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Abstract

Using daily data for 34 emerging markets in the period 1994-2016, we find robust evidence that higher export commodity prices are associated with higher sovereign bond returns (indicating lower sovereign risk). The economic effect is especially pronounced for heavy commodity exporters. Examining the drivers, we find, first, that commodity-dependence is higher for countries that export large volumes of volatile commodities and that the effect increases in times of recessions, high inflation, and expansionary U.S. monetary policy. Second, the importance of raw material prices for sovereign financing can likely be mitigated if a country improves institutions and tax systems, attracts FDI inflows, invests in manufacturing, machinery and infrastructure, builds up reserve assets and opens capital and trade accounts. Third, the concentration of commodities within a country's portfolio, its government indebtedness or amount of received development assistance appear to be only of secondary importance for commodity-dependence.

Keywords: sovereign bond prices, commodity prices, international finance, emerging market economies, institutions, U.S. monetary policy

JEL classification: F36, G12, G15, G18, O13

1 Introduction

Global commodity price cycles have been among the most influential drivers of sovereign defaults in history (Reinhart et al. 2016). Higher export commodity prices improve sovereign solvency by spurring economic growth and tax revenues, by increasing the profitability of state-owned commodity enterprises and by generating inflows of foreign exchange thus increasing the government's ability to service its external debt. Fluctuations in commodity prices are therefore important business cycle drivers, in particular for emerging market economies (Fernández et al. (2018), Fernández et al. (2017)), while also comprising political considerations: In the upturn of the commodity cycle, especially autocratic regimes with poor institutions tend to build up unsustainable debt levels, which can lead to debt overhangs and default in the downturn of the cycle (Arezki & Brückner 2012).

Commodity cycles matter, as in the period of 2013 to 2017, 102 out of 189 countries in the world were considered to be commodity-dependent according to UNCTAD (2019). Both the literature and policy reports often make commodity-dependence responsible for creating vulnerabilities: globally determined raw material prices steer the economic performance and the costs to borrow money on financial markets of commodity-dependent countries beyond their control.[1] Despite its relevance, a comprehensive study of the economic drivers of commodity-dependence is lacking in the literature.

We contribute to the literature by analyzing the magnitude and determinants of commodity sovereign risk dependence from the viewpoint of daily financial market investors. To this end, we build a daily panel of 34 emerging market economies from 01/01/1994 to 31/12/2016. We measure commodity sovereign risk dependence as the relationship between a country's sovereign creditworthiness (measured by Emerging Market Bond Index (EMBI) returns) and the market returns of its export-weighted commodity price index. We control thoroughly for global developments on financial markets and most importantly for a country's general stock return which should account for major economic movements each day. Any impact of commodity prices on sovereign creditworthiness beyond these controls is likely due to raw

[1] An article by the World Economic Forum from 17 May 2019 called "We must help developing countries escape commodity dependence" says: "When a country's economy is not diversified and relies heavily on basic products, it puts itself at the mercy of international market prices. When prices go down, employment, exports and government revenue suffer. (...) [P]utting too many eggs in one basket renders the country vulnerable."

material prices affecting the fiscal situation, investment possibilities and general economic outlook of a country and hence imply commodity-dependence.

We find that an increase in our commodity performance measure by one standard deviation is associated on average with a 1.84% increase in the sovereign creditworthiness of a country, as measured by its EMBI return (which corresponds to 2.6% of the EMBI's standard deviation). For countries with a commodity export share greater than 30% of total exports, a one standard deviation increase in export commodity prices is associated with a 4.5% increase in EMBI returns (corresponding to 6.4% of the EMBI's standard deviation). While the economic effects for the total sample of countries are statistically important and economically modest, the latter effect is statistically and economically large as the standardized effect of export commodity prices on EMBI returns are around 40% as large as for domestic stock returns and U.S. Treasuries and around 55% as large as for the VIX.

We perform several sensitivity checks to test for the robustness of the baseline results on the commodity sovereign risk dependence. First, we use yearly-lagged export weights in our commodity performance measure to rule out simultaneity issues between commodity export weights and commodity prices. Second, we take imported commodities into account, thus specifying our commodity performance measure with actual net export weights. Third, we remove a commodity from its country's portfolio if the country has a significant world-market share in the export volume of this commodity in order rule out a possible influence of domestic shocks to the world market price. Fourth, we consider positive and negative commodity price shocks in a binary variable instead of a continuous price index. All our specifications support our main result and underline the importance of commodity sovereign risk dependence. With respect to the specification in which we take account of world-market relevant exporters we find, if anything, that countries without any world-market power are stronger affected by commodity-dependence, likely because they are pure price-takers.

Our second contribution focuses on the heterogeneous nature of commodity sovereign risk dependence. To the best our knowledge, we are the first to examine a broad set of possible conditioning factors shaping the size of this dependence such as a country's commodity exporting structure, its macroeconomic conditions, and the implementation of policy measures that might reduce commodity-dependence. We find strong heterogeneous effects that differentiate the average magnitude of commodity-dependence reported above.

Looking at the structure of the country's commodity export industry, we find that countries with greater commodity exports on total export shares are significantly more commodity-dependent. Also, if the prices of exported commodities were more volatile over the previous month, commodity sovereign risk dependence increases which supports the appeal of more stable commodities. This result is also in line with Bouri et al. (2017). However, a more diversified portfolio of commodities, measured by a Herfindahl concentration index, has no statistically significant effect on commodity dependence. The ambiguous relationship between commodity concentration and income levels of emerging markets was also found by UNCTAD (2019). We conclude from this result that diversifying, if possible, into an additional commodity is likely unhelpful for a country's financing situation if the country remains overall commodity-dependent.

When analyzing the impact of macroeconomic factors on commodity sovereign risk dependence, we find that the reliance on commodities for sovereign funding increases in economic recessions (lower GDP growth) and, likely associated therewith, when public or private sectors lack fiscal resources (lower tax revenues or corporate profits). We also find that commodity-dependence increases in times of higher inflation when export gains in a stable currency such as the U.S. Dollar are probably more desirable. However, we find no statistically significant connection between commodity dependence and a government's indebtedness.

We find only weak evidence that commodity dependence increases in times of sovereign debt crises, with the respective coefficient being marginally insignificant before the 10% level. In contrast, we uncover that the repayment history of a sovereign matters in that countries with a very distant or no incidents of sovereign default display lower commodity dependence. Also, the level of economic development (measured by GDP per capita) has no significant conditioning effect on commodity sovereign risk dependence. This result could imply that emerging markets are affected similarly by commodity dependence, regardless of their level of economic development, as long as they remain commodity exporters.

Beyond national macroeconomic factors, we find that commodity dependence of emerging markets increases significantly in times of more expansionary U.S. monetary policy. This observation is in line with U.S. interest rates affecting demand and supply conditions in commodity markets (Frankel 2006) and a broad literature arguing that lower interest rates

in the U.S. lead to lower risk aversion, rising capital flows and foreign lending activities into emerging markets (Bräuning & Ivashina 2019, Ahmed & Zlate 2014, Temesvary et al. 2018).

When turning to policy measures that are likely able to mitigate commodity-dependence, we find clear support that countries with stronger institutions are significantly less reliant on the price performance of their main commodity exports for their sovereign creditworthiness. Improving institutional quality, measured with control of corruption, rule of law, political stability or more progressive tax systems, likely makes sure that clear ownership rights for extracted raw materials exist, that rent extraction is limited or that gains from commodity exports are efficiently distributed.[2] Some papers stress that larger endowments of natural resources make it more difficult to improve institutional quality (Arezki & Brückner 2011*a*, Gylfason 2001). We take this issue into account by limiting our estimation to those countries that are heavy commodity exporters. Our main results continue to hold, suggesting that even among strong commodity exporters, those with better institutions fare better in terms of lower commodity-dependence, which is also in line with Bhattacharyya & Hodler (2010), Mehlum et al. (2006) and Arezki & Brückner (2011*b*).

Further measures that are associated with alleviating commodity dependence are attracting more FDI inflows, investing in physical capital and infrastructure, and building larger manufacturing sectors. We conclude from these results that fostering downstream production technologies and diversifying economic activities can be successful ways for countries to reduce commodity dependence. On the other hand, we find only limited evidence that speaks in favor of mitigating commodity dependence by means of development assistance or loans from entities such as the International Bank for Reconstruction and Development (IBRD). For the latter, our results suggest a reducing impact on commodity dependence only via the extensive margin, i.e. a country that has any IBRD loans is somewhat less commodity dependent than a country without any (or very small) outstanding IBRD debt.

Countries that build up higher reserve assets in relation to their external indebtedness face significantly lower commodity dependence by reducing their reliance on foreign exchange inflows via commodity exports. This result suggests that low official reserve buffers coupled

[2]For instance, Frankel (2010) discusses the successful fiscal rule of Chile that is also mentioned in an article in The Economist from 5th October 2017 called "Commodities are not always bad for you": "Resource-rich economies need equally resourceful macroeconomic policies. One of the best examples is Chile. Its fiscal rule curbs government spending when the copper price exceeds its long-term trend, as judged by an independent committee of experts. During good times, fiscal restraint makes room for mining to boom without unduly squeezing the rest of the economy. During bad times, it leaves scope for fiscal easing to offset the damage."

with pronounced indebtedness towards foreign entities makes emerging markets particularly vulnerable to international commodity price developments.

Lastly, we find that countries with shielded trade and financial accounts are subject to a significantly stronger commodity-dependence. These results emerge from interactions with the Chinn-Ito-Index of Chinn & Ito (2006) and the KOF globalization index of Gygli et al. (2018). More detailed analyses show that this effect is driven both by the de-facto and de-jure openness of countries towards trade and financial flows but more so by the former. More transparent and open financial accounts therefore seem to make emerging markets less dependent on export gains from their raw materials.

Our work builds on seminal papers in the literature such as Deaton (1999), Sachs & Warner (1995) and Sachs & Warner (2001) that highlight the tight connection between GDP growth and commodity prices of raw material exporting countries, and which is also shown in more recent work by Drechsel & Tenreyro (2018) and Fernández et al. (2017). Several papers discuss the implications of the "resource curse" of developing countries (see Frankel (2010) for an overview) which is, however, disputed by other authors (James 2015, Alexeev & Conrad 2009, Davis 1995).

A few papers study the relevance of commodity prices for determining sovereign risk. Arezki & Brückner (2011*b*) study the effect of windfall gains from commodity price shocks on sovereign bond yield spreads. They find that higher commodity prices reduce sovereign yield spreads in democratic regimes and increase yield spreads in autocratic regimes, pointing to the resource curse in countries with poor institutions. Similar results are found for countries' external debt ratios in Arezki & Brückner (2012). Hilscher & Nosbusch (2010) use export commodity prices to instrument terms of trade and their effect on sovereign bond spreads at annual frequency. They find that the level and volatility of terms of trade explain a huge fraction of annual variation of sovereign yield spreads. Aizenman et al. (2016) find that higher commodity terms of trade volatility are associated with an increase sovereign CDS.[3]

We contribute to this literature by studying the channels shaping the commodity dependence of sovereign default risk (such as the size, volatility or diversification of the country's commodity exporting regime, the stance of the domestic economy, monetary policy, capi-

[3] A related literature shows that commodity prices determine the value of commodity currencies, by shaping terms of trade and the generation of foreign exchange revenues (Chen & Rogoff (2003); Cashin et al. (2004); Kohlscheen et al. (2017)).

tal controls, as well as institutional and policy factors). Thereby, we aim at explaining the heterogeneity of the effects of commodity price shocks to sovereign solvency across different emerging markets which informs the policy debate on how to curb the commodity sovereign risk nexus. Furthermore, we use daily data instead of quarterly or yearly averages. Daily variation in sovereign bond and commodity prices is less susceptible for endogenously formed policy decisions: On a yearly basis, policy makers might adjust e.g. institutions with respect to longer-term commodity price changes. On a daily basis, institutional quality is given and cannot be adjusted to cushion, for instance, the impact of a negative commodity price shock hitting a country on this day.

The rest of this article is organized as follows: In section 2, we describe the data we use in order to isolate commodity-dependence. Section 3 presents our empirical strategy and reports our baseline results. Following on this, section 4 investigates the drivers of commodity-dependence and discusses the effect of policy measures to tackle it. We conduct encompassing robustness checks in section 5. Section 6 concludes.

2 Data, Variables and Summary Statistics

2.1 Dependent Variable: Sovereign Default Risk

Our sovereign default risk measure is drawn from the Emerging Market Bond Index (EMBI) provided by J.P. Morgan. Sovereign bonds that are issued by emerging markets and included in the EMBI are US dollar-denominated which rules out exchange rate risk. Issued debt must furthermore have more than one year to maturity and exceed an outstanding face value of $500 million to be eligible for the EMBI. For theses reasons, EMBI returns are a well standardized, widely-used and liquid measure to track the daily performance of emerging market sovereign debt. For our analysis, we use EMBI Global data as it covers more instruments than the original EMBI+ index and has better data availability.

The introduction of the EMBI Global at the end of 1993 determines the beginning of our estimation period which is set from 01/01/1994 to 31/12/2016, though some countries enter only at later points in time. We collect EMBI Global data for a panel of 34 countries which can be found in Table 1. Though more countries with EMBI data exist, data availability with respect to other variables, in particular stock returns, restricts our sample to the set of

the countries listed below. To make sure every country included has sufficient variation, we include a country if it has liquid EMBI data for at least nine years, i.e. at least since 2008.[4]

- Table 1 around here -

Data is drawn on a daily frequency to exploit maximum data variation and give our estimation strategy the perspective of market participants which incorporate daily news into their investment behavior. Our dependent variable is the daily return of a country's EMBI (in natural log differences), with positive returns proxying improving sovereign creditworthiness.[5]

We account for episodes with temporarily illiquid country EMBI indices by dropping observations where a zero percent return on the EMBI occurred for more than two consecutive trading days. In a robustness check, we also drop all countries exhibiting such periods of low liquidity and find results in line with our main specification.

2.2 Deriving Country-specific Commodity Performance

We construct the daily market performance of a country's main commodity exports by weighting commodity price returns with the country's commodity export shares. In order to determine which commodities are to be included in the export portfolio of each country, we refer to the commodities comprising the Goldman Sachs Commodity Index (GSCI) provided by S&P.The GSCI provides daily spot index data of 24 commodities in the main index. Each commodity can be grouped either under agriculture, livestock, industrial metals, precious metals or energy. Each of these sub-groups also has its own aggregated group price index. The GSCI includes commodity types based on global production values and the availability of active and liquid futures markets. Commodities in the index are therefore frequently traded and priced in U.S. dollar which is in contrast to many regional commodity price data sources that often suffer from periods of poor liquidity. By using GSCI data, we make sure that our commodity portfolio measures include both highly relevant and globally-priced commodities. Table 3 contains a list of all commodities.

We match commodity price to commodity export data derived from the UN's Comtrade Database and ITC's Trade Map. Most commodity export volumes can be directly matched to

[4]Though we could also choose a ten year inclusion rule, the countries Ghana, Jamaica, Kazakhstan and Sri Lanka start reporting EMBI data in 2007. Also, Thailand reports a nine year EMBI period from 1997 to 2006. To include these countries, we set the threshold at nine years.

[5]In a robustness check, we also use yield spreads instead of bond returns. The results remain robust.

their corresponding prices. However, some price series start after the beginning of our sample period in 1994 or have only a roughly corresponding export match. This issue concerns energy and petroleum-based commodity prices which are included in the GSCI as WTI crude oil, Brent crude oil, gas oil, heating oil, gasoline and natural gas. As there is no perfect export match for all of these commodities, for instance if a crude oil export is classified under WTI or Brent standards, and because price data for Brent crude oil and gas oil starts only after 1994, we aggregate these commodities under their sub-group price index, i.e. energy. The matching export data includes all crude oil and petroleum gas exports. Since all price returns within the energy group are highly correlated, we believe that this sub-group-level aggregation is the most precise way to capture and price petroleum-based exports and to avoid a potentially biasing match between not fully overlapping price and export data.

We further aggregate the GSCI price series Kansas wheat and CBOT wheat under the aggregated price series "All Wheat" and the series for feeder cattle and live cattle under the aggregated spot index of "All Cattle". Table 3 reports the final match between commodity price and export data.

Export volumes for different commodities are available on a yearly (y) frequency only. We therefore calculate the share of each commodity on the total commodity exports of each country as a yearly-varying weighting factor. Each daily commodity price return is then multiplied by its country-specific weighting factor. We aggregate the weighted commodity returns over all commodities c on a daily basis t for each country i, arriving at a country-specific commodity return measure in which the largest commodity exports have the greatest weight: $CommodityPerformance_{it} = \sum_{c} CommodityExportShare_{icy} * \Delta CommodityPrice_{ct}$

We will also test different versions of the commodity performance index to control for world-market relevant exporters, simultaneity issues between export prices and quantities, a dummy-version, and net- instead of gross-exports in the alternative specification section.

Figures 1, 2 and 3 depict the series of EMBI returns and the commodity performance variable over several months for three countries with different commodity export specialization at different points in time: Argentina during the global food price boom of 2007, Chile at the beginning of the copper-cycle boom starting in 2004 and Peru when the gold price reached a peak in the aftermath of the financial crisis in 2011. For all countries, there is an overall strong positive correlation between the price performance of their key commodities and their

sovereign creditworthiness, both for negative and positive events. We will investigate the commodity price dependence of sovereign bond returns in the upcoming sections.

- Table 3 around here -

- Figures 1, 2 and 3 around here -

2.3 Set of Control Variables

In order to isolate the impact of country-specific commodity performance on sovereign risk, we introduce a broad set of explanatory variables to capture international and national financial market developments.

In order to distinguish the effects of country-specific commodity price shocks from general economic fluctuations affecting a country, we control for a country's daily stock market returns. If the commodity performance is fully priced in the stock market, either via the companies effectively exporting the affected raw materials or as a proxy for the economic performance of the economy, our constructed commodity portfolio measure should not affect sovereign risk in any meaningful way. Deriving daily, liquid stock market data for emerging markets can be challenging and therefore restricts our sample as described above. We draw equity returns from either MSCI, Datastream or S&P, depending which provider has the longest and most liquid series. We handle liquidity concerns the same way as we did for EMBIs by setting zero returns to missing if they occur for more than two consecutive trading days. All of our series are in U.S. dollar in order to match with EMBI and GSCI returns. We expect higher stock market returns to have a positive effect on sovereign creditworthiness.

As a second country-specific control variable, we introduce exchange rate returns of each country's currency towards the U.S. dollar. Higher commodity prices could lead to an appreciation of a country's currency which could affect the export performance of non-commodity exporting firms and therefore impact sovereign risk. Exchange rate movements are measured as a daily percentage change and drawn from Thomson Reuters. Higher values indicate depreciation of the domestic currency against the U.S. dollar.

We further control for daily changes in the VIX to capture the implied volatility of U.S. equity markets. Also, we include the U.S. corporate credit spread which is the yield difference between the S&P U.S. high yield corporate bond index and the corresponding S&P investment grade corporate bond index. Both variables capture volatility and risk premiums in U.S.

financial markets that could easily spill-over to emerging market financing conditions, given the importance of global factors for sovereign creditworthiness (Longstaff et al. 2011). We expect them to enter with a negative sign in describing EMBI returns of a country. We also control for the U.S. term spread, i.e. the yield difference between a 10-year U.S. treasury bond and a 3-month U.S. T-Bill. The term spread approximates the premium investors receive for long-term investments. We furthermore control for changes in the yield of 10-year U.S. treasury bonds. Higher yields on U.S. treasuries could lead to investment shifts to the chagrin of emerging market bonds or signal higher interest rate environments which is why they are expected to enter with a negative sign in explaining emerging market sovereign debt performance. Lastly, we want to control for general effects in the market for government debt. We do so by including the daily return of the BofA Merrill Lynch global government bond index and expect a positive correlation with emerging market sovereign creditworthiness.

All variables we use are winsorized at the 1st and 99th percentile to alleviate the impact of outliers. Summary statistics for all daily variables in our baseline estimation can be found in Table 2, all precise variable definitions and sources can be found in Table 14.

- Table 2 around here -

3 Empirical Strategy

3.1 Baseline Specification and Results

We estimate the following OLS panel regression model using daily data for 34 countries from $t = 01/01/1994 - 12/31/2016$:

$$\Delta EMBI_{it} = \beta_1 \Delta CommodityPerformance_{it} + \beta_x \Delta Controls_{(i)t} + \alpha_i + \delta_{m_t} + \epsilon_{it} \quad (1)$$

$\Delta EMBI_{it}$ measures daily natural log changes in the EMBI Global of country i. Higher EMBI returns imply improving sovereign creditworthiness and therefore lower sovereign risk. $\Delta CommodityPerformance_{it}$ is the right-hand-side variable of interest and captures export-weighted commodity price returns of each country, as described in section 2.2. We expect a positive β_1, i.e. higher prices of a country's key commodity exports are associated with stronger sovereign creditworthiness.

$\Delta Controls_{(i)t}$ encompasses all control variables introduced in the previous section, i.e. stock returns, exchange rate returns, global government bond index returns and changes in the VIX, U.S. corporate spread, U.S. term spread and the 10-year U.S. treasury yield. α_i are country fixed effects which account for time-invariant country-specific unobservable factors, such as permanent market structures in a country's commodity exports. We also include time fixed effects δ_{m_t} for every month to capture time-specific, market-wide developments that have a common effect on all countries. We cluster standard errors at the country level to allow for the correlation of unobserved factors in the error terms within countries.

The results are reported in Table 4. Model (1) uses neither control variables, nor fixed effects. Model (2) includes fixed effects. Baseline model (3) uses the full set of control variables and fixed effects. Model (4) interacts the commodity price index with a dummy variable indicating as to whether the country is in a given year a heavy commodity exporter with a commodity share in total exports exceeding 30%. In all specifications, we can reject the null hypothesis of a zero effect of commodity price returns on sovereign bond returns at the 1% level of statistical significance. Investors appear to anticipate an increase in sovereign creditworthiness when the prices of a country's exported commodities increase.

Turning to the economic significance, an increase in the commodity performance variable by one standard deviation is associated with a 1.84% (0.0139×1.326) increase in EMBI returns which corresponds to roughly 46.5% of the average EMBI return ($0.0184 \div 0.0395$) and 2.6% of the standard deviation of EMBI returns ($0.0184 \div 0.706$) which is economically meaningful (column (3)). For heavy commodity exporters (with a commodity share in total exports of more than 30%, see column (4)) we find that a one standard deviation increase in export commodity price returns is associated with a 4.5% increase in EMBI returns (corresponding to 6.4% of the EMBI's standard deviation). This amount equals around 40% of the standardized effects of domestic stock returns and US Treasuries on EMBI returns, and around 55% of the standardized effect of the VIX. Commodity price changes are therefore a key driver of the sovereign debt performance of emerging markets in the daily perspective of financial markets.

Regarding the remaining control variables, we find signs and significance levels broadly in line with our expectations. Stock market returns enter with a positive sign in the regression and are both statistically and economically highly significant. Positive changes in the VIX,

the corporate spread and U.S. treasury bond yields are associated with lower EMBI returns, whereas rising global government bond returns enter with a positive sign and all with statistically significant coefficients. Exchange rate depreciations and an increasing term spread have negative signs but are not statistically significant.

- Table 4 around here -

3.2 Alternative Specifications

In this section, we address possible concerns in our empirical specification to test the robustness of our benchmark results.

First, there may be a simultaneity issue between commodity exports and commodity prices. On average high returns of a commodity in the current year would mechanically increase the commodity's weight share in the constructed portfolio. We address this concern by using the weight shares of the previous year's exports. In this way, current commodity price changes are linked with the export structure of the previous year. Column (1) in Table 5 shows that this approach yields results close to our benchmark specification (3) in Table 4, suggesting that export weights are sticky and any simultaneity bias does not impact our main results.

Second, we consider the effects of market power of domestic commodity exporters. Most papers argue that commodity prices traded at highly centralized world markets are exogenous to domestic fundamentals (e.g. Chen & Rogoff (2003)). Still, the largest exporters of a commodity may not have to take global commodity prices as given, but can strategically manipulate raw material spot rates through their domestic production decisions. If so, domestic concerns such as deteriorating sovereign creditworthiness could impact commodity production which would then affect global commodity prices and thus entail a reversal effect in our econometric inference. We therefore specify a version of our commodity portfolio variable that is more precise in affecting only price takers of a raw material. To do so, we construct the shares of each country's commodity exports on the global export volume of this commodity. We then remove a commodity in the weighted portfolio of a country if this country has at any point in our sample period a global export share of more than 10% for the respective commodity. This threshold is fairly low and almost every commodity is affected by one or more of such dominant global exporters. If a commodity is removed from a country's portfo-

lio due to this procedure, the remaining commodity weights are re-adjusted so that they add to one. We repeat our benchmark estimation with this world market adjusted commodity performance version. The estimated coefficient of the market power adjusted commodity variable remains statistically highly significant and is even somewhat larger than the baseline version (column 2). This result could indeed suggest that there is strategic behavior in price setting decisions. Nevertheless, this specification underlines our main result that emerging markets' sovereign creditworthiness is commodity-dependent, and, if anything, price-taking commodity exporters are even stronger affected.

Third, we want to make sure that the variation in our export-weighted commodity variable is not driven by re-exported commodities. Should raw materials actually be imported from other countries and then get re-exported, we would falsely classify countries as commodity exporters even though actual net exports are much lower. A related issue could be that countries are net-importers of certain commodities and that price increases of key import goods could dominate favorable price developments of important export products. To address these concerns, we construct a portfolio variable capturing the net export values of commodity sales. To this end, we first multiply a country's absolute export value (in U.S. dollars) of each commodity with its daily price change. This measure gives an indication of the extra export revenue generated or lost due to the commodity's price change. We do the same procedure for absolute import values (in U.S. dollars) and aggregate revenue changes for imports and exports for each country on a daily basis. Second, we subtract the import-weighted prices changes from the export-weighted price changes. The resulting variable gives us the net-export values we are after by allowing for negative net-exports and hence negative returns, for instance if a country that imports more energy commodities than it exports faces rising energy prices. Lastly, we need some form of scaling for the derived net returns since larger countries also have larger absolute exports or imports. We do so by dividing the net-export return variable by each country's GDP in U.S. dollars. In sum, this variable adjusts the original commodity performance by taking the price development of a country's most important import commodities into account. Results in column (3) of Table 5 illustrate that the derived variable has a positive effect on sovereign creditworthiness that is statistically significant at the 5% level. Commodity prices are therefore, even when only regarding net exports, affecting sovereign debt performance of emerging markets.

Lastly, we want to alleviate concerns that the statistical significance in our results comes from both EMBI and commodity performance data being measured in natural log returns which might lead to similar statistical properties that increase correlation. We therefore dummify our commodity performance variable in a way that takes both the economic importance of exported commodities (affectedness) and key price events (treatment) into account. To this end, we mark the (at most) five commodities in a country's portfolio that have the greatest weight as long as this weight share is over 10% of total commodity exports. No country has a higher number of commodities than five for which this criteria applies. These commodities are coded with 1, other commodities with 0. We then mark all trading days in which a commodity had a positive price shock which is defined as having a price change above the respective 75th percentile (positive shock). We do the same for negative shocks, defined as a price change below the 25th percentile. We multiply the dummies for a country's most important commodities with their respective positive and negative price shock variables, separately. The resulting country-specific and daily-varying variable for each commodity is 1 if the commodity is economically important for the respective country and has a positive price shock event on this day. We then aggregate these dummies over all commodities, separately for the positive and negative price shocks. The resulting positive-shock variable can take values from 0 (no price shock for economically important commodities) to 5 (all economically important commodities for a country are subject to a positive price shock on the same day). Finally, we subtract the aggregated negative shocks from the aggregated positive shocks and arrive at a net-shock-indicator that ranges between -5 (all important negative shocks materialize) and +5 (all important positive shocks materialize). Note that a value of e.g. 0 on a given day can imply that either no price shock that mattered for the respective country took place or that occurring positive and negative shocks just canceled each other out. We use the net-shock-indicator as our new commodity performance measure in our baseline. Column (4) reports a statistically significant effect at the 1% level. Economically, if the indicator increases by 1 unit, the EMBI return increases by roughly 1%.

- Table 5 around here -

4 Drivers of the Commodity Sovereign Risk Dependence

We now turn to investigate potential drivers of the spillover of export-weighted commodity price changes to sovereign risk. If emerging markets are commodity-dependent, as the previous section indicated, it is important for policy makers to know what affects this dependency and which macroeconomic factors or policy measures can potentially reduce commodity-dependence. We differentiate between channels approximating for commodity-related factors (4.1), macroeconomic and international factors (4.2), and a range of possible policy measures to limit commodity-dependence (4.3). For each channel under investigation we estimate the baseline regression (1) and interact, in order to rule out reverse effects, with the yearly-, quarterly-, monthly- or daily-lagged value of the respective channel unless stated otherwise:[6]

$$\begin{aligned}\Delta EMBI_{it} =& \lambda_1 \Delta CommodityPerformance_{it} \times Channel_{it-1} + \lambda_2 Channel_{it-1} + \\ & \lambda_3 \Delta CommodityPerformance_{it} + \lambda_x \Delta Controls_{(i)t} + \alpha_i + \delta_{m_t} + \epsilon_{it}\end{aligned} \tag{2}$$

We expect channels that increase the commodity-dependence of emerging markets to enter with a positive sign for the respective interaction term, while channels that could mitigate the spillover to have a negative interaction coefficient.

Following Nizalova & Murtazashvili (2016) and Bun & Harrison (2018), we argue that our interaction coefficients are consistently estimated, as long as one variable in the interaction term is exogenously determined. This assumption holds plausibly for weighted commodity prices which are largely world-marked determined. Furthermore, we demonstrated in section 3.2 that potentially biasing effects are small in size and do not disturb our main results. Therefore, even if some channels could be endogenous with respect to sovereign creditworthiness, we argue that the interaction terms allow for exogenous interpretation.

4.1 Commodity-related Factors

A natural starting point is to check if countries that have a larger share of commodity exports on their total export volume also face a more forceful commodity price spillover. We interact with the share of total commodity exports on total exports of each country. As expected, the interaction coefficient is positive and statistically significant at the 5% level as reported

[6]Since we use an emerging market panel, not all countries have full data on all interaction variables. We report on this when it becomes an issue. Definition and sources of all variables can be found in Table 14.

in Table 6, column (1). The margin plot depicted in Figure 4 suggests that commodity price changes turn statistically significant in impacting sovereign creditworthiness at an export share of roughly 15%.[7]

We next test if a higher volatility of a country's export commodity prices is associated with a more intense commodity sovereign risk dependence. To do so, we calculate the rolling standard deviation of each country's export-weighted commodity returns on a 23-day basis, which is roughly the number of trading days each month. The respective interaction coefficient is positive while only statistically significant at the 10% level (column (2)). Still, the resulting margin plot reported in Figure 4, strengthens the conclusion that, given a more volatile price development of a country's key commodities in the previous month, current price changes have stronger effects on sovereign creditworthiness.

Having a high concentration in just one commodity could be associated with a stronger commodity-dependence of a country since it has no diversification benefits in case of a shock to its key raw material. We test this hypothesis by constructing the yearly Hirschman-Herfindahl-Index (HHI), i.e. the sum of squared commodity export weights for each country. The HHI varies from roughly 0.15 for well-diversified export countries such as Poland, to almost 1 for oil-exporting countries such as Nigeria or Venezuela. The interaction of the contemporaneous HHI with the commodity portfolio yields a coefficient with the expected positive sign that is, however, statistically insignificant (Table 6, column (3)). This ambiguous relationship is also confirmed in the margin plot depicted in Figure 4 and was also found in the latest report by UNCTAD (2019). One explanation of this result could be that as long as a country is commodity-dependent, it does not matter much if this dependency is towards several or only one raw material. We therefore conclude that the variety or concentration of commodities is only of secondary importance for understanding commodity-dependence of emerging markets.

- Table 6 around here -

- Figure 4 around here -

[7]The GSCI, from which we derive the included commodities, covers the most important but not all commodities. It is unlikely that our results are biased because of this, nevertheless, calculated ratios such as commodity export shares are not comparable one-to-one with those reported e.g. in UNCTAD (2019).

4.2 Macroeconomic and International Factors

We turn to investigate the impact of broader macroeconomic factors with respect to the commodity-dependence of emerging markets. We start by interacting the export-weighted commodity portfolio with lagged GDP growth, measured on a quarter-to-quarter basis. The resulting interaction term, reported in column (1) of Table 7 enters with a negative sign but is marginally statistically insignificant before the 10% level. Though a zero-effect cannot be ruled out at the common statistical levels, the negative sign gives some indication that prices of exported commodities might matter more for countries if they are in a business cycle downturn. The margin plot in Figure 5 confirms this hypothesis and suggests that commodity price spillovers turn insignificant at a quarterly GDP growth level of roughly 3%. When interacting with the current level of GDP growth, the resulting interaction term is statistically significant at the 5% level (unreported), confirming the conclusion that commodity spillovers matter more during recessions than during economic upswings.

We dig deeper into the importance of the business cycle, first, by interacting with the tax revenues of a government scaled by GDP. Since tax revenues vary positively with the business cycle but also, if higher, make a country less dependent on export gains from commodities, we would also expect a negative coefficient for the interaction term of lagged tax revenues and weighted commodity price changes. Indeed, this result can be confirmed in column (2) with a negative coefficient significant at the 1% level and by the negative margin plot in Figure 5. One further measure for business cycle effects could be profits achieved in the corporate sector. We therefore interact our commodity variable with the lagged ratio of corporate sector profits to GDP which is, however, only available for 16 countries in our sample. The resulting coefficient has the expected negative sign but is short of being statistically significant at conventional levels (column (3)). Still, the margin plot depicted in Figure 5 lends support to the hypothesis that with higher corporate profits, commodity price spillovers eventually matter less than in times of lower private profits. Taking the reduced sample size into account, we interpret these first three estimations as evidence that commodity price shocks hit countries harder if their business cycle is in downturn and if both private and public sector have less capacity in terms of profits or tax revenues to fend off negative shocks.

The indebtedness of a country could be important for its reliance on commodities. Export gains from raw materials might matter more for a country as an income source to stabilize

debt ratios if sovereign debt is larger which would speak for increased commodity dependence. When interacting with the lagged debt-to-GDP ratio of a country, we find, however, a small and negative interaction coefficient that does not differ with statistical significance from zero (column (4)). We find similar results when investigating the interaction with external debt or central government debt ratios (unreported). One underlying reason for this seemingly unimportance of government debt could be that our sample covers a broad variety of countries, with young Eastern European economies starting at low debt ratios but also several sovereign debt defaults and restructuring events that might lead to imprecise estimations.

We next test the hypothesis that higher rates of inflation could be positively linked to commodity price spillovers of emerging markets. If money loses its purchasing power through inflation, income gains from commodities which are measured in U.S. dollar might matter more to stabilize sovereign creditworthiness. Finding some confirmation for this hypothesis, we report an estimated interaction term with lagged annual inflation (column (5)) that is positive and statistically significant at the 10% level. The margin plot depicted in Figure 5 supports this interpretation, showing that in times of higher inflation, the marginal effect of commodity price changes is stronger compared to stable inflation periods in which the spillover is insignificant.

Related to the previous interactions, we test if commodity-dependence increases if a country suffers a sovereign debt crisis. To this end, we exploit the systemic banking crises database by Laeven & Valencia (2018). We interact commodity performance with a contemporaneous dummy that indicates the year in which a country had a sovereign debt crisis. However, with results shown in column (6), we find only weak confirmation that commodity price shocks have a stronger spillover on sovereign creditworthiness during a sovereign debt crisis. While we find the expected positive interaction coefficient, it is marginally insignificant before the 10% level. One reason for this could be measurement error in that the crisis dummy is on a yearly basis which is too imprecise given the daily frequency of our data.

Digging deeper into the sovereign repayment history of a country and using an approach that is less susceptible to the data issue above, we interact with a continuous variable that measures the number of years since the last debt restructuring event occurred. We also include those restructuring events that happened before the start of our sample period in 1994. Overall, 22 countries in our sample negotiated at least one sovereign debt restructuring. The

highest number of years since the last restructuring event is 36. For the twelve non-defaulters, we therefore set the variable to 40 as a measure for a sovereign repayment history without any restructuring events, but also find similar effects for a value of 50. The continuous variable enters negatively and statistically significantly at the 10% level in interaction with commodity price changes (column (7)). The margin plot in Figure 5 furthermore confirms the hypothesis that a country with a distant or no sovereign debt restructuring history is hit significantly less by price shocks of its commodity exports compared to a country with only recent cases of bond renegotiations. This result could imply that financial markets pay closer attention to the commodity price performance of countries with a less stable debt repayment history in recent years, so that, for instance, negative price shocks of key commodities also have a more forceful impact on the riskiness of the respective country's debt.

Next, we test if the level of economic development matters for commodity related spillovers. To this end, we build an interaction term between commodity performance and GDP per capita of each country. The resulting interaction term has a positive sign but is small and statistically insignificant (column (8)). This result could indicate that with regard to the within variation of economic development that we are capturing, commodity-dependence is sticky for emerging market economies even if a country grows in terms of GDP. It could also be due to the fact that the countries in our sample are somewhat more developed since they report EMBI and stock market data which leaves out poorer countries e.g. in Sub-Sahara-Africa. Nevertheless, this analysis gives us some confirmation that our remaining results are not driven by any biases between richer and poorer countries, e.g. when it comes to institutional characteristics that could be a function of economic development.

Lastly, we want to analyze the effect of U.S. monetary policy on commodity-dependence of emerging markets. Interest rates set by the Federal Reserve are determined with regard to the U.S. economy and likely only partially driven by economic developments of emerging markets or commodity prices. However, as shown by Bräuning & Ivashina (2019), monetary policy decisions in the U.S. have powerful effects for emerging markets in that they affect capital flows and borrowing behavior. Furthermore, Frankel (2006) argues that U.S. monetary policy affects the decision for commodity exporters when to extract raw materials, to hold inventories or for investors to go into emerging markets rather than U.S. treasury bills. Our interaction coefficient in column (9) that shows the effect of commodity performance depending on the

U.S. federal funds rate is in line with this literature. We find a negative and highly statistically significant coefficient at the 1% level and a margin plot in Figure 5 which suggests that commodity-dependence increases significantly at a federal funds rate lower than 4%. This effect of more expansionary U.S. monetary policy spinning the commodity cycle remains if we replace the federal funds rate by the 3-month U.S. treasury rate or the shadow rate by Wu & Xia (2016) (unreported).

- Table 7 around here -

- Figure 5 around here -

4.3 Policy Measures against Commodity-Dependence

In order to inform the policy debate, we want to analyze what our model suggests to be promising ways to lower commodity-dependence. We focus on policy measures that are to some degree more under the control of governments than the broader macroeconomic or international variables tested above.

First, we want to investigate if countries with higher institutional quality are less commodity-dependent. To this end, we draw data from the World Bank Governance Indicators which conduct extensive surveys to approximate different forms of institutional quality on a basis of ranks ranging from 0 to 100 whereby higher indicator values imply improving institutional quality. We draw three indicators which we hypothesize to be related to the spillover of commodity prices on sovereign creditworthiness: control of corruption, rule of law and political stability (and absence of violence), which are all available from 1996 onwards.[8]

When interacting separately with the lagged yearly values of the three measures for institutional quality, we find clear results: all respective interaction terms are negative and strongly statistically significant, with control of corruption and rule of law at the 1% level and political stability at the 5% level (Table 8, columns (1)-(3)). The margin plots depicted in Figure 6 support the hypothesis that with better institutional quality, commodity price shocks are less effective in impacting sovereign risk. This result implies that countries are more commodity-dependent if institutional quality is worse, for instance when ownership or legal frameworks in the production process of raw materials are less clearly structured. These

[8]There are some gaps in the data for the early years which we close by linearly interpolating the series. All our results also hold when using unadjusted data.

findings could indicate that with improving control of corruption and a stronger rule of law, countries can mitigate rent extraction behavior in the production and selling of raw materials, reinvest gains from commodity exports more effectively, or smooth negative commodity price shocks thanks to clearer ownership structures. Our results are in line with Mehlum et al. (2006) who suggest that institutional quality is the decisive criteria for commodities to be a curse or a source of wealth.

One could be concerned that institutional quality is more difficult to improve for commodity-exporting countries as suggested by Arezki & Brückner (2011*a*). While our daily data structure in which institutional quality can be considered as given alleviates this concern somewhat, we also test if our results hold if we repeat the analysis for more heavy commodity exporters, defined as having a commodity export share of more than 10% on total exports. We find that the statistical significance of our result remains, except for the political stability interaction (unreported). However, we still obtain a margin plot that clearly suggests that commodity dependence can be significantly lowered with improving political stability. Therefore, even among stronger commodity exporters, those with effective institutions seem to fare better in terms of reducing commodity-dependence.

We test the differentiating impact of commodity prices on sovereign creditworthiness on a further variable that approximates institutional quality namely the progressiveness of the tax system. We draw data on the gini coefficient of emerging markets from the database by Solt (2019).[9] We build two interaction terms with commodity performance, one with the Gini index of income inequality before taxes and one with the amount of tax redistribution, i.e. the difference between the pre- and post-tax Gini indices. Both interaction terms enter negatively as shown in column (4) but only the redistribution coefficient is statistically significant at the 5% level (also if the pre-tax Gini term is not included). The margin plot in Figure 6 suggests that more progressive tax systems are associated with less commodity-dependence.

Next, we test three interactions which might alleviate emerging markets' commodity-dependence. In a direct way, building a stronger manufacturing sector should lead to less dependence towards global price developments of exported commodities. In a more indirect manner, attracting FDI inflows can lead to technological spillovers which could also improve the economic structure of a country beyond pure commodity exporting. Lastly, increas-

[9]We aware that data on inequality of emerging markets is imperfect, even though the data quality by Solt (2019) is considered to be standardized as best as possible. See Lang & Tavares (2018) for a discussion.

ing gross-fixed capital formation (GFCF) i.e. investments in plant, machinery, schools and infrastructure could also diversify the economic structure of a country.

We therefore interact, separately, with the lagged manufacturing value added, net FDI inflows and GFCF investments, all as a share of GDP. All interaction coefficients (columns (5), (6) (7)) are negative and statistically significant, with manufacturing and FDI at the 5% level and GFCF at the 10% level. Margin plots in Figure 6 support the conclusion, speaking more broadly, that fostering downstream production, investing in infrastructure and technology and diversifying economic structures can be promising ways to reduce commodity-dependence.

- Table 8 around here -

- Figure 6 around here -

In recent years, several countries have started to build up foreign-exchange reserves as a buffer e.g. for balance of payment crises. We find evidence that countries with higher foreign exchange reserves (relative to their external debt obligations), are also significantly less commodity-dependent as suggested by the negative and statistically significant coefficient (10%) in column (1) in Table 9 and the margin plot in Figure 7 (we obtain stronger results if monthly reserves are scaled to GDP, unreported). Higher foreign exchange reserves may reduce the dependence on foreign exchange inflows via exporting commodities and thus mitigate the emergence of sovereign distress caused by balance of payments problems.

Furthermore, we investigate the effect of capital controls and trade openness in association with commodity price changes on sovereign creditworthiness. We first use the KOF globalization index by Gygli et al. (2018). This index measures along several dimensions how open a country is towards trade and international financial flows. Our evidence suggests that more open countries are significantly less dependent on the price performance of their exported commodities, as shown by a highly significant (1% level, column (2)) and negative interaction term coefficient and the margin plot in Figure 7. Disentangling the KOF index into the de-facto and de-jure version shows that the de-facto variation matters more for this effect, however, the de-jure KOF also enters negative and statistically highly significantly (not reported).

When using the Chinn-Ito-Index from Chinn & Ito (2006) as a measure for current and capital account openness instead of the KOF index, we find largely similar results. Though the interaction effect is statistically insignificant just before the 10% level, the marginal

effect depicted in Figure 7 lends support to the hypothesis that more closed-off economies have a stronger dependency on their commodities for their sovereign creditworthiness, as the marginal effect of such spillovers decreases and eventually turns insignificant the more open capital accounts are constituted. This could suggest that more open economies could be able to better fend off a negative shock to their commodity performance because of deeper financial markets and a broader set of financing choices. The stronger effects of the de-facto KOF could suggest that attracting trade flows and financial investment can be a further means in diversifying economic structures away from pure commodity extraction.

Lastly, we want to investigate the effects of development assistance measures on commodity-dependence. We interact commodity performance, first, with a country's exposure of loans to the International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA) scaled to GDP. Both institutions are the main World Bank entities that extend loans to spur economic activity and to fight poverty (see Dreher et al. (2019) for a paper on the political economy of IBRD). Second, we interact with the amount of net development assistance received scaled to GNI. Though both measures are not directly implemented to fight commodity-dependence, they could still be associated with diversifying economic activities or investing in infrastructure projects which we showed previously as effective ways to reduce commodity-dependence. However, we find only weak confirmation that development assistance or World Bank loans are promising ways to reduce raw material reliance of emerging markets. For both interactions, the coefficient has the expected negative sign, i.e. more assistance tends to decrease commodity-dependence (columns (4) and (5)). But both coefficients are widely statistically insignificant and the slopes of the interaction effects, depicted in Figure 7, are small. If anything, we find stronger effects for IBRD loans, in that a country is more commodity-dependent if it has none or only small loan exposure compared to countries that have at least some IBRD loan exposure. Therefore, we conclude that development assistance can potentially impact commodity-dependence, however, the more promising results were with regard to improving institutional quality, broadening economic structures, building up reserves and opening trade and financial accounts.

- Table 9 around here -

- Figure 7 around here -

5 Robustness

5.1 Dropping Countries with Liquidity Issues

We perform a range of sensitivity analyses to demonstrate the robustness of our results. First, we want to make sure that our results are not driven by liquidity issues some emerging markets might have in their EMBI or stock market data. To do so, we first drop all countries from the sample if their EMBI index turned temporarily illiquid during our estimation period. So far, we handled these periods by setting the affected EMBI returns to missing for the respective countries. Dropping the eight affected countries and repeating our benchmark estimation (1) shows that the coefficient of export-weighted commodity price shocks is of similar size and statistical significance as in our main specification (Table 10, column (1)).

We then exclude the five countries whose stock market data has temporarily been varying only on a weekly instead of the daily level, which we previously handled the same way as with the EMBI returns. Results in column (2) report a commodity performance coefficient that is statistically significant at the 5% level, comparable to our main results.

Lastly, we drop all countries from the baseline estimation if they have less than 3000 business days of both stock market and EMBI return data which is somewhat over twelve years of data. This criteria affects twelve countries. Results for this specification in column (3) yield a commodity performance coefficient that is extremely close to our main specification and statistically significant at the 5% level. These robustness checks indicate that our way of handling periods of lower liquidity in EMBI or stock data, by setting the respective data to missing if zero returns occur for at least two business days, was already a thorough method to deal with this issue and that any biases from low liquidity periods are limited in importance.

- Table 10 around here -

5.2 Alternative Specifications for EMBI and Commodity Performance

Next, we want to further alleviate concerns that our main results only hold because of the way we measured our variable of interest, i.e. export-weighted commodity price changes. We propose an alternative specification to capture price changes of key commodities of an emerging market that is similar to the procedure we used to take commodity imports into account in section 3.2. We multiply price changes of a commodity with the absolute export

value (in U.S. dollars) of this commodity for every country. We aggregate these value-weighted returns and then divide by the GDP of each country. In this way, we take the importance of commodity exports on the share of a country's total economy into account, similarly as with the interaction model for the share of commodity exports on total exports. Our results are robust with respect to our previous findings, in that we report a coefficient of GDP-weighted commodity export returns that is statistically significant in affecting sovereign creditworthiness at the 1% level (Table 11, column (1)).

Though they are not part of the main GSCI index, there are additional GSCI spot price series for orange juice, palladium, platinum, bio-fuel, soybean oil and tin. We match these price series with the respective export volume of our sample countries and extend our commodity performance measure by these extra raw materials (except for orange juice which has no clear export match). Reassuringly, we find a slightly stronger commodity performance coefficient that is reported in column (2). However, the difference to the main specification is small, likely because these extra commodities otherwise would have been in the main index.

We also test if we receive similar results if our dependent variable, the EMBI returns, are measured as a yield spread towards the U.S. treasury rate, where higher values indicate higher sovereign risk. When specifying the model this way, our commodity performance measure has the expected negative sign and is statistically significant at the 5% level (column 3).

- Table 11 around here -

5.3 Alternative Control Variables

We further check that we have sufficiently controlled for any influences that could impact the relationship between commodity prices and sovereign creditworthiness. To this end, we introduce some new control variables into our main specification. One further variation we might want to control for comes from credit risk in the U.S. interbank market that could spill over to emerging markets and which can be approximated by the TED spread. Though the TED spread enters with negative sign and statistical significance when added to our main estimation, it does not change the significance level of our commodity performance measure which remains at the 1% level (Table 12, column (1)).

So far, we have not controlled for the economic performance of the U.S. Therefore, another potential variable worth including could be U.S. stock market returns, as they might affect

both commodity prices and sovereign creditworthiness of emerging markets. However, adding the daily natural log returns of the S&P 500 to our main specification leaves coefficient size and significance of the commodity performance almost unchanged (column (2)).

We also split up the term spread we included in our main specification and add changes in the 3-month U.S. treasury bill rate as an additional control variable. Our main results are not affected (column (3)).

- Table 12 around here -

5.4 Alternative Fixed Effects, Frequency and Clustering

In order to account for market-wide changes at a higher frequency, we replace the month fixed effects in our baseline estimation by week fixed effects. The commodity performance coefficient becomes just slightly smaller in size due to this procedure but remains statistically significant at the 1% level (Table 13, column (1)).

One further concern we want to alleviate is that the daily frequency in our data could be too noisy for a robust inference. We therefore collapse our data to the weekly frequency and repeat our baseline estimation. We can report a somewhat higher, statistically significant coefficient of export-weighted commodity price shocks at the 5% level (column (2)).

Furthermore, we cluster standard errors of our baseline both on the country and the week level, to also allow for the correlation of errors within weeks. Our results remain statistically significant at the 1% level with this procedure (column (3)).

Finally, we include day-of-the-week fixed effects to make sure our results are not driven by trading anomalies on certain business days, e.g. Fridays. Our main results are not affected by this approach (column (4)). We therefore conclude that the daily data structure is unlikely to bee too noisy or biased with respect to our research design, but rather captures the maximum variation and information in the data.

- Table 13 around here -

6 Conclusion

This paper investigates the economic importance of commodity dependence on emerging markets' sovereign creditworthiness and derives macroeconomic and policy conditions that

could propagate or curb this dependence. Using daily data for 34 emerging market economies from 01/01/1994 to 31/12/2016, we measure dependence as the impact of country-specific, export-weighted commodity price changes on EMBI sovereign bond returns (controlling for a large set of major national and international financial indicators, country and time fixed effects). We find a statistically robust and economic meaningful commodity sovereign risk dependence.

For the full set of countries, a one standard deviation increase in commodity price returns is associated on average with a 1.84% increase in the EMBI return. For heavy exporters (with an export share of more than 30% in total exports), the standardized effect yields an 4.5% increase in EMBI returns which corresponds to 6.4% of the EMBI's standard deviation, and compares to around 40% of the standardized effect of stock returns or US Treasuries, and 55% of the standardized effect of the VIX on EMBI returns. Thus, particularly for commodity dependent countries, commodity price fluctuations are a major determinant of sovereign creditworthiness. This average effect can be further differentiated along the characteristics of a country's commodity portfolio, national and international macroeconomic conditions and set of policy measures that affect commodity extraction.

We find, first, that commodity dependence increases with a larger share of commodity exports and with exported commodities being more volatile in their recent price development. Diversification within the commodity portfolio, i.e. being less concentrated on a single commodity, however, does not seem to be associated with lower commodity dependence. As our later results show, a country can likely do more to tackle commodity dependence if it diversifies its economic structure towards downstream production and manufacturing sectors if feasible, instead of an additional commodity.

Second, we present evidence that commodity dependence increases in times of recession, higher inflation and lower public and private revenue streams. We do not find evidence that the level of public debt and the outbreak of sovereign debt crises affect commodity-dependence. Still, financial markets seem to pay attention to more recent incidents of sovereign defaults, which are associated with stronger commodity-dependence the fewer years they lie back. We also obtain strong evidence that more expansionary U.S. monetary policy spins the commodity cycle and increases commodity-dependence significantly.

Third, we show consistent evidence that improving institutional quality can be a promising way to mitigate commodity-dependence. All of our interactions variables, i.e. control of corruption, rule of law, political stability but also the progressiveness of a country's tax system, indicate that institutional quality is a decisive factor to tackle the dependence of a country's creditworthiness on raw material prices. We argue that better institutions likely increase transparency, provide clear ownership rights and limit corruption in the extraction process. The result also holds when focusing only on heavy commodity-exporting countries.

We also present results indicating that attracting more FDI flows, having larger manufacturing sectors and investing more in physical capital like machinery or infrastructure can be fruitful ways to reduce commodity-dependence by fostering downstream production technologies. In contrast, having a low stock of reserve assets relative to external debt is associated with increasing commodity-dependence. We also uncover that more open trade and financial accounts, both by de-facto and de-jure measures, are associated with a weaker reliance on raw material prices. Lastly, development assistance measures such as received aid or World Bank loans show only a small effect for reducing commodity-dependence.

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8 Tables and Figures

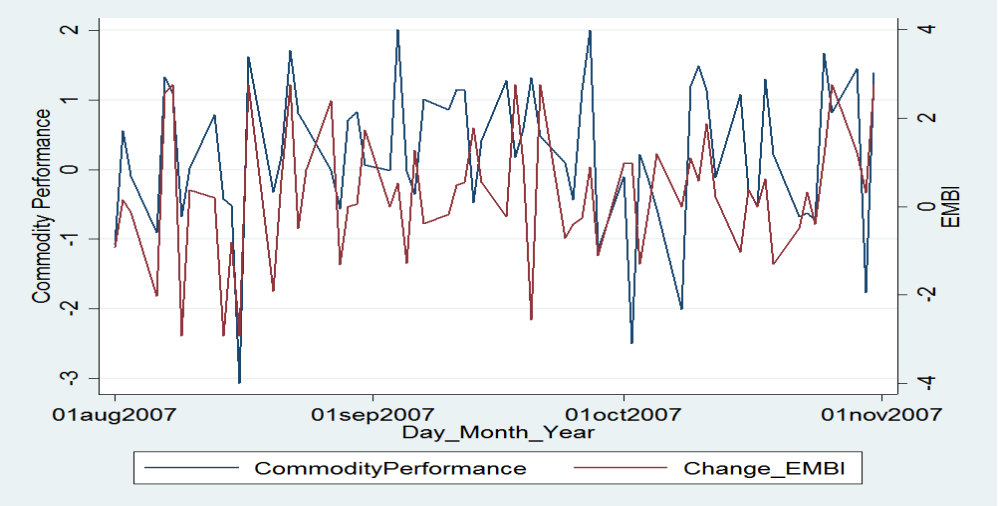


Figure 1: Commodity performance and ΔEMBI for Argentina (food price boom of 2007/08)

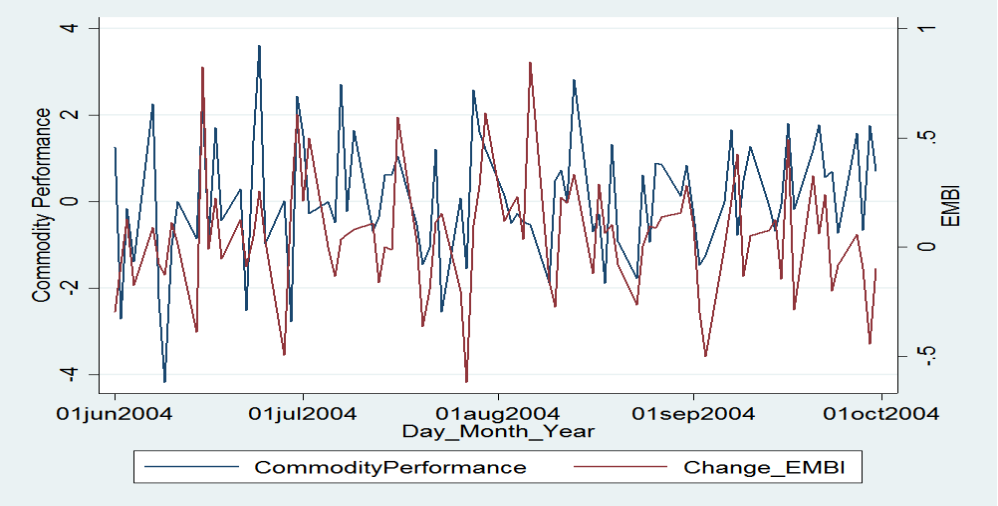


Figure 2: Commodity performance and ΔEMBI for Chile (start of copper-cycle in 2004)

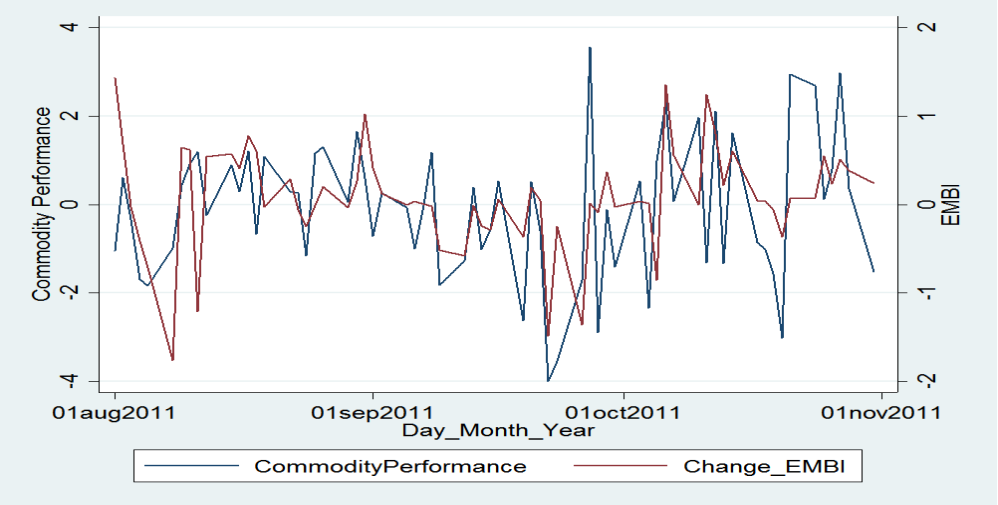


Figure 3: Commodity performance and ΔEMBI for Peru (gold price peak of 2011)

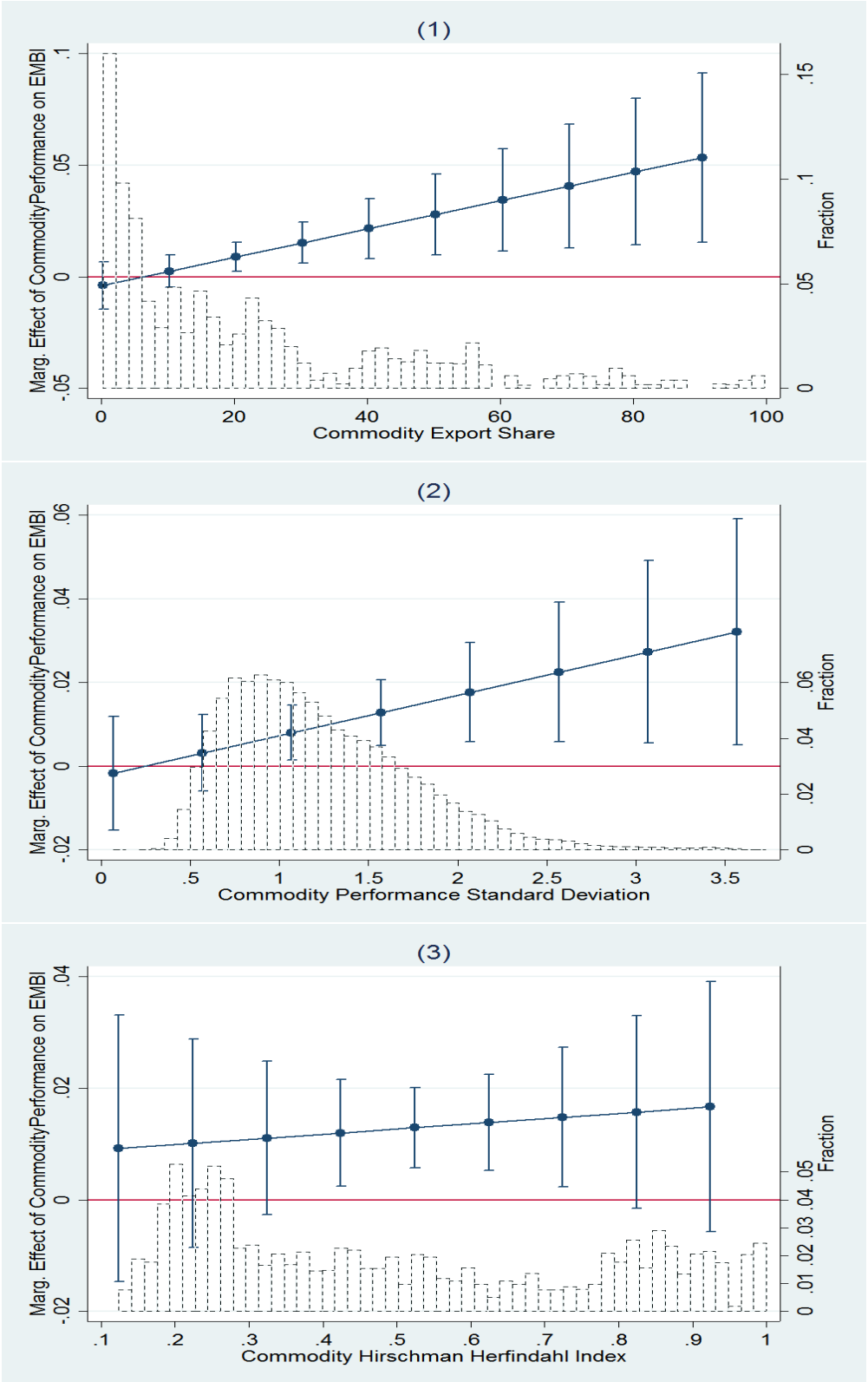
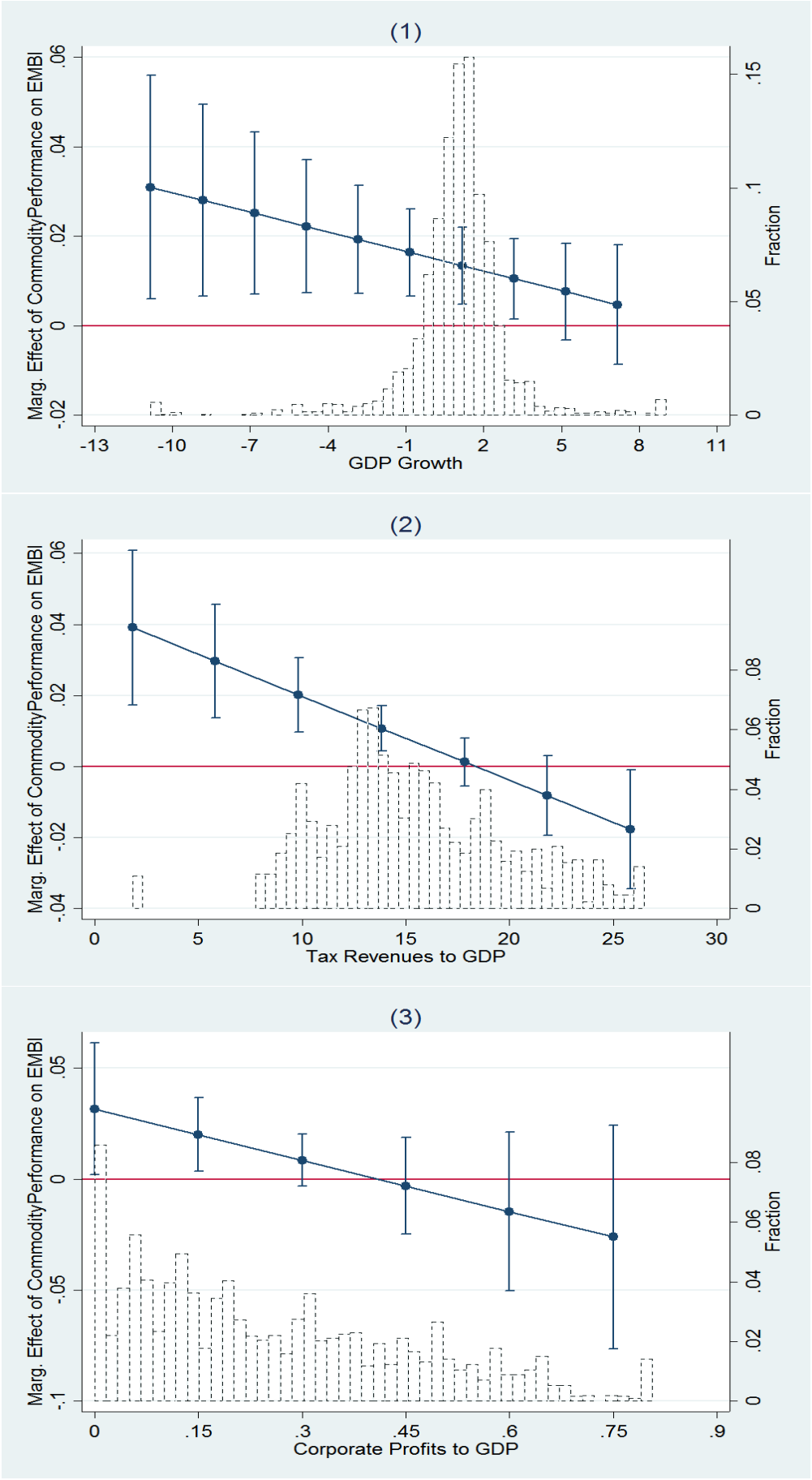
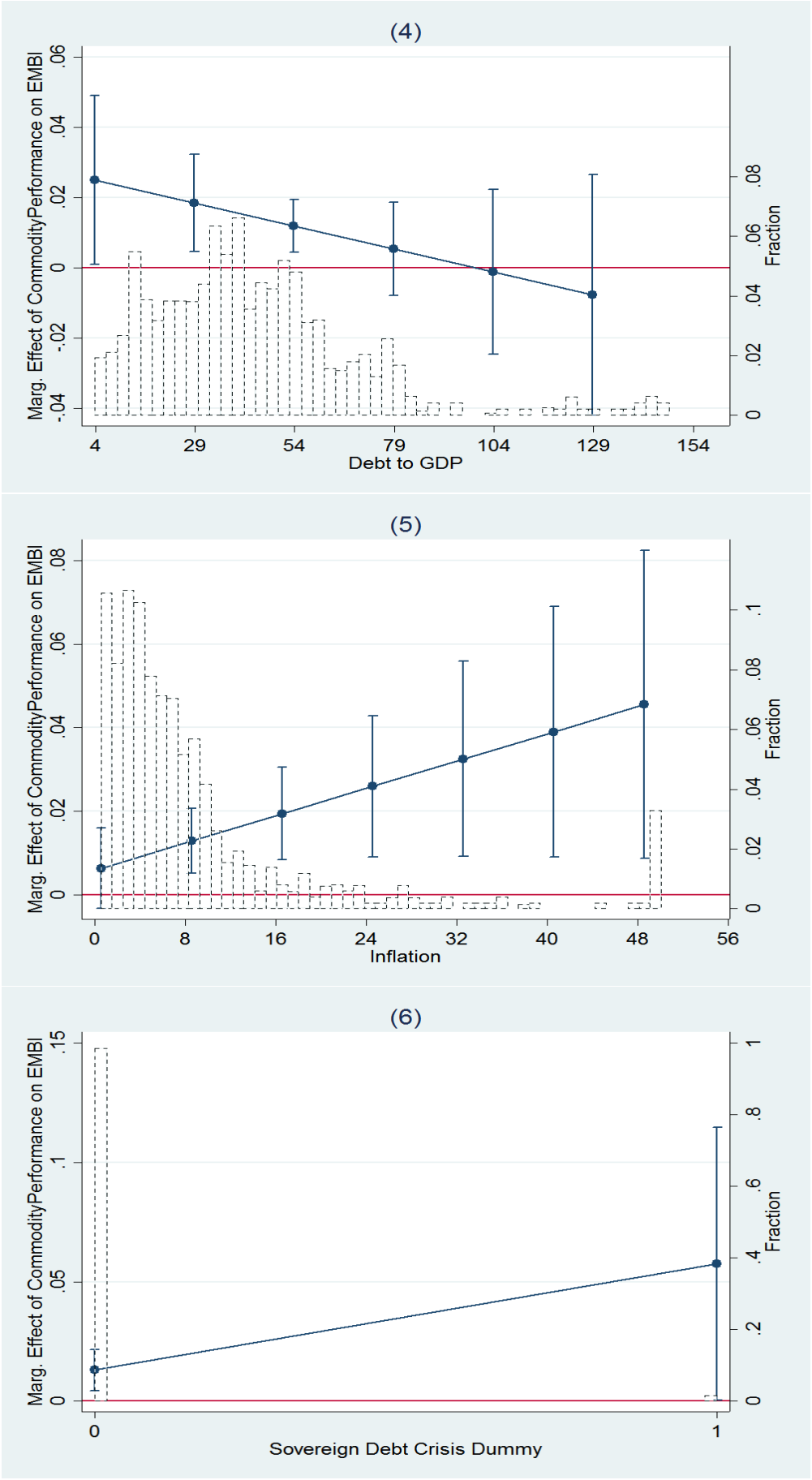


Figure 4: Marginal effects of commodity performance on EMBI returns interacted with commodity-related factors. Bars indicate 95% confidence intervals. The results of the corresponding regressions are in Table 6.


(1)
Marg. Effect of CommodityPerformance on EMBI
-.02
0
.02
.04
.06
Fraction
0
.05
.1
.15
-13
-10
-7
-4
-1
2
5
8
11
GDP Growth
(2)
Marg. Effect of CommodityPerformance on EMBI
-.04
-.02
0
.02
.04
.06
Fraction
0
.02
.04
.06
.08
0
5
10
15
20
25
30
Tax Revenues to GDP
(3)
Marg. Effect of CommodityPerformance on EMBI
-.1
-.05
0
.05
Fraction
0
.02
.04
.06
.08
0
.15
.3
.45
.6
.75
.9
Corporate Profits to GDP


(4)
Marg. Effect of CommodityPerformance on EMBI
-.04
-.02
0
.02
.04
.06
Fraction
0
.02
.04
.06
.08
4
29
54
79
104
129
154
Debt to GDP
(5)
Marg. Effect of CommodityPerformance on EMBI
0
.02
.04
.06
.08
Fraction
0
.02
.04
.06
.08
.1
0
8
16
24
32
40
48
56
Inflation
(6)
Marg. Effect of CommodityPerformance on EMBI
0
.05
.1
.15
Fraction
0
.2
.4
.6
.8
1
0
1
Sovereign Debt Crisis Dummy

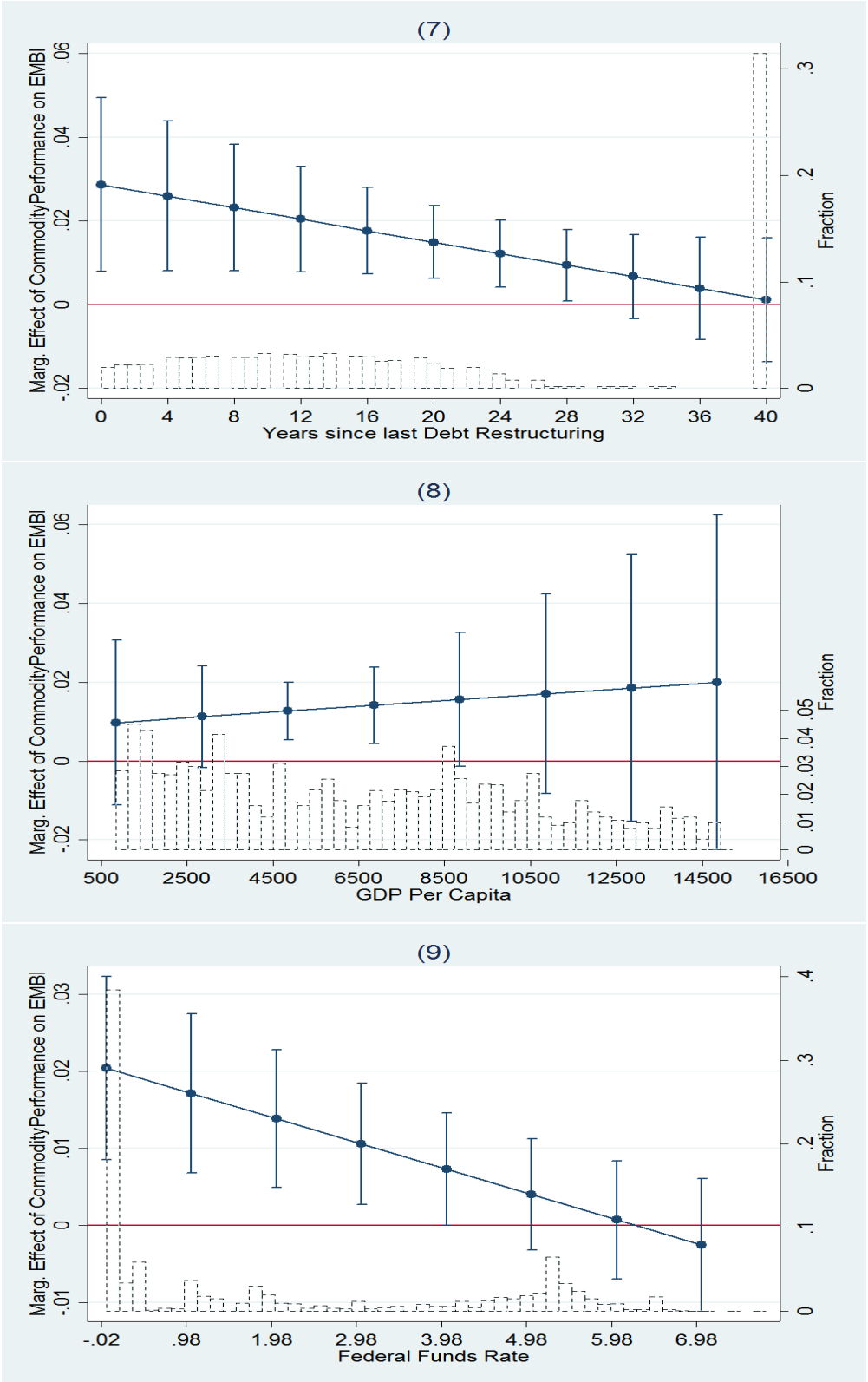
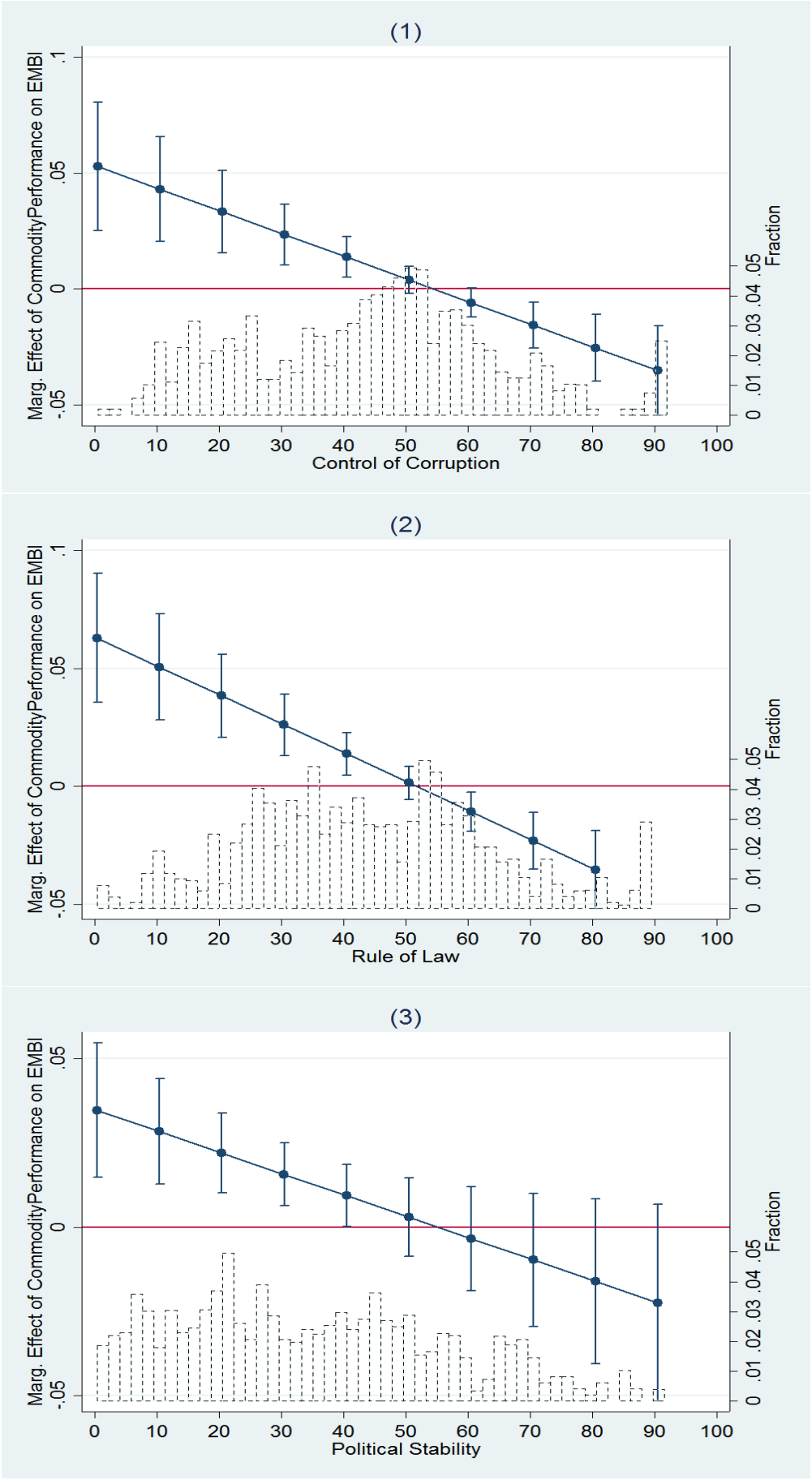
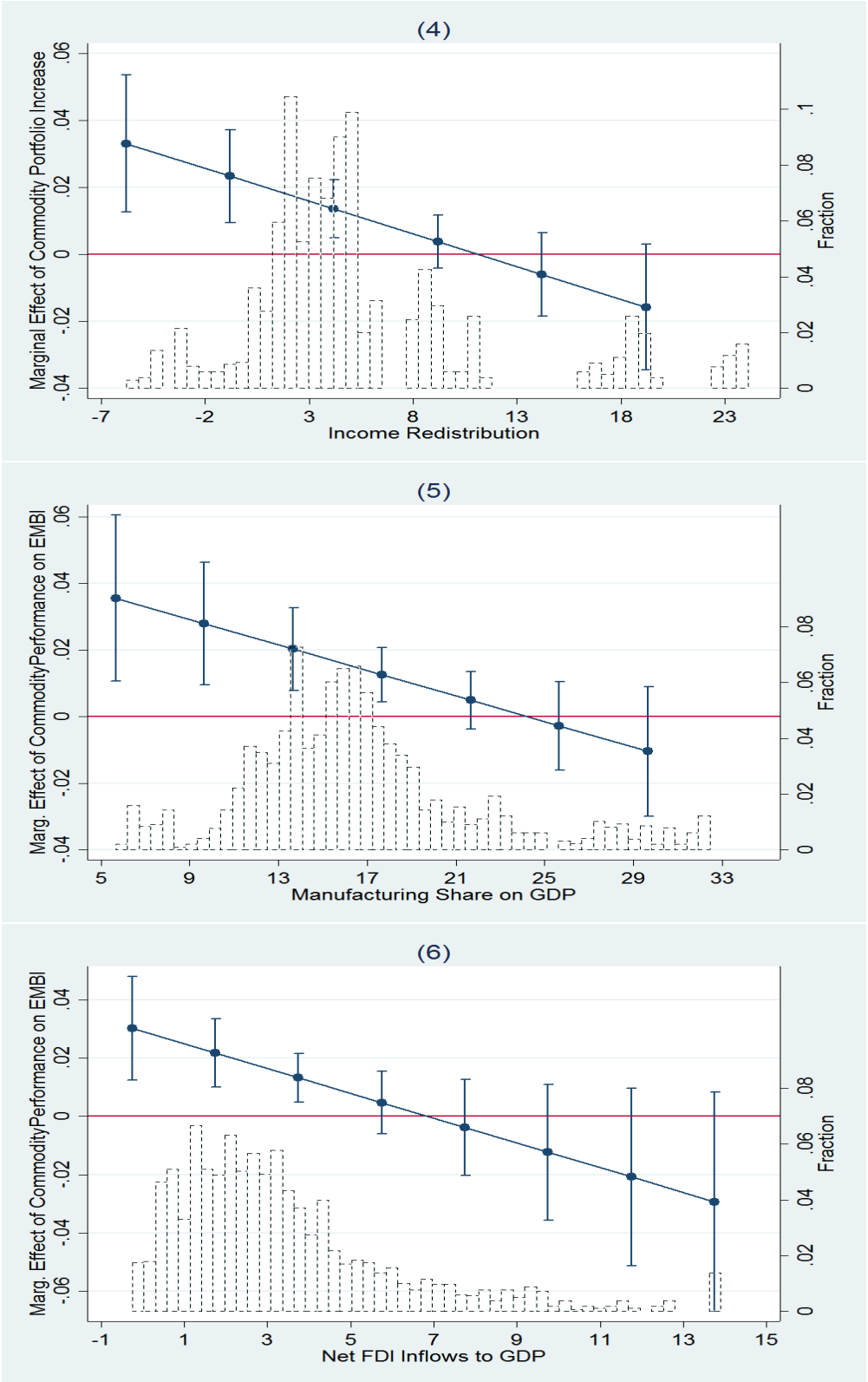


Figure 5: Marginal effects of commodity performance on EMBI returns interacted with macroeconomic and international factors. Bars indicate 95% confidence intervals. The results of the corresponding regressions are in Table 7.


(1)
Marg. Effect of CommodityPerformance on EMBI
-.05
0
.05
.1
Fraction
0
.01
.02
.03
.04
.05
0
10
20
30
40
50
60
70
80
90
100
Control of Corruption
(2)
Marg. Effect of CommodityPerformance on EMBI
-.05
0
.05
.1
Fraction
0
.01
.02
.03
.04
.05
0
10
20
30
40
50
60
70
80
90
100
Rule of Law
(3)
Marg. Effect of CommodityPerformance on EMBI
-.05
0
.05
Fraction
0
.01
.02
.03
.04
.05
0
10
20
30
40
50
60
70
80
90
100
Political Stability


(4)
Marginal Effect of Commodity Portfolio Increase
-.04
-.02
0
.02
.04
.06
Fraction
0
.02
.04
.06
.08
.1
-7
-2
3
8
13
18
23
Income Redistribution
(5)
Marg. Effect of CommodityPerformance on EMBI
-.04
-.02
0
.02
.04
.06
Fraction
0
.02
.04
.06
.08
5
9
13
17
21
25
29
33
Manufacturing Share on GDP
(6)
Marg. Effect of CommodityPerformance on EMBI
-.06
-.04
-.02
0
.02
.04
Fraction
0
.02
.04
.06
.08
-1
1
3
5
7
9
11
13
15
Net FDI Inflows to GDP

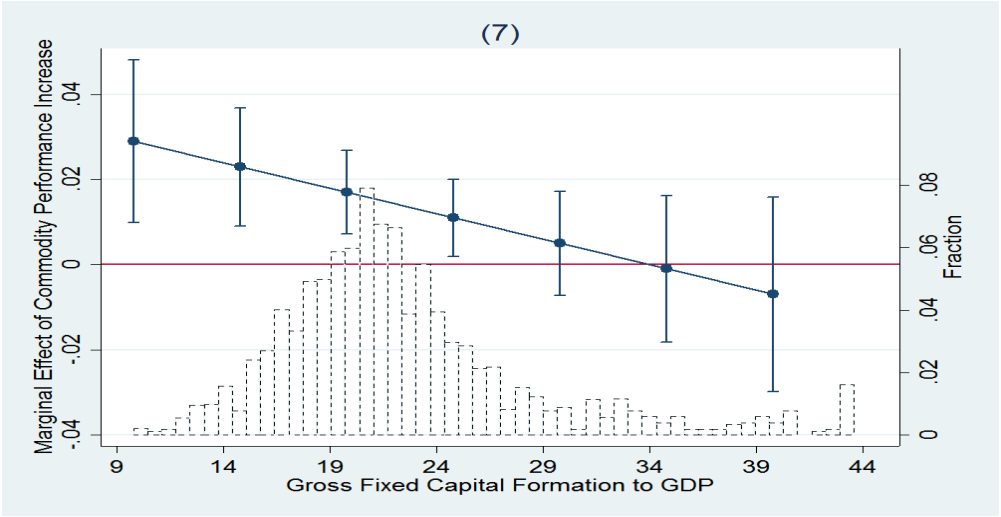
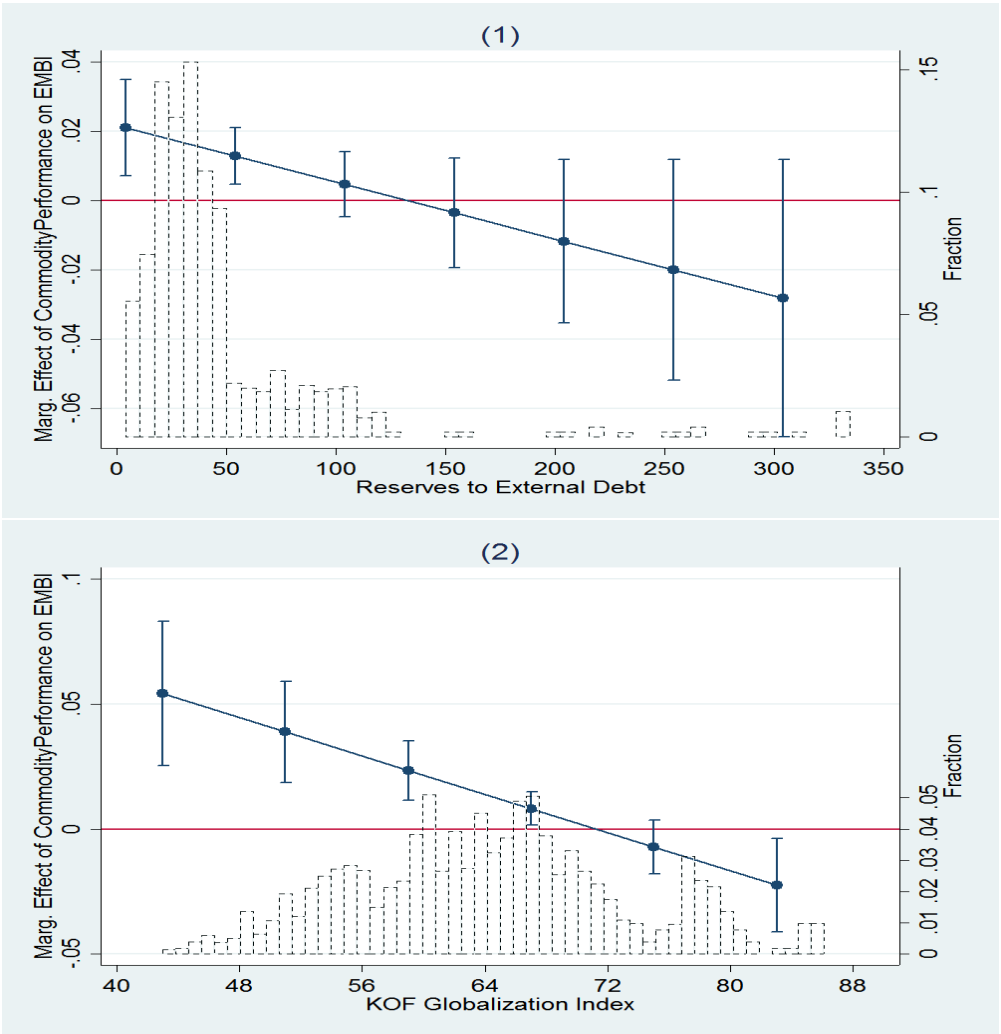


Figure 6: Marginal effects of commodity performance on EMBI returns interacted with policy measures against commodity-dependence (1). Bars indicate 95% confidence intervals. The results of the corresponding regressions are in Table 8.



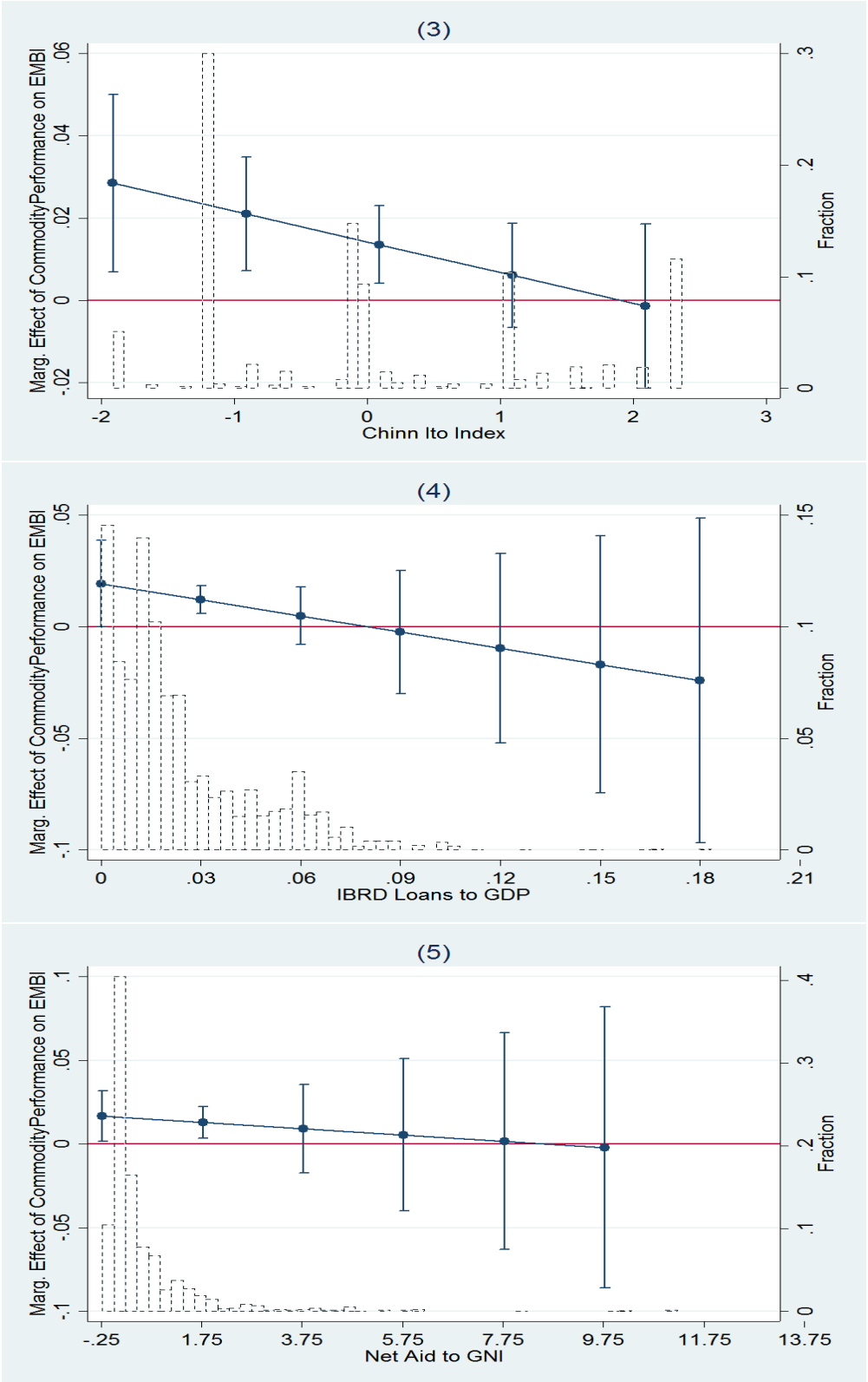


Figure 7: Marginal effects of commodity performance on EMBI returns interacted with policy measures against commodity-dependence (2). Bars indicate 95% confidence intervals. The results of the corresponding regressions are in Table 9.

Table 1: List of included countries

Region	Countries
Americas	Argentina, Brazil, Chile, Colombia, Ecuador, Jamaica, Mexico, Panama, Peru, Venezuela
Asia	China, Indonesia, Kazakhstan, Malaysia, Pakistan, Philippines, Russia, Sri Lanka, Thailand, Turkey, Vietnam
Africa	Egypt, Ghana, Ivory Coast, Morocco, Nigeria, South Africa, Tunisia
Europe	Bulgaria, Croatia, Hungary, Poland, Serbia, Ukraine

Table 2: Summary statistics of daily-varying variables used in our baseline estimation (winsorized at 1st and 99th percentile); Note: the number of observations for non-country-specific variables is lower as their statistical properties are the same for every country

Variable	N	mean	p50	sd	min	max
ΔEMBI	152,680	0.0395	0.0395	0.706	-2.920	2.752
ΔCommodityPerformance	180,798	0.0151	0.0151	1.326	-6.039	5.954
ΔStockIndex	165,407	0.00902	0.00902	1.623	-5.478	5.187
ΔExchangeRate	196,316	0.0203	0.0203	0.543	-1.906	2.197
ΔVIX	6000	-0.00239	-0.00239	1.318	-3.919	4.809
ΔGlobalGovernmentBondIndex	6000	0.0177	0.0177	0.377	-1.005	1.048
ΔTermSpread	6000	-0.000149	-0.000149	0.0591	-0.161	0.186
ΔCorporateSpread	6000	-1.91e-05	-1.91e-05	0.0811	-0.246	0.286
Δ10YearTreasuryYield	6000	-0.000598	-0.000598	0.0561	-0.150	0.164

Table 3: Match between commodity prices and export quantities. We use each commodity export and its corresponding single GSCI index to construct our weighted commodity performance measure. Exceptions are for the sub-groups wheat, cattle and energy, which are in bold type, and for which we use the sub-group price index.

GSCI single commodity index	GSCI sub-group index	GSCI group index	Matching commodity export
Cocoa		Agriculture	1801: Cocoa beans
Coffee			090111: Coffee (excluding roasted and decaffeinated)
Corn			1005: Maize or corn
Cotton			52: Cotton
Soybeans			1201: Soya beans, whether or not broken
Sugar			1701: Cane or beet sugar and chemically pure sucrose
Wheat (CBOT)	**All wheat**		1001: Wheat and meslin
Wheat (Kansas)			
Lean Hogs		Livestock	0103: Live swine
Feeder Cattle	**All cattle**		010229: Live cattle
Live Cattle			
Brent Crude Oil		**Energy**	2709: Petroleum oils and oils obtained from bituminous minerals, crude 2711: Petroleum gas and other gaseous hydrocarbons
WTI Crude Oil			
Gas Oil			
Heating Oil			
RBOB Gasoline			
Natural Gas			
Aluminum		Industrial Metals	2606: Aluminium ores and concentrates 7601: Unwrought aluminium
Copper			2603: Copper ores and concentrates 7402: Copper, unrefined
Lead			2607: Lead ores and concentrates 7801: Unwrought lead
Nickel			2604: Nickel ores and concentrates 7502: Unwrought nickel
Zinc			2608: Zinc ores and concentrates 7901: Unwrought zinc
Gold		Precious Metals	7108: Gold, (...) unwrought or not further worked than semi-manufactured or in powder form
Silver			261610: Silver ores and concentrates 7106: Silver, (...) unwrought or in semi-manufactured forms, or in powder form

Table 4: Benchmark Results

	(1) ΔEMBI	(2) ΔEMBI	(3) ΔEMBI	(4) ΔEMBI
ΔCommodityPerformance	0.0377***	0.0346***	0.0139***	0.00194
	(0.00594)	(0.00573)	(0.00446)	(0.00415)
HighComExport				-0.00403
				(0.0141)
ΔCommodityPerformance				0.0340***
× HighComExport				(0.0116)
ΔStockIndex			0.0660***	0.0658***
			(0.0142)	(0.0142)
ΔExchangeRate			-0.0317	-0.0330
			(0.0238)	(0.0238)
ΔVIX			-0.0617***	-0.0620***
			(0.00973)	(0.00978)
ΔGlobalGovernmentBondIndex			0.0298**	0.0310**
			(0.0118)	(0.0121)
ΔTermSpread			-0.109	-0.114
			(0.110)	(0.110)
ΔCorporateSpread			-0.871***	-0.875***
			(0.0923)	(0.0921)
Δ10YearTreasuryYield			-2.066***	-2.058***
			(0.219)	(0.219)
Constant	0.0385***	0.0698	-0.0187	-0.0194
	(0.00200)	(0.0624)	(0.0605)	(0.0613)
Observations	146,338	146,338	132,581	132,581
R-squared	0.005	0.036	0.110	0.111
Time & Country FE	No	Yes	Yes	Yes
Number of Countries	34	34	34	34

This table shows results from OLS-panel regressions of the daily returns of a country's Emerging Market Bond Index (ΔEMBI) on the daily returns on the weighted price index of a country's exported commodities (ΔCommodityPerformance) and controls. Estimation period is from 01/01/1994 to 12/31/2016. Variable definitions are provided in Table 14. HighComExport is a dummy variable being 1 if a country's share of commodity exports on total exports is larger than 30% and 0 otherwise. Estimations include country and time fixed effects on the monthly level. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 5: Alternative Specifications

	(1) ΔEMBI	(2) ΔEMBI	(3) ΔEMBI	(4) ΔEMBI
ΔCommodityPerformance: Yearly-lagged Weights	0.0139***			
	(0.00454)			
ΔCommodityPerformance: Excluding world-market-relevant Exporters		0.0163***		
		(0.00449)		
ΔCommodityPerformance: Adjusting for Imports			0.137**	
			(0.0567)	
ΔCommodityPerformance: NetShockIndicator				0.00958***
				(0.00343)
Observations	129,945	132,581	130,582	132,581
R-squared	0.109	0.110	0.110	0.109
Number of Countries	34	34	34	34
Time & Country FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

This table shows results from OLS-panel regressions of the daily returns of a country's Emerging Market Bond Index (ΔEMBI) on the daily returns on the weighted price index of a country's exported commodities (ΔCommodityPerformance) and controls. Column (1) uses commodity-export weights of the previous year to calculate ΔCommodityPerformance. Column (2) excludes a commodity from a country's portfolio if the country had in any point in time a world market share of more than 10% for this commodity. Column (3) takes imported commodities in the calculation of ΔCommodityPerformance into account. Column (4) dummifies both relevant commodities for each country and daily price events and aggregates them to a net-shock index. Estimation period is from 01/01/1994 to 12/31/2016. Variable definitions are provided in Table 14. Control variables include a country's stock index and exchange (to U.S. Dollar) returns, changes in the VIX, U.S. term spread, U.S. corporate spread, U.S. 10-year treasury yield and global government bond index. Estimations include country and time fixed effects on the monthly level. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 6: Drivers of commodity spillovers: commodity-related factors

	(1) ΔEMBI	(2) ΔEMBI	(3) ΔEMBI
ΔCommodityPerformance	-0.00406	-0.00235	0.00805
	(0.00548)	(0.00725)	(0.0155)
CommodityExportShare	-0.000459		
	(0.000412)		
ΔCommodityPerformance × CommodityExportShare	0.000636**		
	(0.000260)		
CommodityStandardDeviation		0.0210***	
		(0.00767)	
ΔCommodityPerformance × CommodityStandardDeviation		0.00966*	
		(0.00556)	
CommodityHHI			0.000514
			(0.0188)
ΔCommodityPerformance × CommodityHHI			0.00932
			(0.0281)
Observations	128,655	132,450	132,581
R-squared	0.111	0.110	0.110
Number of Countries	34	34	34
Time & Country FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes

This table shows results from OLS-panel regressions of the daily returns of a country's Emerging Market Bond Index (ΔEMBI) on the daily returns on the weighted price index of a country's exported commodities (ΔCommodityPerformance) and controls. Interaction terms of ΔCommodityPerformance with CommodityExportShare ((1), share of commodity exports on total exports), CommodityStandardDeviation ((2), rolling standard deviation of ΔCommodityPerformance of past 23 business days), CommodityHHI ((3), concentration index of export weights in ΔCommodityPerformance) are estimated. Estimation period is from 01/01/1994 to 12/31/2016. Variable definitions are provided in Table 14. Control variables include a country's stock index and exchange rate (to U.S. Dollar) returns, changes in the VIX, U.S. term spread, U.S. corporate spread, 10-year U.S. treasury yield and global government bond index. Estimations include country and time fixed effects on the monthly level. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 7: Drivers of commodity spillovers: macroeconomic and international factors

	(1) ΔEMBI	(2) ΔEMBI	(3) ΔEMBI	(4) ΔEMBI	(5) ΔEMBI	(6) ΔEMBI	(7) ΔEMBI	(8) ΔEMBI	(9) ΔEMBI
ΔCommodityPerformance	0.0151***	0.0434***	0.0316*	0.0260*	0.00585	0.0130***	0.0287**	0.00916	0.0206***
	(0.00464)	(0.0125)	(0.0152)	(0.0131)	(0.00510)	(0.00443)	(0.0106)	(0.0124)	(0.00609)
GDP-Growth	0.00116								
	(0.00158)								
ΔCommodityPerformance × GDP-Growth	-0.00146								
	(0.000956)								
TaxRevenueToGDP		-0.000237							
		(0.00189)							
ΔCommodityPerformance × TaxRevenueToGDP		-0.00236***							
		(0.000779)							
CorporateProfitToGDP			0.0690						
			(0.0452)						
ΔCommodityPerformance × CorporateProfitToGDP			-0.0770						
			(0.0521)						
DebtToGDP				0.000623**					
				(0.000235)					
ΔCommodityPerformance × DebtToGDP				-0.000261					
				(0.000229)					
Inflation					0.000909				
					(0.000559)				
ΔCommodityPerformance × Inflation					0.000817*				
					(0.000447)				
SovereignDebtCrisis						-0.104**			
						(0.0494)			
SovereignDebtCrisis × ΔCommodityPerformance						0.0445			
						(0.0301)			
YearsSinceLastRestructuring							-0.000627*		
							(0.000358)		
ΔCommodityPerformance × YearsSinceLastRestructuring							-0.000687*		
							(0.000402)		
GDP-PerCapita								-5.28e-06**	
								(2.06e-06)	
ΔCommodityPerformance × GDP-PerCapita								7.25e-07	
								(2.24e-06)	
Federal Funds Rate									-0.0311*
									(0.0157)
ΔCommodityPerformance × FederalFundsRate									-0.00328***
									(0.00104)
Observations	132,581	111,468	73,625	122,082	130,704	132,581	132,581	132,581	132,581
R-squared	0.110	0.124	0.152	0.115	0.109	0.110	0.110	0.110	0.110
Number of Countries	34	33	16	33	34	34	34	34	34
Time & Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table shows results from OLS-panel regressions of the daily returns of a country's Emerging Market Bond Index (ΔEMBI) on the daily returns on the weighted price index of a country's exported commodities (ΔCommodityPerformance) and controls. Interaction terms of ΔCommodityPerformance with GDP-Growth ((1), quarter-to-quarter GDP growth), TaxRevenueToGDP ((2), government tax revenue to GDP), CorporateProfitToGDP ((3), corporate sector profits to GDP), DebtToGDP ((4), gross government debt to GDP), Inflation ((5), consumer price index increase), SovereignDebtCrisis ((6), dummy for Laeven & Valencia (2018) sovereign debt crisis), YearsSinceLastRestructuring ((7), number of years since last sovereign debt restructuring, 40 if no restructuring occurred), GDP-PerCapita (8) and FederalFundsRate ((9), U.S. federal funds rate) are estimated. Estimation period is from 01/01/1994 to 12/31/2016. Variable definitions are provided in Table 14. Control variables include a country's stock index and exchange rate (to U.S. Dollar) returns, changes in the VIX, U.S. term spread, U.S. corporate spread, 10-year U.S. treasury yield and global government bond index. Estimations include country and time fixed effects on the monthly level. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 8: Drivers of commodity spillovers: policy measures (1)

	(1) ΔEMBI	(2) ΔEMBI	(3) ΔEMBI	(4) ΔEMBI	(5) ΔEMBI	(6) ΔEMBI	(7) ΔEMBI
ΔCommodityPerformance	0.0533***	0.0634***	0.0349***	0.0616	0.0465**	0.0291***	0.0406**
	(0.0142)	(0.0141)	(0.0103)	(0.0379)	(0.0176)	(0.00866)	(0.0156)
ControlOfCorruption	-0.000695**						
	(0.000298)						
ΔCommodityPerformance × ControlOfCorruption	-0.000979***						
	(0.000258)						
RuleOfLaw		-0.00123***					
		(0.000385)					
ΔCommodityPerformance × RuleOfLaw		-0.00123***					
		(0.000264)					
PoliticalStability			-0.000469**				
			(0.000182)				
ΔCommodityPerformance × PoliticalStability			-0.000634**				
			(0.000259)				
GiniMarket				0.00107			
				(0.00132)			
ΔCommodityPerformance × GiniMarket				-0.000847			
				(0.000798)			
GiniRedistribution				0.00293			
				(0.00398)			
ΔCommodityPerformance × GiniRedistribution				-0.00195**			
				(0.000739)			
ManufacturingShare					0.000856		
					(0.00105)		
ΔCommodityPerformance × ManufacturingShare					-0.00192**		
					(0.000884)		
FDI-Inflows						-7.88e-05	
						(0.000724)	
ΔCommodityPerformance × FDI-Inflows						-0.00425**	
						(0.00191)	
GFCF							-0.000523
							(0.000491)
ΔCommodityPerformance × GFCF							-0.00120*
							(0.000646)
Observations	125,193	125,193	125,193	131,023	127,455	132,581	132,062
R-squared	0.108	0.109	0.106	0.110	0.111	0.110	0.110
Number of Countries	34	34	34	34	34	34	34
Time & Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table shows results from OLS-panel regressions of the daily returns of a country's Emerging Market Bond Index (ΔEMBI) on the daily returns on the weighted price index of a country's exported commodities (ΔCommodityPerformance) and controls. Interaction terms of ΔCommodityPerformance with ControlOfCorruption ((1), World Bank control of corruption rank), RuleOfLaw ((2), World Bank rule of law rank), Political Stability ((3), World Bank political stability rank), GiniMarket and Gini Redistribution ((4), Gini index for pre-tax inequality; difference in post- and pre-tax Gini index), ManufacturingShare ((5), share of manufacturing value added on GDP), FDI-Inflows ((6), net FDI inflows to GDP), and GFCF ((7), gross-fixed capital formation to GDP) are estimated. Estimation period is from 01/01/1994 to 12/31/2016. Variable definitions are provided in Table 14. Control variables include a country's stock index and exchange rate (to U.S. Dollar) returns, changes in the VIX, U.S. term spread, U.S. corporate spread, 10-year U.S. treasury yield and global government bond index. Estimations include country and time fixed effects on the monthly level. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 9: Drivers of commodity spillovers: policy measures (2)

	(1) ΔEMBI	(2) ΔEMBI	(3) ΔEMBI	(4) ΔEMBI	(5) ΔEMBI
ΔCommodityPerformance	0.0217***	0.137***	0.0142***	0.0193*	0.0162**
	(0.00737)	(0.0395)	(0.00488)	(0.00985)	(0.00683)
ReservesToExternalDebt	-0.000109				
	(0.000103)				
ΔCommodityPerformance ×	-0.000164*				
ReservesToExternalDebt	(8.67e-05)				
KOF		-0.00120			
		(0.00104)			
ΔCommodityPerformance ×		-0.00192***			
KOF		(0.000582)			
ChinnIto			-0.00576*		
			(0.00285)		
ΔCommodityPerformance ×			-0.00747		
ChinnIto			(0.00472)		
IBRDLoans				-0.0462	
				(0.141)	
ΔCommodityPerformance ×				-0.241	
IBRDLoans				(0.258)	
NetAidGNI					-0.00339
					(0.00271)
ΔCommodityPerformance ×					-0.00188
NetAidGNI					(0.00495)
Observations	125,672	132,581	130,098	127,356	120,613
R-squared	0.111	0.111	0.111	0.109	0.112
Number of Countries	34	34	33	34	34
Time & Country FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

This table shows results from OLS-panel regressions of the daily returns of a country's Emerging Market Bond Index (ΔEMBI) on the daily returns on the weighted price index of a country's exported commodities (ΔCommodityPerformance) and controls. Interaction terms of ΔCommodityPerformance with ReservesToExternalDebt ((1), official reserve assets in U.S. Dollar to total external debt), KOF ((2), KOF globalization index by Gygli et al. (2018)), ChinnIto ((3), Chinn-Ito capital account openness index by Chinn & Ito (2006)), IBRDLoans ((4), outstanding International Bank for Reconstruction and Development and International Development Association loans to GDP) and NetAidGNI ((5), net official development assistance to GNI) are estimated. Estimation period is from 01/01/1994 to 12/31/2016. Variable definitions are provided in Table 14. Control variables include a country's stock index and exchange rate (to U.S. Dollar) returns, changes in the VIX, U.S. term spread, U.S. corporate spread, 10-year U.S. treasury yield and global government bond index. Estimations include country and time fixed effects on the monthly level. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 10: Robustness: Dropping countries with liquidity issues

	(1) ΔEMBI	(2) ΔEMBI	(3) ΔEMBI
ΔCommodityPerformance	0.0150**	0.0112**	0.0139**
	(0.00553)	(0.00436)	(0.00572)
Observations	111,106	119,759	104,985
R-squared	0.123	0.120	0.119
Number of Countries	26	29	22
Time & Country FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes

This table shows results from OLS-panel regressions of the daily returns of a country's Emerging Market Bond Index (ΔEMBI) on the daily returns on the weighted price index of a country's exported commodities (ΔCommodityPerformance) and controls. Robustness checks repeat baseline equation and include: (1): drop all countries for which EMBI data turned, at some point, temporarily illiquid. (2): drop all countries for which stock market data turned, at some point, temporarily illiquid. (3): drop countries for which there less than 3000 business days (roughly 12 years) of common EMBI and stock market data. Estimation period is from 01/01/1994 to 12/31/2016. Variable definitions are provided in Table 14. Control variables include a country's stock index and exchange rate (to U.S. Dollar) returns, changes in the VIX, U.S. term spread, U.S. corporate spread, 10-year U.S. treasury yield and global government bond index. Estimations include country and time fixed effects on the monthly level. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 11: Robustness: Alternative specifications for EMBI and commodity performance

	(1) ΔEMBI	(2) ΔEMBI	(3) ΔEMBI Spread
ΔCommodityPerformance:	0.152***		
GDP-weighted	(0.0551)		
ΔCommodityPerformance:		0.0144***	
additional commodities		(0.00456)	
ΔCommodityPerformance			-0.0304**
			(0.0132)
Observations	130,635	132,581	129,891
R-squared	0.110	0.110	0.236
Number of Countries	34	34	34
Time & Country FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes

This table shows results from OLS-panel regressions of the daily returns of a country's Emerging Market Bond Index (ΔEMBI) on the daily returns on the weighted price index of a country's exported commodities (ΔCommodityPerformance) and controls. Robustness checks repeat baseline equation and include: (1): scaling CommodityPerformance to GDP. (2): include additional GSCI commidites in CommodityPerformance. (3): use EMBI as spread towards U.S. treasury rate. Estimation period is from 01/01/1994 to 12/31/2016. Variable definitions are provided in Table 14. Control variables include a country's stock index and exchange rate (to U.S. Dollar) returns, changes in the VIX, U.S. term spread, U.S. corporate spread, 10-year U.S. treasury yield and global government bond index. Estimations include country and time fixed effects on the monthly level. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 12: Robustness: Alternative control variables

	(1) ΔEMBI	(2) ΔEMBI	(3) ΔEMBI
ΔCommodityPerformance	0.0166***	0.0133***	0.0138***
	(0.00465)	(0.00433)	(0.00445)
ΔTED-Spread	-0.544***		
	(0.152)		
ΔS&P-500		0.0278**	
		(0.0102)	
Δ3-Month-TBill-Yield			-0.0496
			(0.101)
Observations	118,474	132,581	132,581
R-squared	0.115	0.110	0.109
Number of Countries	34	34	34
Time & Country FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes

This table shows results from OLS-panel regressions of the daily returns of a country's Emerging Market Bond Index (ΔEMBI) on the daily returns on the weighted price index of a country's exported commodities (ΔCommodityPerformance) and controls. Robustness checks repeat baseline equation and include: (1): include TED-Spread as additional control variable. (2): include S&P-500 return as additional control variable. (3): include 3-month-TBill-yield instead of TermSpread as additional control variable. Estimation period is from 01/01/1994 to 12/31/2016. Variable definitions are provided in Table 14. Control variables include a country's stock index and exchange rate (to U.S. Dollar) returns, changes in the VIX, U.S. term spread, U.S. corporate spread, 10-year U.S. treasury yield and global government bond index. Estimations include country and time fixed effects on the monthly level. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 13: Robustness: Alternative fixed effects, frequency and clustering

	(1) ΔEMBI	(2) ΔEMBI	(3) ΔEMBI	(4) ΔEMBI
ΔCommodityPerformance	0.0122***	0.0210**	0.0139***	0.0139***
	(0.00421)	(0.00921)	(0.00503)	(0.00447)
Observations	132,581	26,996	132,581	132,581
R-squared	0.153	0.224	0.110	0.110
Number of Countries	34	34	34	34
Weekly Time & Country FE	Yes	No	No	No
Month Time & Country FE	No	Yes	Yes	Yes
DayOfWeek FE	No	No	No	Yes
Controls	Yes	Yes	Yes	Yes
Cluster	Country	Country	Country & Week	Country

This table shows results from OLS-panel regressions of the daily returns of a country's Emerging Market Bond Index (ΔEMBI) on the daily returns on the weighted price index of a country's exported commodities (ΔCommodityPerformance) and controls. Robustness checks repeat baseline equation and include: (1): apply weekly instead of monthly fixed effects. (2): collapse data at weekly frequency. (3): cluster on country- and week-level. (4): include day-of-the-week fixed effects. Estimation period is from 01/01/1994 to 12/31/2016. Variable definitions are provided in Table 14. Control variables include a country's stock index and exchange rate (to U.S. Dollar) returns, changes in the VIX, U.S. term spread, U.S. corporate spread, 10-year U.S. treasury yield and global government bond index. Estimations include country and time fixed effects on the monthly level. Standard errors (in parentheses) are clustered at the country level, ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

9 Appendix

Table 14: Description and sources of variables

Variable	Description	Source
Variables in Baseline Regression (Section 3.1) (all variables winsorized at 1st and 99th percentile)		
ΔEMBI	Daily change in natural logarithm of Emerging Market Bond Index (Global)	J.P. Morgan
ΔCommodity Performance	Export-share weighted commodity price changes as described in section 2.2	UN Comtrade, ITC Trade Map, S&P
ΔStock Returns	Daily change in natural logarithm of a country's general stock market index in U.S. Dollar	Datastream,[10] MSCI, S&P
ΔExchange Rate Returns	Daily percentage change of a country's local currency exchange rate towards the U.S. Dollar	Thomson Reuters
ΔVIX	Daily change in VIX volatility index	CBOE
ΔCorporate Spread	Daily change in spread between the S&P U.S. high yield corporate bond index and the corresponding investment grade index	S&P
Δ10-Year Treasury Yield	Daily change in the yield of the 10-year U.S. Treasury bond	Datastream
ΔTerm Spread	Daily change in spread between 10-year U.S. Treasury yield and 3-month U.S. T-Bill yield	Datastream, Federal Reserve
ΔGlobal Government Bond Index	Daily change in natural logarithm of Bank Of America Merrill Lynch Global Government Index	Merrill Lynch
Variables in Alternative Specification Regressions (Section 3.2)		
ΔCommodity Performance: Yearly-lagged Weights	CommodityPerformance using export weights from the previous year	
ΔCommodity Performance: Excluding world-market -relevant exporters	CommodityPerformance excluding a commodity if country had at any time world-export share of more than 10%	
ΔCommodity Performance: Adjusting for imports	CommodityPerformance using net commodity exports (see Section 3.2)	
ΔCommodity Performance: Net Shock Indicator	CommodityPerformance using dummies for relevant commodities and extreme price events (see Section 3.2)	
Variables in Interaction Regressions (Section 4) (all variables winsorized at 1st and 99th percentile, except indices)		
Commodity Export Share	Share of commodity exports on total exports	UN Comtrade, ITC Trade Map
Commodity Standard Deviation	Rolling standard deviation of CommodityPerformance over past 23 business days (one month)	
Commodity HHI	Hirschman-Herfindahl-index (HHI), i.e. sum of squared export weights within CommodityPerformance	
GDP in local currency	GDP in constant prices, seasonally adjusted and local currency	Oxford Economics
GDP in U.S. Dollar	GDP in current prices and U.S. Dollar	World Bank
GDP Growth	Quarterly natural log growth rate of local currency GDP	
Tax Revenues to GDP	Government tax revenue (% of GDP, linearly interpolated)	World Bank
Corporate Profits to GDP	Corporate sector profits (% of GDP)	Oxford Economics
Debt to GDP	General gross government debt (% of GDP)	Oxford Economics

[10] For Ecuador, we merge local Quito Stock Exchange (in $) and S&P data to receive maximum coverage.

Table 14: Description and sources of variables

Inflation	Annual consumer price increase (winsorized at 5th and 95th percentiles to rule out hyperinflation periods)	World Bank
Sovereign Debt Crisis	Yearly dummy for sovereign debt crisis	Laeven & Valencia (2018)
Years since last Sovereign Debt Restructuring	Number of years since last sovereign debt restructuring. Value of 40 if no sovereign debt restructuring took place	Laeven & Valencia (2018)
GDP per Capita	Gross domestic product per capita in constant prices and U.S. Dollar	World Bank
Federal Funds Rate	U.S. federal funds effective rate	Federal Reserve
Shadow Rate	Federal funds shadow rate	Wu & Xia (2016)
Control of Corruption	Control of corruption rank (The extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests; linearly interpolated)	World Bank
Rule of Law	Rule of law rank (The extend of which agents have confidence in and abide by the rules of society; linearly interpolated)	World Bank
Political Stability	Political stability rank (The likelihood that the government will be destabilized by unconstitutional or violent means, including terrorism; linearly interpolated)	World Bank
Gini Market	Gini inequality index in market (pre-tax, pre-transfer) income	Solt (2019)
Gini Redistribution	Absolute income redistribution (market-income inequality minus net-income inequality)	Solt (2019)
Manufacturing Share	Manufacturing value added (% of GDP)	World Bank
FDI-Inflows	Net foreign direct investment inflows (% of GDP)	World Bank
GFCF	Gross Fixed Capital Formation (% of GDP)	World Bank
Reserves to External Debt	Total reserve assets (% of total external debt)	World Bank
Reserves to GDP	Total reserve assets (% of GDP)	IMF
KOF	KOF Globalisation Index (composite index measuring globalization along several criteria such as trade and financial flows and regulation)	Gygli et al. (2018)
Chinn-Ito	KAOPEN index of Chinn & Ito (2006) (index measuring regulatory controls over current or capital account transactions and exchange rate regimes)	Chinn & Ito (2006)
IBRD Loans	Outstanding loans from International Bank for Reconstruction and Development and International Development Association (% of GDP)	World Bank
Aid to GNI	Net official development assistance received (% of GNI; for Hungary, Bulgaria, Poland and Russia: % of GDP)	World Bank
Variables in Robustness Regressions (Section 5) (all variables winsorized at 1st and 99th percentile)		
ΔEMBI Spread	Daily change in natural log of Emerging Market Bond Index (Global), stripped spread	J.P. Morgan
ΔTED Spread	Spread between 3-Month LIBOR based on U.S. dollars and 3-Month Treasury Bill	Fed St. Louis
ΔS&P 500	Daily change in natural log of Standard and Poor's 500 Composite	S&P
Δ3-Month T-Bill Yield	U.S. treasury bill 3-month yield	Federal Reserve

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