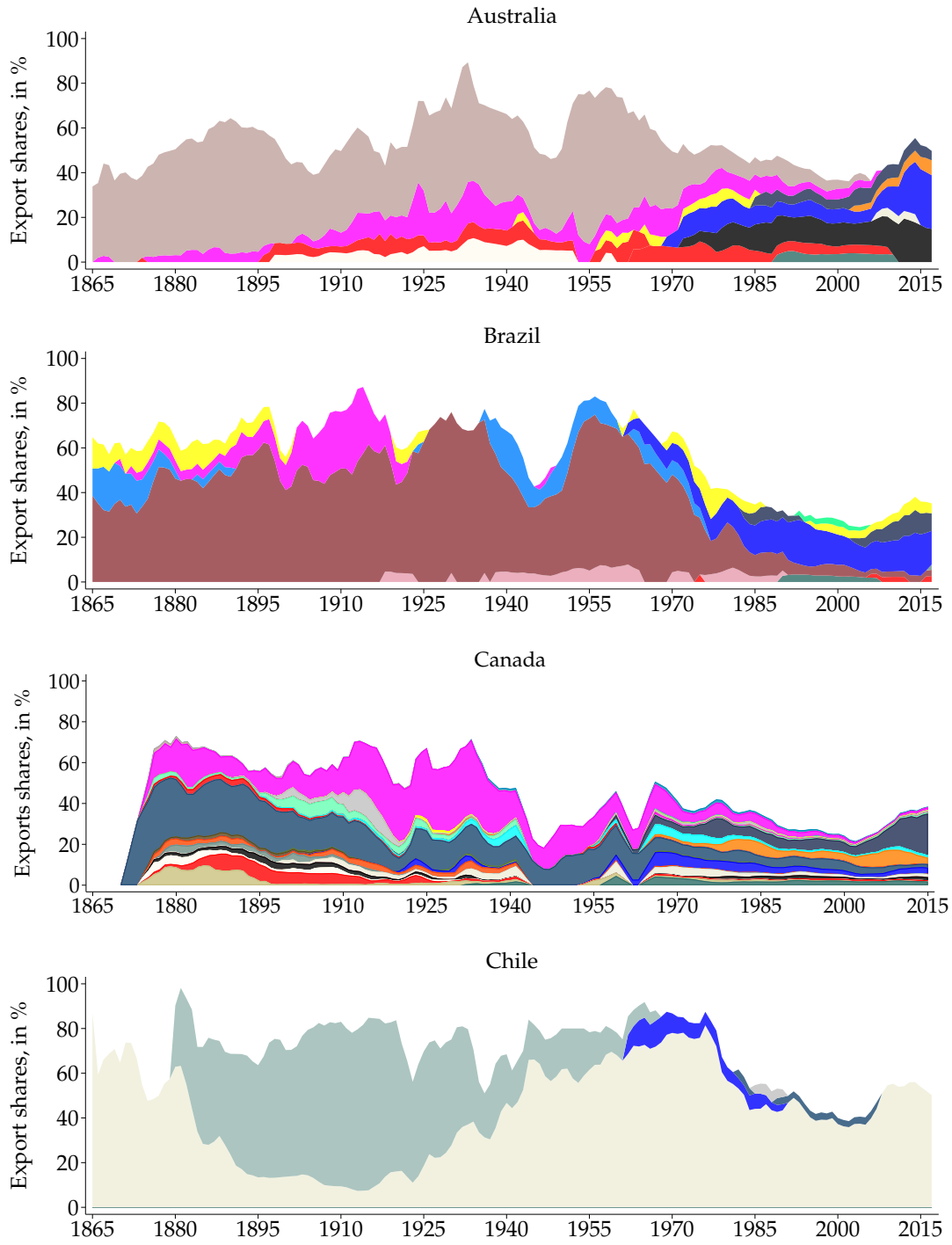
Figure A4: Overlap between commodity price data and sovereign yield spreads

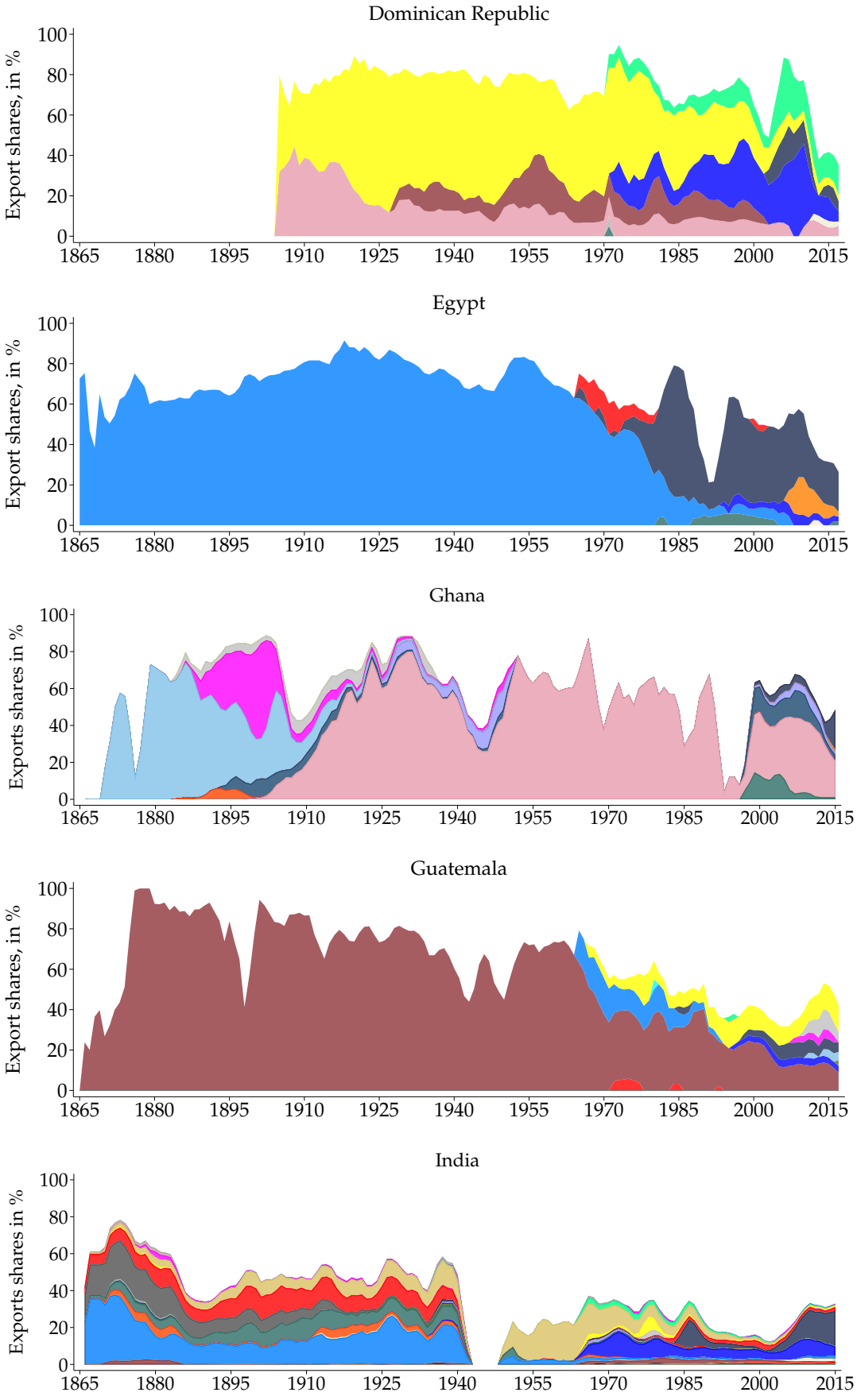


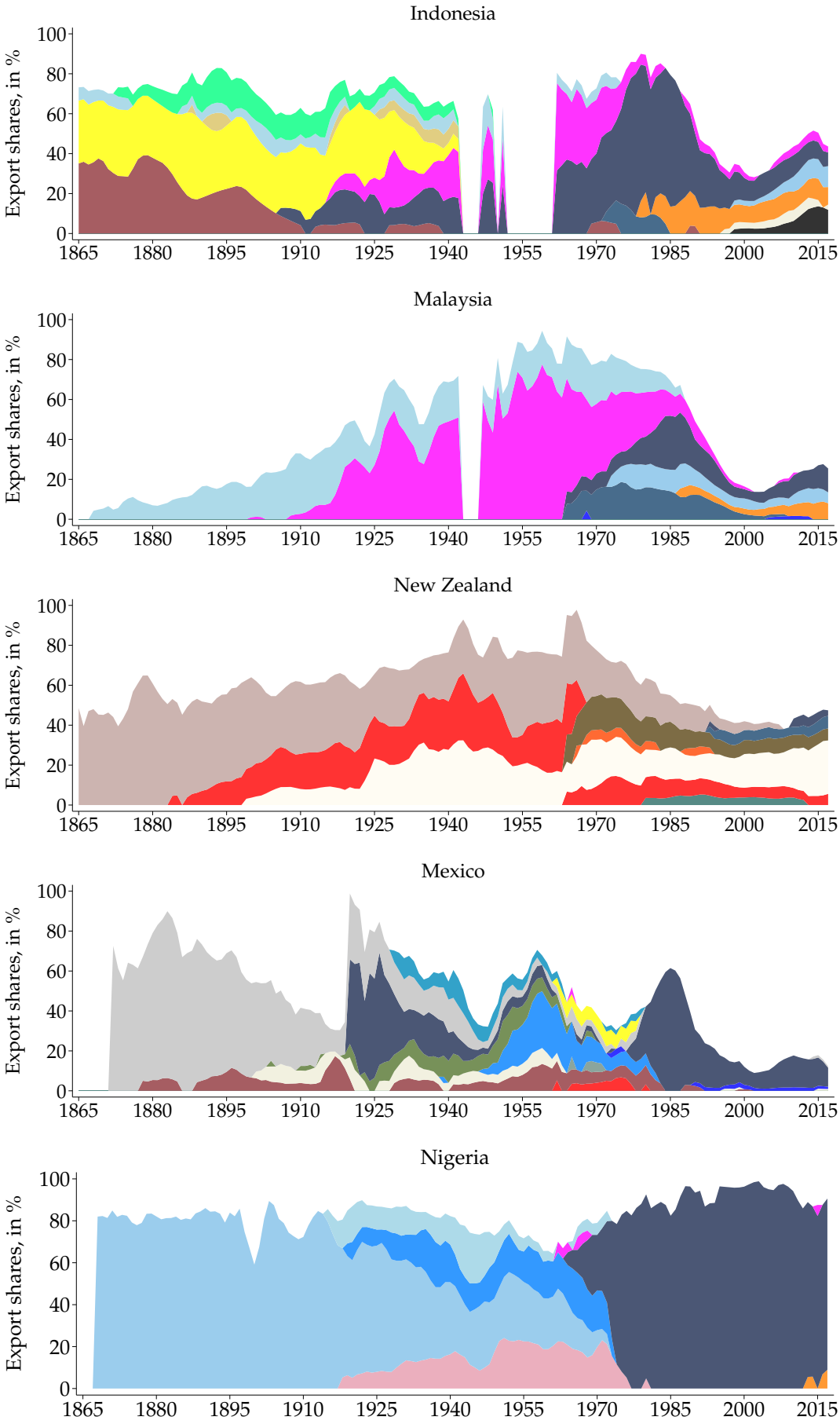
Notes: The stripplot shows the overlap for which commodity prices and sovereign yield spreads are available. The graphic lists all 41 countries in alphabetical order. The gap in the 1970s and 1980s represents the time period during which syndicated loans where the major sovereign lending instrument (among 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.

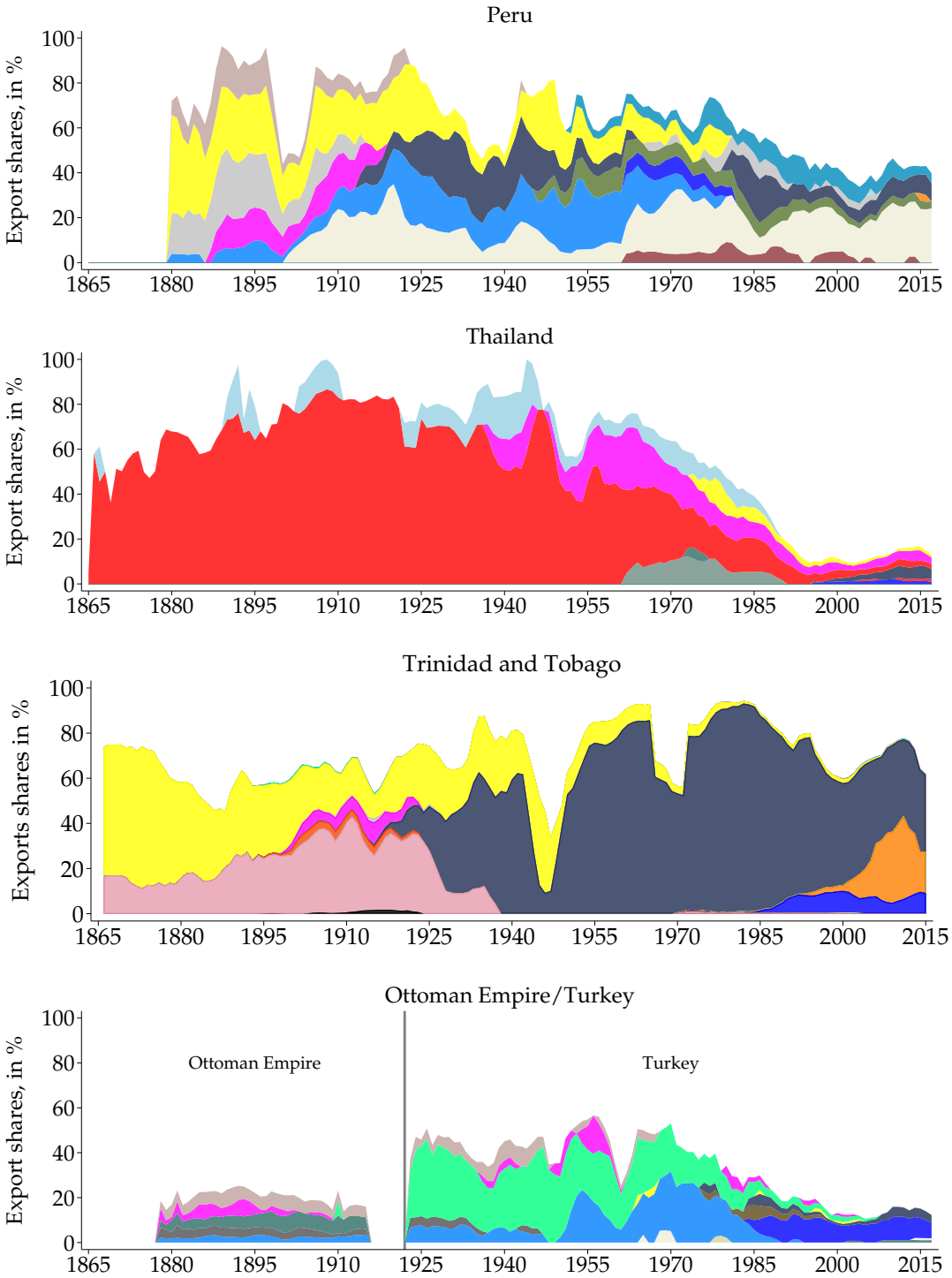
F Selected commodity composition

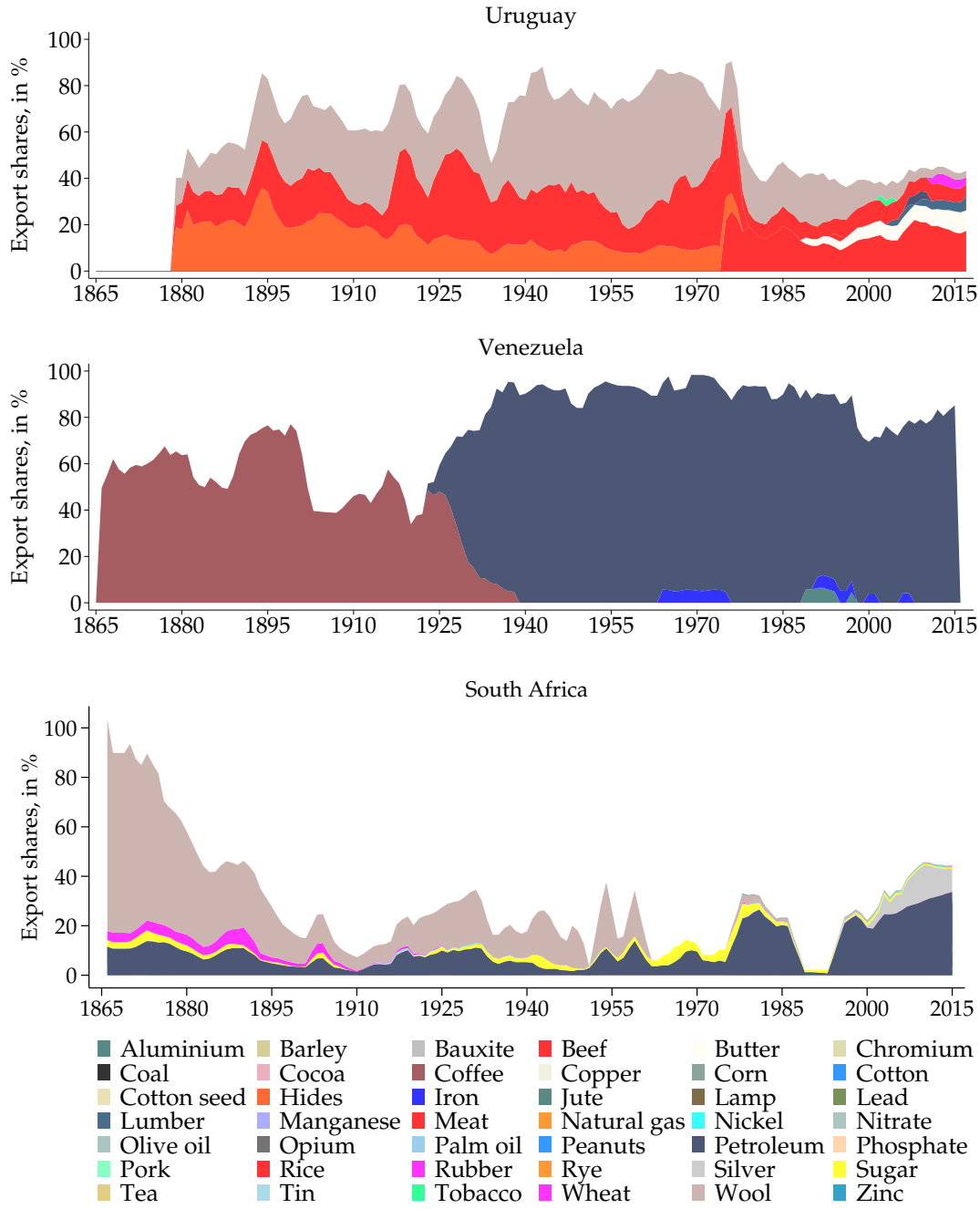
Figure A5: Commodity export composition by country over time




Dominican Republic
Export shares, in %
Egypt
Export shares, in %
Ghana
Exports shares in %
Guatemala
Export shares, in %
India
Exports shares in %
0
20
40
60
80
100
1865
1880
1895
1910
1925
1940
1955
1970
1985
2000
2015


Indonesia
Malaysia
New Zealand
Mexico
Nigeria
Export shares, in %
0
20
40
60
80
100
1865
1880
1895
1910
1925
1940
1955
1970
1985
2000
2015


Peru
Export shares, in %
100
80
60
40
20
0
1865
1880
1895
1910
1925
1940
1955
1970
1985
2000
2015
Thailand
Export shares, in %
Trinidad and Tobago
Exports shares in %
Ottoman Empire/Turkey
Export shares, in %
Ottoman Empire
Turkey



Notes: The figures show the commodity export composition of selected countries in our sample over the course 1865-2015.