Long-run determinants of sovereign bond index in emerging market: New evidence from asymmetric and nonlinear pass-through

Sy-Hoa HO[a,b,*]

[a] *EPEE, University of Evry Val d'Essonne, France*
[b] *CEPN (CNRS-UMR 7234), University of Paris North, Sorbonne Paris Cité, France*

Abstract

In this paper, we study the asymmetric long-run and short-run determinants of the sovereign bond index, a proxy of sovereign default, for two typical emerging countries: Turkey and Brazil over the 2000Q1-2011Q4 period. The determinants of the sovereign bond index are estimated by three macroeconomic factors: the current account, the external debt and international reserves. In particular, we use the positive and negative partial sum decomposition of the current account to determine the asymmetric effects on the sovereign bond index. Our findings can be summarized as follows: *i,* An asymmetric long-run relationship exists between the sovereign bond index and the explanatory variables for the following models. Only the long-run effect is asymmetric for Turkey while both short-run and long-run effects are asymmetric for Brazil. *ii,* The positive and negative shocks on the current account are more significant than a shock on international reserves to reduce the sovereign default risk for Turkey. *iii,* A negative shock on the current account is stronger than a positive one for Brazil.

Keywords: EMBI+, asymmetry, NARDL

*Corresponding author
Email address: hosyhoa1987@gmail.com (Sy-Hoa HO)

1. Introduction

From the Asian and Latin American financial crises of the 1990s and the 2000s to the current global financial crisis, the sovereign bond spread has been an important indicator to measure the country risk. In this paper, we investigate a way to estimate the sovereign bond index, proxied by the *Emerging Market Bond Index Plus (EMBI+)*. EMBI+ is a JPMorgan index capturing the total return for liquid sovereign debt in emerging markets.

Numerous articles link the relationship between the fundamental factors and sovereign bond index using panel techniques (Ferrucci, 2003; Gupta et al., 2008; Petrova et al., 2010). Indeed, Ferrucci (2003) tests 11 emerging countries from the period 1997-2002 in order to determine the EMBI+ and EMBI Global in the short and long-term. His work finds that external liquidity conditions are important factors of market spreads. Moreover, Petrova et al. (2010) have further developed the work of Ferrucci (2003) by using fixed effect for a long period from 1997.Q1 to 2009.Q2 for a panel of 14 emerging markets. The results show that political risk is determined emerging market sovereign bond spreads.

Rowland and Torres (2004) use a random-effect generalized least squares regression for a panel of 16 emerging markets from 1998 to 2002. They find significant explanatory variables including the economic growth rate, the debt/GDP ratio, the reserves/GDP ratio and the debt/exports ratio.

Through two-stage least square and GMM, Gupta et al. (2008) explain the sovereign bond spreads for a panel of 30 emerging market economies from 1997 to 2007. Their paper highlights the importance of the fiscal variable that is the most essential and has the largest impact on EMBI+. Jaramillo and Tejada (2011) uses a fixed-effect model for a panel of 35 emerging markets in the period 1997-2010 and find that the investment grade status reduces bond spreads by a magnitude of 30 to 40 percent.

Papers focusing on specific countries are less. Nogus and Grandes (2001) focus on how to determine the long-run Argentina's EMBI+ from the period 1994 to 1998 by applying the Pooled Mean Group estimation of Pesaran et al.

(2001). They find a long-run relationship between Argentina's EMBI+ and the following series: the debt-service-to-export ratio, the GDP growth rate, the fiscal balance and the 30-year US Treasury yield. Ebner (2009) studies the spread between 10 year Euro denominated Central and Eastern European government bonds and their German counterpart. He finds three prominent explanatory variables during crisis periods: market volatility, political instability and global factors. However, these regressions take into account the linear influence of these explanatory variables to the sovereign bond index in the long-run but do not examine their asymmetric effects.

This paper examines how fundamental macroeconomic factors are asymmetrically passed on to sovereign bond index over both the short and long runs for two typical emerging countries: Brazil and Turkey. We adopt a novel approach to study the short-run (SR) and long-run (LR) macroeconomic determinants of this index by using an asymmetric model. Choosing this approach is justified by the necessity to distinguish different kind of shocks, i.e. negative or positive. And more importantly, clarifying the asymmetric long-run effects of sovereign bond index should help regulators designing policies aiming at reducing a country default risk.

The asymmetric and non-linear models begins with Balke and Fomby (1997) who introduce threshold cointegration with a regime-switching model to the field. This is a welcome development since there is a risk of "hidden cointegration"as highlighted by Granger and Yoon (2002) when positive and negative components are cointegrated. Schorderet (2003) develop the paper of Granger and Yoon (2002) in order to estimate the asymmetric effect of hidden cointegration. Based on the work of Pesaran et al. (2001), some studies test the cointegration for small samples (Romilly et al., 2001; Narayan, 2005; Baek and Gweisah, 2013).

The asymmetric nonlinear approach is used in recent articles: Katrakilidis and Trachanas (2012) study the asymmetric effects of consumer price index and GDP on housing price for Greece's case. Shin et al. (2014) investigate the asymmetric effect of unemployment on output. Atil et al. (2014) suggest that

there is an asymmetric pass through from crude oil prices to gasoline and natural gas prices. Delatte and Lpez-Villavicencio (2012); Elbejaoui (2013) study the asymmetric exchange rate pass-through to domestic general price and to export or import prices respectively.

The remainder of this paper is organized as follows: We start by introducing the econometric methodology to examine asymmetric short and long runs effects of macroeconomic determinants on the sovereign bond. We then present our empirical results. The last section concludes.

2. Econometric approach

In this paper, we study the cointegration autoregressive distributed lag (ARDL) to examine the fundamental macroeconomics to emerging market bond index. We use the nonliear autoregressive distributed lag (NARDL) estimator as introduced by Shin et al. (2014) and derived from the seminal work by Pesaran et al. (2001). This methodology allows to estimate the asymmetric long-run and short-run relationships.

We consider three explanatory variables, used to proxy respectively the macroeconomic state of the country, the government solvency and the government liquidity: current account to GDP ratio, external debt to GDP ratio and international reserves to GDP ratio. We argue that these three variables are important determinants of sovereign default risk. Indeed, the EMBI+ captures the total return for liquid sovereign debt in emerging markets. Hence, when the external debt burden increases, it would be expected to increase the EMBI+. International reserves are expected to impact negatively the EMBI+, i.e., the higher government liquidity, the smaller the sovereign default probability as well as EMBI+. The current account is an important macroeconomic variable accounting the health of an economy. It can be influenced by numerous factors such as trade policies, level of investment and others. Those two last variables are likely to lower sovereign default risk (Baek et al., 2005; Ramos-Francia and Rangel, 2012).

We assume the following long-run regression:

$$LE_t = \alpha_0 + \alpha_1 CA_t + \alpha_2 ED_t + \alpha_3 RES_t + \epsilon_t \tag{1}$$

where LE is Emerging Market Bond Index (EMBI) in log; CA is ratio of current account to GDP; ED is ratio of external debt to GDP; RES is international reserves to GDP ratio; $t = 1, 2...T$ is number of periods.

Following Shin et al. (2014), we adopt an error correction model (ECM) to estimate the linear relationship:

$$\begin{aligned}\Delta LE_t = c + \rho_e LE_{t-1} + \rho_c CA_{t-1} + \rho_d ED_{t-1} + \rho_r RES_{t-1} + \sum_{i=1}^{p} b_i \Delta LE_{t-i} \\ + \sum_{i=0}^{q} c_i \Delta CA_{t-i} + \sum_{i=0}^{q} d_i \Delta ED_{t-i} + \sum_{i=0}^{q} e_i \Delta RES_{t-i} + \upsilon_t\end{aligned} \tag{2}$$

where Δ is the first difference operator. $\rho_e, \rho_c/-\rho_e, \rho_d/-\rho_e, \rho_r/-\rho_e$ are the error term, long-run coefficients of the current account, the external debt and international reserves respectively; c_i, d_i, e_i are the short-run coefficients.

In order to determine asymmetric pass-through of fundamental factors to sovereign bond index, we follow the approach of Schorderet (2003); Shin et al. (2014). This approach requires to decompose the variable of interest. Here, we decompose the current account variable[1] into its surplus and deficit sub-variables. CA^+ and CA^- are therefore the partial sums of positive and negative changes in the current account. We calculate them as follows:

$$CA_t^+ = \sum_{j=1}^{t} \Delta CA_j^+ = \sum_{j=1}^{t} max(\Delta CA_j, 0); CA_t^- = \sum_{j=1}^{t} \Delta CA_j^- = \sum_{j=1}^{t} min(\Delta CA_j, 0). \tag{3}$$

Following equation (3), equation (2) can then be expressed distinguishing long and short runs asymmetric relationships:

[1]The partial sum decomposition for the external debt and international reserves variables do not show any cointegration relationship with the EMBI+. Results are not reported here but are available upon request.

$$\Delta LE_t = c + \rho_e LE_{t-1} + \rho_c^+ CA_{t-1}^+ + \rho_c^- CA_{t-1}^- + \rho_d ED_{t-1} + \rho_r RES_{t-1} + \sum_{i=1}^{p} \varphi_i \Delta LE_{t-i} + \sum_{i=0}^{q} \{\pi_i^+ \Delta CA_{t-i}^+ + \pi_i^- \Delta CA_{t-i}^- + d_i \Delta ED_{t-i} + e_i \Delta RES_{t-i}\} + \upsilon_t \tag{4}$$

where $L_{ca}^+ = \rho_c^+ / -\rho_e$ and $L_{ca}^- = \rho_c^- / -\rho_e$ are positive and negative long-run coefficients of the current account to EMBI respectively, and $L_d = \rho_d / -\rho_e$, $L_r = \rho_r / -\rho_e$ the long-run coefficients of the external debt and international reserves to EMBI.

Following Shin et al. (2014), Equation (4) can be modified to allow for long-run symmetry & short-run asymmetry (Equation (5)) and long-run asymmetry & short-run symmetry (Equation (6)).

Only short-run asymmetry:

$$\Delta LE_t = c + \rho_e LE_{t-1} + \rho_c CA_{t-1} + \rho_d ED_{t-1} + \rho_r RES_{t-1} + \sum_{i=1}^{p} \varphi_i \Delta LE_{t-i} + \sum_{i=0}^{q} \{\pi_i^+ \Delta CA_{t-i}^+ + \pi_i^- \Delta CA_{t-i}^- + d_i \Delta ED_{t-i} + e_i \Delta RES_{t-i}\} + \upsilon_t \tag{5}$$

Only long-run asymmetry:

$$\Delta LE_t = c + \rho_e LE_{t-1} + \rho_c^+ CA_{t-1}^+ + \rho_c^- CA_{t-1}^- + \rho_d ED_{t-1} + \rho_r RES_{t-1} + \sum_{i=1}^{p} \varphi_i \Delta LE_{t-i} + \sum_{i=0}^{q} \{\pi_i^+ \Delta CA_{t-i} + d_i \Delta ED_{t-i} + e_i \Delta RES_{t-i}\} + \upsilon_t \tag{6}$$

Equation (4), (5), (6) present the long-run cointegration between EMBI and positive/negative component of the current account with the two control variables such as the external debt and international reserves.

In order to test the existence of an asymmetric long-run cointegration, Shin et al. (2014) propose the *bounds test* that is a joint test on all the lagged levels regressors. There are two tests: t-statistic of Banerjee et al. (1998) and F-statistic of Pesaran et al. (2001). The t-statistic tests the null hypothesis of $\rho_e = 0$ against the alternative hypothesis $\rho_e < 0$. The F-statistic tests the null hypothesis of $\rho_e = \rho_c^+ = \rho_c^- = \rho_d = \rho_r = 0$ for the case of long-run asymmetry;

and $\rho_e = \rho_c = \rho_d = \rho_r = 0$ for the case of only long-run symmetry. If we reject the null hypothesis of no cointegration, indicating there is not a long-run relationship among the variables.

The long-run symmetry can be tested by the *Wald test* of the null hypothesis of $L_{ca}^{+} = L_{ca}^{-}$; to test the existence of short-run symmetry, we use the *Wald test* to test the null hypothesis of $\sum_{i=0}^{q} \pi_i^{+} = \sum_{i=0}^{q} \pi_i^{-}$. If we reject the null hypothesis of symmetric, implying the model allow the asymmetric effect.

When the null hypothesis of symmetric is rejected, we can find the asymmetric dynamic multiplier of the change of the current account CA^{+} and CA^{-} respectively:

$$m_h^{+} = \sum_{j=0}^{h} \frac{\partial LE_{t+j}}{\partial CA_t^{+}}; m_h^{-} = \sum_{j=0}^{h} \frac{\partial LE_{t+j}}{\partial CA_t^{-}} \tag{7}$$

where $h \to \infty$, $m_h^{+} \to L_{ca}^{+}$ and $m_h^{-} \to L_{ca}^{-}$. The dynamic multipliers could capture the positive and negative shocks of the current account on the EMBI from an initial equilibrium to the new equilibrium (Shin et al., 2014).

3. Econometrics Results

3.1. Data

In this paper, we use quarterly data from 2000.Q1 to 2011.Q4 for two typical emerging countries: Brazil, Turkey. Emerging Market Bond Index in log denoted LE is taken from Datastream[2]. CA is the current account to GDP ratio, ED is the external debt to GDP ratio, both variables taken from each country central bank statistics. RES is international reserves to GDP ratio (IMF International Financial Statistic). Table 1 shows the descriptive statistics.

3.2. Results

We first present the long-run relationship results by the bounds test for the four models: LR & SR symmetry with equation (2), LR & SR asymmetry

[2]We chose these countries and focus on the 2000.Q1-2011.Q4 period based on data availability

Table 1: Descriptive statistics

	Var.	Min	Max	Mean	StDev	Skewness	Kurtosis
Turkey	LE	5.16	6.81	5.88	0.50	0.52	-1.07
	CA	-0.11	0.04	-0.04	0.03	0.34	0.14
	ED	1.31	2.59	1.66	0.30	1.40	1.58
	RES	0.25	0.49	0.40	0.05	-0.56	0.17
Brazil	LE	5.05	7.36	5.96	0.62	0.43	-0.82
	CA	-0.06	0.03	-0.01	0.02	-0.10	-0.68
	ED	0.40	1.99	0.95	0.50	0.51	-1.24
	RES	0.17	0.57	0.37	0.12	0.21	-1.28

with equation (4), LR symmetry & SR asymmetry with equation (5) and LR asymmetry & SR symmetry with equation (6). Both t-statistic and F-statistic are reported in Table 2 below:

As shown in Table 2 for Turkey, all of F-test statistics exceed their upper critical values so we can reject the null hypothesis of no cointegration relationship between the EMBI and explanatory variables. Nevertheless, t-test statistics are smaller than the lower critical values for long-run symmetry & short-run asymmetry and long-run & short-run asymmetry model, implying we do not reject the null hypothesis of no cointegration. However, for long-run asymmetry & SR symmetry model, t-test statistic is between the lower and upper critical values, so we cannot reject the null hypothesis of cointegration. In this case, we can consider the existence of long-run relationship between the EMBI and the explanatory variables for Turkey.

Regarding F-test and t-test statistics for Brazil: t-test statistic is between its lower and upper critical values for LR asymmetry & SR symmetry, indicating we cannot reject the null hypothesis of cointegration for this case. The three others t-test statistics exceed their upper critical values, suggesting that we reject the null hypothesis of no cointegration. As seen, only F-test statistic of long-run & short-run asymmetry model is rejected the null hypothesis of no cointegration while other F-test statistics are between their lower and upper critical values, reporting that we cannot reject the null hypothesis of no

Table 2: Bounds cointegration test

		LR & SR symmetry	LR symmetry & SR asymmetry	LR asymmetry & SR symmetry	LR & SR asymmetry
Turkey	t_{BMD}	**-3.813****	-0.782	-3.586^{i}	-0.543
	F_{PSS}	**5.767****	**4.258****	**4.784****	**5.278****
	W_{LR}	-	-	**9.659**	0.264
	W_{SR}	-	**6.066**	-	**16.236**
Brazil	t_{BMD}	**-3.217***	**-3.649****	-3.112^{i}	**-3.941****
	F_{PSS}	3.496^{i}	4.605^{i}	2.491^{i}	**4.777****
	W_{LR}	-	-	0.021	**4.829**
	W_{SR}	-	1.324	-	1.727

Notes: t_{BMD} denotes the t-statistic of Banerjee et al. (1998) and F_{PSS} is the F-statistic of Pesaran et al. (2001) testing the null hypothesis $\rho_e = 0$ and $\rho_e = \rho_c = \rho_d = \rho_r = 0$ (for only short-run asymmetric), $\rho_e = \rho_c^+ = \rho_c^- = \rho_d = \rho_r = 0$ (for long-run asymmetry) respectively. *,** indicate the rejection of the null hypothesis of no cointegraion at the 10 %, 5 % level, and i implies that we cannot reject the null hypothesis of no cointegration. The expected sign of international reserves is negative, but for Brazil, equation (4),(5),(6) is without the RES variable cause the sign of RES is positive. Hence in order to avoid many tables, we do not present the Brazil's results with the RES variable, therefore to test long-run relationship, we test $\rho_e = 0$, $\rho_e = \rho_c = \rho_d = 0$ (for only short-run asymmetric), $\rho_e = \rho_c^+ = \rho_c^- = \rho_d = 0$ (for long-run asymmetry).

cointegration. Hence, both t-statistic and F-statistic confirm to reject the null hypothesis of no cointegration if we allow the short-run and long-run asymmetric. By considering the existence of long-run cointegration for symmetric model, we can therefore conclude the cointegration between EMBI and the explanatory variables for Brazil.

In total, the preferred models that we will present in the next section which are symmetry model and LR asymmetry & SR symmetry model for Turkey, and symmetry model and long-run & short-run asymmetry model for Brazil.

Table 3 reports the long-run estimations of the ARDL symmetric and asymmetric models for Turkey and Brazil. The error correction terms are significant at 1% level for four case of Turkey and Brazil.

The overall impression is the sign of all long-run coefficients is as expected and consistent with economic theory.

The sign coefficient of the current account for Turkey is negative as expected for two cases, but it is not significant statistically with symmetric model, and it

Table 3: Long-run estimates of the symmetric and asymmetric current account pass-through

		Symmetric ARDL		*NARDL with LR asymmetry*		
Turkey	*Var.*	*Coeff.*	*t-stat*	*Var.*	*Coeff.*	*t-stat*
	ρ_e	-0.491***	-3.813	ρ_e	-0.492***	-3.586
	ρ_c	-1.755	-1.113	ρ_c^+	-3.968**	-2.561
	ρ_d	0.854***	4.155	ρ_c^-	-3.230**	-2.105
	ρ_r	-1.747**	-2.421	ρ_r	-0.551	-0.736
				ρ_d	0.766***	3.841
	L_{ca}	**-3.574**		L_{ca}^+	**-8.065**	
	L_d	**1.739**		L_{ca}^-	**-6.565**	
	L_r	**-3.558**		L_d	**1.557**	
	R^2	0.701		L_r	**-1.119**	
				t_{BMD}	-3.586	
				F_{PSS}	4.784	
				R^2	0.626	
Brazil		*Symmetric ARDL*		*NARDL with LR,SR asymmetry*		
	ρ_e	-0.409***	-3.217	ρ_e	-0.529***	-3.941
	ρ_c	-0.369	-0.312	ρ_c^+	-0.643	-0.452
	ρ_d	0.477***	3.065	ρ_c^-	-3.536*	-1.879
				ρ_d	0.994***	4.179
	L_{ca}	**-0.902**		L_{ca}^+	**-1.216**	
	L_d	**1.166**		L_{ca}^-	**-6.684**	
	R^2	0.646		L_d	**1.879**	
				t_{BMD}	-3.941	
				F_{PSS}	4.777	
				R^2	0.757	

Notes: we apply a general-to-specific approach to find the final specification by setting $p = q = 4$. L_{ca}^+, L_{ca}^-, L_{ca}, L_d and L_r are the long-run coefficients of the current account, the external debt and international reserves to LMBI. t_{BMD} denotes the t-statistic of Banerjee et al. (1998) and F_{PSS} is the F-statistic of Pesaran et al. (2001) testing the null hypothesis $\rho_e = 0$ and $\rho_e = \rho_c = \rho_d = 0$ respectively.

becomes significant with long-run asymmetry model at 5% level. The long-run coefficient of the current account with symmetric model for Turkey is -3.574, indicating that the increase (decrease) by 3.574 of LMBI makes the current account to improve (decline). The long-run coefficients of the positive and negative component of the current account are -8.065, -6.565 respectively, implying that LMBI increases -8.065 when the current account improves 1% and decreases 6.565 when the current account declines 1%. The asymmetric long-run effect is confirmed by the *Wald test* (9.659) that exceeds its upper critical value of Pesaran et al. (2001), reflecting the fact that we reject the null hypothesis of symmetric in the model.

The long-run coefficient of the current account with symmetric model for Brazil is weaker than one of Turkey which is -0.902. The long-run coefficients of the positive, negative component of the current account for Brazil are -1.216, -6.684 respectively, suggesting that LMBI increases 1.216 when the current account improves 1% and decreases 6.684 when the current account declines 1%. More specifically, the positive component effect is higher than the negative one for Turkey but that phenomenon is on the other way round for Brazil. The long-run asymmetric for Turkey is confirmed by the *Wald test* (9.659) that exceeds its upper critical value of Pesaran et al. (2001), reporting that we reject the null hypothesis of symmetry in the model.

The finding of the long-run coefficient of the external debt for Turkey is 1.739 in symmetric model which is higher than 1.557 for the asymmetric model, announcing that LMBI will increases (decreases) 1.739 and 1.557 when the external debt increases (declines) 1% for the symmetric model and asymmetric model respectively. But in Brazil, the long-run coefficient of the external debt is 1.116 smaller than the one when we allow both long-run and short-run asymmetric effect that is 1.879, revealing that LMBI increases (decreases) 1.116, 1.879 when the external debt increases (declines) 1%.

We now compare with the findings of Petrova et al. (2010), who use the Pooled Mean Group approach for 14 emerging markets including Turkey and Brazil. The long-run coefficient current account varies from -3.033 to -3.364,

and the long-run coefficient external debt flutters from 2.205 to 2.655. The previous results have just linear coefficients for all countries including Turkey and Brazil which do not distinct the impact of the positive and negative shocks. Successfully, our findings show clearly the change of the LMBI with the different positive and negative shocks.

The long-run coefficients of international reserves for Turkey are -3.558 for symmetric model and -1.119 for asymmetric model, signalling if Turkey's government increases its liquidity then EMBI decreases -3.558, -1.119 for the symmetric model and asymmetric model respectively. We do not present international reserves for the Brazil in this paper because the sign of long-run coefficient of international reserves is positive not as expected with theoretical economic.

The long-run asymmetric statistic test for Brazil is confirmed by the Wald test (4.829) that exceeds its upper the critical value of Pesaran et al. (2001), indicating we reject the null hypothesis of symmetric in the model, and the *Wald test* for short-run asymmetric is 1.727 below the its critical value, but we cannot to reject the null hypothesis of short-run symmetry.

From the view point of risk management, the findings of Turkey prove very interesting. In order to reduce country risk, the current account and international reserves have a more important role than the external debt in long-run. The role of these two factors is almost equality in the symmetric model ($L_{ca} = -3.574, L_r = -3.558$). But improving the current account will reduce higher than increasing international reserves ($L^+_{ca} = -8.065, L_r = -1.119$). In order to explain the role of external debt, the government has sufficient time in long-run to restructure the external debt. For the Brazil, we do not find the same results.

Table 3 and Table 4 present the short-run coefficients of the symmetric and asymmetric model for the Turkey and Brazil respectively.

As shown in Table 4, 5: in Turkey, the short-run coefficients of the current account are not significant for both symmetric model and follows a asymmetric long-run model. The other coefficients of the external debt and international reserves are significant in short-run, indicating the important role in short-run

Table 4: Short-run estimates of the symmetric and asymmetric model for Turkey

		Symmetric ARDL		*NARDL with LR asymmetry*		
Turkey	*Var.*	*Coeff.*	*t-stat*	*Var.*	*Coeff.*	*t-stat*
	ΔLE_{t-1}	0.512**	2.485	ΔLE_{t-1}	0.329***	2.067
	ΔLE_{t-2}	-	-	ΔLE_{t-2}	-	-
	ΔLE_{t-3}	0.173	1.165	ΔLE_{t-3}	-	-
	ΔLE_{t-4}	0.302**	2.063	ΔLE_{t-4}	-	-
	ΔCA_t	-	-	ΔCA_t	-	-
	ΔCA_{t-1}	0.982	0.780	ΔCA_{t-1}	0.771	0.607
	ΔCA_{t-2}	-	-	ΔCA_{t-2}	-	-
	ΔCA_{t-3}	-	-	ΔCA_{t-3}	-	-
	ΔCA_{t-4}	-	-	ΔCA_{t-4}	-	-
	ΔED_t	0.511***	3.083	ΔED_t	0.575***	3.739
	ΔED_{t-1}	-	-	ΔED_{t-1}	-	-
	ΔED_{t-2}	-0.727**	-2.653	ΔED_{t-2}	-	-
	ΔED_{t-3}	-0.167	-1.099	ΔED_{t-3}	-	-
	ΔED_{t-4}	-0.281*	-2.002	ΔED_{t-4}	-	-
	ΔRES_t	-	-	ΔRES_t	-	-
	ΔRES_{t-1}	-2.535***	-2.952	ΔRES_{t-1}	-1.992***	-2.774
	ΔRES_{t-2}	2.956**	2.260	ΔRES_{t-2}	-	-
	ΔRES_{t-3}	-	-	ΔRES_{t-3}	-	-
	ΔRES_{t-4}	-	-	ΔRES_{t-4}	-	-
	c	2.092***	2.901	c	2.049***	3.018

Notes: we apply a general-to-specific approach to find the final specification by setting $p = q = 4$. L_{ca} and $L_d$are the long-run coefficients of current account and external debt to LMBI. t_{BMD} denotes the t-statistic of Banere(1998) and F_{PSS} is the F-statistic of PSS(2001) testing the null hypothesis $\rho_e = 0$ and $\rho_e = \rho_c = \rho_d = 0$ respectively.

Table 5: Short-run estimates of the symmetric and asymmetric model for Brazil

		Symmetric ARDL		*NARDL with LR, SR asymmetry*		
Brazil	*Var.*	*Coeff.*	*t-stat*	*Var.*	*Coeff.*	*t-stat*
	ΔLE_{t-1}	0.223*	1.793	ΔLE_{t-1}	0.411**	2.309
	ΔLE_{t-2}	-	-	ΔLE_{t-2}	-	-
	ΔLE_{t-3}	0.156	1.259	ΔLE_{t-3}	0.341*	-2.001
	ΔLE_{t-4}	-	-	ΔLE_{t-4}	0.333**	2.128
	ΔCA_t	-	-	ΔCA_t^+	-	-
	ΔCA_{t-1}	-	-	ΔCA_{t-1}^+	-	-
	ΔCA_{t-2}	-2.504	-1.543	ΔCA_{t-2}^+	-7.829**	-2.463
	ΔCA_{t-3}	-	-	ΔCA_{t-3}^+	-	-
	ΔCA_{t-4}	-	-	ΔCA_{t-4}^+	-	-
	ΔED_t	1.248***	6.691	ΔCA_t^-	-10.453**	-2.320
	ΔED_{t-1}	-	-	ΔCA_{t-1}^-	-	-
	ΔED_{t-2}	-	-	ΔCA_{t-2}^-	-	-
	ΔED_{t-3}	-	-	ΔCA_{t-3}^-	-6.141*	-1.707
	ΔED_{t-4}	-	-	ΔCA_{t-4}^-	-	-
	c	2.005***	3.127	ΔED_t	1.671***	6.308
				ΔED_{t-1}	-0.848**	-2.701
				ΔED_{t-2}	-	-
				ΔED_{t-3}	-0.361	-1.279
				ΔED_{t-4}	-0.822**	-2.764
				c	1.743**	2.504

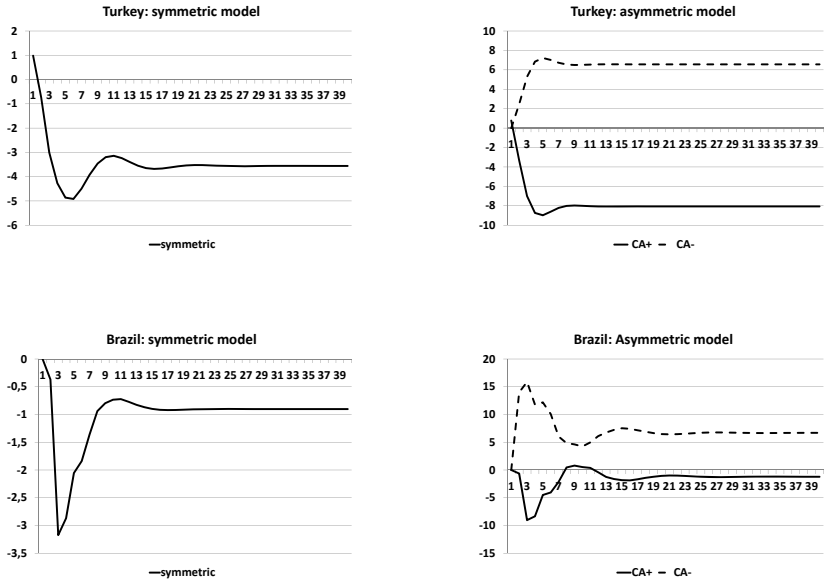
Notes: we apply a general-to-specific approach to find the final specification by setting $p = q = 4$. L_{ca} and $L_d$are the long-run coefficients of current account and external debt to LMBI. t_{BMD} denotes the t-statistic of Banere(1998) and F_{PSS} is the F-statistic of PSS(2001) testing the null hypothesis $\rho_e = 0$ and $\rho_e = \rho_c = \rho_d = 0$ respectively.

to determine the EMBI.

In Brazil, the short-run effect of the current account is not significant with symmetric model, it becomes significant when the model allows long-run and short-run asymmetric effect. The external debt coefficient is significant in short-run for both two cases, implying the level of EMBI in short-run depends on the repayment capacity of the external debt.

The dynamic multipliers up to 40 quarters presented in Figure 1 based on Equation (7). This shows the new long-run equilibrium for the EMBI with the positive and negative shock of the current account from an initial long-run equilibrium.

Figure 1: Dynamic multipliers



Source: author's calculation.

The evolution of dynamic multipliers in symmetric model for Turkey and Brazil is the same by regarding two peak shocks after 4 periods and 11 periods (about 1 year and 2 year respectively). An seen, the dynamic multipliers go to

the long-run equilibrium after about 4 years.

These findings in Table 3 and Figure 1 show the presence of the positive and negative shock of the current account on the EMBI. In fact, when we allow only asymmetric long-run effect for Turkey, the sovereign bond responds very asymmetric in positive and negative shock of the current account with reference to Figure 1, suggesting the sovereign bond run to equilibrium after 2 years. In view of the Brazil's curves of dynamics multipliers, there is a great shock positive and negative of the current account after 1 year and 2 years, and the only positive effect is not significant during the third year. This explication maybe from without international reserves effect in the model. The new equilibrium takes after 4 years to converge to the long-run multipliers. From a risk-management point of view, the positive and negative shock of the current account provides the useful information for predict the sovereign bond.

4. Conclusion

In this paper, we investigate the recent technique of asymmetric modelling proposed by Shin et al. (2014) in order to determine the Emerging Market Bond Index Plus by the current account, the external debt and international reserves for Turkey and Brazil in the period 2000.Q1-2011.Q4. We used the positive and negative partial sum compositions of the current account expressing the excess current account and the deficit current account in order to determine their asymmetric effect on the sovereign bond index.

The findings from the *bounds test* of t-test and F-test statistic proposed by Banerjee et al. (1998); Pesaran et al. (2001) respectively highlight the existence of long-run cointegration between the EMBI+ and the three explanatory variables for both countries in the symmetric model, for Turkey in only long-run asymmetry model and for Brazil with both long-run, short-run asymmetric model. Our results suggest a great asymmetric long-run effect of the current account on the EMBI+ of Turkey and Brazil in a model including variables such as the external debt and international reserves. Especially, we only detect

long-run asymmetric effect for Turkey while both long-run and short-run asymmetric effects exist for Brazil. The sign of international reserves variable for Brazil does not corroborate economic theory when we allow the short-run and asymmetric long-run effects.

The asymmetric long-run coefficients of the current account are greater than one of symmetry for both Turkey and Brazil. This finding highlights the importance of precisely specifying the long-run relationship when we allow for asymmetric effect. In addition, the positive component of the current account is higher than the negative one for Turkey. In contrast, the positive component of the current account is smaller than the negative one for Brazil. This tends to show that the positive component of current account has a stronger impact on EMBI+ than the negative one for Turkey, and that the negative one has a stronger impact than the current account in the case of Brazil. Besides, the asymmetric long-run coefficients of the external debt and international reserves for Turkey are smaller than one of symmetry. The asymmetric long-run effect of the external debt is greater than one of symmetry for Brazil. This result means the allowing for asymmetry increases the magnitude and the significance.

The finding of dynamic multipliers permits to capture the new long-run equilibrium from the initial equilibrium which confirms the long-run effects of these explanatory variables. We believe such insights could inform risk management strategies in the future.

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References

Atil, A., Lahiani, A., Nguyen, D.K.. Asymmetric and nonlinear pass-through of crude oil prices to gasoline and natural gas prices. Energy Policy 2014;65(C):567–573.

Baek, I.M., Bandopadhyaya, A., Du, C.. Determinants of market-assessed sovereign risk: Economic fundamentals or market risk appetite? Journal of International Money and Finance 2005;24(4):533–548. URL: http://EconPapers.repec.org/RePEc:eee:jimfin:v:24:y:2005:i:4:p:533-548.

Baek, J., Gweisah, G.. Does income inequality harm the environment?: Empirical evidence from the united states. Energy Policy 2013;62(C):1434–1437.

Balke, N.S., Fomby, T.B.. Threshold cointegration. International Economic Review 1997;38(3):627–45.

Banerjee, A., Dolado, J., Mestre, R.. Error-correction mechanism tests for cointegration in a single-equation framework. Journal of Time Series Analysis 1998;19(3):267–283.

Delatte, A.L., Lpez-Villavicencio, A.. Asymmetric exchange rate pass-through: Evidence from major countries. Journal of Macroeconomics 2012;34(3):833–844. URL: http://ideas.repec.org/a/eee/jmacro/v34y2012i3p833-844.html.

Ebner, A.. An empirical analysis on the determinants of cee government bond spreads. Emerging Markets Review 2009;10(2):97–121.

Elbejaoui, H.J.. Asymmetric effects of exchange rate variations: An empirical analysis for four advanced countries. Economie Internationale 2013;(135-136):29–46. URL: http://ideas.repec.org/a/cii/cepiei/2013-q3-4-135-136-3.html.

Ferrucci, G.. Empirical determinants of emerging market economies' sovereign bond spreads. Bank of England working papers 205; Bank of England; 2003. URL: http://ideas.repec.org/p/boe/boeewp/205.html.

Granger, C.W., Yoon, G.. Hidden Cointegration. Royal Economic Society Annual Conference 2002 92; Royal Economic Society; 2002. URL: http://ideas.repec.org/p/ecj/ac2002/92.html.

Gupta, S., Mati, A., Baldacci, E.. Is it (Still) Mostly Fiscal? Determinants of Sovereign Spreads in Emerging Markets. IMF Working Papers 08/259; International Monetary Fund; 2008. URL: http://ideas.repec.org/p/imf/imfwpa/08-259.html.

Jaramillo, L., Tejada, C.M.. Sovereign Credit Ratings and Spreads in Emerging Markets: Does Investment Grade Matter? IMF Working Papers 11/44; International Monetary Fund; 2011.

Katrakilidis, C., Trachanas, E.. What drives housing price dynamics in greece: New evidence from asymmetric ardl cointegration. Economic Modelling 2012;29(4):1064–1069.

Min, H.G.. Determinants of emerging market bond spread : do economic fundamentals matter? Policy Research Working Paper Series 1899; The World Bank; 1998.

Narayan, P.K.. The saving and investment nexus for china: evidence from cointegration tests. Applied Economics 2005;37(17):1979–1990.

Nogus, J., Grandes, M.. Country risk: Economic policy, contagion effect or political noise? Journal of Applied Economics 2001;0:125–162.

Pesaran, M.H., Shin, Y., Smith, R.J.. Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics 2001;16(3):289–326.

Petrova, I., Papaioannou, M.G., Bellas, D.. Determinants of Emerging Market Sovereign Bond Spreads: Fundamentals vs Financial Stress. IMF Working Papers 10/281; International Monetary Fund; 2010.

Ramos-Francia, M., Rangel, J.G.. Revisiting the effects of country specific fundamentals on sovereign default risk. Economics Bulletin 2012;32(4):3008–3016. URL: http://EconPapers.repec.org/RePEc:ebl:ecbull:eb-12-00222.

Romilly, P., Song, H., Liu, X.. Car ownership and use in britain: a comparison of the empirical results of alternative cointegration estimation methods and forecasts. Applied Economics 2001;33(14):1803–1818.

Rowland, P., Torres, J.L.. Determinants of Spread and Creditworthiness for Emerging Market Sovereign Debt:A Panel Data Study. Borradores de Economia 295; Banco de la Republica de Colombia; 2004.

Schorderet, Y.. Asymmetric Cointegration. Research Papers by the Department of Economics, University of Geneva; Dpartement des Sciences conomiques, Universit de Genve; 2003.

Shin, Y., Yu, B., Greenwood-Nimmo, M.. Modelling Asymmetric Cointegration and Dynamic Multipliers in a Nonlinear ARDL Framework. Springer Science & Business Media, 2014.