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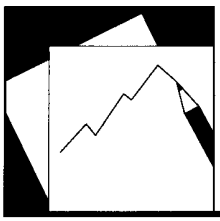

IMF Working Paper

Public Debt in Advanced Economies and its Spillover Effects on Long-term Yields

C. Emre Alper and Lorenzo Forni

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Public Debt in Advanced Economies and its Spillover Effects on Long-term Yields[1]

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Abstract

Several models establish a positive association between public debt ratios and long-term real yields, but the empirical evidence is not always conclusive. We reconsider this issue, focusing in particular on possible spillover effects of large advanced economies' debt levels to other economies' borrowing yields, especially in emerging markets. We extend the existing literature by using real time expectations of fiscal and other macroeconomic variables for a large sample of advanced and emerging economies. We show that an increase in the public debt levels of large advanced economies—especially the United States—spills over to both emerging markets and other advanced economies' long-term real yields and that this effect is significant at the current levels of advanced economies' debt ratios.

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I. INTRODUCTION

Following the recent financial crisis and the associated rise in the already high levels of public debt, concerns for fiscal sustainability remain elevated in many advanced economies. While most of these economies are already implementing fiscal consolidation, in most of them public debt-to-GDP ratios are projected to rise further in the next couple of years. With few exceptions, so far the reactions of the sovereign yields have been muted, but it is unlikely that the deterioration in the fiscal stance of advanced economies won't have implications on global borrowing costs going forward.

In theory, the reaction of domestic private saving and the size and openness of an economy determine the magnitude of the rise in long-term real interest rates as a result of a debt financed fiscal expansion. Assuming that the Ricardian equivalence holds, a rise in government debt implies a fully anticipated increase in the future tax burden, leading to an offsetting rise in private saving and leaving long-term real rates unchanged. Models with non-Ricardian features, instead, envisage that an increase in fiscal deficit and debt, all else equal, would drive real rates up. The latter result holds both in closed and in open economies. For example, Kumhof and Laxton (2007) consider a DSGE model with two-large economies in which consumers have finite horizon *à la* Blanchard (1985).[2] They show that a rise in the fiscal deficit financed by debt in one of the two economies leads to a substantial short-term increase in private consumption (as agents with a finite horizon do not internalize all future increase in taxes needed to repay the higher debt) and a medium-term fall in the saving rate in that economy. Therefore, to re-establish an equilibrium in world saving and investment, real rates will have to rise and real investment to fall. As long-run real rates are equalized internationally, there will also be spillover effects to the other economy where output and consumption will decline. The transmission channel works mainly though interest rates, as the trade channel appears to be weak.

The spillover effect from large advanced economies operates mainly through changes in the risk free rate. In the case of small open economies an increase in the debt ratio of large advanced economies will also affect their sovereign spreads. The impact of an increase in large economies' debt on small open ones (such as most emerging economies) will have to take into account the fact that these economies have been in the past more prone to sovereign risk. An increase in large economies' debt will tend to increase not only the global risk free rate but also their spreads. Indeed, yields in small open economies will increase more than the global risk free rate as investors need to be compensated for the probability of a sovereign credit event.[3]

Establishing empirically the quantitative impact of a debt-financed fiscal expansion on domestic

[2] Additionally Ferrero (2010) considers a finite horizon model with two economies and reaches similar qualitative conclusions. For a comparison of different models see, among others, Engen and Hubbard (2004).

[3] For a discussion of this point, see Arora and Cerisola (2001).

long-term real rates has proven to be difficult. At the global level, the balance between saving and investment is influenced by many factors. During the 2009 financial crisis, for example, global investment fell, reducing the upward pressure on interest rates due to high and rising debt levels. Other forces have recently weighed on sovereign bond yields including central bank interventions, "flight to quality", and concerns about debt sustainability in some Euro-area economies. The complex nature of the problem might partly account for the varying magnitude of fiscal impact on long-term real interest rates reported in the empirical literature. The estimates for the rise in real long-term yields for a one percentage increase in the debt-to GDP ratio range from about zero—see papers that support the Ricardian equivalence, including Barro (1989) and Seater (1993) —to about 3 to 7 basis points. These are obtained using different sample of countries, time periods, control variables and specifications of the estimated equation (nominal versus real yields; deficits and/or debt to proxy fiscal stance, actual values versus expected values of fiscal variables, linear versus quadratic relationship, etc.).

Laubach (2009) argues that establishing an empirical relation between the current level of debt and long-term real rates may be distorted by the state of the business cycle. During recessions, while budget deficits increase due to the operation of automatic stabilizers, long-term interest rates may fall if the central bank follows monetary easing. Therefore, if the cycle is not properly controlled for, the relationship between the two variables can turn out to be the opposite of what the theory would suggest. To address this problem, Laubach suggests using long-horizon expectations of both interest rates and fiscal variables as they should not be affected by current cyclical conditions. Using semi-annual data of the U.S. between 1976 and 2006, Laubach's results suggest that a 1 percentage point increase in projected debt/GDP raises long-term expected yields by 3-4 basis points, at the lower bound of earlier estimates. Using a panel of 16 advanced OECD countries from 1960 to 2002, Ardagna *et al.* (2007) emphasize the importance of non-linearities in the relationship and report that only for countries with above-average public debt levels, an increase in public debt implies an increase in sovereign bond yields. Baldacci and Kumar (2010), using a sample of 31 advanced and emerging economies over the period 1980-2008, show that the impact of fiscal deterioration on the bond yields depends also on the initial fiscal conditions and country characteristics.

Our key findings can be summarized as follows. Using a non-linear specification and various *ex-ante* control factors based on real time data, motivated by the recent empirical literature, we find that long-term real interest rates rise by about 2.5 to 4 basis points for a one percentage point increase in the expected debt-to-GDP ratio in emerging markets and by 1 to 7 basis points in advanced economies. We show that the fiscal spillover effects on domestic long-term real yields from an increase in large advanced economies debt ratios are significant: a one percentage point increase in advanced economies' public debt from the current high levels would lead to a rise in long-term real yields of about 10 basis points in both emerging and other advanced economies. Finally, we show that the interest rate channel is an important element in explaining the spillover effect from advanced economies: long-term real yields, in particular the U.S. ones, exert an upward pressure on emerging economies real yields.

This paper is structured as follows. Section II describes our empirical approach and the data used. Section III presents the regression models. Sections IV to VI describe the results, focusing first (section IV) on the effect of domestic debt, then (section V) on the spillover from advanced economies' debt ratios to emerging market economies and other advanced economies' yields, finally (section VI) explores the interest rate channel. Section VII concludes.

II. EMPIRICAL METHODOLOGY AND DATA

Our paper extends Laubach's approach to a large set of advanced and emerging markets, drawing on vintages of the IMF's World Economic Outlook database (from 2002 onward, as before real-time forecasts for emerging market economies' debt levels are not available) rather than *ex-post* data. We make use of expectations, not only on fiscal variables but also on other fundamental variables (inflation and growth rates, among others). Real time expectations are based on the information set actually available to market participants at the time when interest rates are determined. Finally, since the WEO database is issued twice a year, we are able to use semi-annual data in our estimations.

As for the long-term yields, there is a fundamental difference between advanced (AEs) and emerging (EMEs) economies. AEs have well developed domestic financial markets and therefore have available long-term real rates (LTBY) on government bonds, while for many EMEs the domestic market is very thin or non-existent and quotes for yields exists only for the shortest maturities.[4] For the AEs we use real long-term interest rate data from IMF's WEO database.[5]

EMEs tend to be small open economies that rely on foreign financing and, as such, are price takers in the global financial markets. The real interest rate they face can be regarded as the sum of two components: an international real rate and a country-specific spread. The use of spreads on dollar-denominated Eurobonds is consistent with the assumption that EMEs domestic debt can affect the country risk premium but not the international risk free rate (such as the U.S. rate). As Neumeyer and Perri (2005) argue, since EME Eurobonds are traded on international financial markets, they reflect the intertemporal terms of trade investors face on these markets, which are also relevant for domestic investors as long as there are no large and predictable changes in purchasing power parity.[6] Therefore, for EMEs we use stripped spreads quoted in US

[4] Moreover, the high variability of local inflation in some cases makes it hard to derive a measure of domestic expected inflation needed to construct the real interest rate. Only recently some EMEs have started to issue securities with longer-term maturities, but these are mostly indexed to inflation or to the foreign exchange rate.

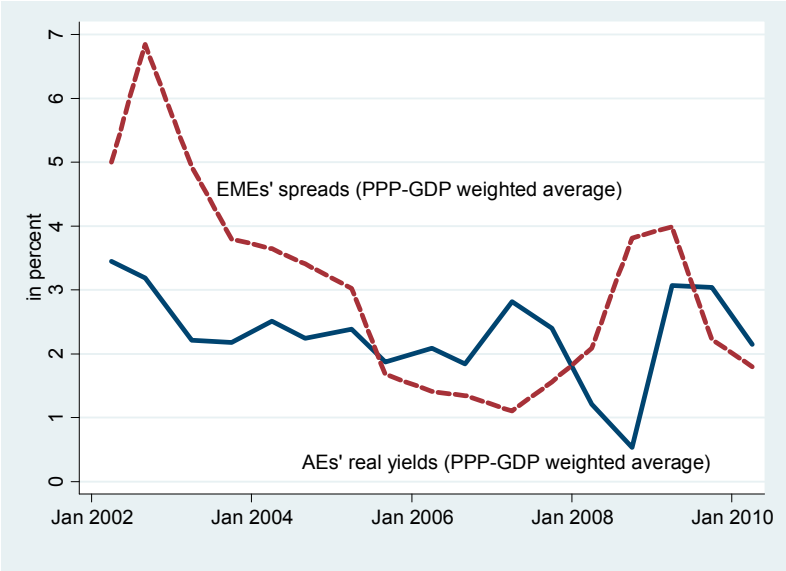
[5] Unless stated otherwise, the variables used in the following empirical analysis are obtained from IMF's WEO database.

[6] Fernandez-Villaverde *et al.*(2009) have a similar treatment as they construct long-term real interest rates of EMEs by adding the sovereign spread to the *ex ante* US long-term real rate.

dollars using six-month averages of the Emerging Markets Bond Index Global (EMBIG) spreads from JP Morgan.[7]

Figure 1 depicts the evolution of the PPP-GDP weighted average of our data for long-term real yields for AEs and EMEs from 2002 to 2010. AEs' LTBY has been steadily declining during this period, although it started to rise more recently. EMEs real long-term yields have been more volatile and higher than AEs on average (note that the figure reports spreads for EMEs, not yields).

Figure 1. Evolution of Government Long-term Borrowing Costs

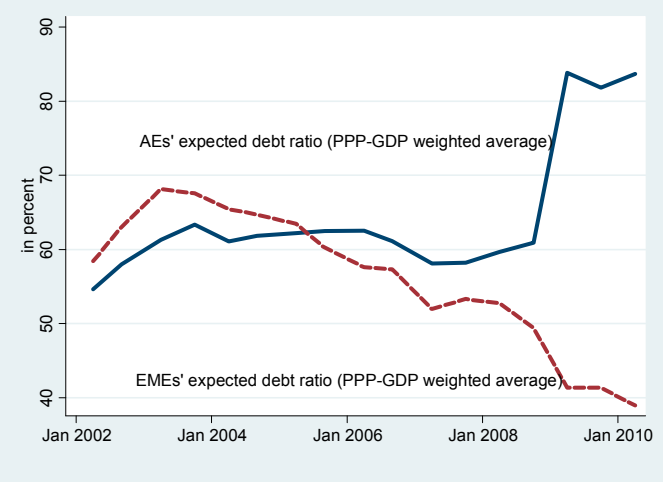


Sources: IMF WEO, DataStream, authors' calculations.

To give a sense of the evolution of the expected debt in our sample of countries, Figure 2 shows the weighted average of AEs' and EMEs' one-year-ahead expected debt to GDP ratios. The fact that the evolution of debt has been different for EMEs and AEs over our sample period—together with structural differences in the two types of economies—highlights the importance of presenting regressions separately for the two groups and the need to assess whether increasing debt ratios in large AEs is affecting EMEs' long-term real borrowing rates.

[7] The bonds included in the EMBI Global index are liquid debt instruments actively traded. Their notional sizes are at least equal to $500 million and each issue must have at least 2.5 years until maturity when it enters the index and at least 1 year until maturity to remain in the index. Moreover, JP Morgan sets liquidity criteria such as easily accessible and verifiable daily prices either from an inter-dealer broker or a certified JP Morgan source.

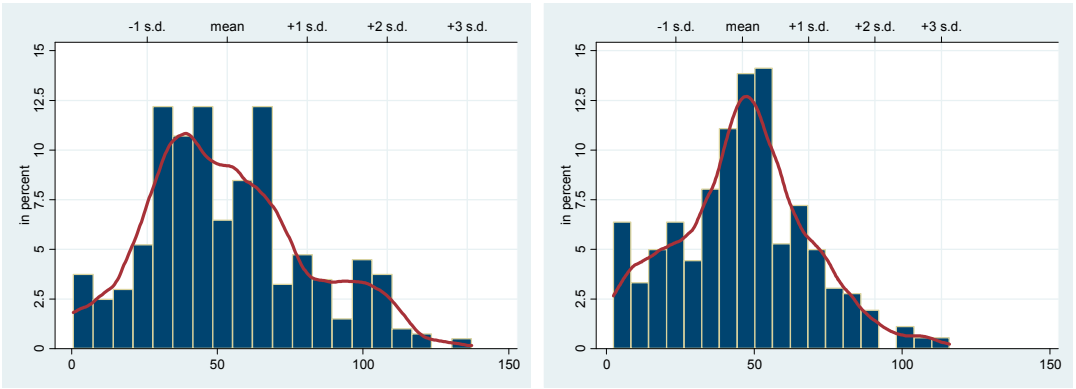
Figure 2. Evolution of One-Year-Ahead Expected Debt/GDP



Sources: IMF WEO, authors' calculations.

We dropped outliers by excluding those observations with the dependent variable being three standard deviations larger than the sample mean. Also Japan is considered as an outlier and is excluded from the analysis.[8] Moreover, for countries that defaulted on government debt (as Ukraine in 2000), we dropped observations three years prior and after the default year. Figure 3 plots the distribution of the one-year-ahead expected debt ratio for AEs (left panel) and EMEs (right panel) and shows that our data set does not contain outliers.

Figure 3. Distribution of One-Year-Ahead Expected Debt/GDP: Advanced Economies (left panel) and Emerging Economies (right panel)



Sources: IMF WEO, authors' calculations.

Eventually, our sample includes 53 economies, 28 of which are AEs and 25 are EMEs, and about 280 observations for EMEs and 430 for AEs.[9] To the best of our knowledge, this is the

[8] Japan's general government gross debt to GDP ratio during this period ranges from 0.93 to 2.34, while our sample mean is 0.54 and the standard deviation 0.28.

[9] The list of countries included in the study can be found in the appendix.

largest sample considered in term of the number of countries for this type of analysis.

III. MODEL SPECIFICATION

Empirical studies on the effect of fiscal variables on long-term real interest rates use as the main fiscal indicator either the primary deficit or the gross general government debt as a percent of GDP, or both. From a theoretical point of view, the level of long-term real rates should depend on the level of public debt, as it is the stock of public debt that crowds out private capital in the portfolio of savers. Conversely, the change in the level of government debt, thus the deficit, should affect the change in the long-term real rate. Moreover, any increase in deficit translates into a rise in long-term debt, the magnitude of the increase depending on the persistence of the deficit. Using the fiscal deficit to explain the level of the real rates would violate this basic theoretical framework, as pointed out by Engen and Hubbard (2004). In our baseline specification, therefore, we assess the effect of the *level* of expected debt level on the *level* of long-term real rates. We will also concentrate on the effects of government debt on *real*—as opposed to *nominal*—long-term sovereign rates, as the crowding out of private capital due to a rise in the level of public debt works through higher long-term *real* rates.

Most recent empirical papers (Ardagna, Caselli and Lane, 2007; Baldacci and Kumar, 2010) have considered a non-linear relationship between the initial level of public debt and yields. The standard hypothesis is that the relation between the level of debt and long-term bond yields has a U-shaped form. When the stock of public debt is limited, additional public borrowing can increase market liquidity and reduce volatility, therefore leading to a surge in demand. At higher levels of public debt, liquidity considerations start to play a smaller role, while the crowding out effect and public debt sustainability concerns start becoming more important. Alternatively, additional public borrowing is more difficult when market participants are already holding large amounts of public debt. In the context of EMEs, the aforementioned discussion is even more relevant since their threshold level of public debt, as pointed out by Reinhart *et al.* (2003), is much lower than AEs.[10]

We next turn to our baseline specification, which is:

$$(1) \quad r_{i,t}^{10Y} = \alpha_i + \beta_1 r_{i,t}^{m} + \beta_2 E_t g_{i,t+\tau} + \beta_3 E_t \pi_{i,t+\tau} + \beta_4 E_t D_{i,t+\tau}^{d} + \beta_5 \left(E_t D_{i,t+\tau}^{d}\right)^2 + \beta_6 X_{i,t}^{d} + \varepsilon_{i,t}$$

[10] Among others, see Edwards (1984), Min (1998), and Baldacci *et al.* (2008) on empirical studies that find significant impact of country specific fundamentals in explaining sovereign spread changes in emerging market economies. Baldacci et al. (2008) argue that also political risk factors, including expropriation risk, matter for credit risk in emerging market economies, although fiscal variables are more important and have a larger impact on spreads. On the other hand, Neumeyer and Perri (2005) show that a small open economy real business cycle with real shocks can account for most empirical regularities regarding volatility of EMEs spreads.

where i denotes the country, t is time and α_i are the fixed effects.[11] r^{10Y} denotes the real long-term (10-year) government bond yields (LTBY). $r_{i,t}^{m}$ is the real short-term money market rate, $E_t g_{i,t+\tau}$ is expected growth and $E_t \pi_{i,t+\tau}$ is expected CPI based inflation.[12] $E_t D_{i,t+\tau}^{d}$ is expected debt based on information available at time t, and $\left(E_t D_{i,t+\tau}^{d}\right)^2$ is its square. τ refers to a calendar year and ranges between one and five, as five years is the maximum WEO forecast horizon. [13] $X_{i,t}^{d}$ is a vector of controls. We include a measure of financial openness[14] to control for the level of integration in the global financial market, the ratio of liquid liabilities of the financial system as a share of GDP to control for financial development[15], the current account balance-to-GDP to capture the effect of capital inflows, foreign reserve-to-GDP ratio to take into account the recent buildup in reserves in many EMEs and VIX (US Stock Market Volatility Index, obtained from Datastream) which is used to proxy global risk aversion in empirical studies.

As the expected (domestic) debt level might depend on the current long-term yields, there may be a potential endogeneity between them. We therefore use also an instrumental variables approach. As instruments for one-year-ahead expected debt and its square we use two-period lagged real GDP growth, debt, and its square, and expected primary deficit.[16] The estimates of the coefficients and their standard errors are very similar to the ones obtained when we estimate models by the fixed effects.[17] We conducted a variety of diagnostic tests on the instruments to test for the existence of over or both under and weak identification.[18]

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[11] In all our regressions we use country fixed effects and control for heteroskedasticity and first order autocorrelation in the error term. When only domestic variables are used as dependent variables, we also include time fixed effects.

[12] Short-term money market interest rate data is not available for some EMEs and had to be replaced by policy rate data.

[13] Therefore we could use expectations of the fiscal and other variables up to five years. For many EMEs, however, projections beyond the one year horizon are of poor quality as the focus of the forecast tends to be on short-term developments. We therefore opted to use one-year-ahead projections. We tried including longer horizons in the regression analysis and we did not obtain a better fit.

[14] Financial openness is constructed taking the absolute sum of direct investment abroad, direct investment in the domestic economy, portfolio investment assets and liabilities, other investment assets and liabilities, all as a share of GDP. We also controlled for the exchange rate regimes using the *de facto* exchange rate regime classification (see Ghosh *et al.* 2010), but we did not detect a significant effect of these variables in our regression analysis.

[15] The financial development indicator is obtained from the World Bank's Financial Structure Database and is available only until 2008. We assumed a constant value for the two following years.

[16] Data on the expected primary balance is missing for some countries/years due to lack of interest revenue data. For these countries and observations we constructed primary balance by subtracting interest expenditures from the overall budget balance.

[17] Ardagna *et al.* (2007) also report similar estimates using instrumental and non-instrumental panel regressions.

[18] In order to test for overidentifying restrictions, we rely on the Sargan-Hansen test (also known as the Hansen's J test). Rejection of the null hypothesis casts doubts on the validity of the instruments since the null specifies that the excluded instruments are correctly excluded and that the instruments are uncorrelated with the error term. We fail to reject the null at 5 percent significance level. Using the Kleinbergen-Paap test statistic, we test that the regression equation is underidentified under the assumption that the errors are not necessarily independently and

(continued…)

We then assess whether long-term real interest rates depend on measures of "global debt". We include measures of global debt (and some other "global" controls) to our baseline specification (1). We consider three possible aggregates for global debt: (i) the PPP-GDP weighted average[19] of G20 advanced economies' one-year-ahead expected debt to GDP ratio (excluding Japan); (ii) the one year ahead US debt to GDP ratio and (iii) the PPP-GDP weighted average of the four largest euro area economies' public debt as a share of GDP.[20] Our specification is as follows:

$$(2) \quad r_{i,t}^{10Y} = \alpha_i + \beta_1 r_{i,t}^{m} + \beta_2 E_t g_{i,t+\tau} + \beta_3 E_t \pi_{i,t+\tau} + \beta_4 E_t D_{i,t+\tau}^{d} + \beta_5 \left(E_t D_{i,t+\tau}^{d}\right)^2 + \beta_6 E_t D_{t+\tau}^{g} + \beta_7 \left(E_t D_{t+\tau}^{g}\right)^2 + \beta_8 X_{i,t}^{d} + \beta_9 X_t^{g} + \varepsilon_{i,t}$$

where D^g is one of our measures of global debt, X^g is a vector of "global" controls, including global short term real interest rate, global expected growth and inflation. For the global controls, we use the same weighted average as the one used for D^g.[21]

In the final step, in specification (2) we replaced the global debt with an analogous PPP-GDP weighted average of long-term real rates in order to test whether higher "global" interest rates have an effect on domestic long-term real yields. More specifically, we present regressions replacing the linear and squared D^g term with $r_{i,t}^{10Y,g}$, a weighted average of AEs' long-term real rates. The aim in this latter case is to see whether the spillover from global debt to domestic real rates goes mainly through the effect on global interest rate.

Finally, as a general robustness check, all regressions have been run dropping a single country or a single year at a time in a rolling fashion (dropping two periods of observations in a consecutive way) without significant changes in the results.[22]

IV. Baseline Regressions: Debt and Yields in the Domestic Economy

Table 1 shows regression results for the baseline specification (1). It splits the sample into AEs and EMEs and, for each group of countries, reports OLS and IV specifications, both excluding and including the control variables X^d. It is important to note that the OLS regressions allow for

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identically distributed. The existence of weak identification test is performed, based on Stock and Yogo test statistics. We reject the existence of underidentification and weak identification problems at 5 percent level of significance.

[19] Weighted average calculated using PPP valued GDP. Source: IMF WEO (2010).

[20] These are France, Germany, Italy, and Spain.

[21] In specification (2) we do not include VIX among the dependent variables, as global short term real interest rate, global expected inflation and global expected growth explain most of it (a regression of VIX on these three variables has an R^2 of 80 percent).

[22] We also tried to explore whether the impact of global debt is similar across different economic regions. Unfortunately, we are unable to test properly for this hypothesis, as our sample contains a limited number of observations for each region.

heteroskedasticity and first order autocorrelation in the residuals, while IV regressions only for the former. Several results emerge.

Expected domestic debt and its square are significant for EMEs, indicating a U-shaped relation between debt and long-term yields. A rise in gross general government debt ratio exerts an upward pressure on yields after a certain threshold level. In the three bottom rows of the table, we report: (i) the estimated threshold on own gross general government debt ratio above which rates increase; (ii) the increase in real rates assuming that the one year ahead expected debt ratio is 60 percent of GDP (the median level in 2010 for AEs, which we use also for EMEs for comparability); (iii) the median debt ratio value. For EMEs the domestic debt ratio threshold is slightly below 50 percent of GDP, while the median is 44 percent. The magnitude of the increase in EME long-term real rates at the 60 percent level of public debt-to GDP ratio is between 2.5 and 4 basis points.

For AEs our results suggest a linear relation between debt ratios and yields when all controls are included. Our estimated effect ranges between 2.5 and 7 basis points, depending on the specification. When the controls X^d are not included the estimated effect appears to be non-linear, suggesting an effect of 1 to 1.5 basis points at the 2010 median debt level (60 percent).

Moreover, some important control variables behave differently for AEs compared to EMEs. Real money market rates have the expected positive and significant sign for AEs, but they have a zero and insignificant coefficient for EMEs. This suggests that either domestic monetary policy is not captured by short-term real money market rates or that monetary policy does not affect long-term real rates in EMEs. Expected one-year-ahead real GDP growth, on the other hand, reduces real rates for EMEs, as higher growth brings along higher revenues and likely reduces sovereign risk, while this term is not significant for real yields in AEs. Expected inflation raises real yields in EMEs, while it decreases yields in AEs. Higher inflation is often associated with macroeconomic instability in EMEs and therefore might induce a higher risk premium. These differences justify estimating the two group of economies separately.

Finally, for EMEs higher degrees of financial development and level of foreign exchange reserves seem to be associated with lower real rates, as these elements proxy the availability of domestic financing and hence the resilience with respect to increases in global interest rates. A high VIX, signaling an increase in global risk aversion, is associated with higher yields as in times of uncertainties foreign portfolio investment might flee away from EMEs to safe heavens. The degree of financial development seems to matter also in the case of AEs, although the variable comes with a smaller coefficient.

For AEs, but not apparently for EMEs, current account surpluses exert a downward pressure on real rates. A current account surplus signals an excess of domestic savings over investment and therefore a relative abundance of funds. Again these provide evidence on important structural differences between EMEs and AEs.

V. SPILLOVER EFFECTS OF AEs' DEBT TO EMEs AND OTHER AEs' REAL YIELDS

In this section, we assess the effects of rising large AEs' debt ratios on EMEs' and other AEs' long-term real yields. We focus on a rise in large AEs' debt ratios as source of spillover because their level is much higher and relevant than EMEs' for the determination of global yields. The regression controls for the same variables as in the baseline specification (1) with some additions. First, we introduce measures of "global" public debt ratios. We consider three measures: the PPP-GDP weighted average of G20-advanced public debt ratio, the U.S. public debt ratio and the PPP-GDP weighted average public debt ratio of the four largest euro area economies (France, Germany, Italy and Spain). We also control for other "global" variables, defined by the same weighted average: global real money-market rates, global one year ahead expected growth and global expected inflation.

The results—reported in Table 2a—point to a significant spillover effect from increases in global debt ratio (past a threshold) on the EMEs' long-term real rates. The one-year-ahead average expected G20-advanced debt-to-GDP ratio appears to have a U-shaped relationship with the long-term real yields in the EMEs. It starts exerting upward pressure on EMEs' yields after the threshold value of 77½ percent of average public debt- to-GDP ratio, while its median value in 2010 was 89 percent. At the 2010 median value, the effect of a one percent of GDP increase in average AE debt on EME long-term real rates is about 10 basis points. Similar results hold for the one-year-ahead expected US gross general government debt-to-GDP ratio. At the 2010 U.S. expected debt ratio (a value of 97 percent) an additional increase of 1 percent of GDP US expected debt ratio would lead to an increase of about 10 basis points[23]. EA-4 debt ratio, on the contrary, appears not to have a relevant impact on the long-term real yields of EMEs. First, coefficients are not significant or significant only at the 10 percent level. And Second, in the IV specification EA-4 debt enters with an inverted U shape with a threshold at about 71 percent of GDP. At the 2010 debt ratio (76 percent), a 1 percent of GDP increase in the EA-4 debt would slightly reduce EME real yields.

Other control variables display a similar pattern as in the baseline regression for EMEs. In particular, a one percent of GDP increase in domestic public debt-to-GDP ratio, starting from the level of 60 percent, would increase long-term real yields by about 3 basis points. Real money-market rates, one-year-ahead expected real GDP growth, expected inflation and one year ahead expected domestic debt-to-GDP ratio have similar estimated coefficients. One important difference is that now the current account variable is significant (although mainly at the 10 percent level) implying about 10 basis points lower yields for a one percent of GDP higher surplus. It is worth mentioning that the fit of the model improves when global variables are introduced, with the R^2 improving from 34 percent to about 56 percent. Hence, we conclude that introducing global variables does not significantly alter the coefficient estimates of the domestic

[23] Our results are broadly consistent with Sommer and Li (2011), which use a different country coverage, data span, model specification, and nominal yield spreads as the dependent variable.

variables while at the same time improving the model fit.

Table 2b reports the effects of an increase in average AE public debt ratio on real yields of other AEs. We focus on the impact of a rise in the U.S. and EA-4 debt ratios. The table shows that the U.S. debt ratio has a broadly similar impact on the real yields of other AEs (excluding U.S. and EA-4), as the one estimated for the EMEs.[24] It starts exerting an upward pressure on long-term real yields of other AEs at a level of about 70-75 percent, much lower of the 2010 expected value of 97 percent. At this latter value, a one percent of GDP increase in the U.S. gross general government debt-GDP ratio leads to an increase of about 8 basis points in the long-term real yield of other AEs. Similar to the results obtained for EMEs, the results for the EA-4 debt level seem to be less clear cut. Coefficients are either not significant or they are only at the 10 percent significance level, suggesting an inverted-U shaped relationship between debt and yields. However, in the IV specification the estimated threshold (84 percent) appears to be higher than the 2010 expected EA-4 debt level (76 percent), leading to an estimated positive effect of about 6 basis points for a rise of one percentage point in one-year-ahead expected debt-to-GDP ratio.

Overall, we find that one-year-ahead expected increases in advanced economies public debt ratios exert a significant upward pressure on long-term real yields of other countries, in particular EMEs, past a threshold. Also, starting from the current elevated debt levels of AEs, this effect is higher in magnitude than the impact of a change in domestic debt ratio. This is certainly the case for EMEs, where both G20 advanced and US debt ratios have considerable impact on long-term real yields, but holds also for other AEs. Indeed, we have shown that the rise in U.S. debt ratio may have larger impact on long-term real yields of other AEs than a rise in their own domestic debt ratio.

VI. Spillover Effects of AEs' Yields to EMEs and Other AEs' Yields

The question we turn now to is whether the higher "global" real rates have an effect on EMEs' and other AEs' real long-term yields, after controlling for the same set of domestic and global control variables. In particular, we are interested in analyzing the magnitude of long-term real rate pass through from large AEs to other economies, especially the EMEs. We expect the interest rate channel to be an important determinant of the effects of rising global debt ratio on domestic long-term real rates. Of course, AEs debt can have spillover effects also through other channels—for example through trade flows—therefore we should not expect the interest rate channel to fully explain the estimated effect of AEs' public debt ratios to real yields.

Table 3a replicates the regressions reported in Table 2a with the difference that now the "global" debt ratio is replaced by the "global" real rate. In contrast to the regression involving

[24] In regressions for AEs we don't include the controls variables, X^d, as they become insignificant once the global control variables, X^g, (short term global real rate, global expected growth and inflation) are introduced. Results regarding the effect of global debt are not affected by the inclusion or omission of X^d.

the global debt ratio as the explanatory variable, we consider only the linear term but drop the quadratic one, while we continue to control for the domestic debt ratio in a nonlinear fashion.

The results show that the G20 advanced long-term real rate has a positive effect on EMEs' and other AEs' real rates. For EMEs the effect is found only in the IV specification and at the 10 percent significance level. In this case, a one percentage point higher global real rate increases EMEs' rates by about 30 basis points, implying a 30 percent pass-through. An effect of a similar magnitude, although with a more significant coefficient, is obtained for the US interest level[25], while again the EA-4 variable produces inconclusive results, where the only significant coefficient has a negative sign. The results are stronger for other AEs (Table 3b). The effect is about 40-50 basis points for both the OLS and IV specifications and for both the US and EA-4 yields on other AEs.

Other control variables provide a similar picture as in the baseline regressions. In particular, the domestic debt ratio thresholds (about 50 percent for EMEs and above 60 percent for AEs) and the effects on domestic rates of an increase in domestic debt ratio (about 3 basis points for each point of GDP of higher debt ratio in the case of EMEs) are comparable. The main difference is that the expected one-year-ahead domestic GDP growth on EMEs is no longer significant when global long-term real rates are present.

The last set of regressions suggests that there is an effect of global real rates on domestic real yields and that this effect is stronger for the AEs than for the EMEs. This is consistent with the higher integration of AEs financial markets as compared to EMEs'.

VII. CONCLUSIONS

This paper has reassessed the impact of rising government debt ratios on long-term real rates using real time expected fiscal and macroeconomic variables for a large sample of AEs and EMEs over the period 2002-10. We specifically addressed whether emerging economies are exposed to increases in funding costs due to high and rising AEs' debt. Our main conclusions are the following:

- Our results support previous findings of a positive effect of domestic debt on domestic long-term real yields. Long-term real interest rates rise by about 2.5 to 4 basis points for a one percentage point increase in one-year-ahead expected debt-to-GDP ratio in EMEs (past a threshold for the debt ratio of about 50 percent). On the other hand, for AEs our estimates support a linear effect with impact ranging between 2.5 and 7 basis points.

- EMEs are exposed to increases in funding costs due to high and rising AEs' debt. Past a

[25] Sommer and Li (2011) report about 60-70 percent pass-through from the U.S. nominal rates to the EME nominal spreads. The higher magnitude of the pass-through is partly due to the additional effect of expected inflation.

threshold of about 70-80 percent of GDP, a one percent of GDP increase in expected AEs' debt-to-GDP ratio (and in particular the U.S. debt) has a significant impact (about 10 basis points evaluated at the 2010 debt ratio levels) on EMEs' yields. We also show that the U.S. debt ratio has a broadly similar impact on the real yields of others AEs.

- The interest rate channel is an important element in explaining the spillover effect from AEs' debt. We show that AEs' real rates, and in particular U.S. long-term real rates, have spillover effects on other countries' real yields, including EMEs.

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Appendix. Countries Included in the Sample

Emerging Market Economies	Advanced Economies
Brazil	Australia
Bulgaria	Austria
Chile	Belgium
Colombia	Canada
Croatia	Hong Kong
Estonia	Czech Republic
Hungary	Denmark
India	Finland
Indonesia	France
Latvia	Germany
Lithuania	Greece
Malaysia	Iceland
Mauritius	Ireland
Mexico	Israel
Morocco	Italy
Pakistan	Japan
Panama	Korea
Philippines	Netherlands
Poland	New Zealand
Romania	Norway
South Africa	Portugal
Thailand	Singapore
Tunisia	Slovak Republic
Turkey	Spain
Uruguay	Sweden
	Switzerland
	United Kingdom
	United States

Table 1. Domestic Expected Debt and Long-term Real Yields

	Emerging				Advanced			
	LS	**IV**	**LS**	**IV**	**LS**	**IV**	**LS**	**IV**
Short term real int. rate	-0.00	-0.00	0.02	0.02	**0.44*** **	**0.47*** **	**0.47*** **	**0.53*** **
	(0.03)	(0.04)	(0.02)	(0.03)	(0.05)	(0.06)	(0.09)	(0.08)
Exp. GDP Growth	**-0.18*** **	**-0.18*** **	**-0.07***	**-0.07*** **	-0.03	-0.01	0.02	0.02
	(0.05)	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.05)
Exp. Inflation	**0.25*** **	**0.25*** **	**0.22*** **	**0.22*** **	**-0.45*** **	**-0.42*** **	**-0.42*** **	**-0.39*** **
	(0.07)	(0.06)	(0.04)	(0.04)	(0.10)	(0.10)	(0.13)	(0.15)
Exp. Domestic Debt	**-9.94*** **	**-11.45*** **	**-13.76*** **	**-15.05*** **	**5.35*** **	**10.15*** **	**2.49***	**7.03*** **
	(3.78)	(5.31)	(5.42)	(5.78)	(1.20)	(2.92)	(1.24)	(3.11)
Exp. Domestic Debt Sqr.	**10.46*** **	**11.65*** **	**14.63*** **	**15.82*** **	**-3.60*** **	**-7.27*** **	0.43	-3.24
	(4.43)	(5.22)	(4.77)	(5.02)	(0.86)	(2.35)	(0.75)	(2.21)
Financial Openness			-0.69	-0.62			**-0.59*** **	**-0.64*** **
			(1.35)	(1.52)			(0.28)	(0.32)
Financial Development			**-11.03*** **	**-11.53*** **			**-2.24*** **	**-3.45*** **
			(3.14)	(3.14)			(0.94)	(0.98)
Current Account/GDP			-7.76	-8.72			**-8.01*** **	**-9.83*** **
			(5.71)	(5.76)			(2.99)	(4.35)
Foreign reserve/GDP			**-5.40*** **	**-5.28*** **			**2.54***	-2.03
			(2.42)	(2.22)			(1.47)	(3.15)
VIX			**0.10*** **	**0.10*** **			0.01	0.01
			(0.01)	(0.01)			(0.01)	(0.01)
Constant	**4.04*** **		**9.74*** **		**1.26*** **		**3.00*** **	
	(1.06)		(3.11)		(0.51)		(1.25)	
Number of observations	283	272	280	270	427	348	256	230
Number of countries	25	23	24	22	25	22	22	20
R-squared	0.34	0.345	0.34	0.34	0.38	0.38	0.47	0.475
Domestic debt threshold	0.48	0.49	0.47	0.48	0.74	0.70	--	--
Increase in LTBY for 1% increase in domestic Exp. Debt/GDP (in bps)	2.61	2.53	3.80	3.93	1.03	1.43	2.49	7.03
median in 2010	0.44	0.44	0.44	0.44	0.61	0.61	0.61	0.61

Notes: i) LS= Least Squares; IV= Instrumental Variable Estimates. Standard errors are in brackets. * denotes significant at 10 percent; ** at 5 percent; *** at 1 percent. LS estimation is based on a fixed effects regression controlling for within country heteroskedasticity and for first order autocorrelation in the error term. IV estimation is also based on fixed effect and control for error heteroskedasticity. In the IV estimation, second lag of real GDP growth rate, current domestic debt to GDP, current domestic debt to GDP square, expected primary deficit are used as instruments for expected debt and expected debt square. ii) Global variables are constructed using PPP-GDP weighted average of G-20 Advanced economies', EA-4 or US growth, expected inflation, short term real money market rate and expected debt ratio.

Table 2a. Impact of Global Expected Debt on Long-term Real Yields —Emerging Market Economies

Global variable:	G20-Advanced		US		EA-4	
	LS	IV	LS	IV	LS	IV
Short term real int. rate	0.02	0.02	0.01	0.01	0.01	0.02
	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)
Exp. GDP Growth	**-0.09***	**-0.09****	**-0.13*****	**-0.12*****	-0.03	-0.03
	(0.05)	(0.04)	(0.04)	(0.04)	(0.06)	(0.04)
Exp. Inflation	**0.23*****	**0.23*****	**0.22*****	**0.22*****	**0.26*****	**0.25*****
	(0.05)	(0.05)	(0.05)	(0.05)	(0.04)	(0.05)
Exp. Domestic Debt	**-14.17****	**-15.77*****	**-14.01*****	**-15.62*****	**-16.00****	**-17.43*****
	(5.38)	(5.85)	(4.97)	(5.62)	(5.99)	(6.38)
Exp. Domestic Debt Sqr.	**14.33*****	**15.79*****	**14.05*****	**15.52*****	**15.23*****	**16.60*****
	(4.78)	(5.14)	(4.51)	(4.97)	(5.16)	(5.50)
Financial Openness	0.65	0.69	0.72	0.77	1.18	1.33
	(1.27)	(1.64)	(1.45)	(1.63)	(1.50)	(1.78)
Financial Development	**-10.89*****	**-11.39*****	**-10.69*****	**-11.11*****	**-11.13*****	**-11.71*****
	(3.21)	(3.30)	(3.03)	(3.13)	(3.47)	(3.42)
Current Account	**-10.35***	**-11.37***	**-10.44***	**-11.29***	**-11.43***	**-12.81****
	(5.54)	(6.05)	(5.11)	(5.79)	(6.23)	(6.22)
Foreign Reserve	**-5.14***	**-5.11****	**-4.89***	**-5.00****	**-5.93****	**-5.47****
	(2.62)	(2.45)	(2.61)	(2.45)	(2.66)	(2.36)
Global Short term real int. rate	**-0.35*****	**-0.33*****	**-0.22*****	**-0.22*****	-0.07	-0.02
	(0.07)	(0.08)	(0.05)	(0.05)	(0.16)	(0.14)
Global Exp. Growth	**-0.43*****	**-0.43*****	**-0.24*****	**-0.23****	-0.30	**-0.32***
	(0.10)	(0.14)	(0.07)	(0.10)	(0.18)	(0.16)
Global Exp. Inflation	**-1.10*****	**-1.12*****	**-0.66*****	**-0.65*****	**-1.59*****	**-1.70*****
	(0.24)	(0.29)	(0.12)	(0.18)	(0.30)	(0.30)
Global Exp. Debt	**-70.26****	**-66.99****	**-51.50*****	**-50.96*****	34.08	**49.61***
	(28.51)	(28.38)	(12.21)	(16.40)	(44.57)	(29.73)
Global Exp. Debt Sqr.	**45.41****	**43.19****	**31.59*****	**31.38*****	-24.70	**-35.15***
	(19.05)	(19.06)	(7.69)	(10.31)	(28.36)	(18.91)
Constant	**40.96*****		**33.79*****		3.98	
	(11.81)		(5.93)		(17.32)	
Number of observations	280	270	280	270	280	270
Number of countries	24	22	24	22	24	22
R-squared	0.56	0.56	0.56	0.56	0.53	0.54
Domestic debt threshold	0.49	0.50	0.50	0.50	0.53	0.53
Increase in LTBY for 1% increase in domestic Exp. Debt/GDP (in bps)	3.03	3.18	2.85	3.00	2.28	2.49
Global exp. debt threshold	0.77	0.78	0.82	0.81	--	0.71
Increase in LTBY for 1% increase in global Exp. Debt/GDP (in bps)	10.57	9.89	9.78	9.92	--	-3.82
Domestic median in 2010	0.44	0.44	0.44	0.44	0.44	0.44
Global debt 2010	0.89	0.89	0.97	0.97	0.76	0.76

Notes: i) LS= Least Squares; IV= Instrumental Variable Estimates. Standard errors are in brackets. * denotes significant at 10 percent; ** at 5 percent; *** at 1 percent. LS estimation is based on a fixed effects regression controlling for within country heteroskedasticity and for first order autocorrelation in the error term. IV estimation is also based on fixed effect and control for error heteroskedasticity. In the IV estimation, second lag of real GDP growth rate, current domestic debt to GDP, current domestic debt to GDP square, expected primary deficit are used as instruments for expected debt and expected debt square. ii) Global variables are constructed using PPP-GDP weighted average of G-20 Advanced economies', EA-4 or US growth, expected inflation, short term real money market rate and expected debt ratio.

Table 2b. Impact of U.S. and EA-4 Expected Debt on Real Long-term Yields —Advanced Economies

	Advanced			
Global variable:	US		EA-4	
	LS	IV	LS	IV
Short term real int. rate	**0.50*** **	**0.52*** **	**0.48*** **	**0.51*** **
	(0.07)	(0.08)	(0.07)	(0.08)
Exp. GDP Growth	-0.04	-0.04	0.01	0.01
	(0.04)	(0.04)	(0.04)	(0.05)
Exp. Inflation	**-0.35*** **	**-0.35*** **	**-0.33*** **	**-0.33*** **
	(0.10)	(0.10)	(0.09)	(0.10)
Exp. Domestic Debt	**3.32*** **	**7.76*** **	**3.19*** **	**7.80*** **
	(0.88)	(2.73)	(0.82)	(2.71)
Exp. Domestic Debt Sqr.	**-2.84*** **	**-6.35*** **	**-2.60*** **	**-6.21*** **
	(0.81)	(2.13)	(0.79)	(2.10)
Global Short term real int. rate	**-0.10** **	**-0.09** **	-0.01	0.10
	(0.04)	(0.04)	(0.17)	(0.14)
Global Exp. Growth	**0.30*** **	**0.27*** **	**0.51*** **	**0.56*** **
	(0.04)	(0.07)	(0.08)	(0.12)
Global Exp. Inflation	-0.03	-0.05	**-0.66*** **	**-0.71*** **
	(0.08)	(0.15)	(0.15)	(0.19)
Global Exp. Debt	**-20.61*** **	**-30.58*** **	54.55	**67.97***
	(5.56)	(7.02)	(39.13)	(39.36)
Global Exp. Debt Sqr.	**14.62*** **	**20.35*** **	-31.58	**-40.43***
	(3.65)	(4.58)	(23.97)	(24.47)
Constant	**8.04*** **		-21.01	
	(1.96)		(15.87)	
Number of observations	427	348	427	348
R-squared	0.48	0.47	0.49	0.48
Number of countries	25	22	25	22
Domestic debt threshold	0.58	0.61	0.61	0.63
Increase in LTBY for 1% increase in domestic Exp. Debt/GDP (in bps)	-0.1	0.1	0.1	0.3
Global debt threshold	0.70	0.75	--	0.84
Increase in LTBY for 1% increase in global Exp. Debt/GDP (in bps)	7.8	8.9	--	6.2
Domestic median in 2010	0.61	0.61	0.61	0.61
Global debt in 2010	0.97	0.97	0.76	0.76

Notes: i) LS= Least Squares; IV= Instrumental Variable Estimates. Standard errors are in brackets. * denotes significant at 10 percent; ** at 5 percent; *** at 1 percent. LS estimation is based on a fixed effects regression controlling for within country heteroskedasticity and for first order autocorrelation in the error term. IV estimation is also based on fixed effect and control for error heteroskedasticity. In the IV estimation, second lag of real GDP growth rate, current domestic debt to GDP, current domestic debt to GDP square, expected primary deficit are used as instruments for expected debt and expected debt square. ii) Global variables are constructed using PPP-GDP weighted average of G-20 Advanced economies', EA-4 or US growth, expected inflation, short term real money market rate and expected debt ratio.

Table 3a. Impact of Global Long-term Real Yields on Long-term Real Yields —Emerging Economies

Global variable:	G20-Advanced		US		EA-4	
	LS	IV	LS	IV	LS	IV
Short term real int. rate	0.03	0.03	0.02	0.03	0.02	0.02
	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)
Exp. GDP Growth	-0.03	-0.02	-0.05	-0.05	-0.04	-0.03
	(0.04)	(0.04)	(0.04)	(0.03)	(0.05)	(0.04)
Exp. Inflation	**0.25*** **	**0.25*** **	**0.24*** **	**0.24*** **	**0.27*** **	**0.26*** **
	(0.04)	(0.04)	(0.05)	(0.05)	(0.04)	(0.04)
Exp. Domestic Debt	**-16.31** **	**-17.96*** **	**-15.91*** **	**-17.50*** **	**-16.63** **	**-18.24*** **
	(5.95)	(6.12)	(5.60)	(5.90)	(6.34)	(6.44)
Exp. Domestic Debt Sqr.	**16.19*** **	**17.84*** **	**15.92*** **	**17.54*** **	**16.17*** **	**17.77*** **
	(5.29)	(5.38)	(5.06)	(5.25)	(5.38)	(5.52)
Financial Openess	0.00	0.08	-0.07	0.02	0.09	0.07
	(1.60)	(1.64)	(1.76)	(1.65)	(1.40)	(1.67)
Financial Development	**-12.17*** **	**-12.49*** **	**-12.21*** **	**-12.42*** **	**-12.18*** **	**-12.74*** **
	(3.51)	(3.34)	(3.45)	(3.31)	(3.51)	(3.42)
Current Account	-9.92	-10.85*	**-10.19***	**-10.99***	-10.55	-11.51*
	(6.08)	(6.04)	(5.75)	(5.82)	(6.18)	(6.36)
Foreign Reserve	**-6.81** **	**-6.64*** **	**-6.61** **	**-6.45*** **	**-6.76** **	**-6.62*** **
	(2.60)	(2.34)	(2.60)	(2.39)	(2.61)	(2.33)
Global Short term real int. rate	**-0.33*** **	**-0.34*** **	**-0.24*** **	**-0.25*** **	0.27	**0.28** **
	(0.11)	(0.09)	(0.07)	(0.05)	(0.17)	(0.13)
Global Exp. Growth	**-0.51*** **	**-0.53*** **	**-0.30*** **	**-0.31*** **	-0.22	-0.25
	(0.11)	(0.17)	(0.08)	(0.12)	(0.21)	(0.17)
Global Exp. Inflation	-0.46	-0.46	**-0.39***	**-0.39***	**-1.59*** **	**-1.58*** **
	(0.33)	(0.36)	(0.21)	(0.22)	(0.37)	(0.30)
Global Long-term real rates	0.32	**0.34***	**0.30***	**0.33** **	-0.39	**-0.36***
	(0.25)	(0.19)	(0.16)	(0.13)	(0.25)	(0.20)
Constant	**14.63*** **		**14.21*** **		**16.85*** **	
	(3.17)		(3.25)		(3.75)	
Number of observations	280	270	280	270	280	270
Number of countries	24	22	24	22	24	22
R-squared	0.54	0.55	0.55	0.55	0.52	0.53
Domestic debt threshold	0.50	0.50	0.50	0.50	0.51	0.51
Increase in LTBY for 1% increase in domestic Exp. Debt/GDP (in bps)	3.12	3.45	3.19	3.55	2.77	3.08

Notes: i) LS= Least Squares; IV= Instrumental Variable Estimates. Standard errors are in brackets. * denotes significant at 10 percent; ** at 5 percent; *** at 1 percent. LS estimation is based on a fixed effects regression controlling for within country heteroskedasticity and for first order autocorrelation in the error term. IV estimation is also based on fixed effect and control for error heteroskedasticity. In the IV estimation, second lag of real GDP growth rate, current domestic debt to GDP, current domestic debt to GDP square, expected primary deficit are used as instruments for expected debt and expected debt square. ii) Global variables are constructed using PPP-GDP weighted average of G-20 Advanced economies', EA-4 or US growth, expected inflation, short term real money market rate and expected debt ratio.

Table 3b. Impact of U.S. and EA-4 Global Long-term Real Yields on Long-term Real Yields—Advanced Economies

	Advanced			
Global variable:	**US**		**EA-4**	
	LS	**IV**	**LS**	**IV**
Short term real int. rate	**0.49*****	**0.53*****	**0.49*****	**0.51*****
	(0.07)	(0.07)	(0.07)	(0.08)
Exp. GDP Growth	0.02	0.02	0.04	0.04
	(0.03)	(0.04)	(0.05)	(0.05)
Exp. Inflation	**-0.36*****	**-0.35*****	**-0.31*****	**-0.30*****
	(0.09)	(0.10)	(0.10)	(0.10)
Exp. Domestic Debt	**3.34*****	**8.02*****	**3.32*****	**8.01*****
	(0.67)	(2.61)	(0.72)	(2.71)
Exp. Domestic Debt Sqr.	**-2.62*****	**-6.35*****	**-2.57*****	**-6.25*****
	(0.74)	(2.06)	(0.74)	(2.11)
Global Short term real int. rate	**-0.19*****	**-0.18*****	**-0.46*****	**-0.34****
	(0.05)	(0.04)	(0.10)	(0.14)
Global Exp. Growth	**0.14*****	**0.14****	**0.25*****	**0.31*****
	(0.02)	(0.06)	(0.07)	(0.09)
Global Exp. Inflation	-0.01	0.03	**-0.34***	**-0.37****
	(0.04)	(0.14)	(0.19)	(0.17)
Global Long-term real rates	**0.46*****	**0.44*****	**0.53*****	**0.48*****
	(0.07)	(0.08)	(0.15)	(0.17)
Constant	0.46		0.87	
	(0.30)		(0.64)	
Number of observations	427	348	427	348
Number of countries	25	22	25	22
R-squared	0.51	0.50	0.50	0.48
Domestic debt threshold	0.64	0.63	0.65	0.64
Increase in LTBY for 1% increase in domestic Exp. Debt/GDP (in bps)	0.20	0.40	0.24	0.51

Notes: i) LS= Least Squares; IV= Instrumental Variable Estimates. Standard errors are in brackets. * denotes significant at 10 percent; ** at 5 percent; *** at 1 percent. LS estimation is based on a fixed effects regression controlling for within country heteroskedasticity and for first order autocorrelation in the error term. IV estimation is also based on fixed effect and control for error heteroskedasticity. In the IV estimation, second lag of real GDP growth rate, current domestic debt to GDP, current domestic debt to GDP square, expected primary deficit are used as instruments for expected debt and expected debt square. ii) Global variables are constructed using PPP-GDP weighted average of G-20 Advanced economies', EA-4 or US growth, expected inflation, short term real money market rate and expected debt ratio.