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

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Abstract

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We would like to thank Rong Qian for excellent research assistance. The views expressed in this paper are those of the authors and do not necessarily represent those of the IMF or IMF policy.
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April 2011

Abstract

Several models establish a positive association between the level of public debt and the long-term real interest rates, but only few empirical papers support this theoretical prediction. We provide further empirical evidence on this issue improving with respect to the existing literature in two directions. First, we use real time expectations of fiscal and other macroeconomic variables. Second, our sample contains a large number of advanced and emerging market economies. We show that an increase in the public debt levels of large advance economies spills over to both emerging market and other advanced economies' long-term real interest rates and that this effect tend to be larger compared to the impact of a rise in own domestic public debt.

JEL Classification Numbers:C41, H30

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1. Introduction

Following the recent financial crisis and the associated rise in the public debt, concerns for fiscal sustainability remain elevated in many advanced economies. While most of these economies are implementing fiscal consolidation in the short-term, the public debt stocks are expected to rise. With few exceptions so far the reactions of the sovereign yields have been muted, but it is unlikely that these adverse fiscal developments won't have implications on global borrowing costs going forward. How concerned should the emerging market economies be? This paper attempts to shed light on this issue.

In theory, the reaction of private saving and the size and openness of an economy may determine the magnitude of the rise in long-term real interest rates as a result of a debt financed fiscal expansion. Under Ricardian equivalence, a rise in government debt implies a fully anticipated hike in the future tax burden, leading to an increase in private saving and therefore leaving interest rates unchanged. Models with non-Ricardian features, instead, envisage that an increase in fiscal deficit and debt, all else equal, would drive interest rates up and growth down. This 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 *a la* Blanchard (1985).[2] They show that a rise in fiscal deficit financed by debt in one of the two economies leads to a substantial short-term increase in private consumption (as agents with finite horizon do not internalize all future increase in taxes needed to repay the higher debt) and a medium-term fall in saving rate in that economy. Therefore to preserve equilibrium in world saving and investment, real interest rates have to rise and real investment to fall. As long-run real interest rates are equalized internationally, there will be also spillover effects to the rest of the world, where output and consumption will decline. The transmission channel works mainly though interest rates, as the trade channel appears to be weak.

[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).

Establishing empirically the quantitative effect on long-term real interest rates of a debt-financed fiscal expansion 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 abruptly, reducing the pressure on interest rates. Other forces have recently weighed on sovereign bond yields including Central Banks 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 range from 14 to 45 basis points rise in real long-term yields for a one percentage point increase in the deficit-to-GDP ratio and 3-7 basis points rise in real long-term yields for a one percentage increase in the debt-to GDP ratio. These are obtained using different sample of countries, time periods, control variables and specifications of the estimated equation (nominal or real yields; deficits and/or debt to proxy fiscal stance, actual values or expected values of fiscal variables, linear or quadratic relationship, etc.).

Laubach, T. (2009) argues that the relation between the current level of debt and long-term real rates is distorted by the state of the business cycle. During recessions, budget deficits increase due to the operation of automatic stabilizers, while long-term interest rates fall because of monetary easing. Therefore, if the cycle is not properly controlled for, the relationship between the two variables can turn out to be opposite to what the theory would suggest. To address the 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 percent increase in projected debt/GDP raises long-term expected yields by 3-4 basis points. For a sample of 16 advanced OECD countries from 1960 to 2002, Ardagna, Caselli and Lane (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 imply 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.

Using a non-linear specification and various control factors motivated by the recent empirical literature, our results are consistent with the effect of domestic debt on domestic long-term real yields previously reported (Laubach, 2009; Baldacci and Kumar, 2010). In particular, our results point to an effect of about 1 to 3 basis points for a one percentage point increase in the expected debt to GDP ratio in advanced economies and of about 2.5 to 4 basis points for emerging markets. We also show that the fiscal spillover effects from large advanced economies debt are higher in magnitude: a one percentage point expected increase in advanced economies' public debt leads to a rise in long-term real yields of about 10 basis points in both emerging and other advanced economies.

2. Our approach

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) rather than *ex post* data. We make use of expectations, not only on fiscal variables but also on other fundamental variables (inflations and growth, among others). Real time expectations represent the information set actually available to market participants when fixing the interest rate. Finally, since the WEO database is issued twice a year, we are able to use semiannual 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 easily available long-terms rates 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.[3] For the former countries we use the six-month average of the monthly real LTBY from the International Financial Statistics (IFS), supplemented by WEO annual data when IFS data are not available. For EMEs we use six-month averages of the Emerging Markets Bond Index Global (EMBIG) spreads from JP Morgan (that are quoted in US dollar).

[3] 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.

EMEs tend to be small open economies that rely on foreign financing and as such are price takers in the global financial market. Therefore the interest rate they face is the sum of two independent components: an international rate plus a country risk spread. We identify the relevant international rate as the rate on ten years US Treasuries. As for the country risk spread we use spreads on the secondary market of emerging market bonds (EMBI) to recover nominal U.S. dollar interest rates and obtain real rates by subtracting expected U.S. inflation. As Neumeyer and Perri (2005) argue, since these bonds are traded on international financial markets, they reflect the intertemporal terms of trade agents face on these markets, and, since they are dollar denominated, real interest rates can be computed without constructing domestic expected inflation. The interest rates on dollar denominated assets are also relevant for domestic agents as long as there are no large and predictable changes in purchasing power parity. [4]

We will use the so-constructed data on long term yields for AEs and EMEs to assess whether domestic public debt has an effect on domestic interest rates and whether "global public debt" (where global refers to a weighted average of advanced economies debt) has an impact on domestic long-term real rates, in particular on emerging market economies' sovereign yields. Except for the different definition of the long term yield, we will use a similar model for both AEs and EMEs (see following section). The model control for a wide range of factors, as EMEs spreads have been explained by both domestic fundamentals (accounting for fiscal sustainability, current account sustainability and financial sector stability) and global factors (as global financial liquidity and investors' risk appetite).[5]

Finally, the global financial market is very integrated and therefore we should expect global debt to have similar impact on long term interest rates across different economic regions.

[4] 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.

[5] 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.

Unfortunately we are not able to test this hypothesis as our sample contains a limited number of observations for each area. Therefore a proper regional analysis cannot be carried out.[6]

3. 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 yields should depend on the level of public debt, as it's 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 interest rate. Using the fiscal deficit to explain the level of the interest 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 interest rates. We will also concentrate on the effects of government debt on *real* – as opposed to *nominal* – long-term sovereign yields, as the crowding out of private capital due to a rise in the level of public debt works through higher long-term *real* yields.

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 interest rates. This is because any increase in the level of public debt, starting from a low level, should have a lower effect on interest rates as it reduces the sovereign risk premium. Some studies have also pointed out to the importance of liquidity considerations. 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 public debt sustainability starts becoming more important. Alternatively, additional public borrowing can be more difficult when

[6] In the most constrained regressions we have 93 observations and 7 countries in emerging America (Brazil, Chile, Colombia, Mexico, Panama, Peru', Uruguay), 46 observations and 3 countries in Africa (Morocco, South Africa Tunisia), 66 and 5 in Asia and Pacific (Indonesia, Malaysia, Pakistan, Philippines, Thailand) and 67 and 7 for emerging Europe (Bulgaria, Croatia, Hungary, Lithuania, Poland, Russian Federation, Turkey).

market participants are already holding a large amount of public debt. These arguments support the view that the relationship between debt levels and yields should have a U-shaped relationship. In the context of emerging market economies, 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 advanced economies.

While the U shape relationship is appropriate for most economies, an inverted-U shape is also a possibility. This may be the case when advanced countries with high level of debt are perceived as "safe havens" and at times of uncertainties are able to increase the outstanding amount of debt at decreasing interest rates. As we will see, this is especially relevant for advanced economies over the most recent period.

We next turn to our baseline specification, which is:

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

where i denotes the country, t is time and α_i are the fixed effects.[7] i^{10Y} denotes the real long-term (10-year) government bond yields (LTBY). $r_{i,t}^{m}$ is the real short-term money market rate and $\pi_{i,t}$ is the expected end-year CPI based inflation rate. $E_t D_{i,t+\tau}^{d}$ is expected debt at time $t+\tau$ based on information available at time t, and $\left(E_t D_{i,t+\tau}^{d}\right)^2$ is its square. $X_{i,t}^{d}$ is a vector of standard controls in the literature. We include short-term real money market and expected end-year inflation rates to control for monetary policy, the real GDP growth rate to control for the current business cycle, the ratio of liquid liabilities of the financial system as a share of GDP to control for financial development, the current account balance to GDP to capture the effect of capital inflows, and foreign reserve to GDP ratio to take into account the recent

[7] 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.

buildup in reserves in many emerging economies.[8] Finally, we introduce the VIX to capture for global risk aversion.

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, lagged debt, lagged debt square, and expected primary deficit. The estimates of the coefficients and their standard errors are very similar to the ones obtained when we estimate models by the fixed effects.[9] We conducted a variety of diagnostic tests on the instruments to test for the existence of over or both under and weak identification.[10]

We then assess whether domestic 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[11] of G20 advanced economies' one-year ahead expected debt to GDP ratio, excluding Japan;[12] ii) the one year-ahead US debt to GDP ratio and iii) the PPP-GDP

[8] We also used a number of other variables that might be correlated with long-term real yields. In particular, we constructed a measure of financial openness 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). We did not detect a significant effect of these variables in our regression analysis.

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

[10] 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. To test for the null hypothesis that the regression equation is underidentified under the assumption that the errors may not be independently and identically distributed we rely on the Kleinbergen-Paap test statistic, while the existence of weak identification is based on Stock and Yogo test statistics. Again, we reject the existence of underidentification and weak identification problem at 5 percent level of significance.

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

[12] We consider Japan to be an outlier. Its 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.

weighted average of the four largest economies public debt as a share of GDP in the euro area.[13] Our specification is as follows:

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

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.

In the final step, in specification (2) we replaced the global debt with an analogous PPP-GDP weighted average of interest rates in order to test whether higher "global" interest rates have an effect on domestic long-term real yields. More specifically, we will present regressions replacing the linear and squared D^g term with $i_{i,t}^{10Y,g}$, 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 interest rates goes mainly through the effect on global interest rate.

4. Data and descriptive analysis

Our main data source is IMF's World Economic Outlook (WEO) database (unless otherwise indicated) which is released twice a year, in April and October. We use the actual real time vintage data, not the *ex post* revised data, so we are able to capture the expected macro and fiscal developments in each country at the time of the WEO release. We are somehow constrained by data availability, as expected debt-to-GDP ratio data is not available for emerging market economies prior to 2002. Thus we consider the WEO releases starting from April 1995 to April 2010 for advanced economies, and from April 2002 to April 2010 for emerging ones. The sample includes 53 economies, 28 of which are advanced and 25 are

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

emerging markets.[14] As far as we know, this is the largest sample considered in term of the number of countries for this type of analysis.

We also had to do some data cleaning, as it is frequent when working with a large sample of emerging countries. First, for countries that over our sample period defaulted on government debt (Russia in 1998 and Ukraine in 2000) we dropped the three years prior and after the default year. Moreover, data on the expected primary balance is missing for some country/years due to unavailable interest revenue data. We constructed the primary balance values (that we use as an instrument in the IV regressions) by subtracting data on interest expenditures from the overall budget balance. Also, short-term money market real interest rate data were not available for some EMEs and had to be replaced by policy rate data. The financial development annual series 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. Finally, we dropped outliers by excluding those observations with the dependent variable being three standard deviations larger than the sample mean.

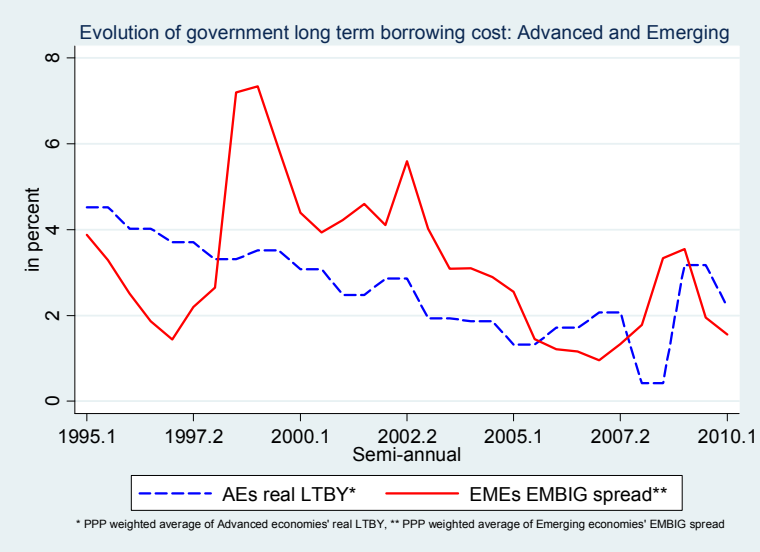
As far as expectations are concerned, each WEO vintage reports up to five-years-ahead forecasts. Therefore, theoretically, we could use expectations of the fiscal and other variables up to five years. For many EMEs, however, projections beyond the one year ahead are of poor quality as the focus of the forecast tends to be on short term developments. We therefore opted to use one-year-ahead projections.[15]

Figure 1 depicts the evolution of *ex post* PPP-GDP weighted long-term real yields for advanced and EME from 1995 to 2010. Advanced economies' 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. Figure 2 shows the evolution of the weighted average of AEs' and EMEs' debt to GDP ratio and the large recent increase in AEs' debt. EMEs' debt has been increasing until 2000, but has stabilized since then.

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

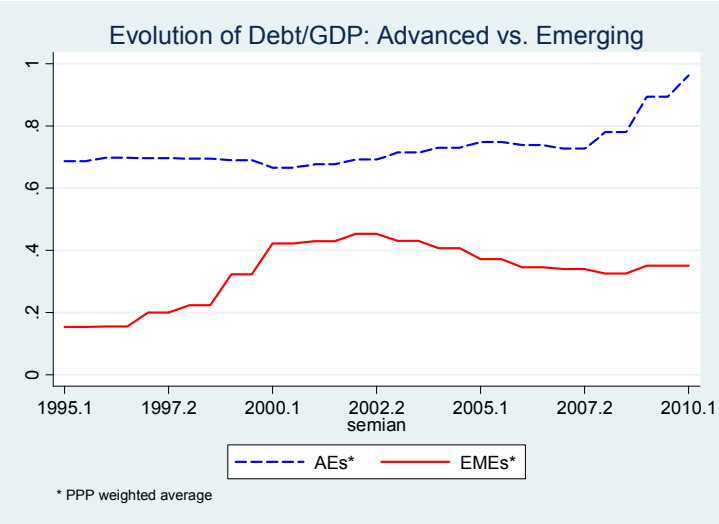
[15] We also included different horizons in the regression analysis and we did not get a better fit.

Figure 1



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 – has two implications for our analysis. The first one is that it will be important to present regressions separated for the two groups of countries in order to evaluate whether there are differences in the results. The second one is that we will assess whether the increasing debt levels in advanced countries is affecting EMEs' borrowing rates.

Figure 2



5. Baseline regressions

Table 1 shows regression results for the baseline specification (1). It splits the sample into advanced and emerging economies and, for each group of countries, reports OLS and IV specifications, both excluding and including the control variables X^d. Several elements emerge.

First, expected domestic debt and its square are significant for both groups of economies, but the shape of the non-linearity is different: it's a U shaped relation for EMEs, while it is an inverted U shaped for AEs. We already discussed in Section 2 why this might be the case. While for EME domestic gross general government debt has an upward effect on yields after a certain threshold level, for AEs yields start decreasing after a certain level of debt, although this level might be very high (is 97 percent of GDP in the IV specification). In the three bottom rows of the table, we report: i) the estimated threshold on domestic gross general government debt above which rates increase; ii) the increase in yields assuming that the one-year-ahead expected debt level is 60 percent of GDP (the median level in 2010 for AEs, which we use also for EMEs for comparability); iii) the median debt value. For EMEs the domestic debt threshold is slightly below 50 percent of GDP, while the median is 44 per cent. The increase in yields at the 60 percent level of public debt-to GDP is between 2.5 and 4 basis points. For AEs, the increase in yields at the same level of public debt is somewhat smaller, between 1 and 3 basis points.

Second, some important control variables behave differently for AEs and EMEs. Domestic 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 EMEs' domestic monetary policy might rely less on short term rates or that short term rates have a moderate impact on long-term external borrowing rates. Expected one-year ahead real GDP growth, on the other hand, reduces yields for EMEs, as higher growth bring along higher revenues and likely reduces sovereign risk, while it is not significant for 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, while

for AEs the negative relation partly reflects the way the real rate is constructed (nominal long term rate minus current inflation). These differences underscore the importance of running separate regressions for the two groups of countries.

Finally, for EMEs higher the degree of financial development and the availability of foreign reserves lower the yields, as these elements increase the amount of domestic financing and thus 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 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, a current account surplus can have a significant downward effect on yields. A current account surplus signals an excess of domestic savings over investment and therefore a relative abundance of funds. Again we document important diversities between the two groups of countries, underscoring once more the structural differences between EMEs and AEs.

6. Spillover effects – Global debt

In the previous sections we set the stage and documented some differences between EMEs and AEs. We next move to assess the effects of rising AEs' debt on EMEs' long-term real yields. The reason why we focus on this direction of causality from AEs to EMEs, although it might be obvious, is because the size of AEs, and their debt is much more relevant and able to affect global yields than that of EMEs. As outlined in section 2, the approach that we will follow is straightforward, simply adding to the baseline regressions our measures of global debt as a control variable. In a successive step we will analyze also the effects of global interest rates on EMEs' yields.

Table 2a reports results using the specification (2). The regression controls for the same variables as in the baseline specification (1) with some additions. First we introduce measures of "global" debt. We consider three measures of "global" debt: the weighted average of G20-Advanced debt, the U.S. debt and PP-GDP weighted average of the four

largest economies (Germany, France, Italy and Spain) in the Euro area. We control also for other global variables: global short term real rates, global expected growth and expected inflation. Again, the weighted averages for these variables are the same as the one used for global debt. In table 2b we report results for similar regressions for AEs, although dropping the financial openness, financial development, current account and foreign reserve controls as they are not significant.

The results point to a significant effect of global debt on EMEs' long-term real yields. The one-year ahead expected G20-advanced debt-to-GDP level appears to have a U shaped relationship with long-term real yields in EMEs. It starts having a positive effect on EMEs' yields at a value of 77-78 percent of debt to GDP ratio, while its median value in 2010 was 89 per cent. At the 2010 median value the effect on EME yields of a one per cent of GDP increase is about 10 basis points. Similar results hold for the one-year ahead expected US debt-to-GDP ratio. At the 2010 US expected debt level (a value of 97 per cent) an additional increase of 1 per cent of GDP would lead to an increase of again about 10 basis points. EA-4 debt, on the contrary, appears to have a much smaller impact on the long-term real yields of EMEs. First, coefficients are not significant or significant only at the 10 per cent level. Second EA-4 debt enters with an inverted U shape with a threshold at about 71 per cent of GDP (in the IV specification). At the 2010 debt level (76 per cent), a 1 per cent of GDP increase in the EA-4 debt would slightly reduce EME yields.

Other variables display a similar pattern as in the baseline regression. In particular, a one per cent of GDP increase in domestic debt-to-GDP ratio, staring from the level of 60 per cent, would increase domestic long-term real yields by about 3 basis points. Short term real rates, 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 per cent level) implying 10 basis points lower yields for a one per cent of GDP higher surplus. Overall the fit of the model improves significantly when introducing global debts and global controls, with the R^2 improving from 34 per cent to about 56 per cent. Hence we conclude that introducing global

variables does not significantly alter the coefficient estimates of the domestic control variables while at the same time improving the model fit.

In table 2b we report the effects of advanced economies debt on other AEs yields. We will focus on the US and EA-4 debt. The table shows that the US debt has a similar impact on the other AEs' (excluding the US) yields as the one estimated for the EMEs. It starts having an upward effect on AEs' long-term real yields at a level of about 74-76 percent, against a 2010 expected value of 97 percent. At this latter value, a one percent of GDP increase in the US debt-GDP ratio leads to an increase of about 10 basis points in the average of the other AEs. The table shows also that a one per cent of GDP increase in domestic debt, staring from the level of 60 percent, would have a very moderate upward effect on domestic yields. Again, the results for the EA-4 debt level seem to be less clear cut. Coefficients are significant only at the 10 percent significance level, suggesting an inverted U shaped relationship between debt and yields. However, the estimated threshold (84-86 per cent) appears to be higher than the 2010 expected EA-4 debt level (76 per cent), leading to an estimated effect of about 6 to 7 basis points for a rise of one percentage point in one-year ahead expected debt-to-GDP ratio.

This section has shown that expected global debt can have a significant effect on domestic long-term real yields. Also, this effect can be higher than the one of domestic debt. This is certainly the case for EMEs, where both G20 advanced and US debt have a considerable impact on EME long-term real yields, but holds also among AEs. Indeed, we have shown that the US (and to a certain extent also the EA-4) debt levels can have a large impact on other AEs long-term real yields than the corresponding domestic debt.

7. Spillover effects – Global yields

The increase in one-year ahead expected domestic debt-to-GDP ratio has – as argued – a direct effect on domestic long-term real interest rates. Therefore, a higher "global" debt will imply higher "global" long-term real yields. The question we turn now is therefore whether the higher "global" interest rates have an effect on EME real long-term yields, again after

controlling for the usual set of domestic variables. Indeed we expect the interest rate channel to be important to explain the effects of global debt on domestic interest rates.

Table 3a replicate the same regressions reported in Table 2a with the difference that now the "global" variable is the global interest rate – differently from the debt level, we consider only the linear term and not also the quadratic one, while we continue to control for the domestic debt level in a nonlinear fashion.

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

Other control variables provide a similar picture as in the baseline regressions. In particular, the domestic debt thresholds (about 50 percent for EME and above 60 percent for advanced) and the effects on domestic rates due to an increases in domestic debt (about 3 basis point for each point of GDP of higher debt in the case of EM and a more limited value for AE) are comparable. The main difference relates to the effect of domestic GDP growth on emerging economies yield that lose significance when controlling for global long-term real rates.

These last set of regressions suggest that there is an effect of global interest rates on domestic yields and that this effect is stronger for AEs than for EMEs. This is consistent with the higher integration of AEs financial markets and with the fact that most emerging markets still have restrictions or imperfections that prevent full capital mobility.

8. Conclusions

This paper has revisited the issue of the effect of government debt on domestic long-term real rates using real time expected fiscal and macroeconomic variables for a large sample of advanced and emerging market economies over the period 2002-2010. Our baseline regressions support previous results of a positive effect of expected domestic debt on domestic long term yields. As we have a large sample of emerging and advanced countries we addressed the question of whether small open economies are exposed to increases in funding costs due to the mounting advanced economies debt. Our results support this view. While controlling for a wide range of domestic variables, we show that a one percent of GDP increase in expected global debt-to-GDP ratio (and in particular the US debt) has an impact of about 10 basis points on both EMEs and other AEs' yields, an impact that is larger in magnitude than the own domestic debt. Finally, we show that global interest rates, and in particular the US long-term real rates, have a significant spillover effects on other countries' yields, suggesting that the interest rate channel is an important element in explaining the spillover effect from global debt.

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Appendix - Countries included in the sample

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

Table 1 - Domestic Expected Debt and Real Long-term Rates

	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*** **	**0.42*** **	**0.47*** **	**0.45*** **
	(0.03)	(0.04)	(0.02)	(0.03)	(0.06)	(0.06)	(0.09)	(0.08)
Current GDP Growth	**-0.18*** **	**-0.18*** **	**-0.07***	**-0.07** **	-0.02	0.02	0.02	0.03
	(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*** **	**-0.47*** **	**-0.50*** **	**-0.42*** **	**-0.50*** **
	(0.07)	(0.06)	(0.04)	(0.04)	(0.10)	(0.11)	(0.13)	(0.15)
Exp. Domestic Debt	**-9.94** **	**-11.45** **	**-13.76** **	**-15.05*** **	**5.42*** **	**11.80*** **	**2.49***	**8.47*** **
	(3.78)	(5.31)	(5.42)	(5.78)	(1.48)	(2.96)	(1.24)	(3.10)
Exp. Domestic Debt Sqr.	**10.46** **	**11.65** **	**14.63*** **	**15.82*** **	**-3.57*** **	**-8.40*** **	0.43	**-4.35** **
	(4.43)	(5.22)	(4.77)	(5.02)	(1.01)	(2.41)	(0.75)	(2.18)
Financial Openness			-0.69	-0.62			**-0.59** **	-0.46
			(1.35)	(1.52)			(0.28)	(0.33)
Financial Development			**-11.03*** **	**-11.53*** **			**-2.24** **	**-3.24*** **
			(3.14)	(3.14)			(0.94)	(1.02)
Current Account/GDP			-7.76	-8.72			**-8.01** **	**-8.60** **
			(5.71)	(5.76)			(2.99)	(4.08)
Foreign reserve/GDP			**-5.40** **	**-5.28** **			**2.54***	-2.75
			(2.42)	(2.22)			(1.47)	(3.22)
VIX			**0.10*** **	**0.10*** **			0.01	0.00
			(0.01)	(0.01)			(0.01)	(0.01)
Constant	4.04***		9.74***		1.25**		3.00**	
	(1.06)		(3.11)		(0.58)		(1.25)	
Number of observations	283	272	280	270	387	308	256	220
Number of countries	25	23	24	22	25	22	22	20
R-squared	0.34	0.345	0.34	0.34	0.38	0.39	0.47	0.46
Domestic debt threshold	0.48	0.49	0.47	0.48	0.76	0.70	--	0.97
B.P. increase in R for 1% increase in Exp. Debt/GDP	2.61	2.53	3.80	3.93	1.14	1.72		3.25
median in 2010	0.44	0.44	0.44	0.44	0.61	0.61	0.61	0.61

Notes: i) LS= Least Square; IV= Instrumental Variable. 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 heteroskedastoicity 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 weighted average of G-20 Advanced economies', EA-4 or US growth, expected inflation, short term real rate and expected debt.

Table 2a - Impact of Global Expected Debt on Domestic Rates – Emerging 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)
Current 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	0.558	0.56	0.564	0.53	0.537
Domestic debt threshold	0.49	0.50	0.50	0.50	0.53	0.53
B.P. increase in R for 1% increase in Exp. Debt/GDP	3.03	3.18	2.85	3.00		2.49
Global exp. debt threshold	0.77	0.78	0.82	0.81		0.71
B.P. increase in R for 1% increase in Global Exp. Global Debt/GDP	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 Square; IV= Instrumental Variable. 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 weighted average of G-20 Advanced economies', EA-4 or US growth, expected inflation, short term real rate and expected debt.

Table 2b - Impact of U.S. and EA-4 Expected Debt on Domestic Rates – Advanced Economies

	Advanced			
Global variable:	US		EA-4	
	LS	IV	LS	IV
Short term real int. rate	**0.50*** **	**0.48*** **	**0.49*** **	**0.48*** **
	(0.08)	(0.08)	(0.08)	(0.08)
Current GDP Growth	-0.02	-0.02	0.05	0.04
	(0.04)	(0.04)	(0.04)	(0.05)
Exp. Inflation	**-0.36*** **	**-0.40*** **	**-0.33*** **	**-0.38*** **
	(0.10)	(0.11)	(0.10)	(0.10)
Exp. Domestic Debt	**3.18*** **	**8.90*** **	**2.96*** **	**9.04*** **
	(1.01)	(2.94)	(0.96)	(2.93)
Exp. Domestic Debt Sqr.	**-2.66*** **	**-7.17*** **	**-2.33** **	**-7.02*** **
	(0.88)	(2.28)	(0.84)	(2.23)
Global Short term real int. rate	**-0.10** **	**-0.08** **	0.10	0.13
	(0.04)	(0.04)	(0.16)	(0.16)
Global Exp. Growth	**0.27*** **	**0.26*** **	**0.56*** **	**0.54*** **
	(0.04)	(0.08)	(0.06)	(0.13)
Global Exp. Inflation	-0.06	-0.09	**-0.82*** **	**-0.76*** **
	(0.11)	(0.14)	(0.13)	(0.20)
Global Exp. Debt	**-34.65*** **	**-40.57** **	**64.96***	**70.21***
	(9.42)	(17.04)	(33.54)	(40.02)
Global Exp. Debt Sqr.	**23.44*** **	**26.52** **	**-37.79***	**-41.96***
	(5.97)	(10.52)	(20.64)	(24.92)
Constant	13.52***		-25.20*	
	(3.42)		(13.50)	
Number of observations	387	308	387	308
R-squared	0.48	0.46	0.49	0.47
Number of countries	25	22	25	22
Domestic debt threshold	0.60	0.62	0.64	0.64
B.P. increase in R for 1% increase in Exp. Debt/GDP	-0.01	0.30	0.16	0.62
Global debt threshold	0.74	0.76	0.86	0.84
B.P. increase in R for 1% increase in Exp. Global Debt/GDP	10.82	10.88	7.52	6.43
Domestic median in 2010	0.61	0.61	0.61	0.61
Global debt median in 2010	0.97	0.97	0.76	0.76

Notes: i) LS= Least Square; IV= Instrumental Variable. 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 heteroskedastoicity 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 weighted average of G-20 Advanced economies', EA-4 or US growth, expected inflation, short term real rate and expected debt.

Table 3a – Impact of Global Long-term Real Rates on Domestic Rates – 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)
Current 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
B.P. increase in R for 1% increase in Exp. Debt/GDP	3.12	3.45	3.19	3.55	2.77	3.08

Notes: i) LS= Least Square; IV= Instrumental Variable. 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 heteroskedastoicity 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 weighted average of G-20 Advanced economies', EA-4 or US growth, expected inflation, short term real rate and expected debt.

Table 3b - Impact of U.S. and EA-4 Global Long-term Real Rates on Domestic Rates – Advanced Economies

	Advanced			
Global variable:	**US**		**EA-4**	
	LS	**IV**	**LS**	**IV**
Short term real int. rate	**0.50*** **	**0.51*** **	**0.49*** **	**0.49*** **
	(0.08)	(0.07)	(0.08)	(0.08)
Current GDP Growth	0.04	0.05	**0.08***	0.07
	(0.03)	(0.04)	(0.04)	(0.05)
Exp. Inflation	**-0.37*** **	**-0.38*** **	**-0.31*** **	**-0.34*** **
	(0.09)	(0.10)	(0.11)	(0.11)
Exp. Domestic Debt	**3.33*** **	**8.93*** **	**3.23*** **	**9.25*** **
	(0.86)	(2.82)	(0.91)	(2.91)
Exp. Domestic Debt Sqr.	**-2.52*** **	**-6.99*** **	**-2.36*** **	**-7.05*** **
	(0.81)	(2.18)	(0.81)	(2.24)
Global Short term real int. rate	**-0.19*** **	**-0.18*** **	**-0.40*** **	**-0.30****
	(0.05)	(0.05)	(0.09)	(0.15)
Global Exp. Growth	**0.12*** **	**0.13****	**0.26*** **	**0.28*** **
	(0.02)	(0.06)	(0.06)	(0.11)
Global Exp. Inflation	-0.02	0.03	**-0.50*** **	**-0.44*** **
	(0.04)	(0.14)	(0.14)	(0.17)
Global Long-term real rates	**0.49*** **	**0.47*** **	**0.54*** **	**0.45*** **
	(0.07)	(0.12)	(0.14)	(0.17)
Constant	0.44		0.96	
	(0.36)		(0.62)	
Number of observations	387	308	387	308
Number of countries	25	22	25	22
R-squared	0.50	0.49	0.49	0.47
Domestic debt threshold	0.66	0.64	0.68	0.66
B.P. increase in R for 1% increase in Exp. Debt/GDP	0.31	0.54	0.40	0.79

Notes: i) LS= Least Square; IV= Instrumental Variable. 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 heteroskedastoicity 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 weighted average of G-20 Advanced economies', EA-4 or US growth, expected inflation, short term real rate and expected debt.