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Interest premium and external position: A state dependent approach ☆

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ABSTRACT

Using a broad sample of countries between 1980 and 2017, this paper re-examines the empirical relationship between sovereign yield spreads and the level of external indebtedness of advanced, emerging and less-developed economies in both normal and crisis periods. It finds a significant relationship that is much stronger during crisis periods and its strength decreases with the level of economic development. It also shows that this relationship is non-linear which is primarily driven by periods of financial crises. We carry out a number of robustness checks, which highlight issues related to sample composition, the definition of sovereign bond yield spreads and crisis events. In all checks, our results are largely unchanged. These findings have a number of implications with regard to the calibration of macroeconomic models and debt sustainability analysis.

1. Introduction

The effect of indebtedness on the sovereign yield spreads has been of great theoretical and empirical interest in international finance and international macroeconomics. On the empirical side, the conditions under which countries can borrow from abroad differ greatly. An obvious explanation is that markets assign different probabilities to sovereign default.

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If default risk is positively correlated with the extent of indebtedness, this creates a link between the level of debt and the external spread.[1]

On the theoretical side, debt-dependent interest premia are introduced into open economy macro models to induce stationarity on the one hand, and as a simple stand-in for financial frictions on international capital markets on the other hand. Since Schmitt-Grohe and Uribe (2003), a positive debt elasticity of the external interest rate is a regular feature of small open economy models.

The exact relationship between measures of indebtedness and external interest rates, however, remains elusive. Macroeconomic models where a debt-dependent interest rate was introduced to guarantee stationarity, starting with Schmitt-Grohe and Uribe (2003), tended to use a small value for the elasticity parameter. Estimated DSGE models tended to find larger values, such as Garcia-Cicco et al. (2010). In these latter models, the debt dependent interest rate stands in for financial frictions, which helps explain the dynamics of consumption and the trade balance.

In this paper we carry out an extensive empirical study of the impact of external indebtedness on sovereign spreads. Our main question is whether the debt elasticity of the yield spread is state-dependent. In particular, we examine whether the elasticity depends on (i) the size of the external position, (ii) external financial conditions, or (iii) the level of development of the country in question. Our findings indicate that the debt-premium relationship is indeed state dependent. The relationship is much stronger during crisis times, and its strength also decreases with the level of economic development. We find some evidence of non-linearity, but primarily during crisis times. These findings are naturally important for financial markets and policymakers. But it is also highly relevant for macroeconomic modelers. Evidence of state dependence means that small open economy macro models either have to be calibrated or estimated for particular episodes/countries/debt levels, or they have to be non-linear or feature switching regimes. Specifically, our results are consistent with regime switching frameworks (see for example Blagov, 2018), where tranquil and turbulent periods alternate and are accompanied by different debt-premium functional relationships.

Our work is closely related to two studies. First, a recent contribution testing for potential non-linearity is Brzoza-Brzezina and Kotlowski (2018). The paper estimates a regime switching regression, where the regimes are linked to the extent of external indebtedness. Findings indicate that the yield spread - debt relationship is indeed non-linear in their sample, and non-linearity becomes important when the net foreign asset (NFA) - GDP ratio reaches about (negative) 70–75%.

Second, Dell'Erba et al. (2013) also estimate the relationship between sovereign spreads and government debt. Similar to our work, they look at differences across emerging and advanced economies, and across turbulent and tranquil times. In addition, they study whether the currency composition of external debt matters for the spreads. In general, they find some evidence of state dependence, especially in the Euro Area.

In terms of motivation and methodology, our paper is closer to Brzoza-Brzezina and Kotlowski (2018). Similar to theirs, we use the net foreign assets position (NFA) to GDP ratio as a measure of external indebtedness. This is in constrast to Dell'Erba et al. (2013) that use gross public debt. Since one of our main goals is to provide guidance for macroeconomic modelers, we choose the NFA position, which is in line with the theoretical literature. Our main contribution to Brzoza-Brzezina and Kotlowski (2018) is that in addition to nonlinearity, we look at additional evidence for state dependence. We show that much of what they identify as a non-linear relationship between the interest premium and the NFA position is in fact due to different behavior in crisis periods, and is mostly driven by poorer countries.

Compared to Dell'Erba et al. (2013), we differ in our larger sample coverage, in the measurement of indebtedness and the external premium, and a more general definition of state dependence. In particular, we use a much broader crisis definition in our baseline, and not just the global financial crisis between 2008 and 2012. In contrast to their - somewhat counterintuitive – result that the financial crisis had no significant effect on the debt elasticity of sovereign spreads in emerging economies, we find evidence to the contrary: the elasticity increases more for less developed countries in turbulent periods.

An important question concerns the measurement of the external premium. The literature on emerging markets mostly uses the JP Morgan Emerging Market Bond Index (EMBI) spread. The advantage of this measure is that it calculates dollar denominated sovereign bond yield spreads over US government securities, and as such it is free from exchange rate risk. Although it is only available for a range of emerging economies, a synthetic measure can be calculated for advanced countries using domestic currency bonds and data on interest rate swaps (Codogno et al., 2003). These are the measures used by Dell'Erba et al. (2013) for emerging and advanced countries, respectively. There are two drawbacks of using EMBI and swaps data, however. First, the country and period coverage is relatively small. Second, more and more emerging countries issue debt in their own currency, so the EMBI spread is less and less representative of the average borrowing cost of these countries.[2] Valchev (2019) shows that domestic and foreign currency bonds are not viewed as perfect substitutes, so focusing only on dollar denominated assets might be misleading.

[1] In the following we use the terms "yield spread", "external premium" and "interest premium" as close substitutes. While our empirical analysis uses sovereign bond yield spreads, "interest premium" is more common in the macroeconomic literature to which we also want to speak. The rational is that returns to different financial assets are linked via arbitrage, and changes in sovereign bond yields and premia have a first-order impact on central bank, corporate and household interest rates. In simple macroeconomic models, where arbitrage is full and immediate, there is no practical difference between bond yields and interest rates. As a rule, we will use "external premium" as a generic term for the cost of debt (relative to the benchmark US). In addition, we will refer to yields when discussing the empirical measures, and to the "interest premium" in the context of macroeconomic modeling.

[2] https://www.economist.com/finance-and-economics/2007/02/22/bye-bye-embi.

Another possibility is to use yields on long-term government bonds, which is the strategy followed by Brzoza-Brzezina and Kotlowski (2018). This way the sample can be extended to a broader set of countries and to a longer time period. The obvious disadvantage is that spreads are expressed in different currencies. To remedy this, Brzoza-Brzezina and Kotlowski (2018) control for the inflation differential relative to the United States, and for exchange rate volatility. The first choice is motivated by uncovered interest parity (UIP), which is a statement about the expected movement of the nominal exchange rate. The second variable is expected to capture additional risk related to holding assets in a different currency.

In this paper we report results using both measures of the external premium. We show for the first time that the relationship between net foreign assets and yield spreads is strongly negative, non-linear and state dependent irrespective of whether bonds are denominated in domestic currency or in US Dollars (as with the EMBI). We perform a number of robustness checks where we vary the sample, include additional controls, re-define crisis period as 2008–2013, include continent-year dummies, and non-clustered errors. In all these checks, we find our results to be largely unchanged. This provides further support for the stability of our baseline results.

Our paper is partly motivated by discussions on the global financial cycle (Rey, 2013;Passari and Rey, 2015), which posits that financing conditions of individual countries vary with the global appetite for risk. It is reasonable to expect that the debt-premium relationship varies with global – or possibly regional or even local – conditions.

Another strand of the literature tried to uncover whether the relationship between the external interest premium and indebtedness is nonlinear. In a model of the global financial crisis of 2008–2011, Benczúr and Kónya (2016) assume a Linex specification, and show that this is important to match quantitatively the different experience of four Central-Eastern European economies (the Czech Republic, Hungary, Poland and Slovakia) during the crisis. The paper models the financial crisis as a permanent shift in the premium function. The debt-premium relationship may also depend on the level of economic development. In general, the level of sustainable debt relative to GDP is considered lower in emerging countries than in advanced economies. This may be a result of lower trust in the economic policies followed by the former group. Therefore, we also test for state dependence with respect to relative GDP per capita.

Our paper is also related to the work on the determinants of emerging economy bond spreads. Agca and Celasun (2012) use firm-loan level data to estimate determinants on yield spread for the private sector. They find that there are significant spillovers from external public debt and private spreads, but they find no relationship between domestic public debt and spreads. This supports our use of the overall net foreign asset position as the main measure of aggregate indebtedness. Similar to DHP, Comelli (2012) also uses the EMBI spread as a measure of the external premium, and focuses on emerging markets. He also finds that the debt-premium relationship depends on global economic conditions. This is also similar to González-Rozada and Yeyati (2008) who use EMBI spreads and show that it depends negatively on international risk appetite and positively on international liquidity. In contrast to our paper, however, they do not include measures of indebtedness as an explanatory variable. Csontó (2014) studies the interactions between global financial conditions and country-level fundamentals, also focusing on emerging economies. Aizenman et al. (2016) focuses on sovereign credit default swaps (CDS) spreads of emerging markets and studies the underlying economic fundamentals that explains their movements between 2004–2012. They find that trade openness and higher fiscal balance to GDP ratio have negative association with sovereign CDS spreads, while inflation, external debt ratios, state fragility, and commodity terms of trade volatility have positive association. Moreover, their paper provides evidence on the relative importance of these fundamentals, which varies over time depending on pre-, post- or during the 2008 financial crisis. Relative to these literature, we focus on a very broad set of both emerging and developed economies, much longer time periods, broader definitions of crisis ranging from 1981 to 2017 and a different research question.

The paper is organized as follows. First, we discuss our sample and some measurement issues in Section 2. Next we turn to our baseline results, including tests of state dependence and non-linearity in Section 3. Then we present a number of robustness exercises in Section 4. Finally, Section 5 concludes.

2. Measurement

2.1. Samples

We estimate the debt elasticity of sovereign spreads using two different samples, which correspond to our two measures of the external premium. *Sample I* corresponds to countries for which we collected government bond yields from the International Financial Statistics. *Sample II* refers to countries with either EMBI coverage, or to countries where we could calculate synthetic US dollar spreads using interest rate swaps.

Sample I consists of an annual unbalanced panel data for 83 advanced, emerging and developing countries between 1980 and 2017. The unbalanced nature results from limited availability of long term bond yield data for many countries in some – typically the earlier – time periods. Only some advanced countries have continuous yield coverage for most of the years. Others enter the sample later, and some countries also experience gaps.We make two adjustments to the sample we use for estimation. First, we drop very small countries (with population on average below 1 million), based on the assumption that their behavior is highly idiosyncratic. These countries are Botswana, Cyprus, Fiji, Iceland, Luxembourg, Maldives, Malta, Mauritius, Samoa, Seychelles, Solomon Islands and Vanuatu. Second, we remove country-year observations where inflation is persistently high. We define such high inflation episodes as ones where the five-year average inflation rate is above 10%, starting from the year in question. The rational is that calculating real returns is highly unreliable in these cases, and when inflation is very high, ex-post real returns - and hence premia – can easily be significantly negative, but it is unlikely that this is due to favorable treatment by financial markets. We experimented with other thresholds, and results are robust to the precise definition.

Sample II contains 44 emerging and advanced economies over the period 1989–2017, and it is also an unbalanced panel. Similar to Sample I, we drop high inflation episodes (there are no small countries in Sample II). Although all spreads are expressed in US dollar, we do this to be as close as possible to Sample I.[3] The composition of our two samples used for estimation is presented in Table 1.

The two key variables that we need for the estimation are a measure of the external premium and a measure of external indebtedness. We follow Brzoza-Brzezina and Kotlowski (2018) and use the net foreign asset position (NFA) over GDP ratio as our main measure of debt, since we want to provide estimated elasticities for open economy macro models. As we discussed already earlier, we have two external premium measures. In Sample I, we use long government bond yields. The premium is constructed as a difference of these yields and the long bond yield for the United States. The yields are denominated in domestic currency, and contain expectations of inflation and currency movements. Therefore, we include the forward-looking inflation differential between a country and the United States as a right-hand side variable. Our inflation measure for year t is a 5-year moving average between t and t + 4. We use actual observations when available. For years 2014–2017, when averaging takes us past the sample period, we rely on inflation forecasts in the IMF World Economic Outlook.

Controlling for (expected) inflation is motivated by (i) the uncovered interest parity (UIP) condition, which is the key no arbitrage condition between similar assets denominated in different currencies, and (ii) purchasing power parity (PPP), which links exchange rate movements to inflation differentials across countries. UIP and PPP tend to hold up better in the long-run than in the short-run, so we expect estimated coefficients on the inflation term to be between zero and one. Financial markets are likely to react more to persistent movements in price levels, hence our choice of a 5-year moving average for future inflation. Spreads in Sample II are expressed in the same currency, so inflation and exchange rate movements should not play a direct role.

2.2. Empirical specification

The regressions we run take the generic form given in Eq. (1):

$$y_{it} = \alpha + \beta_1 NFA_{it} + \gamma' x_{it} + \mu_i + \eta_t + \epsilon_{it}, \tag{1}$$

where y_{it} is the external premium of country i in time t, NFA is the net foreign asset to GDP ratio, x_{it} is a vector of various covariates, μ_i is a country fixed effect, and η_t is a year fixed effect. We include time dummies to capture global financial conditions that may vary over time. Country fixed effects control for time-invariant, country-specific factors such as long-term reputation, institutional quality etc.

We follow Dell'Erba et al. (2013) and use very simple baseline specifications. For Sample I, we regress the bond yield differential on the NFA/GDP ratio, the inflation differential and exchange rate volatility. The latter two are included to control for exchange rate risk. For Sample II, the spreads are regressed on the NFA/GDP ratio. We add country and time dummies to all specifications.

Our main goal is to investigate various sources of state dependence. Our main questions are the following.

1. Is the NFA – premium relationship present in our samples, and if yes what is the magnitude of the estimated parameter?
2. Is there evidence of non-linearity, i.e. does the elasticity depend on the level of indebtedness?
3. Is the debt-premium slope parameter state dependent? In particular, does it increase in times of financial turbulance (i.e. crisis)?
4. Is the debt-premium relationship different for rich and emerging/developing countries?

To test these hypotheses, we run various additional regressions with interactions. First, we interact NFA/GDP with a crisis dummy to see if the elasticity changes in turbulent periods. Next, we interact GDP per capita relative to the US with NFA/GDP to test whether the elasticity changes with the level of relative development. Finally, we look for evidence of nonlinearity. We simply include a quadratic term for the NFA/GDP ratio, along with its interactions with the crisis dummy and relative development.

A question that arises in the context of our panel estimation is whether we should worry about unit roots in the main variables. The short answer is no, for the following main reasons. First and most importantly, all our variables are theoretically (and thus asymptotically) stationary. The NFA/GDP ratio and the sovereign bond spread are bounded by the natural borrowing limit, and relative GDP per capita falls between zero and one for most countries. While we could observe trend-like behavior for a few countries over the sample period, this cannot be a general feature of the data generating process.

[3] Our Sample II results are robust to the inclusion of all countries, with the exception of Venezuela, whose recent economic history clearly makes it an outlier.

Table 1
List of countries.

Country	Sample I	Sample II	Country	Sample I	Sample II
Armenia	2000–2017	–	Malaysia	1992–2017	1997–2017
Australia	1980–2017	1997–2017	Mexico	2000–2017	2000–2017
Austria	1980–2017	1995–2017	Moldova	2005–2017	–
Bangladesh	2006–2017	–	Mongolia	2013–2017	–
Belgium	1980–2017	1992–2017	Morocco	1997–2007, 2010–2017	1997–2006, 2012–2017
Brazil	2007, 2010–2017	2007, 2010–2017	Myanmar	2010–2017	–
Bulgaria	2003–2017	2003–2013	Namibia	1994–2010, 2012	–
Burkina Faso	2012–2015	–	Nepal	1981, 1987, 1993–2017	–
Canada	1980–2017	1997–2017	Netherlands	1981, 1987–2017	1992–2017
Chile	2005–2017	2005–2017	New Zealand	1986–2017	1997–2017
China	2005–2017	2005–2017	Norway	1985–2017	–
Colombia	2003–2017	2003–2017	Pakistan	1992, 1995–1998,2001–2004, 2011–2017	2001–2004, 2011–2017
Costa Rica	2014–2016	–	Papua New Guinea	2005–2017	–
Denmark	1980–2017	1993–2017	Philippines	1994–2007, 2014	1997–2007
Ethiopia	1986–1987, 1992–1997	–	Portugal	1990–2017	1995–2017
Finland	1987–2017	1996–2017	Romania	2005–2017	–
France	1981–2017	1992–2017	Russia	2008–2017	2008–2017
Germany	1980–2017	1989–2017	Senegal	2012–2015	2012–2015
Ghana	2009–2010	2009–2010	Singapore	1999–2017	2000–2017
Greece	1993–2017	1998–2017	Slovakia	2000–2017	–
Honduras	1983–1986, 1999–2007	–	Slovenia	2002–2017	–
Hungary	2000–2017	2000–2017	South Africa	1992–2017	1997–2017
India	1981–1985, 1993–2017	–	Spain	1983–2017	1991–2017
Indonesia	2003–2017	2003–2017	Sri Lanka	2009–2017	2009–2017
Ireland	1982–2017	1997–2017	Sweden	1981–2017	1992–2017
Israel	1997–2017	2007–2017	Switzerland	1980–2017	–
Italy	1983–2017	1991–2017	Thailand	1999–2017	1999–2006
Jamaica	1997–1998	–	Togo	2012–2015	–
Japan	1989–2017	1990–2017	Trinidad and Tobago	1984–1993	–
Korea	1981–2017	1997–2004	Turkey	2010–2016	2010–2017
Kyrgyzstan	2009–2017	–	United Kingdom	1980–2017	1989–2017
Latvia	2001–2017	–	Uruguay	2011–2017	2011–2017
Lithuania	2001–2017	2008–2017			

Second, our regressions are mostly about the cross-sectional dimension. The exception is the crisis dummy, but even in this case we look at regime switches in a stationary setting. Moreover, our sample satisfies the criterion that $N > T$, i.e. the cross-sectional dimension is larger than the time series one. Given the inclusion of time dummies and the fact that we cluster standard errors by countries, our estimated coefficients and standard errors are robust to the presence of serial correlation (Moody, 2016;Kezdi, 2003).

Finally, it is well-known that unit root tests have low power, so they are unreliable when the time series dimension is short. Moreover, most panel unit root tests require balanced panels. The test procedure advocated by Choi (2001) works with unbalanced panels since it aggregates individual unit root tests run separately for each panel, but its asymptotical properties are derived under $T \to \infty$. Nevertheless, we ran the test for the two samples and the main variables.[4] Unit roots are strongly rejected for the two spread measures, and they are inconclusive for NFA/GDP and relative GDP per capita.[5] While these results are only indicative, they further strengthen confidence in our baseline specifications.

2.3. Data sources

We use the following set of independent variables, including the two just described and additional controls.

1. Net Foreign Assets to GDP ratio.

[4] More precisely, we used the `xtunitroot fisher` command in Stata.
[5] Detailed results are available from the authors upon request.

- Data comes from two sources. The principal source is the updated dataset described in Lane and Milesi-Feretti (2018, LMF henceforth), which contains data until 2015. We add observations for 2016 and 2017 using the IMF Balance of Payments statistics.

2. Long-term yields on government bonds.
   - The principal data source is the IMF International Financial Statistics. We augment this with observations from the OECD Statistics (Chile, Columbia, Costa Rica, Israel), and Bloomberg (Brazil, China, Indonesia, Turkey, Uruguay). The data typically refers to yields on government bonds with a 10 year maturity, but in some cases maturity can be 5 years or less (but always higher than 1 year). Details are reported for each country in IMF (2018) in the Country Notes section. OECD and Bloomberg data always refer to 10-year yields.
3. EMBI spreads
   - Source: World Bank.
4. Interest rate swaps
   - Source: Thomson-Reuters Datastream.
   - We use interest rate swaps and long-term yields on government bonds to create a synthetic measure of spreads denominated in US dollars (Codogno et al., 2003) for advanced countries (see Table 14) defined as:

$$s_{it} = (y_{i,t} - y_{US,t}) - (ir_{i,t} - ir_{US,t}) \tag{2}$$

   where $y_{i,t}$ and $ir_{i,t}$ are the long-term yield on government bonds and interest rate swaps in country i, and t denotes year.
5. Inflation
   - Annual CPI inflation. Source: World Economic Outlook
6. Exchange rate volatility.
   - Data come from the Bank for International Settlements and International Financial Statistics. We calculate annual volatilities from monthly data.
7. Relative GDP per capita
   - At purchasing power parity, relative to the United States. Source: World Economic Outlook.
8. Crisis dummy
   - We use the crisis timing in Laeven and Valencia (2018), and code a country-year cell a crisis event according to their classification. A crisis event for a country occurs if there was a banking, currency, or sovereign debt crisis as in Laeven and Valencia (2018). Alternative crisis definitions are available in Eichengreen and Gupta (2018) or Cavallo, Powell et al. (2015). We work with the classification of Laeven and Valencia because of its comprehensiveness.

Table 2 presents descriptive statistics for the main variables. For the full sample (Panel A), we see that inflation differential in some country-year observations is as high as 1095. The range of the long term yield spread is over 210, which is driven by observations with high inflation. As already mentioned earlier, we drop high inflation episodes because proxying real returns with inflation becomes highly unreliable (See Section 2.1 for detailed discussions). In Panel (B), we present our main sample (Sample I) for the case where the long term bond yield is our dependent variable. Clearly, the maximum value for inflation differential with the US is 8.4% and the range for long term yield spread drops to 21.6. Finally, in Panel (C), we present the summary statistics for the case where EMBI spreads is our dependent variable.

3. Empirical results

3.1. Sample I results

We estimate Eq. (1) using various interactions on Sample I and Sample II. Results for Sample I are reported in Table 3. The baseline specification (column 1) only includes country and time dummies, along with the inflation differential relative to the US and exchange rate volatility. In columns 2–5 we add additional variables along with their interactions with NFA/GDP to check for various forms of state dependence. As discussed above, we use robust standard errors clustered at the country level to take care of potential autocorrelation. The cost of this is larger standard errors and lower levels of significance, so we also report results with non-clustered errors in the Appendix A.

The baseline specification shows that there is a significant, positive relationship between the level of external indebtedness (measured by the negative of the NFA/GDP position) and the yield spread over US government bonds. The estimated coefficient is -0.0074, which means that if the NFA/GDP position deteriorates by 10 percentage points, the external premium increases by 7.4 basis points. This is an economically meaningful magnitude, which is larger than the original small value calibration in Schmitt-Grohe and Uribe (2003), and in line with some estimates from small open economy DSGE models.

Column 2 adds relative development (measured by PPP GDP per capita relative to the US) and its interaction with indebtedness. The coefficients are of the expected sign, but are not significant. This is due to clustering standard errors: without it, both coefficient are significant at 1% (see Appendix Table A). The interaction coefficient means that for a country at the US level of development (where relative GDP equals 1), the debt elasticity of the yield spread is the same as in the baseline. For a country with a relative GDP of 0.5, however, the elasticity equals -0.0155, or twice the size.

Table 2
Descriptive statistics.

	Obs.	Mean	St. Dev.	Min	Max
			Panel A: Full Sample		
Long term yield spread	1816	2.950	7.316	−8.403	202.520
NFA per GDP	1787	−18.008	102.367	−661.019	1726.767
Inflation Differential	1810	3.191	27.208	−4.138	1095.870
Exchange rate Volatility	1390	0.025	0.044	0.002	1.135
GDP per Capita (% of US)	1798	0.529	0.374	0.013	1.936
			Panel B: Sample I		
Long term yield spread	1373	2.200	3.672	−8.403	21.579
NFA per GDP	1371	−20.066	53.306	−287.61	291.279
Inflation Differential	1373	0.990	2.295	−3.166	8.387
Exchange rate Volatility	1104	0.021	0.018	0.002	0.117
GDP per Capita (% of US)	1373	0.562	0.335	0.014	1.578
			Panel C: Sample II		
EMBI/Swap Spread	747	1.308	1.955	−3.527	20.731
NFA per GDP	747	−18.688	54.968	−243.519	291.269
GDP per Capita (% of US)	747	0.605	0.287	0.043	1.578

Notes: Sample I is our main estimation sample using Long Term Bond Yields and restricting the sample to (i) periods where inflation is not more that 10% and (ii) countries with population of at least 1 million. Sample II is our main estimation sample using EMBI spreads.

Table 3
Results for Sample I.

	(1)	(2)	(3)	(4)	(5)
Variables			Spread on Long-Term Bond Yields		
Lag NFA	−0.00744**	−0.0234**	−0.00395	−0.00306	−0.0162
	[0.00335]	[0.00953]	[0.00339]	[0.00396]	[0.0103]
Inflation diff.	0.329***	0.378***	0.360***	0.376***	0.415***
	[0.118]	[0.122]	[0.115]	[0.116]	[0.122]
NEER Volatility	11.26*	11.59*	9.737	10.20	9.839
	[6.662]	[6.500]	[6.800]	[6.771]	[6.904]
Relative GDP		−4.983			−4.541
		[3.156]			[2.965]
Rel. GDP × Lag NFA		0.0160			0.0108
		[0.0100]			[0.0106]
Crisis Periods			0.795**	0.441	0.257
			[0.346]	[0.277]	[0.332]
Lag NFA × Crisis			−0.0169**	−0.00968**	−0.0599***
			[0.00703]	[0.00442]	[0.0180]
NFA squared				2.13e−05	
				[2.27e−05]	
NFA squared × Crisis				0.000178***	
				[5.48e−05]	
Rel. GDP × Lag NFA × Crisis					0.0650**
					[0.0256]
Constant	−0.291	2.799	−0.294	−0.369	2.503
	[0.826]	[2.022]	[0.800]	[0.822]	[1.865]
Year FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Observations	1,063	1,063	1,063	1,063	1,063
R-squared	0.283	0.310	0.322	0.332	0.360
Number of countries	49	49	49	49	49

Robust standard errors clustered at the country level in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Column 3 looks at the impact of being in a crisis period as defined in the previous section. Times of turbulence increase both the level of the external premium, and also the debt elasticity. Both coefficients are significant at the 5% level (1% without clustering), while the baseline elasticity drops to half its original size, and loses significance. Apparently the relationship between debt and premium is driven mostly by market behavior over turbulent periods.

Column 4 investigates linearity in a simple way, adding a quadratic term and its interaction with the crisis dummy. Interestingly, only the interaction is significant, meaning that nonlinearity (as found by Brzoza-Brzezina and Kotlowski, 2018) is only present in crisis times. The coefficient is sizable: it implies that for a country with an NFA/GDP position of −50%, the elasticity in crisis times is −0.009 higher than for a country with a zero NFA position.

Column 5 tests whether the effect of relative development on the debt elasticity of the external premium is different in crisis periods. We therefore include a three-way interaction term between NFA/GDP, relative development and the crisis dummy. The coefficient is significant at 5% (1% without clustering). To make sense of the coefficient, we compare two countries, both with a -50% NFA/GDP position. The first country is a rich one, with a relative development of 1, while the second is a middle income economy with a relative development level of 0.5.

In normal times, the elasticity for the rich country is $-0.0162 + 0.0108 = -0.0054$. In crisis periods, the rich country elasticity equals $-0.0162 + 0.0108 - 0.0599 + 0.065 = 0.0003$. For the middle income country, in tranquil periods the elasticity is $-0.0162 + 0.0108 \times 0.5 = -0.0108$. In crisis times, the middle income country's elasticity increases to $-0.0162 + 0.0108 \times 0.5 - 0.0599 + 0.065 \times 0.5 = -0.0382$. According to our results, crises have basically no effect on the debt sensitivity of rich country indebtedness, but they heavily affect poorer economies.

To summarize, we found that the overall debt elasticity of the external premium is moderate, but much larger than values originally proposed by the macro literature to ensure model stationarity. This masks significant differences, however. The elasticity tends to be much higher in crisis periods, especially for countries at lower levels of development. Non-linearity seems to be present only in crisis periods. Significance levels vary depending on whether we use clustered standards errors, but these main conclusions are robust to clustering as well.

3.2. Sample II results

Sample I uses long-term government bonds to calculate external premia. Since these bonds are issued in domestic currency, they are not directly comparable with US government bonds. To correct for the effect of the exchange rate, we controlled for the inflation differential vis-a-vis the US, and also for exchange rate volatility. In this section we focus on Sample II, which uses spreads between (actual or synthetic) US dollar assets. For emerging economies, we use EMBI spreads. For advanced countries, we correct government bond yields with interest rate swaps, as described in an earlier section. The cost of this is that Sample II is smaller, as detailed in Tables 1 and 14, both in terms of country and time coverage.

Table 4 presents results with Sample II. Note that since spreads are now calculated without currency differences, we do not include the inflation differential and exchange rate volatility in the regressions. The baseline thus contains only country and time dummies, and we add additional variables and interactions in subsequent columns.

The broad message of Table 4 is that the results are remarkably similar to Table 3. The baseline elasticity point estimate is somewhat bigger, but even with non-clustered standard errors not statistically different from Sample I. The effect of relative development (column 2) is also very similar, but now the coefficients are significant even with clustering.

Coefficients capturing the effect of crisis periods are almost identical to Sample I, and are usually significant. The exception is the column 5, where the triple interaction is now not significant (without clustering, significant only at 10%, see the Appendix A) and the point estimate is also lower than for Sample I.

To sum up results with Sample II, we again find strong evidence for state dependence. The debt elasticity of the external premium varies with relative development, and increases in crisis periods. During turbulent times, we also find evidence of nonlinearity. In contrast to Sample I, however, crisis episodes do not seem to hit less developed countries harder than advanced economies.

4. Robustness

4.1. Additional controls

We first present results when additional controls are added to the regressions. These are typical in the literature; here we rely on the list of controls used in Brzoza-Brzezina and Kotlowski (2018). Tables 5 and 6 present results with the following additional variables: the current account (% GDP), central bank reserves (% GDP), and budget balance (% GDP). The series come from the World Development Indicators (World Bank).

Overall, the main coefficients of interest – the debt elasticity and the various interactions – are very similar to the baseline results. There are a few changes in significance in both directions, but results, if anything tend to be stronger. This is partly due to the fact that the additional controls tend not to be significant, with the partial exception of budget balance for the long bond sample. For completeness, we included the inflation differential and exchange rate volatility in the regressions for Sample II. In line with expectations, the former is not significant. Exchange rate volatility, however, is highly significant, although the coefficient is smaller than for Sample I. This variable is likely to capture general uncertainty about countries, and not only deviations from uncovered interest parity.

4.2. Crisis definition

Our baseline results used a detailed, country-level definition of crisis events described in Table 13 in the Appendix A. Now we restrict attention to the global financial crisis of 2008–2013, which includes both the first wave of the crisis originating from the US, and its second, European wave in 2011–2013. This is the same definition that was used by Dell'Erba et al.

Table 4
Results for Sample II.

	(1)	(2)	(3)	(5)	(6)
Variables	EMBI spreads				
Lag NFA	−0.0134**	−0.0391***	−0.00946*	−0.00791**	−0.0317***
	[0.00560]	[0.0107]	[0.00476]	[0.00371]	[0.0107]
Relative GDP		−7.781**			−7.154**
		[2.901]			[3.121]
Rel. GDP × Lag NFA		0.0288***			0.0237**
		[0.00938]			[0.00992]
Crisis Periods			0.508*	0.388	0.375
			[0.269]	[0.253]	[0.235]
Lag NFA × Crisis			−0.0182***	−0.00826	−0.0303
			[0.00557]	[0.00540]	[0.0246]
NFA squared				1.97e−05	
				[2.15e−05]	
NFA squared × Crisis				0.000138**	
				[6.58e−05]	
Rel. GDP × Lag NFA × Crisis					0.0251
					[0.0362]
Constant	1.069***	5.558***	1.060***	1.011***	5.206***
	[0.204]	[1.684]	[0.189]	[0.224]	[1.802]
Country FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Observations	727	727	727	727	727
R-squared	0.179	0.291	0.264	0.273	0.353
Number of Countries	44	44	44	44	44

Robust standard errors clustered at the country level in brackets. * p < 0.10, ** p < 0.05, *** p < 0.01

Table 5
Include additional controls (using long-term bond yields as dependent variable).

	(1)	(2)	(3)	(54)	(5)
Variables	Interest Premium of Long-Term Bond Yields				
Lag NFA	−0.00629	−0.0260***	−0.00338	−0.00320	−0.0179*
	[0.00397]	[0.00910]	[0.00356]	[0.00379]	[0.00931]
Inflation diff.	0.281**	0.340**	0.317**	0.339**	0.381**
	[0.126]	[0.137]	[0.132]	[0.133]	[0.147]
NEER Volatility	15.70**	16.06***	13.76**	14.44**	13.88**
	[6.035]	[5.923]	[6.091]	[6.164]	[6.314]
Relative GDP		−5.732*			−5.096
		[3.401]			[3.455]
Current Account	0.0536*	0.0570*	0.0566	0.0585*	0.0576*
	[0.0318]	[0.0301]	[0.0340]	[0.0348]	[0.0328]
Reserves	0.0100	0.00668	0.00721	0.00934	0.00352
	[0.00873]	[0.00949]	[0.00887]	[0.00926]	[0.00911]
Budget Balance	−0.0965***	−0.0890***	−0.0608	−0.0634*	−0.0839**
	[0.0320]	[0.0308]	[0.0367]	[0.0366]	[0.0365]
Rel. GDP × Lag NFA		0.0201**			0.0135
		[0.00835]			[0.00858]
Crisis Periods			0.852**	0.482	0.148
			[0.390]	[0.307]	[0.331]
Lag NFA × Crisis			−0.0148*	−0.00770	−0.0647***
			[0.00760]	[0.00479]	[0.0164]
NFA squared				9.11e-06	
				[1.77e−05]	
NFA squared × Crisis				0.000178***	
				[5.63e−05]	
Rel. GDP × Lag NFA × Crisis					0.0775***
					[0.0217]
Constant	0.438	3.983	0.666	0.514	3.602
	[0.906]	[2.413]	[0.881]	[0.907]	[2.380]
Year FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Observations	996	996	996	996	996
R-squared	0.321	0.346	0.358	0.367	0.399
Number of Countries	49	49	49	49	49

Robust standard errors clustered at the country level in brackets. * p < 0.10, ** p < 0.05, *** p < 0.01

Table 6
Include additional controls (using EMBI spreads as dependent variable).

	(1)	(2)	(3)	(4)	(5)
Variables	EMBI Spreads				
Lag NFA	−0.00838*	−0.0322***	−0.00495	−0.00384	−0.0240***
	[0.00451]	[0.00788]	[0.00371]	[0.00320]	[0.00800]
Inflation diff.	−0.309	−0.209	−0.249	−0.248	−0.165
	[0.231]	[0.185]	[0.193]	[0.198]	[0.150]
NEER Volatility	8.573***	8.262***	5.950*	5.849*	4.918*
	[2.716]	[2.570]	[2.943]	[2.964]	[2.841]
Relative GDP		−7.539**			−7.018**
		[2.783]			[2.883]
Current Account	0.0350	0.0306	0.0506*	0.0475*	0.0469*
	[0.0252]	[0.0202]	[0.0290]	[0.0278]	[0.0244]
Reserves	−0.0258	−0.0296	−0.0272	−0.0288	−0.0348*
	[0.0220]	[0.0206]	[0.0194]	[0.0195]	[0.0201]
Budget Balance	−0.00513	0.000579	0.0327	0.0324	0.0192
	[0.0480]	[0.0394]	[0.0557]	[0.0551]	[0.0394]
Rel. GDP × Lag NFA		0.0251***			0.0192**
		[0.00747]			[0.00771]
Crisis Periods			0.507	0.359	0.329
			[0.321]	[0.280]	[0.251]
Lag NFA × Crisis			−0.0200***	−0.00948	−0.0348
			[0.00652]	[0.00662]	[0.0249]
NFA squared				1.32e−05	
				[1.69e−05]	
NFA squared × Crisis				0.000146**	
				[6.96e−05]	
Rel. GDP × Lag NFA × Crisis					0.0284
					[0.0365]
Constant	1.288**	5.790***	1.242***	1.195***	5.581**
	[0.490]	[2.031]	[0.415]	[0.434]	[2.096]
Year FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Observations	664	664	664	664	664
R-squared	0.230	0.327	0.320	0.325	0.328
Number of Countries	37	37	37	37	37

Robust standard errors clustered at the country level in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(2013), so our Sample II results here are directly comparable to theirs, although we have a somewhat larger sample. In Table 7 we only report specifications that include the crisis dummy, for both Sample I and Sample II.

Again, the estimated coefficients of interest are very similar to the baseline. In general we lose some significance for Sample I, and gain significance for Sample II. This may be because a larger fraction of Sample II is composed of Eurozone countries, where the second wave of the crisis was particularly severe (see also Dell'Erba et al. (2013)). Relative GDP, however, has a significant impact on the debt elasticity, while Dell'Erba et al. (2013) do not find differences between advanced and emerging markets. One possible reason for this difference is that within-group differences are important, and the binary emerging-advanced distinction is too simple to capture the effect of relative development.

4.3. Full sample

In our baseline we dropped small countries and episodes of high inflation. In Table 8 we report results without this restriction in the case of Sample I. The estimated coefficients are typically smaller, but remain mostly significant. The main difference is that the inflation differential coefficient drops to almost zero, although it remains significant. As expected, high inflation episodes sully even the partial evidence for uncovered interest parity that we found in the baseline case. The main message is therefore that for high-inflation episodes spreads based on domestic currency denominated bonds are not reliable.

4.4. Continent effects

The time dummies we included in all specifications capture global changes in financial market sentiment. The crisis dummy picks up country-level changes in these sentiments. One could argue, however, that there are times of turbulence which are neither global nor local. In these cases countries in such a region may be affected even if they are not in crisis according to our definition. The Russian crisis of 1998, for example, impacted many countries in Eastern Europe, but not severely enough to actually put them in crisis. In this section we add continent-time interactions to the baseline regressions,

Table 7
Crisis periods defined in terms of 2008 global financial crisis.

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Long-Term Bond Yields			EMBI spreads		
Lag NFA	−0.00531	−0.00284	−0.0189*	−0.0102**	−0.00645*	−0.0311***
	[0.00320]	[0.00414]	[0.0112]	[0.00475]	[0.00324]	[0.00931]
Inflation diff.	0.359***	0.368***	0.407***			
	[0.119]	[0.121]	[0.125]			
NEER Volatility	10.81	9.660	10.74			
	[6.553]	[6.498]	[6.431]			
Financial Crisis	1.763*	1.526*	1.648*	−0.272	0.0990	0.217
	[0.919]	[0.881]	[0.823]	[0.261]	[0.327]	[0.308]
NFA × Fin. Crisis	−0.00894**	−0.0114**	−0.0159	−0.0124**	−0.0156***	−0.0237**
	[0.00440]	[0.00491]	[0.0126]	[0.00517]	[0.00442]	[0.00987]
Relative GDP			−4.943			−7.030**
			[3.276]			[2.984]
Rel. GDP × NFA			0.0137			0.0238***
			[0.0118]			[0.00876]
Rel. GDP × NFA × Fin. Cr.			0.00840			0.0149*
			[0.0115]			[0.00766]
NFA squared		2.19e−05			1.61e−05	
		[2.50e−05]			[2.00e−05]	
NFA squared × Fin. Crisis		7.05e−05*			7.82e−05***	
		[3.73e−05]			[2.31e−05]	
Constant	−0.341	−0.355	2.749	1.027***	0.945***	5.074***
	[0.814]	[0.817]	[2.127]	[0.200]	[0.231]	[1.724]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,063	1,063	1,063	727	727	727
R-squared	0.294	0.305	0.321	0.235	0.272	0.336
Number of Countries	49	49	49	44	44	44

Notes: Financial Crisis is a dummy that takes the value 1 between 2008 and 2013. Robust standard errors clustered at the country level in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 8
Results with full sample.

	(1)	(2)	(3)	(4)	(5)
Variables	Interest Premium of Long-Term Bond Yields				
Lag NFA	−0.00393	−0.0243**	−0.00213	−0.00278	−0.0220**
	[0.00255]	[0.0117]	[0.00256]	[0.00347]	[0.0109]
Inflation diff.	−0.00018***	−0.00018**	−0.00025***	−0.00021***	−0.00017*
	[3.62e−05]	[7.09e−05]	[3.62e−05]	[4.54e−05]	[8.38e−05]
NEER Volatility	−5.559	−5.488	−6.969	−6.995	−6.487
	[8.534]	[8.359]	[8.445]	[8.278]	[8.135]
Relative GDP		−5.518			−4.989
		[3.518]			[3.295]
Rel. GDP × Lag NFA		0.0234*			0.0202*
		[0.0130]			[0.0113]
Crisis Periods			1.612***	1.321***	1.099**
			[0.425]	[0.453]	[0.466]
Lag NFA × Crisis			0.000655	−0.0116*	−0.0382**
			[0.00341]	[0.00647]	[0.0157]
NFA squared				5.28e-06	
				[7.32e-06]	
NFA squared × Crisis				−2.98e−05***	
				[1.11e−05]	
Rel. GDP × Lag NFA × Crisis					0.0528***
					[0.0195]
Constant	0.220	3.931*	0.147	0.157	3.531
	[0.925]	[2.306]	[0.905]	[0.912]	[2.193]
Year FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Observations	1,351	1,334	1,351	1,351	1,351
R-squared	0.183	0.215	0.204	0.205	0.208
Number of Countries	59	59	59	59	59

Robust standard errors clustered at the country level in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 9
Controlling for time-varying continent effects using long-term bond yields.

	(1)	(2)	(3)	(4)	(5)
Variables	Interest Premium of Long-Term Bond Yields				
Lag NFA	−0.00763*	−0.0226**	−0.00395	−0.00319	−0.0166
	[0.00387]	[0.0103]	[0.00339]	[0.00465]	[0.0108]
Inflation diff.	0.366**	0.407**	0.360***	0.415***	0.450***
	[0.147]	[0.156]	[0.115]	[0.149]	[0.157]
NEER Volatility	10.24	10.79	9.737	8.075	8.966
	[9.753]	[9.587]	[6.800]	[10.16]	[10.69]
Relative GDP		−5.914			−5.468
		[3.807]			[3.584]
Rel. GDP × Lag NFA		0.0138			0.00924
		[0.0113]			[0.0114]
Crisis Periods			0.795**	0.170	−0.0689
			[0.346]	[0.339]	[0.456]
Lag NFA × Crisis			−0.0169**	−0.0106**	−0.0658***
			[0.00703]	[0.00503]	[0.0206]
NFA squared				3.87e−05	
				[3.02e−05]	
NFA squared × Crisis				0.000172***	
				[6.03e−05]	
Rel. GDP × Lag NFA × Crisis					0.0730**
					[0.0296]
Constant	−4.938***	−1.348	−0.294	−5.529***	−2.336
	[1.165]	[2.544]	[0.800]	[1.231]	[2.518]
Year FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Continent × year FE	Yes	Yes	Yes	Yes	Yes
Observations	1,063	1,063	1,063	1,063	1,063
R-squared	0.390	0.420	0.322	0.430	0.463
Number of Countries	49	49	49	49	49

Robust standard errors clustered at the country level in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 10
Controlling for time-varying continent effects using EMBI spreads.

	(1)	(2)	(3)	(4)	(5)
Variables	EMBI Spreads				
Lag NFA	−0.0125**	−0.0366***	−0.00949*	−0.00834*	−0.0309***
	[0.00613]	[0.0115]	[0.00552]	[0.00465]	[0.0114]
Relative GDP		−7.719**			−7.273**
		[3.224]			[3.541]
Rel. GDP × Lag NFA		0.0257**			0.0216**
		[0.00968]			[0.00937]
Crisis Periods			0.728	0.613	0.696
			[0.478]	[0.520]	[0.443]
Lag NFA × Crisis			−0.0159***	−0.00989	−0.0289
			[0.00488]	[0.00669]	[0.0266]
NFA squared				1.31e−05	
				[2.31e−05]	
NFA squared × Crisis				8.71e−05	
				[7.99e−05]	
Rel. GDP × Lag NFA × Crisis					0.0276
					[0.0403]
Constant	0.843***	5.539***	0.959***	0.747**	4.973**
	[0.308]	[1.836]	[0.321]	[0.343]	[1.915]
Year FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Continent × Year FE	Yes	Yes	Yes	Yes	Yes
Observations	727	727	727	727	727
R-squared	0.329	0.419	0.395	0.394	0.398
No of Countries	44	44	44	44	44

Robust standard errors clustered at the country level in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 11
Results with non-clustered error term.

	(1)	(2)	(3)	(4)	(5)
Variables	Interest Premium on Long-Term Bond Yields				
Lag NFA	−0.0074***	−0.0234***	−0.00395*	−0.00306	−0.0162***
	[0.00240]	[0.00536]	[0.00238]	[0.00242]	[0.00524]
Inflation diff.	0.329***	0.378***	0.360***	0.376***	0.415***
	[0.0585]	[0.0581]	[0.0572]	[0.0571]	[0.0563]
NEER Volatility	11.26***	11.59***	9.737**	10.20**	9.839**
	[4.180]	[4.106]	[4.082]	[4.059]	[3.973]
Relative GDP		−4.983***			−4.541***
		[0.988]			[0.956]
Rel. GDP × Lag NFA		0.0160***			0.0108*
		[0.00568]			[0.00551]
Crisis Periods			0.795***	0.441	0.257
			[0.252]	[0.272]	[0.263]
Lag NFA × Crisis			−0.0169***	−0.00968**	−0.0599***
			[0.00405]	[0.00453]	[0.00973]
NFA squared				2.13e−05	
				[1.41e−05]	
NFA squared × Crisis				0.000178***	
				[5.35e−05]	
Rel. GDP × Lag NFA × Crisis					0.0650***
					[0.0133]
Constant	−0.291	2.799***	−0.294	−0.369	2.503***
	[0.583]	[0.886]	[0.568]	[0.565]	[0.856]
Year FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Observations	1,063	1,063	1,063	1,063	1,063
R-squared	0.283	0.310	0.322	0.332	0.360
Number of countries	49	49	49	49	49

Standard errors brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

for both Sample I and Sample II to control for such regional effects. The results are reported in Tables 9 and 10. Clearly, they are mostly unaffected, although we lose some significance for the interaction terms in Sample II. (see Table 11).

5. Conclusion

The paper studied the relationship between measures of indebtedness and the yield spread on government bonds. In particular, the main question was whether such a relationship is dependent on time, the state of economy, and the types of countries studied. The answer is yes to all three questions. Whether we look at tranquil of turbulent periods, and the relative development of the countries, all influence the magnitude and significance of the debt-premium relationship.

The estimated elasticity is in line with both previous empirical work and estimates from DSGE models. Linear models, however, have to be calibrated such that they take into account the type of the country (emerging or advanced) they model. When the time period under study includes the global financial crisis (or other important global events), regime switching models might need to be used.

Our results also have important policy implications. Most importantly, the level of external indebtedness matters for the external premium, but the extent of this differs across countries and time periods. The most vulnerable economies are emerging countries with already high levels of debt. While these economies can borrow relatively cheaply in normal times, during crisis periods the price of debt increases dramatically. This result means that when assessing debt sustainability either by countries themselves or by international organizations, such conditionality has to be taken into account.

Overall, we think that our study provides useful findings to understand the complex interactions between indebtedness and the risk appetite of international financial markets.

CRediT authorship contribution statement

Istvan Konya: Methodology. **Franklin Maduko:** Data curation, Formal analysis, Writing - review & editing.

Appendix A

See Tables 12–14.

Table 12
Additional results with non-clustered error term.

	(1)	(2)	(3)	(4)	(5)
Variables	EMBI Spreads				
Lag NFA	-0.0134^{***}	-0.0391^{***}	-0.00946^{***}	-0.00791^{***}	-0.0317^{***}
	[0.00194]	[0.00427]	[0.00189]	[0.00206]	[0.00421]
Relative GDP		-7.781^{***}			-7.154^{***}
		[0.942]			[0.908]
Rel. GDP × Lag NFA		0.0288^{***}			0.0237^{***}
		[0.00465]			[0.00450]
Crisis Periods			0.508^{**}	0.388^{*}	0.375^{**}
			[0.197]	[0.204]	[0.190]
Lag NFA × Crisis			-0.0182^{***}	-0.00826	-0.0303^{***}
			[0.00316]	[0.00557]	[0.00845]
NFA squared				$1.97e-05^{*}$	
				[1.14e−05]	
NFA squared × Crisis				0.000138^{**}	
				[6.43e−05]	
Rel. GDP × Lag NFA × Crisis					0.0251^{*}
					[0.0129]
Constant	1.069	5.558^{***}	1.060	1.011	5.206^{***}
	[0.856]	[0.984]	[0.812]	[0.808]	[0.944]
Country FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Observations	727	727	727	727	727
R-squared	0.179	0.291	0.264	0.270	0.273
Number of Countries	44	44	44	44	44

Standard errors brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 13
Crisis events from Laeven and Valencia (2018).

Country	Years	Country	Years
Angola	2015	Luxembourg	2008–2012
Austria	2008–2012	Malaysia	1997–1999
Belgium	2008–2012	Moldova	2014–2017
Brazil	2015	Myanmar	2012
Cyprus	2011–2015	Nepal	1984, 1988. 199
Czech Republic	2000	Netherlands	2008–2009
Denmark	2008–2009	New Zealand	1984
Ethiopia	1993	Norway	1991–1993
Finland	1991–1995	Philippines	1997–2001
France	2008–2009	Portugal	1983, 2008–2012
Germany	2008–2009	Russia	2000, 2008–2009, 2014
Ghana	2009, 2014	Slovakia	2000–2002, 2008–2012
Greece	2008–2012	South Africa	1984–1985, 1993, 2015
Honduras	1990, 1992	Spain	1980–1981, 1983, 2008–2012
Hungary	2008–2012	Sweden	1991–1995, 2008–2009
Iceland	2008–2012	Switzerland	2008–2009
Ireland	2008–2012	Thailand	1999–2000
Italy	1981, 2008–2009	Trinidad and Tobago	1986, 1989
Jamaica	1983, 1990–1991, 1996–1998	Uganda	1980–1981, 1988, 1993
Japan	1997–2001	United Kingdom	2007–2011
Korea	1997–1998	United States	1988, 2007–2011
Latvia	2008–2012	Venezuela	2002, 2010, 2017

Table 14
List of countries with EMBI spreads.

EMBI Spreads	Synthetic Spreads in USD
Brazil	Australia
Bulgaria	Austria
Chile	Belgium
China	Canada
Colombia	Denmark
Cote d'Ivoire	Finland
Ghana	France
Hungary	Germany
Indonesia	Greece
Korea, Republic of	Ireland
Lithuania	Israel
Malaysia	Italy
Mexico	Japan
Morocco	Netherlands
Pakistan	New Zealand
Philippines	Portugal
Poland	Singapore
Russia Federation	Spain
Senegal	Sweden
South Africa	UK
Sri Lanka	
Thailand	
Turkey	
Uruguay	

The periods which we observe these countries are under sample 2 in Table 1.

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