# "Debt Intolerance:" The Double-edged Sword of Financial Globalization*

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**Abstract**

Risk premia is heterogeneous across countries even when their debt levels are similar. Interest rates in a developing economy can suddenly rise above what is referred to as their debt tolerance ceiling, even though the debt level would be considered manageable in an advanced economy. By focusing on funding sources, the aim of this paper is to address the following question: what is the tipping point at which the share of foreign private investors triggers a surge in the sovereign risk premium? We employ a panel smooth transition regression in 11 advanced economies excluding the Euro Area, 15 emerging markets and 11 countries within the Euro Area. Our results show that while an increase in the share of foreign private investors reduces long-term interest rates, it also increases the risk premium by raising expectations of higher public debt. We conclude that the sovereign risk premium passes the tolerance/intolerance threshold in emerging markets when the ratio of foreign private holding of public debt is above 37 percent and does so in the Euro Area when it surpasses 40 percent.

**Key Words:** debt intolerance, sovereign risk premium, panel smooth transition regression, foreign private investors

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*The views expressed herein are my own and do not represent those of World Bank. All errors are my responsibility.

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# 1. Introduction

Investors in the debt of a country require a higher risk premium if the debt-to-GDP ratio of that nation reaches a level at which they fear the possibility of default. However, risk premia is heterogeneous across countries even their debt level are similar. An influential paper by Reinhart et al (2003)[42] describe the "debt intolerance" phenomenon, in which interest rates in developing economies can spike above the "tolerance ceiling", even though the debt levels could be considered manageable by advanced country standards. Significant research has been devoted to estimating the positive impact of public debt on long-term interest rates, focusing on government debt securities denominated in local currency. In summary, their impact of an increase in public debt is larger for emerging markets and the Euro Area than advanced economies excluding the Euro Area[1].

The aim of this paper is to explore, by focusing on funding sources, why the level of public debt has a different effect on long-term interest rates in different countries. To understand risk perception in an era of extensive global financial integration, we focus on foreign private investors, who are more risk-sensitive and have been the main drivers of capital flight.

Figure 1 shows the share of several kinds of investors in government debt securities denominated in local currency. While the share of foreign private investors has increased substantially in emerging markets, the share has plummeted in the Euro Area since the sovereign default crises of 2010. At the same time, the share of foreign official investors in the Euro Area has increased as the share of foreign private investors has fallen. In contrast, the share of foreign private investors in advanced economies excluding the Euro Area has been lower than the other two regions recently.

Why does the influence of government debt levels on long-term interest rates depend on the share of foreign private investors? Studies concluded that an increase in the share of foreign holdings has both positive and negative impacts on government bond yields. Some argue that an increase in the share of foreign private investors is associated with lower long-term interest rates because these holdings supplement domestic saving in capital-scarce countries, especially in times of high global liquidity (Reinhart and Trebesch (2015)[43]). Peiris (2010)[41] argues that while domestic investors

[1] See Section 2 for details.

are typically buy-and-hold investors, foreign investors are more likely to trade. Therefore, foreign investors can be supportive of increased market liquidity, which would support lower yields. Others maintain that foreign investors require higher risk premia because sovereigns, if forced to choose, would likely repay domestic creditors before foreign debt holders (Broner et al (2010)[11], Gros (2013)[31] and Ichiue and Shimizu (2015) [34]). According to this line of thinking, foreign creditors are particularly reluctant to purchase debt and require large spreads during pessimistic periods – moments when default becomes a possibility (Broner et al (2014) [10]and Reinhart and Trebesch (2015)[43]).

This article contributes to the literature in three ways. First, we examine both the positive and negative channels of the effect of an increase in share of foreign private investors on government bond yields and we explore the threshold at which risk premia for external and domestic debt begin to differ. We address the following question: at what specific percentage is the share of foreign private investors a tipping point for a spike in the sovereign risk premium? Second, we use more comprehensive data that includes 11 Advanced Economies excluding the Euro Area, 15 Emerging Markets and 11 countries in the Euro Area. Third, this paper employs forecast data by several international institutions including the International Monetary Fund, the Organisation for Economic Co-operation and Development and the European Commission because long-term interest rates are influenced by forward-looking variables such as expectations of growth, inflation and public debt. Moreover, real-time vintages of data could affect long-term interest rates because fiscal data has been revised largely (De Castro et al (2013) [20]). Our results show that an increase in the share of foreign private investors both reduces long-term interest rates but also increases risk premia by contributing to a rise in the public debt. The sovereign risk premium becomes larger when the foreign private holdings ratio in emerging markets is above 37 percent and above 40 percent in the Euro Area. The remainder of this paper is organized as follows. Section 2 reviews the related literature discussing the impact of foreign investors on government bond yields. Section 3 builds a panel smooth transition model to explore the borderlines differentiating risk premia. Section 4 shows the baseline estimation results and robustness. We also examine the non-linear behavior of the sovereign risk premium in relation to the fiscal deficit, replacing the

public debt. The conclusion is provided in Section 5.

## 2. Related literature review

Significant research has been devoted to estimating the positive impact of public debt on long-term interest rates, focusing on government debt securities denominated in local currency. Gruber and Kamin (2012)[32] show that a one percentage point rise in the expected government debt ratio boosts yields by 0.4 of a basis point, using a panel of 19 OECD countries, while for Group of Seven countries, the impact is 1 basis point. In the United States, the effect has been estimated variously to be 2.8 basis points (Engen and Hubbard (2005)[25]) to 3.3 to 4.6 basis points (Laubach(2009)[40])[2]. For the Euro Area, the boost from this rise in the expected government debt ratio has been assessed at 7.6 basis points by Constantini et al (2014)[17] and 9 basis points by De Grauwe and Ji (2013)[21]. Baum, Checherita-Westphal and Rother(2013)[4] find that when the public debt-to-GDP ratio in the Euro Area is above 73.8 percent, the impact of a 1 percentage point rise in long-term interest rates is 2.8 basis points, using data over the period 1990 to 2010 and a dynamic threshold regression model developed by Caner and Hansen (2004)[12][3]. With regard to the comparison with the Euro Area and others, De Grauwe and Ji (2013)[21] , Dell'Erba et al (2013)[23] and Fournier and Fall (2017)[27] find that a coefficient of the Euro Area is larger than that of others. According to De Grauwe and Ji (2013)[21],Gros (2013)[31] and Krugman (2014)[39], one possible reason is that in non-Euro Area, cash is always available to issue their debt through their own currency, but each central bank in the Euro Area is unable to perform the lender of last resort function and cannot issue debt by their own currency. In the emerging markets, Jaramillo and Weber (2013)[35] show that every additional percentage point in the expected deb to GDP ratio raises domestic bond yields by 6 basis points during times

[2]Engen and Hubbard(2005)[25] and Laubach(2009)[40] use long-horizon forward rates as well as nominal long-term interest rates and forecasts of federal government debt by the Congressional Budget Office.

[3]On the other hand, Checherita and Rother(2012)[14] show the level of the public debt in either linear or quadratic forms is not found to be statistically significant on average in determining long-term interest rates in the Euro Area.

characterized by high global risk aversions[4]. In summary, the impact of an increase in public debt long-term interest rates is larger for emerging markets and the Euro Area than advanced economies excluding the Euro Area

In considering the impact of different of funding sources, some empirical studies have found that foreign investors have contributed to a decrease in long-term interest rates. U.S. long-term interest rates remained low in the mid-2000s despite increases in the federal funds rate, a phenomenon Alan Greenspan labeled a "conundrum" (Greenspan (2005)[30]). Bernanke (2005)[6] hypothesized that a global saving glut – driven by net savings in Asia and oil-exporting countries – lowered long-term interest rates through an accumulation of foreign exchange reserves. Warnock and Warnock (2009) [44] showed that foreign flows exhibit significant negative impact on interest rates. A 12-month total of foreign flows of one percentage point of GDP is associated with a 19 basis point reduction on nominal 10-year yields. In the case of foreign official flows, the corresponding impact is a 40 basis point reduction. Beltran et al (2013)[7] found that a 10 percentage point increase in foreign official flows into and out of Treasuries lowers the 5-year term premium by 135 basis points. In the Euro Area, Carvalho and Fidora (2015)[13] found similar results, concluding that a 10 percentage point increase in foreign holdings of Euro Area debt securities lowered 10-year government bond yields by 130 basis points. The corresponding impacts in Advanced Economies including the Euro Area (Arslanalp and Poghosyan (2016)[1]) and emerging markets (Ebeke and Lu(2015)[24]) are 60 to 100 basis points and 60 to 80 basis points, respectively.

On the other hand, Dell'Erba et al (2013)[23] found that in fact it is how much of total debt is external that has the greatest positive influence on bond spreads in advanced and emerging countries. Similarly, Ichiue and Shimizu (2015) [34] concluded that when an increase in debt is financed entirely by foreign borrowing, the increase in forward real interest rate is approximately three times greater than when the increase is financed domestically. Seeking to explain this, Gros (2013)[31] and Ichiue and Shimizu (2015) [34], argue that if domestic financial institutions have a large share of government bonds, any losses they might incur would be amplified by

[4]Csonto (2014)[18] indicates that a 1 percent point rise in the lagged public debt to GDP ratio boosts EMBIG spreads by about 4-5 basis points.

the damage these losses would cause to the broader financial system. To avoid this, governments would have a clear incentive to raise taxes rather than undergo default. In contrast, when foreign investors hold substantial amounts of government bonds, authorities would weigh losses to a small number of the country's citizens against losses to foreign investors in the event of a default, making that option preferable to a tax increase. This scenario would lead to higher long-term interest rates. The search for yield and greater risk appetite among foreign investors could further contribute to raising long-term rates.

This paper examines both positive and negative channels of the effect of an increase in share of foreign private investors on government bond yields. However, this article is not the first to empirically investigate both impacts. Ebeke and Lu (2015)[24] show that in emerging markets an increase in the share of foreign holdings has a negative impact on yield but if the lagged external debt-to-GDP ratio exceeds 90 percent, the corresponding impact turn positive by using the interaction terms including these two variables. Our analysis differs from theirs in three important ways. First, in terms of non-linearity, we estimate a panel smooth transition regression (PSTR); continuous regime-switching will allow an exploration of the borders that differentiate risk premia and make it possible to find multiple thresholds to explore more general implications. Second, we employ more comprehensive forecast data that includes 11 advanced economies , 15 emerging markets and 11 countries in the Euro Area. Third, we use forecast data from IMF, the OECD and the European Commission since long-term interest rates are influenced by forward-looking variables such as expectations for growth, inflation and public debt.

# 3. Empirical strategy and data

We follow a panel smooth transition regression (PSTR) developed by Gonzalez et al (2005)[29], which can be used to allow for a continuum of regimes, each one being characterized by a different value of the transition variable. Continuous regimes-switching could incorporate how the share of foreign private investors would change sovereign risk for public debt.

## 3.1 Panel smooth transition regression(PSTR)

The PSTR model can be generalized to $r+1$ extreme regimes as follows:

$$L_{it} = \alpha_i + \beta_0 Debt_{it} + \sum_{j=1}^{r} \beta_j Debt_{it} g(q_{it}; \gamma_j, c_j) + \delta q_{it} + \phi \mathbf{z_{it}} + \varepsilon_{it} \quad (1)$$

where a country $i = 1,\ldots, N$ at a time $t = 1,\ldots, T$ , $L_{it}$ is nominal long-term interest rate, $Debt_{it}$ is general government gross debt (percent of GDP) , $\mathbf{z_{it}}$ describes the vector control variables and $\varepsilon_{it}$ is the error term. The $r$ transition functions $g(q_{it}; \gamma_j, c_j)$ depend on the threshold variable $q_{it}$, the slope parameters $r_j$ and location parameters $c_j$. The share of government debt by foreign private investors $FP_{it}$ is assumed to be the threshold variable $q_{it}$ and considered a lagged value of foreign holdings ratio as the threshold variable to avoid a simultaneity bias, i.e, $q_{it}$=$FP_{it-1}$ . Introducing the threshold variable implies that foreign private holdings ratio $FP_{it-1}$ is assumed to have indirect effects on long-term interest rate through the expected government debt. In addition, as discussed in section 2, the foreign holdings ratio might have a negative impacts on long-term interest rates because foreign holdings could supplement domestic savings. Therefore, this threshold variable $q_{it}$=$FP_{it-1}$ is also added to explanatory variables.

The logistic specification can be used for the transition function:

$$g(q_{it}; \gamma_j, c_j) = \left[1 + \exp(-\gamma_j (q_{it} - c_j))\right]^{-1}, \gamma > 0 \quad (2)$$

The sensitivity of the public debt to the long-term interest rate for the $i^{th}$country at time $t$ is defined as follows:

$$e_{it} = \frac{\partial L_{it}}{\partial Debt_{it}} = \beta_0 Debt_{it} + \sum_{j=1}^{r} \beta_j Debt_{it} g(q_{it}; \gamma_j, c_j) \quad (3)$$

The estimation of the parameters of the PSTR model consists in eliminating the individual effects $\alpha_i$ by removing individual-specific means and then in applying non-linear least squares to the transformed model. Denoting $\widetilde{L}_{it} = L_{it} - \bar{L}_i$, $\widetilde{Debt}_{it} = Debt_{it} - \overline{Debt}_i$, $\widetilde{q}_{it} = q_{it} - \bar{q}_i$ and $\tilde{\mathbf{z}}_{\mathbf{it}} = \mathbf{z_{it}} - \bar{\mathbf{z}}_{\mathrm{it}}$. The transformed explanatory variables in the second regime depends on the

parameters and the transition function:$\hat{G}_{it}(\gamma,c) = \widetilde{Debt}_{it}g(q_{it};\gamma_j,c_j) - \frac{1}{T}\sum_{t=1}^{T} Debt_{it}g(q_{it};\gamma,c)$ . Consequently, the matrix of transformed explanatory variables denoted $x^*(\gamma,c)=\left[\widetilde{Debt}_{it} : \widetilde{G}_{it} : \widetilde{q}_{it} : \mathbf{\tilde{z}_{it}}\right]'$. Given a couple $(\gamma,c)$, the parameters can be estimated by ordinary least squares, which yields:

$$\hat{\Psi}(\gamma,c) = \left[\sum_{i=1}^{N}\sum_{t=1}^{T} x_{it}^*(\gamma,c)x_{it}^*(\gamma,c)'\right]^{-1}\left[\sum_{i=1}^{N}\sum_{t=1}^{T} x_{it}^*(\gamma,c)\widetilde{L}_{it}\right] \tag{4}$$

where$\hat{\Psi}(r,c) = (\beta_j : \delta : \phi)'$ for $j = \{0,\dots r\}$ is conditional to the values$(r,c)$. Conditionally to $\hat{\Psi}(r,c) = (\beta_j : \delta : \phi)'$, the parameters of the transition function $r$ and $c$ are estimated by non-linear least squares according to the program:

$$(\hat{\gamma},\hat{c}) = \underset{\{\gamma,c\}}{ArgMin}\sum_{i=1}^{N}\sum_{t=1}^{T}\left[\widetilde{L}_{it} - \hat{\Psi}'(\gamma,c)x^*(\gamma,c)\right] \tag{5}$$

Finally, given $\hat{\gamma},\hat{c}$, it is possible to estimate $\hat{\Psi}(\hat{\gamma},\hat{c}) = (\beta_j : \delta : \phi)'$ .

## 3.2 Specification Tests

We conduct the tests for model specifications. With regard to $H_0 : r = 0$ vs $H_1 : r = 1$, testing the null hypothesis $H_0 : \gamma_1{=}0$ or $H_0 : \beta_0 = \beta_1$ can examine the linearity in a PSTR model (1). However, this test is not standard since under $H_0$ the PSTR model contains unidentified nuisance parameters (Hansen (1996)[33]). Following Fouquau et al (2008)[26] and Gonzalez et al (2005)[29], replacing the transition function $g(q_{it};\gamma_1,c_1)$ by its first-order Taylor expansion around $\gamma_1 = 0$ gives

$$L_{it} = \alpha_i + \beta_0 Debt_{it} + \frac{\beta_1\gamma_1}{4}Debt_{it}q_{it} + \delta q_{it} + \phi\mathbf{z_{it}} + \varepsilon_{it} + (\frac{1}{2} - \frac{\gamma_1 c_1}{4})\beta_1 Debt_{it} \tag{6}$$

This first-order Taylor expansion (6) can be rewritten as

$$L_{it} = \alpha_i + \beta_0 Debt_{it} + \beta_1^* Debt_{it}q_{it} + \delta q_{it} + \phi\mathbf{z_{it}} + \varepsilon_{it}^* \tag{7}$$

where $\beta_1^*=\frac{\beta_1\gamma_1}{4}$ and $\varepsilon_{it}^*=\varepsilon_{it}+(\frac{1}{2}-\frac{\gamma_1 c_1}{4})\beta_1 Debt_{it}$. Since $\beta_1^*$ is proportional to the slope parameter $\gamma$, testing the null hypothesis $H_0 : \beta_1^*=0$ is the same as testing $H_0 : \gamma_1=0$.

The approximate likelihood ratio of $H_0$ is based on

$$LM_F = TN(SSR_0 - SSR_1)/(SSR_0/(TN - N - 1)) \tag{8}$$

where $SSR_0$ is the sum of squared residuals of the linear model and $SSR_1$ is that of the PSTR model with two regimes.

If a p-value associated with $LM_F$ leads us to reject the null hypothesis, we then examine whether three regimes exist. We limit our analysis to a model with three regimes at maximum, considering the computation cost of such models.

## 3.3 Data

Data for the composition of holdings of government bonds by residency of the holders (foreign vs. domestic) is drawn from Arslanalp and Tsuda (2014a)[2] and Arslanalp and Tsuda (2014b)[3]. As we use data for 10-year government bond issued by local-currency, foreign holdings ratio $F_{it}$ is measured as foreign holdings share of government debt securities denominated in local currency. While Arslanalp and Tsuda (2014a)[2] provide foreign holdings ratio in EMs, Arslanalp and Tsuda (2014b)[3] do not have the corresponding ratio in AEs and EA but provides total general government debt securities including both debts denominated in foreign currency and local currency. Hence, assuming that only foreign investors hold government debt securities denominated in foreign currency (data that can be obtained from the Bank for International Settlements *Debt Securities Statistics*) , we can make an approximate estimate of the foreign holdings share of general government debt securities denominated in local currency by removing the amount of debt securities denominated in foreign currency from the total.

In terms of risk perception, the fact that foreign private investors behave differently than foreign official investors should be considered. Foreign private investors have been the main drivers of capital flight. Therefore, we divide the foreign holdings ratio $F_{it}$ into a foreign private holdings ratio $FP_{it}$ and a foreign official holdings ratio $FO_{it}$ using data from Arslanalp

and Tsuda (2014a)[2] and Arslanalp and Tsuda (2014b)[3]. As a result, the lagged share of private foreign investors $FP_{it-1}$ can be used for the threshold variable $q_{it}$ .

We use nominal 10-year government bond rates as the dependent variable: nominal long-term interest rates $L_{it}$. We do not use the forward interest rates employed by Ichiue and Shimizu (2015) [34], Engen and Hubbard (2005) [25] and Laubach (2009)[40] since these are not available for a large number of countries. Because the long-term interest rates are influenced by forward-looking variables such as expectations, we employ projections of government gross financial liabilities to GDP ratio $Debt_{it}$, specifically 1-year-ahead projections as calculated by the IMF *World Economic Outlook*, which covers EMs as well as AEs and the EA. Since the IMF has started to publish its public debt projections for most countries twice a year since 2010, we use bi-annual data. Also, we examine the OECD *Economic Outlook* and the European Commission*European Economic Forecast* for robustness checks in AEs and the EA. A vector of control variables $z_{it}$ includes policy rates $S_{it}$, expected inflation rates $P_{it}$ and expected real GDP growth rate $Y_{it}$.

Central banks in AEs and the EA have been important players in government bond markets, purchasing government bonds financed by the creation of central bank reserves through quantitative easing — which central banks implemented to put downward pressure on interest rates when policy rates were at or near zero. The portfolio balance channel operates when central bank bond purchases, which change the relative supply of assets held by the private sector, induce equilibrating changes in relative yields[5]. In the case of the United States, Gagnon et al (2011)[28] show a cumulative decline in 10-year Treasury yields by about 91 basis points after announcements of quantitative easing. According to Joyce et al (2011)[36], the corresponding impacts in the United Kingdom are estimated to be 100 basis points. Hence, we add the lagged domestic official sector holdings ratio $DO_{it-1}$ as a control variable.

[5]Christensen and Rudebusch (2012)[15], D'Amico et al (2012)[19] and Joyce et al (2017)[37] provide further discussion.

# 4. Estimation results

## 4.1 Specification tests and baseline results

Following country groups used by the World Bank[6], we divide the data of 37 countries into 3 sub-groups: (a) Advanced Economies excluding the Euro Area (AEs) , (b) Emerging Markets (EMs) and (c) the Euro Area (EA), considering the following two reasons. First, each result from 3 sub-groups is comparable to previous studies rather than full panel data. Second, the share of foreign private investors in the EA has been quite higher than others (Figure 1). In terms of capital regulation by Basel, 0 percent risk weight has been a main driver of banks' holdings of foreign debt securities denominated in local currency[7]. Considering this regulatory impact, we divide data for Advanced Economies into (a) and (c).

Table 1 presents the results of the tests for nonlinearity. With regard to $H_0 : r = 0$ vs $H_1 : r = 1$, all tests for EMs and the EA are significant with p-values smaller than 0.01. The corresponding test for AEs using IMF and OECD forecasts is not significant. In the case of $H_0 : r = 1$ vs $H_1 : r = 2$ for EMs and EA using IMF, OECD and EC forecasts, $LM_F$ tests are not significant with p-values larger than 0.05. Hence, we employ PSTR models with two regimes.

Following the results for specification tests, Table 2 shows the estimation results for PSTR or Linear models. The main parameters of interest here are the coefficient for expected public debt. In column 3,4,5 and 6 of Table 2, coefficients for expected public debt in the first regime are not significant with p-values larger than 0.05, which means that there is no impact of public debt on long-term government bond yields when foreign private holdings ratios are below the location parameter. On the other hand, the corresponding coefficients are significant in the second regime. When foreign private holdings ratio in EMs and the EA are above 36.7 percent and approximately 40 percent, respectively, the impact of the expected public debt would be larger$(\beta_1 + \beta_2)$. In EMs, Hungary, Indonesia, Peru, Poland and South Africa are considered "debt intolerated" countries because the share of foreign private holdings of public debt has been above 36.7 percent

[6]See Table A.1 in Appendix for details.

[7]Bonner (2016)[9] shows capital regulation encourages banks to substitute other bonds with government bonds.

for a certain period. In the EA, the share of foreign holdings of the public debt of Austria, Belgium, Finland, Greece, Ireland and Portugal belongs to the same group. At the same time, an increase in foreign private holdings of government debt is also associated with a reduction of long-term interest rates, which is consistent with the literature (Arslanalp and Poghosyan (2016)[1] and Ebeke and Lu (2015)[24]). Therefore, our results show both positive and negative impacts from an increase in the share of foreign debt on government bond yields. In column 1 and 2 of Table 2, the impact of the expected public debt on long-term interest rates in AEs is insignificant positively because foreign private holding ratios for these countries are at the low level, except in New Zealand .

While the impact of expected growth rates on long-term interest rates for the EA is negative (columns 4,5 and 6 of Table 2), the corresponding impact for AEs is positive (column 2 of Table 2). These results are in line with literature (de Haan et al (2014)[22], and Gruber and Kamin (2012)[32]). As expectations of high growth rates would also anticipate increased tax revenues and reduced debt, growth expectations could also put downward pressure on government bond yields in EA countries where the sovereign risk premium is large. On the other hand, investors may expect central banks to raise policy rates in the near future, accompanied by an increase in long-term interest rates in AEs. The impact of the domestic central bank holdings ratio on long-term interest rates is negative for AEs (column 1 and 2 of Table 2). This result shows that quantitative easing by central banks contributed to a reduction in long-term interest rates.

## 4.2 Robustness

We present additional tests for nonlinearity and PSTR models to check robustness in four ways. First, we use longer sample periods in AEs. While the IMF started to publish its public debt projections for most countries in 2010, forecast data from the OECD *Economic Outlook* is available from 2004.

Second, following Ebeke and Lu (2015)[24], expected exchange rates can be added because foreign investors can obtain their returns in exchange rate-adjusted terms in EMs. Expectations of currency depreciation would cause investors to demand higher yields. Therefore, we introduce 1-year-

ahead projections for exchange rages of local currencies to the U.S. dollar, using Consensus Economics' *Consensus Forecast*.

Third, we can control for investor losses due to sovereign defaults in Greece, Ireland and Portugal. Beers and Mavalwalla (2016)[5] developed a comprehensive database of sovereign defaults. They define default as having occurred when debt service is not paid on the due date or when payments are not made within the time frame specified under a guarantee absent an outright payment default. Sovereign defaults with investor losses are in particular associated with significantly higher yields. We construct a sovereign default ratio defined as debt in default scaled by lagged public debt. Fourth, we examine data for the pre-crisis period from the second half of 2004 to 2009, using the OECD *Economic Outlook* and the European Commission *European Economic Forecast*. Bernoth et al (2012)[8] conclude that after the beginning of the European Monetary Union, investors seem to have paid less attention to government debt levels than before because the monetary union may have reduced perceived default risk since markets may expect governments or the central bank to rescue a member government in fiscal trouble.

Table 3 shows that a test for $H_0 : r = 0$ vs $H_1 : r = 1$ in AEs is not significant while corresponding tests for EM and the EA is significant, which are consistent with baseline results. Moreover, in EMs, a test for $H_0 : r = 1$ vs $H_1 : r = 2$ is significant with p-value larger than 0.05. Hence, we employ a PSTR model with three regimes. In the EA, tests including default rate for $H_0 : r = 1$ vs $H_1 : r = 2$ are insignificant. Hence, we employ PSTR models with two regimes. As tests for pre-crisis are significant with p-value larger than 0.05, PSTR models with three regimes can be estimated.

Table 4 provides estimation results for PSTR or Linear models for robustness. The results are in line with the baseline. In EMs (column 2 of Table 4), expectations for currency depreciation would cause investors to demand higher yields, but this impact is small. EMs become vulnerable for an increase in public debt when the foreign holdings share is 36.9 percent or higher, which is close to the baseline result .

Columns 3,4 and 5 also show the E.A could be fragile for the increase in public debts when the ratios of foreign private holdings are above certain levels (40.1 percent, 40.6 percent, and 38.6 percent), which are almost same

as the baseline results. At the same time, an increase in foreign private holdings of government debt is also associated with a reduction of long-term interest rates. In Columns 5 of Table 4, a default rate is slightly significant with a p-value smaller than 0.1, using OECD data. Columns 6 and 7 of Table 4 for PSTR models for the pre-crisis period show that the expected public debt has quite a smaller positive impact than the corresponding impacts of the post-crisis period, although there is also non-linearity, depending on the foreign private investors. This implies that investors might pay less attention to government debt levels before a financial crisis (Bernoth et al (2012)[8]).

To clarify the transition of coefficients, Figure 2, 3 and 4 show show the estimated transition function and the corresponding coefficients for the PSTR models for baselines and robustness checks in EMs and the EA. Overall, sovereign risk premium passes the tolerance/intolerance threshold in emerging markets when foreign private holdings ratio is above 37 percent and in the Euro Area when it surpasses about 40 percent, respectively. In some EMs (Hungary, Indonesia, Peru, Poland and South Africa) and the EA (Austria, Belgium, Finland, Greece, Ireland and Portugal ) where the foreign holdings shares is higher for a certain period, interest rates have been particularly susceptible to increase.

## 4.3 Net impact of an increase in share of private foreign investors on government bond yields

To sum up, our results show that while an increase in the share of foreign private investors holding a country's debt reduces long-term interest rates, it also increases the risk premium in reaction to an increase of the public debt. In other words, while the foreign private holdings ratio has a direct downward impact on long-term interest rates, probably because it contributes to a more liquid market, a rise in the ration of foreign holdings could indirectly have a upward effect on long-term rates through an expected rise in government debt. Therefore, we quantify the net impact by combining these opposing effects.

The contribution of the interaction between the expected public debt $Debt_{it}$ and foreign holdings share $FP_{it-1}$can be calculated from $\beta_0 Debt_{it} + \sum_{j=1}^{r} \beta_j Debt_{it} g(FP_{it-1}; \gamma_j, c_j) + \delta FP_{it-1}$ using the equation(1).

Figure 5 and 6 show the interaction between expected public debt and the foreign holdings share in EMs and the EA. It is clear that a higher foreign private holdings ratio can reduce long-term interest rates and a larger expected public-debt-to-GDP ratio can have a larger impact on long-term interest rates. In terms of the interaction, when the foreign holdings share is above location parameters, the expected public-debt-to-GDP ratio would have an even greater impact.

## 4.4 Fiscal balance

If a country's fiscal deficit appears persistent, investors may identify it as delivering the same signal as expected public debt. Employing projections of the fiscal balance-to-GDP ratio $FB_{it}$, specifically one-year-ahead projections by the IMF, the OECD and the European Commission, we examine the non-linear behavior of the sovereign risk premium in connection to the fiscal deficit. Replacing expected public debt $Debt_{it}$ in the equation (1) with expected fiscal balance $FB_{it}$, we investigate how the share of private investors would change sovereign risk in relation to fiscal deficit, using the same variables as the robustness check for public debt.

Table 5 shows tests for $H_0 : r = 0$ vs $H_1 : r = 1$ in EMs are significant. The corresponding tests for AEs and the EA, are not significant with p-values larger than 0.05. Hence, we employ PSTR models for EMs and linear models for AEs and the EA.

Table 6 provides the estimation results for PSTR or Linear models for fiscal balance. In AEs, the impact of expected fiscal balance on long-term interest rates is significant (Column 1 of Table 6) while the corresponding results for public debt are insignificant (Tables 2 and 4).

In EMs, when the ratio of foreign private holdings is above about 38 percent, the impact of the expected fiscal deficit is bigger. This result is in line with the case of public debt. In the EA, while the impact of expected fiscal balance on long term interest rates is significant for European Commission data, the corresponding results for IMF and OECD data are insignificant. In Column 3,4 and 5 of Table 6, foreign private holdings of government debt are not significant negatively for the Euro Area, which are different from previous results using expected public debt. Also, default rate turns significant with p-values smaller than 0.05. This result suggests

that omitting expected public debt could affect other coefficients.

To sum up, in terms of risk perception, expected fiscal balance could also be important information in addition to expected public debt, because investors may conclude that deficits will endure. The size of impact long-term interest rates for EMs and the EA is larger than AEs, which is partly in line with the recent literature[8]. The non-linear behavior of the sovereign risk premium in relation to the fiscal deficit is clear only for EMs, but not for the EA or AEs.

# 5. Conclusion

In summary, we examine both the positive and negative channels of the effect of an increase in the share of foreign private investors on government bond yields and explore the non-linear behavior of the sovereign risk premium. We address the following question: at what percentage does the share of foreign private investors reach a tipping point for a spike in the sovereign risk premium? To answer this, we estimate a panel smooth transition regression (PSTR) to explore the borders that differentiate risk premia for 11 Advanced Economies excluding the Euro Area, 15 Emerging Markets and 11 countries in the Euro Area. In addition, we use forecast data from several international institutions including the IMF, the OECD and the European Commission to assess forward-looking variables such as expectations of growth, inflation and public debt.

Our results show that while an increase in the share of foreign private investors reduces long-term interest rates, it also increases risk premia by raising expectations of higher public debt. Thus, an influx of foreign investors can be a double-edged sword for long-term interest rates. The sovereign risk premium increases when the foreign private holdings share is above 37 percent in emerging markets and above 40 percent in the Euro Area. In contrast, the impact of expected public debt on long-term interest rates in advanced economies excluding the Euro Area is insignificant because foreign private holding ratios in these countries are low. Therefore, we can explain why interest rates may rise abruptly above their debt

[8]According to Cimadomo et al (2016)[16], the corresponding impacts in Italy and France are also larger than UK from September 2008 to October 2014, using future government bond spreads data obtained by Consensus Economics *Consensus Forecast*.

tolerance thresholds, even if debt levels for emerging markets and the Euro Area appear manageable by advanced economy standards, as Reinhart et al (2003)[42] discuss in describing the debt intolerance phenomenon.

Future research can examine monetary-fiscal policy interactions. Kamin (2010)[38] argues that with long-term bond yields increasingly set in international markets, their responsiveness to the central bank policy rate may decline. Our results suggest that an increase in the share of foreign private investors could affect the term premia by raising expectations of the public debt. Therefore, we can estimate how the interaction between expected public debt and the foreign holdings share alters the impact of the monetary policy shock on the yield curve.

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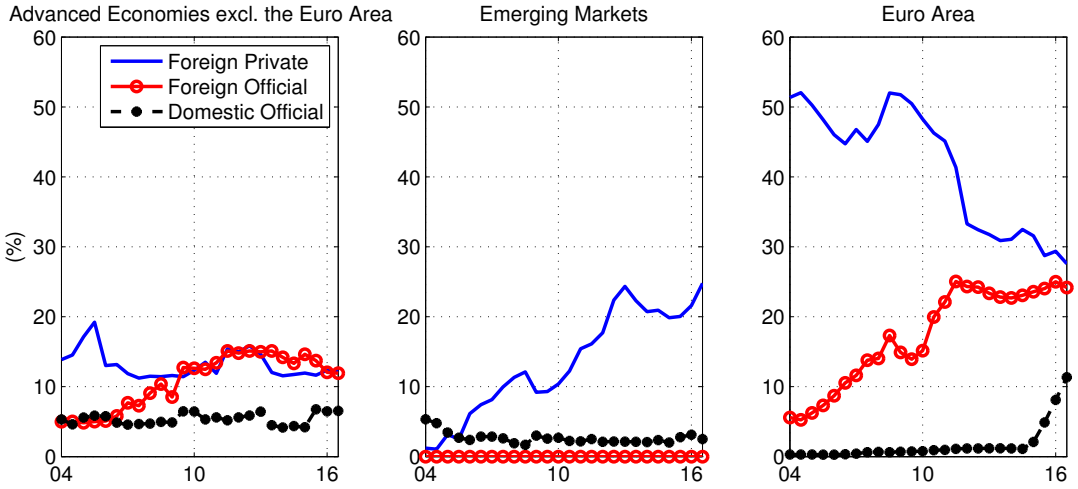
Figure 1: The share of government debt securities denominated in local currency




Notes: Following country groups by World Bank, we divide 37 countries data into 3 sub-groups: Advanced Economies excluding the Euro Area, Emerging Markets and the Euro Area(Table A.1 in Appendix for details.). Line charts show the median within each country group. Calculations based on data from Arslanalp and Tsuda (2014a), Arslanalp and Tsuda (2014b) and BIS Debt Securities Statistics (See 3.3 for details).

Table 1: $LM_F$ tests for nonlinearity (Baseline results)

| Forecast Data | $H_0$ vs $H_1$ | AEs | EMs | EA |
|---|---|---|---|---|
| IMF | $r=0$ vs $r=1$ | 0.00 (0.97) | $13.88^{***}$ (0.00) | $26.24^{***}$ (0.00) |
| | $r=1$ vs $r=2$ | | $3.22^{*}$ (0.07) | 1.21 (0.27) |
| OECD | $r=0$ vs $r=1$ | 1.63 (0.21) | | $14.82^{***}$ (0.00) |
| | $r=1$ vs $r=2$ | | | 0.55 (0.01) |
| European Commission (EC) | $r=0$ vs $r=1$ | | | $9.32^{***}$ (0.00) |
| | $r=1$ vs $r=2$ | | | 2.63 (0.11) |

Notes: The corresponding p-values are reported in parentheses.$^{***}$p<0.01, $^{*}$p<0.05, $^{*}$p<0.1

Table 2: PSTR or Linear model (Baseline results)

| Dependent Variable: 10−year government bond yields | | | | | | |
|---|---|---|---|---|---|---|
| Model | (1)Linear | (2)Linear | (3)PSTR | (4)PSTR | (5)PSTR | (6)PSTR |
| Sample Group | AEs | AEs | EMs | EA | EA | EA |
| Forecast Data | IMF | OECD | IMF | IMF | OECD | EC |
| Location parameters($c$) | | | 36.7 | 39.8 | 39.5 | 38.3 |
| Slopes parameters($\gamma$) | | | 3.1 | 0.1 | 0.1 | 0.1 |
| Expected PublicDebt($\beta_1$) | $-0.002$ | $-0.020^{***}$ | $0.015^{*}$ | $-0.037$ | $-0.002$ | 0.003 |
| | (0.01) | (0.01) | (0.10) | (0.03) | (0.01) | (0.02) |
| Expected PublicDebt($\beta_2$) | | | $0.019^{***}$ | $0.103^{***}$ | $0.088^{***}$ | $0.069^{***}$ |
| | | | (0.00) | (0.03) | (0.01) | (0.03) |
| Policy rate | $0.971^{***}$ | $0.857^{***}$ | $0.498^{***}$ | $3.492^{***}$ | $2.838^{***}$ | $3.578^{***}$ |
| | (0.11) | (0.10) | (0.05) | (0.43) | (0.39) | (0.42) |
| Expected inflation | 0.037 | $0.224^{***}$ | $0.282^{***}$ | $-1.63^{***}$ | $-0.184$ | $-1.458^{***}$ |
| | (0.09) | (0.08) | (0.07) | (0.50) | (0.21) | (0.45) |
| Expected growth rate | $0.181^{*}$ | $0.161^{**}$ | $-0.026$ | $-0.748^{***}$ | $-0.689^{***}$ | $-0.599^{***}$ |
| | (0.11) | (0.02) | (0.06) | (0.18) | (0.17) | (0.17) |
| Lagged domestic official sector | $-0.033^{**}$ | $-0.037^{***}$ | $-0.076^{**}$ | $-0.023$ | $-0.024$ | 0.047 |
| | (0.02) | (0.01) | (0.04) | (0.04) | (0.03) | (0.18) |
| Lagged foreign official sector | $-0.047^{***}$ | $-0.053^{***}$ | $-0.016$ | $-0.023$ | $-0.033$ | 0.022 |
| | (0.01) | (0.01) | (0.02) | (0.03) | (0.03) | (0.42) |
| Lagged foreign private sector | $-0.081^{***}$ | $-0.088^{***}$ | $-0.053^{***}$ | $-0.214^{***}$ | $-0.162^{*}$ | $-0.115^{*}$ |
| | (0.00) | (0.01) | (0.01) | (0.08) | (0.09) | (0.06) |
| No. of observations | 154 | 154 | 210 | 154 | 154 | 154 |
| Sample periods | 10:2-17:1 | 10:2-17:1 | 10:2-17:1 | 10:2-17:1 | 10:2-17:1 | 10:2-17:1 |

Notes: The corresponding standard error are reported in parentheses.$^{***}$p<0.01, $^{*}$p<0.05, $^{*}$p<0.1

Table 3: $LM_F$ tests for nonlinearity (Robustness check)

| Forecast Data | $H_0$ vs $H_1$ | AEs | EMs (incl.exchange rate forecast) | EA (incl.default rate) | E.A (pre−crisis) |
|---|---|---|---|---|---|
| IMF | $r = 0$ vs $r = 1$ | | $18.02^{***}$ (0.00) | $28.28^{***}$ (0.00) | |
| | $r = 1$ vs $r = 2$ | | $5.28^{**}$ (0.02) | 0.81 (0.37) | |
| | $r = 2$ vs $r = 3$ | | 0.09 (0.76) | | |
| OECD | $r = 0$ vs $r = 1$ | 1.03 (0.31) | | $21.81^{***}$ (0.00) | $6.25^{***}$ (0.00) |
| | $r = 1$ vs $r = 2$ | | | 0.16 (0.69) | $5.53^{**}$ (0.02) |
| | $r = 2$ vs $r = 3$ | | | | 2.17 (0.14) |
| European Commission (EC) | $r = 0$ vs $r = 1$ | | | $12.72^{***}$ (0.00) | $7.80^{***}$ (0.01) |
| | $r = 1$ vs $r = 2$ | | | 1.73 (0.19) | $5.75^{**}$ (0.02) |
| | $r = 2$ vs $r = 3$ | | | | 2.36 (0.12) |
| Sample periods | | 05:1-17:1 | 10:2-17:1 | 10:2-17:1 | 04:2-09:2 |

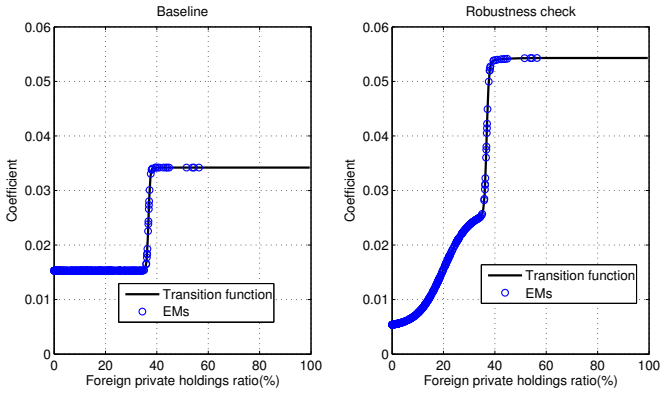
Notes: The corresponding p-values are reported in parentheses.$^{***}$p<0.01, $^{*}$p<0.05, $^{*}$p<0.1

Table 4: PSTR or Linear models (Robustness check)

| Dependent Variable: 10−year government bond yields | | | | | | | |
|---|---|---|---|---|---|---|---|
| Model | (1)Linear | (2)PSTR | (3)PSTR | (4)PSTR | (5)PSTR | (6)PSTR | (7)PSTR |
| Sample Group | AEs | EMs | EA | EA | EA | EA | EA |
| Forecast Data | OECD | IMF | IMF | OECD | EC | OECD | EC |
| Location parameters($c$) | | 19.6, 36.9 | 40.1 | 40.6 | 38.6 | 41.9, 74.2 | 41.9, 74.2 |
| Slopes parameters($\gamma$) | | 0.3, 2.3 | 0.1 | 0.1 | 0.1 | 23.8, 19.1 | 30.3, 60.9 |
| Expected PublicDebt($\beta_1$) | $-0.006$ | 0.005 | $-0.035^{*}$ | $-0.023$ | $0.060^{***}$ | 0.001 | 0.004 |
| | (0.00) | (0.01) | (0.02) | (0.02) | (0.02) | (0.01) | (0.01) |
| Expected PublicDebt($\beta_2$) | | $0.021^{***}$ | $0.106^{***}$ | $0.111^{***}$ | $0.027^{***}$ | $0.006^{***}$ | $0.004^{***}$ |
| | | (0.00) | (0.02) | (0.04) | (0.01) | (0.00) | (0.01) |
| Expected PublicDebt($\beta_3$) | | $0.028^{***}$ | $0.028^{***}$ | | | $0.003^{***}$ | $0.006^{***}$ |
| | | (0.01) | (0.01) | | | (0.01) | (0.00) |
| Policy rate | $0.369^{***}$ | $0.483^{***}$ | $3.340^{***}$ | $2.631^{***}$ | $3.346^{***}$ | $0.334^{***}$ | $0.315^{***}$ |
| | (0.04) | (0.05) | (0.42) | (0.38) | (0.44) | (0.04) | (0.04) |
| Expected inflation | $0.271^{***}$ | $0.278^{***}$ | $-1.352^{***}$ | $-0.182$ | $-1.110^{***}$ | $-0.061^{***}$ | $-0.025$ |
| | (0.08) | (0.06) | (0.40) | (0.21) | (0.37) | (0.02) | (0.05) |
| Expected growth rate | 0.052 | $-0.000$ | $-0.661^{***}$ | $-0.563^{***}$ | $-0.051^{***}$ | $-0.191^{***}$ | $-0.193^{***}$ |
| | (0.05) | (0.06) | (0.20) | (0.17) | (0.17) | (0.02) | (0.04) |
| Lagged domestic officialsector | $-0.052^{***}$ | $-0.123$ | 0.018 | $-0.034$ | 0.037 | $-0.112^{**}$ | $-0.151^{**}$ |
| | (0.01) | (0.04) | (0.04) | (0.04) | (0.04) | (0.06) | (0.06) |
| Lagged foreign officialsector | $-0.078^{***}$ | $-0.032$ | $-0.024$ | 0.001 | $-0.018$ | $-0.006$ | $-0.006$ |
| | (0.01) | (0.02) | (0.03) | (0.03) | (0.05) | (0.01) | (0.01) |
| Lagged foreign private sector | $-0.036^{***}$ | $-0.081^{***}$ | $-0.206^{***}$ | $-0.191^{**}$ | $-0.121^{**}$ | $-0.006^{***}$ | $-0.014$ |
| | (0.01) | (0.01) | (0.07) | (0.08) | (0.05) | (0.01) | (0.01) |
| Expected exchangerate | | $0.002^{***}$ | | | | | |
| | | (0.00) | | | | | |
| Default rate(EA) | | | 0.029 | $0.056^{*}$ | 0.035 | | |
| | | | (0.33) | (0.03) | (0.03) | | |
| No. of observations | 275 | 210 | 154 | 154 | 154 | 121 | 121 |
| Sample periods | 05:1-17:1 | 10:2-17:1 | 10:2-17:1 | 10:2-17:1 | 10:2-17:1 | 04:2-09:2 | 04:2-09:2 |

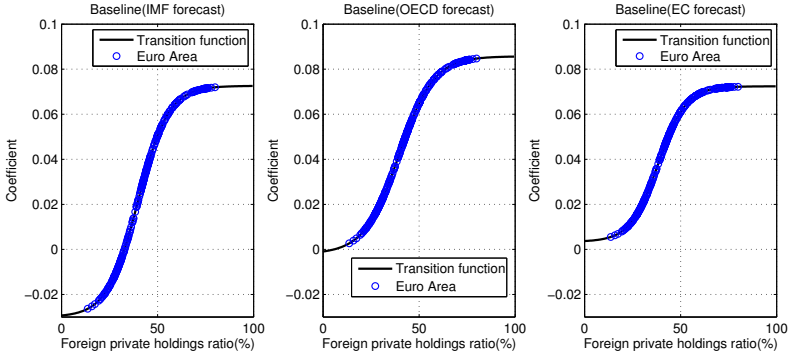
Notes: The corresponding standard error are reported in parentheses.$^{***}$p<0.01, $^{*}$p<0.05, $^{*}$p<0.1

Figure 2: Estimated public debt coefficients for EMs



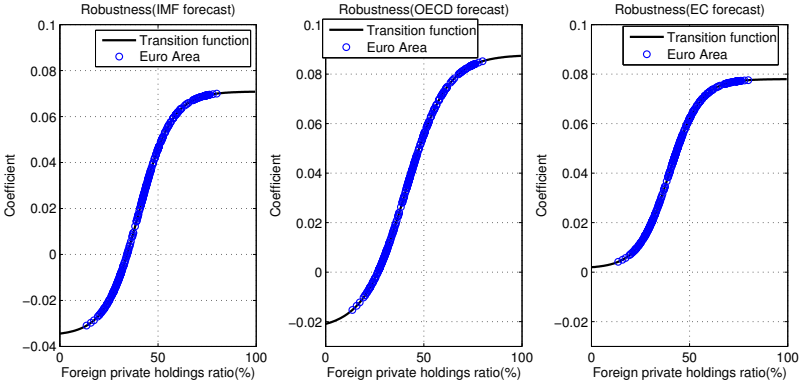

Notes: Corresponding results are column 3 of Table 2 and column 2 of Table 4.

Figure 3: Estimated public debt coefficients for the EA (Baseline)



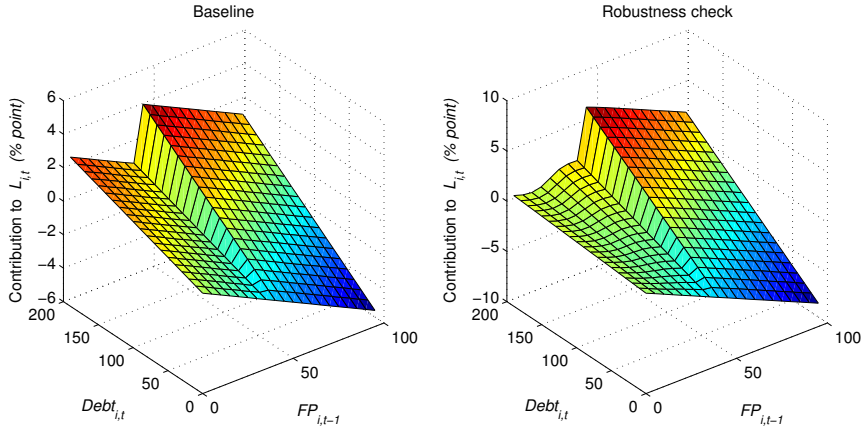

Notes: Corresponding results are columns 4,5 and 6 of Table 2.

Figure 4: Estimated public debt coefficients for the EA (Robustness)



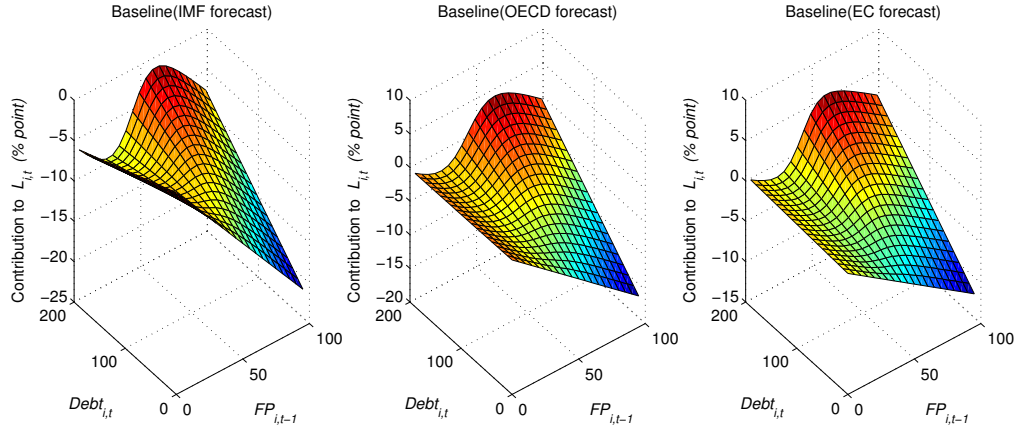

Notes: Corresponding results are Columns 3,4 and 5 of Table 4.

Figure 5: The impact of public debt and foreign holdings share for EMs

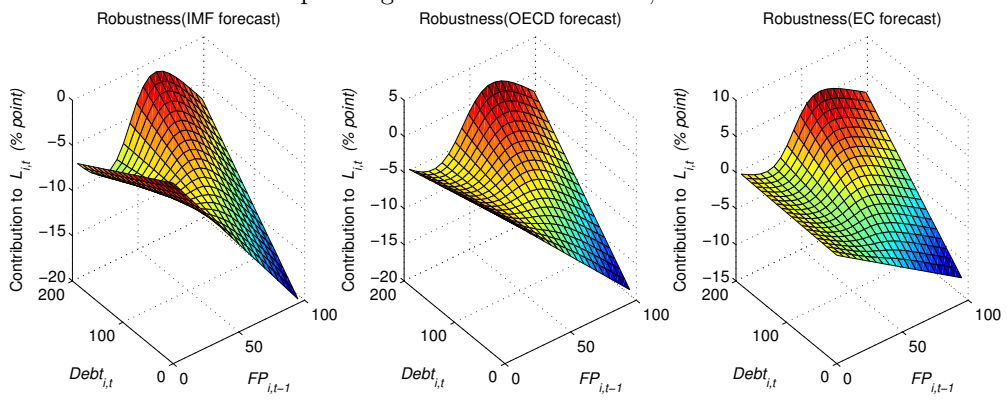



Notes: Corresponding results are column 3 of Table 2 and column 2 of Table 4.

Figure 6: The impact of public debt and foreign holdings share for the EA




Notes: Corresponding results are columns 4,5 and 6 of Table 2.




Notes: Corresponding results are Columns 3,4 and 5 of Table 4.

Table 5: $LM_F$ tests for nonlinearity (Fiscal Balance)

| Forecast Data | $H_0$ vs $H_1$ | AEs | EMs (incl.exchange rate forecast) | EA (incl.default rate) |
|---|---|---|---|---|
| IMF | $r = 0$ vs $r = 1$ | | $13.67^{***}$ (0.00) | 0.16 (0.69) |
| | $r = 1$ vs $r = 2$ | | 1.94 (0.16) | |
| OECD | $r = 0$ vs $r = 1$ | 0.16 (0.69) | | 0.35 (0.55) |
| | $r = 1$ vs $r = 2$ | | | |
| European Commission (EC) | $r = 0$ vs $r = 1$ | | | 0.95 (0.33) |
| | $r = 1$ vs $r = 2$ | | | |
| Sample periods | | 05:1-17:1 | 10:2-17:1 | 10:2-17:1 |

Notes: The corresponding p-values are reported in parentheses.$^{***}$p<0.01, $^{*}$p<0.05, $^{*}$p<0.1

Table 6: PSTR or Linear models (Fiscal Balance)

| Dependent Variable: 10−year government bond yields | | | | | |
|---|---|---|---|---|---|
| Model | (1)Linear | (2)PSTR | (3)Linear | (4)Linear | (5)Linear |
| Sample Group | AEs | EMs | EA | EA | EA |
| Forecast Data | OECD | IMF | IMF | OECD | EC |
| Location parameters($c$) | | 37.5 | | | |
| Slopes parameters($\gamma$) | | 2.8 | | | |
| Expected FiscalBalance($\beta_1$) | $-0.159^{***}$ (0.02) | $-0.044$ (0.05) | $-0.006$ (0.12) | $-0.167$ (0.13) | $-0.348^{***}$ (0.11) |
| Expected FiscalBalance($\beta_2$) | | $-0.461^{***}$ (0.09) | | | |
| Policy rate | $0.558^{***}$ (0.04) | $0.480^{***}$ (0.05) | $3.271^{***}$ (0.42) | $2.240^{***}$ (0.40) | $2.965^{***}$ (0.40) |
| Expected inflation | $0.218^{***}$ (0.07) | $0.282^{***}$ (0.07) | $-1.0342^{***}$ (0.36) | $-0.164$ (0.24) | $-1.002^{***}$ (0.34) |
| Expected growth rate | $0.125^{***}$ (0.04) | $-0.021$ (0.05) | $-0.856^{***}$ (0.16) | $-0.710^{***}$ (0.13) | $-0.515^{***}$ (0.14) |
| Lagged domestic official sector | $-0.039^{***}$ (0.01) | $-0.098^{***}$ (0.03) | $-0.032$ (0.04) | $-0.001$ (0.04) | $0.071^{*}$ (0.07) |
| Lagged foreign official sector | $-0.089^{***}$ (0.01) | $-0.008$ (0.02) | $-0.002$ (0.04) | $-0.003$ (0.04) | $-0.013$ (0.03) |
| Lagged foreign private sector | $-0.023^{***}$ (0.01) | $-0.042^{***}$ (0.01) | $0.056^{**}$ (0.03) | $0.058^{**}$ (0.02) | $0.043^{*}$ (0.02) |
| Expected exchangerate(EMs) | | $0.001^{***}$ (0.00) | | | |
| Default rate(EA) | | | $0.034^{**}$ (0.02) | $0.058^{***}$ (0.01) | $0.039^{***}$ (0.02) |
| No. of observations | 275 | 210 | 154 | 154 | 154 |
| Sample periods | 05:1-17:1 | 10:2-17:1 | 10:2-17:1 | 10:2-17:1 | 10:2-17:1 |

Notes: The corresponding standard error are reported in parentheses.$^{***}$p<0.01, $^{*}$p<0.05, $^{*}$p<0.1

# Appendix

Table A.1: Country groups

| | |
|---|---|
| Advanced Economies excluding the Euro Area (11 countries) | Australia, Canada, Czech Republic,Denmark, Japan, Korea, New Zealand,Norway, Sweden, United Kingdom, United States |
| Emerging Markets (15 countries) | Brazil, China, Colombia, Hungary,India, Indonesia, Malaysia, Mexico, Peru, Philippines, Poland, Russia, South Africa, Thailand, Turkey |
| Euro Area (11 countries) | Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain |

Notes: Country groups by World Bank

Table A.2: Descriptive statistics

| | Variable Names | Obs | Mean | Std.Dev | Max | Min |
|---|---|---|---|---|---|---|
| Advanced Economies | Long-term interest rate | 275 | 3.1 | 1.6 | 6.4 | -0.1 |
| excluding the Euro Area | Policy rate | 275 | 1.9 | 1.9 | 8.3 | -0.5 |
| | Foreign pricate holdings ratio | 275 | 15.8 | 11.5 | 62.4 | 0.1 |
| | Foreign official holdings ratio | 275 | 12.0 | 10.3 | 39.4 | 0.0 |
| | Domestic official holdings ratio | 275 | 6.5 | 6.9 | 35.4 | 0.0 |
| | Expected public debt to GDP(IMF) | 154 | 72.1 | 60.0 | 253.0 | 23.3 |
| | Expected fiscal balance to GDP(IMF) | 154 | -1.5 | 4.4 | 12.9 | -9.7 |
| | Expected inflation(IMF) | 154 | 2.0 | 0.7 | 5.5 | -0.5 |
| | Expected growth rate(IMF) | 154 | 2.4 | 0.8 | 4.5 | -0.1 |
| | Expected public debt to GDP(OECD) | 275 | 69.7 | 50.7 | 237.5 | 12.7 |
| | Expected fiscal balance to GDP(OECD) | 275 | -1.0 | 5.4 | 18.8 | -14.0 |
| | Expected inflation(OECD) | 275 | 1.9 | 0.9 | 4.6 | -1.4 |
| | Expected growth rate(OECD) | 275 | 2.4 | 1.1 | 5.3 | -1.1 |
| Emerging Markets | Long-term interest rates | 210 | 6.5 | 2.6 | 25.7 | 0.1 |
| | Policy rate | 210 | 5.2 | 2.7 | 4.0 | 0.0 |
| | Foreign pricate holdings ratio | 210 | 20.6 | 12.8 | 79.9 | 13.6 |
| | Foreign official holdings ratio | 210 | 0.8 | 1.8 | 42.7 | 2.1 |
| | Domestic official holdings ratio | 210 | 5.7 | 7.8 | 24.0 | 0.0 |
| | Expected exchange rate to US dollar (year over year) | 210 | 8.5 | 74.4 | 63.0 | 0.0 |
| | Expected public debt to GDP(IMF) | 210 | 44.1 | 18.1 | 82.7 | 7.9 |
| | Expected fiscal balance to GDP(IMF) | 210 | -2.8 | 2.0 | 1.6 | -9.1 |
| | Expected inflation(IMF) | 210 | 4.2 | 2.0 | 10.7 | 0.8 |
| | Expected growth rate(IMF) | 210 | 4.2 | 2.0 | 9.6 | -1.1 |
| The Euro Area | Long-term interest rate | 286 | 3.8 | 2.9 | 25.7 | 0.1 |
| | Policy rate | 286 | 1.4 | 1.3 | 4.0 | 0.0 |
| | Foreign pricate holdings ratio | 286 | 44.5 | 15.7 | 79.9 | 13.6 |
| | Foreign official holdings ratio | 286 | 19.0 | 11.5 | 42.7 | 2.1 |
| | Domestic official holdings ratio | 286 | 2.8 | 3.9 | 24.0 | 0.0 |
| | Default ratio | 286 | 1.2 | 7.6 | 63.0 | 0.0 |
| | Expected public debt to GDP(IMF) | 154 | 99.5 | 32.8 | 206.6 | 50.3 |
| | Expected fiscal balance to GDP(IMF) | 154 | -2.8 | 2.0 | 0.7 | -11.2 |
| | Expected inflation(IMF) | 154 | 1.3 | 0.6 | 2.5 | -1.1 |
| | Expected growth rate(IMF) | 154 | 1.3 | 1.1 | 3.8 | -4.0 |
| | Expected public debt to GDP(OECD) | 286 | 95.5 | 34.9 | 200.0 | 26.9 |
| | Expected fiscal balance to GDP(OECD) | 286 | -2.7 | 2.6 | 4.4 | -13.6 |
| | Expected inflation(OECD) | 286 | 2.0 | 1.3 | 14.9 | -1.5 |
| | Expected growth rate(OECD) | 286 | 1.4 | 1.4 | 5.5 | -6.3 |
| | Expected public debt to GDP(EC) | 286 | 85.8 | 33.4 | 199.7 | 21.7 |
| | Expected fiscal balance to GDP(EC) | 286 | -2.9 | 2.9 | 4.6 | -15.6 |
| | Expected inflation(EC) | 286 | 1.6 | 0.7 | 3.6 | -3.0 |
| | Expected growth rate(EC) | 286 | 1.5 | 1.3 | 5.3 | -4.2 |

Table A.3: Sources and description of the data

| Variable Names | Description | Sources |
|---|---|---|
| Long-term interest rate | 10-year nominal yield on treasury securities in local currency | Haver Analytics, Bloomberg |
| Expected public debt to GDP ratio | 1-year-ahead projections for general government debt to nominal GDP | IMF *World Economic Outlook*, OECD *Economic Outlook* European Commission *European Economic Forecast* |
| Expected fiscal balance to GDP ratio | 1-year-ahead projections for general government fiscal balance to nominal GDP | |
| Expected inflation | 1-year-ahead projections for CPI or harmonized headline inflation | |
| Expected growth rate | 1-year-ahead projections for real GDP growth rate | |
| Policy rate | Central bank bank key policy rate | Haver Analytics |
| Foreign private or official holdings ratio in Emerging Markets | Foreign holdings share of central government debt securities denominated in local currency | Author's calculations based on Arslanalp and Tsuda (2014a)[2] |
| Foreign private or official holdings ratio in Advanced Economies | Foreign holdings share of general government debt securities denominated in local currency | Author's calculations based on Arslanalp and Tsuda (2014b)[3] and BIS *Debt Securities Statistics* |
| Domestic central bank holdings ratio | Domestic central bank holdings share of general government debt securities | Arslanalp and Tsuda (2014a)[2] Arslanalp and Tsuda (2014b)[3] |
| Expected exchange rate (year over year) | 1-year-ahead projections for local currency to US dollar | Consensus Economics *Consensus Forecast* |
| Default rate | Total debt in default scaled by lagged public debt. | Beers and Mavalwalla (2016)[5] IMF *World Economic Outlook* |