

Determinants of sovereign bond yields in emerging economies: Some panel inferences

Sri Hari NAIDU. A

National Institute of Public Finance and Policy, India
sriharinaidua@gmail.com

Phanindra GOYARI

University of Hyderabad, India
phanin12@gmail.com

Bandi KAMAIAH

University of Hyderabad, India
kamaiahbandi@gmail.com

Abstract. *In the backdrop of international financial crisis, debt markets across the globe became highly volatile, highly contagious and posed a high risk to advanced as well as emerging economies. In this regard, the study tries to identify the proximate determinants of sovereign bond yields in emerging economies from 1980 to 2013. The empirical results of Pedroni panel cointegration tests and dynamic ordinary least squares tests show that the factors like exchange rate, federal reserve rate, oil price, US bond yield, gold price and real interest rate are the proximate determinants of the emerging economies' bond yields.*

Keywords: Sovereign bond yields, spillover effects, panel cointegration, fed rate, oil price.

JEL Classification: C23, E42, E43, E44, E52, E58, E63, G12.

1. Introduction

Historically, sovereign market bonds have been the major source of financing to emerging economies for various developmental activities. However, sovereign bonds are influenced by various global and domestic shocks and market sentiments. Hence, countries had to borrow under very volatile conditions. There was a time when people talked about “decoupling”. But, in a globalized world, as long as countries take part in international debt markets, the cost of borrowing will be affected by the global shocks and hence, it’s growth.

According to Calvo (2002, 2005), with international financial integration, emerging market economies have become more vulnerable to exogenous shocks originating from global capital markets, which is referred to as “globalization hazard”. In the backdrop of global financial crisis, as the advanced economies were caught up in a liquidity trap situation due to “zero bound interest rates” and due to unconventional monetary policies, the emerging economies started facing various new challenges in the sovereign debt markets.

The effects of these policies are basically in the form of huge capital flow movements and spillover effects on asset, currency and debt markets. Apart from the havoc created by huge capital flows in bond yields and exchange rate movements in emerging economies, the monetary policies pursued by advanced economies have been posing challenges to emerging economies by destabilizing international debt markets. In the international debt markets, the vulnerability of emerging economies are translated into the higher borrowing costs, shorter maturity periods and there is also less liquidity in the market as a whole. In this context, there is a need to identify the factors which determine the sovereign borrowing and their bond yields.

Given the above issues surrounding the sovereign bonds, the present study tries to identify the determinants of sovereign bond yields in twelve emerging economies during the period 1980-2013. These emerging economies are Argentina, Brazil, Dominican Republic, Ecuador, India, Panama, Paraguay, Peru, Philippines, Turkey, Nigeria and Venezuela. The sovereign bond yields of twelve emerging economies are analyzed using panel unit roots and panel cointegration techniques.

This paper is organized into different sections. In Section 2, the issues and debates surrounding sovereign bond markets and cost of borrowing are explained. Then in Section 3, the spill-over and volatility effects faced by the emerging economies are explained. Data, variables, methodology and estimation results are explained in Section 4 and Section 5. The summary and concluding remarks are given in Section 6.

2. Sovereign bond markets and cost of borrowing

Sovereign bond market is one such place, where governments issue bonds and raise funds. Sovereign bonds have been traded in international capital markets for centuries. These bonds can be of either local currency denominated or denominated in a foreign currency. The cost of borrowing of the sovereign is strongly related to countries’ credit risk. The bond “yield” and “yield spread” and collateral debt swap (CDS) and CDS

spreads are used to measure the credit risk of an economy. But yields are the best tool to capture the absolute change (Tomz 2007, Cruces and Trebesch 2013).

The “yield” is generally defined as the ratio of the nominal interest rate to the market price of the bond. In general, the “price” that the sovereign pays reflects the market expectations and risk towards a sovereign. Similarly, in the case of domestic bonds, the credit risk of the country plays a significant effect in determining yields in the long run.

In the emerging economies, in particular, long-term government bond yields have become increasingly more dependent on global economic conditions. The availability of global savings has made the price of these securities (and hence yields) increasingly dependent on global investors’ preferences, while country specific risk factors have been playing a more limited role (Kumar and Okimoto, 2009). This means that factors such as global risk appetite, savings, interest rates and investment have become more important in pricing of longer debt maturities. With the result of that, cross country correlations of long term government bond yields have improved over the last two decades. On the other hand, national deficits, debts and other country specific factors would still be expected to play a role.

Researchers have tried to examine why yields vary across countries and over time. First, we need to remember that all bonds are not same in nature, in the sense that sovereign bonds differ in the type of issue, interest charged, currency denomination of the issue, maturity periods, repayment options and exit options. So, the yield which is calculated for a given sovereign is an average value. There are various factors responsible for this differential in yields. Some of these factors are briefly discussed in the following.

Defaulted history: The studies found that countries with defaulted history will pay higher yields than non-defaulted countries. The risky countries issue bonds at discount rate so that their bond prices should rise and the yields should come down over time automatically.

The gold standard: The question arises, how the economic, political and institutional factors affect the cost of borrowing. Bordo and Rockoff (1996) analyzed the influence of the gold standard on borrowing costs among a group of ten economies. It is found that countries with gold standard paid less, around 30 to 40 basis points, than countries without gold standard. Obstfeld and Taylor (2003) also came with the similar results by studying twenty countries. The gold standard will increase the confidence of the investor or lender, as it will have a backup of gold to a certain percentage and the economy will also be running in a much prudent manner.

The colonial delight: The colonies and former colonies have been found to be treated better in London, one of the major financial centers of the world. As Ferguson and Schularick (2006) found that British colonies could able to borrow at far lower rates compared to non-colonies at London. One of the reasons may be that the lenders saw the transaction as domestic rather than foreign.

Fiscal management: Ardagna (2009) analyses the behavior of government and corporate bond yields in times of large changes in the fiscal position for the OECD countries from

the period 1960 to 2002. The study found that ten year nominal yields on government bonds increased by more than 180 basis points during years in which the primary fiscal deficit widened by more than one and half percent of GDP in one year or else 1 percent of GDP per year in two consecutive years.

Kinoshita (2006) developed a theoretical model to study the nexus between sovereign bond yields and government debt. The study tested the model on a panel of 19 advanced economies and found that a one percent increase in the debt-gdp ratio increases the real long term sovereign bond yield around two to five basis points. The results are in conformity with the earlier studies by Laubach (2009) and Engen and Hubbard (2004), which found the impact to be around three to five percent. Hauner and Kumar (2009) try to resolve the “conundrum” of low government bond yields and high fiscal imbalances observed in G-7 advanced economies in the aftermath of the crisis. Poghosyan (2014), and Baldacci and Kumar (2010) found that fiscal variables determine the bond yields for advanced economies.

But Faini (2006) and Knot and De Haan (1995) found the contrary. Faini (2006) studies the case of 10 euro area countries for the period 1979–2002. The study finds that public debt has no significant impact on long-term government bond yields in individual country regressions, but its impact becomes significant for the 10 euro area countries as a whole. Knot and De Haan (1995) arrive at a similar conclusion using a sample of five European countries. So there is no consensus on the determinants of the sovereign bond yields.

Monetary policies: International effects of unconventional monetary policy on foreign asset prices contribute to a rapidly growing empirical literature that evaluates the financial transmission of unconventional policy measures. Much of this research focuses on the question of whether purchases of large quantities of treasury coupon securities by the fed impacted the level of longer-term treasury yields. Employing a variety of approaches, Gagnon et al. (2011), Krishnamurthy and Vissing-Jorgensen (2011), Hamilton and Wu (2012), and Bauer and Rudebusch (2013) present compelling evidence that the unconventional policy measures employed by the Federal Open Market Committee since the end of 2008 have significantly lowered longer-term treasury yields and also significant spillover effects on emerging economies. According to Uribe and Yue (2006), the price level and real output in a typical emerging economy respond to Federal Reserve monetary policy shocks by more than the price level and real output in the U.S. itself.

Gilchrist et al. (2014) study the impact of U.S. conventional monetary policy on foreign government bonds with those of the unconventional measures employed after the target federal funds rate hit the zero lower bound (ZLB). The study makes a relative comparison of the spillover effects during conventional monetary policy period compared to unconventional monetary period. The study includes both advanced and emerging economies. The short run impact is captured as the change in the two year nominal treasury yield around policy announcement. To see the long run impact, change in ten year nominal treasury yield is decomposed into observed and surprise component of shock. The study found a profound effect of both conventional and unconventional monetary policy stand on advanced and emerging economies both in short run and long run.

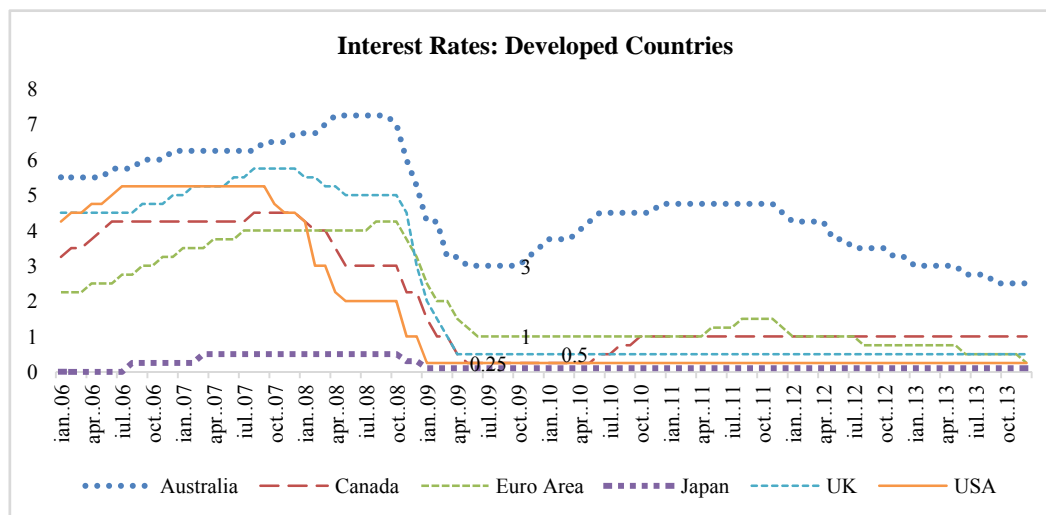
Bauer and Neely (2014) find substantial effects of both portfolio balance and signaling channels in international bond yields. Bauer and Rudebusch (2011), however, claim that the signaling channel accounts for 30 to 65 percent of the total impact, rather than 30 percent suggested by their interpretation of Gagnon et al.'s (2011) analysis.

Anomalies and exceptions: Even though “issue of bonds” in international capital markets dominates the sovereign borrowing, the choice and availability of other credit avenues do play a role, when it comes to sovereign borrowing costs. These other avenues, like borrowing from commercial banks, directly from other sovereign governments and multilateral organizations like IMF and World Bank do have a role. Some countries may also get an aid or grant, which does not have borrowing costs.

3. Spillover and volatility effects faced by emerging economies

In modern economies, disruptions in the flow of credit are detrimental to economic activity and lead to unemployment, cancelled investment plans and even recession. Capital account liberalization and increasing globalization add an international dimension for capital flows (Lee et al. 2011). International linkages have become more prominent in the post financial crisis period in discussions around interest rates, exchange rates, pricing of financial instruments, such as bonds, equities and trade channels, although trade channels continue to dominate the impact (Forbes and Chinn, 2004).

Graph-1: *The interest rates of developed countries during “financial crisis”*



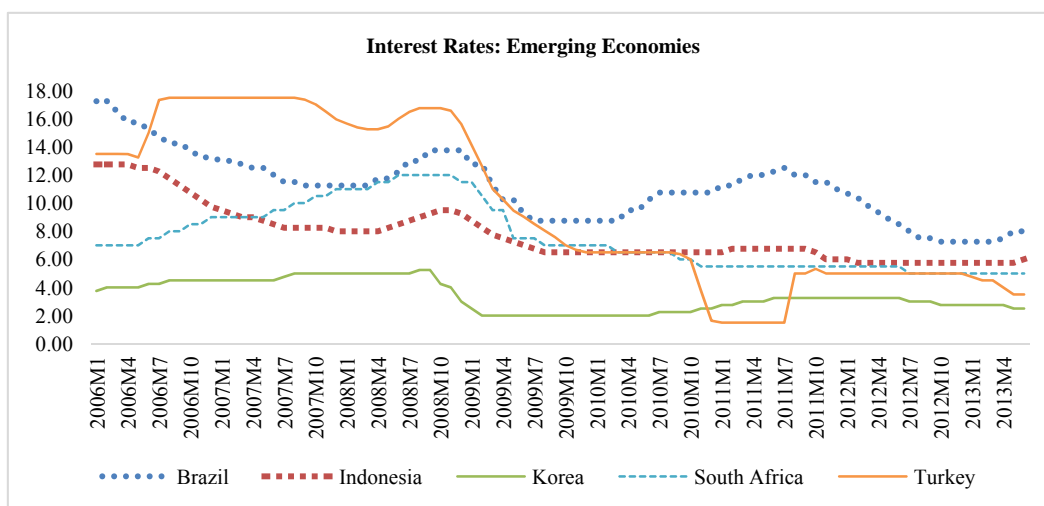
Source: Federal Reserve of New York and Other Respective Central Banks.

The recent global financial crisis has brought new challenges to emerging economies. In general, the prime objective of monetary policy is to maintain inflation. To achieve this, central banks use “interest rate” as the main instrument. But in the back drop of financial crisis, the advanced economies are operating under “zero bound interest rates”. The US Federal Reserve rate lowered to 0.25 percent by Feb, 2009 and other developed countries

too followed suite and maintained low interest rates, Japan (0.1 percent), U.K (0.5 percent) in the post Feb, 2009 period (See Graph 1). The advanced economy monetary policies have a serious spillover effects on emerging economies in different respects.

The interest rates in developing countries (See Graph 2) during the financial crisis period were much higher than advanced economies. Interest rates were varying in the range of 2 percent to 6 percent. Due to interest rate differentials huge capital flight had taken place in the initial stages of financial crisis from advanced economies to emerging economies. This created an adverse situation for the developed countries. At the same time, emerging economies experienced an unprecedented exchange rates appreciations, equity market booms through foreign institutional investors, the cost of borrowing was also lowered and bond yields were higher. The liquidity in the capital markets dipped low.

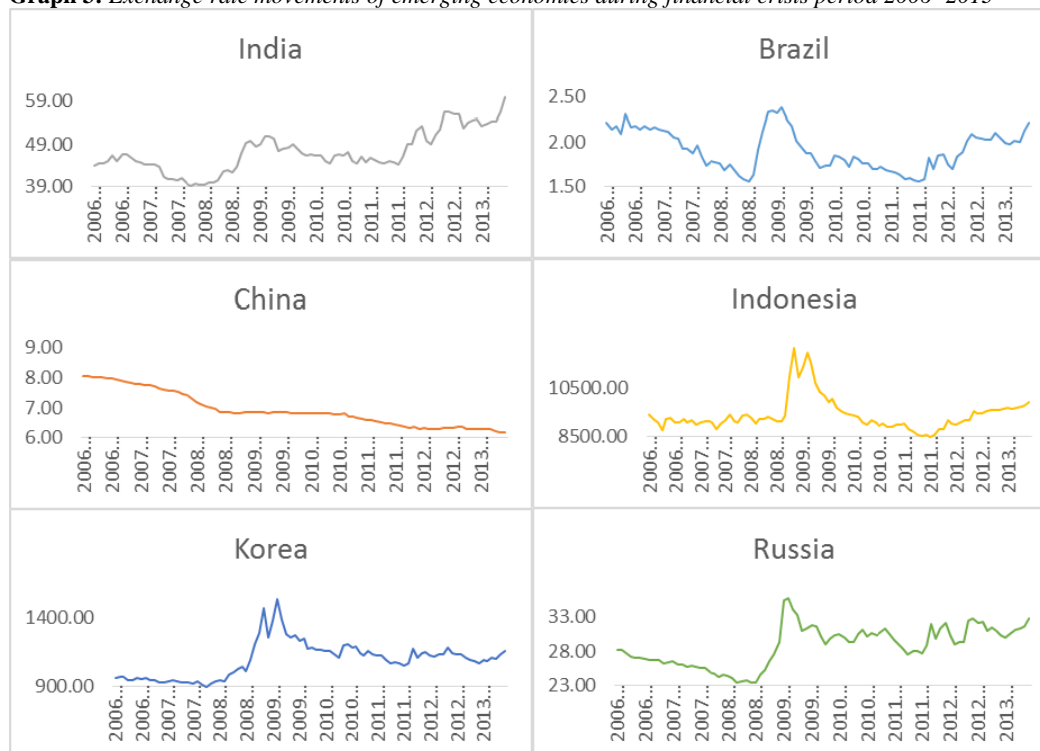
Graph 2: *The interest rates of emerging countries during “financial crisis”*



Source: Respective Central Banks

Advanced economies want to maintain long term yields at low level to push investments and achieve growth. To maintain the low long term yields in the long run, advanced economies resorted to unconventional policies like, large-scale asset purchase program, providing liquidity to key credit markets and lending to financial institutions. The effects of these policies have to be looked from two dimensions. One, the effectiveness in achieving desired objective at domestic economy and second, spill over effects on outside world, especially, emerging economies.

The exchange rates of emerging economies became more volatile in this period. As we can see from Graph 3, the exchange rates in India, Brazil, Indonesia, Korea and Russia got a high depreciation in the immediate post July, 2008 and this is the time when the huge amount of capital was pumped into the emerging economies.

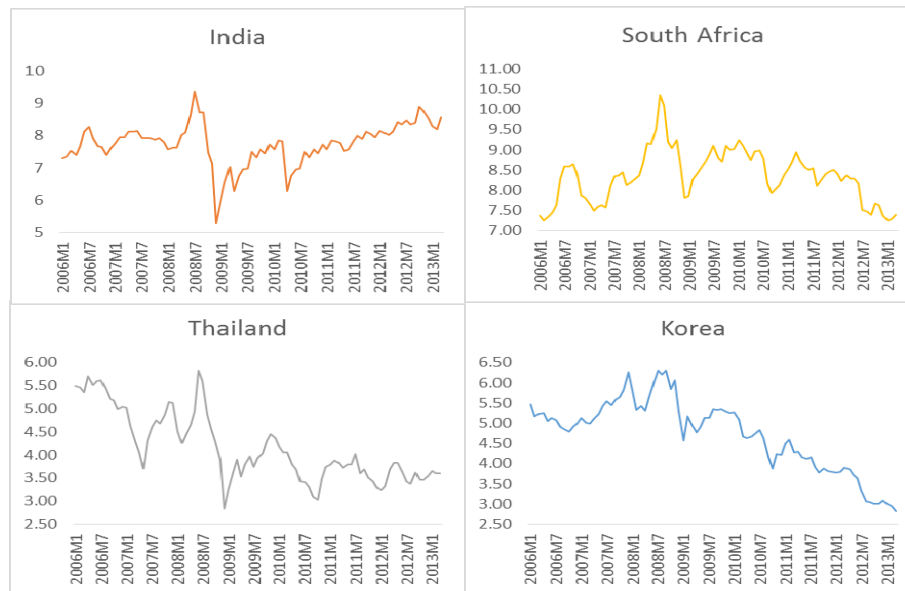
Graph 3: Exchange rate movements of emerging economies during financial crisis period 2006 -2013

Source: Respective Central Banks

Again, after 2010, exchange rate position became reverse and got high appreciation. This is the time when the “capital flight” took place due to “federal taper” and some positive signals in the western economic recovery.

The “flight to safety and to quality” effect has often been a common pattern of crisis episodes. After the financial crisis periods, emerging markets’ bonds were in huge demand due to prevailing crisis situation in the US economy and due to better prospects in the emerging economies. Investors shifted from low yielding US bonds to high yielding emerging economy bonds.

Conversely, due to the better returns in the US economy due to “tapering”, the investors were selling emerging market bonds and shifted back to US bonds. As we can see from the Graph 4, the bond yields were highly volatile throughout the period in all the countries. Moreover, immediately after July 2008, there was a sudden sky rocketed fall in the yields, which was the direct impact of global shock.

Graph 4. Bond Yields of emerging economies during 2006-2013

Source: Respective Central Banks

4. Data and variables

The changes in the US Federal Reserve rates are generally accompanied by parallel shifts in interest rates in other G-7 countries and this will determine the world interest rates. The benchmark 10 year bond yield is considered the best instrument to capture the financial market movements. Hence, the US Federal Reserve rate and 10 year benchmark bond yields are the most significant variables to capture the international debt markets. As lower Fed funds rate is assumed to be associated with higher liquidity, it is expected to have a positive relationship with yield. But, Fed rate will have a negative effect on emerging markets bond yields. The data of Federal Reserve rate, nominal 10 year benchmark bond yield for the USA and the nominal 10 year benchmark bond yields for 12 emerging economies were collected from the Federal Reserve and respective central banks.

It is expected that the emerging market bond yields are sensitive to the changes in the US bond yields. The US bond yields are expected to push the emerging market bond yields in a considerable manner. Emerging market bonds are also sensitive to domestic factors like gross national income (gni) and debt to gdp ratio (govd2gdp), real interest rate (rir). Therefore, gni, real interest rate and debt to gdp ratio are taken as variables in the model. The data on interest rates, on an annual frequency, were primarily obtained from the IFS database. Data on fiscal and other macroeconomic variables are obtained largely from the IMF's World Economic Outlook Database.

Inflation is expected to be positively related to yields as investors need compensation for inflation and the prolonged higher inflation may also reflect a higher degree of economic

uncertainty. The lower current account balance (as percent of GDP) improves the ability of the country to repay its external debt and avoids the liquidity crisis. Lower current account deficit (cad) is expected to be associated with lower yields. External debt (as percent of GDP) is another fiscal indicator, which is expected to be positively related to yields, reflecting that countries with higher debt are assumed to be riskier. Table 1 shows descriptions of study data variables.

Table 1. *Descriptions of data variables*

Variable	Description
dyield	Nominal 10 year benchmark bond yield for respective country
usyield	Nominal 10 year benchmark bond yield for USA
inf	Inflation, consumer prices (annual %)
rir	Real interest rate (%)
govd2gdp	Government debt (as % of GDP)
ed2gdp	External debt (as % of GDP)
er	Exchange rate (No. of domestic currency units per 1 US dollar)
reer	Real effective exchange rate
cad	Current account deficit
gni	Gross national income (current US\$)
fedrate	Federal Reserve Interest Rate
oilprice	Crude oil price-brent (dollars per barrel)
vix	Implied volatility index

To capture global risk, volatility index (vix) and oil prices (oilprice) are used. The Chicago Board Options Exchange Volatility Index (vix) which measures the implied volatility of S&P index options (1) is used as a proxy for global risk appetite (2). The Vix is expected to be positively related to yields. Oil price is also used as one of the global factors. Brent crude oil price data is taken from the US energy information administration. The study included 12 emerging countries based on data availability. The countries are: India, Mexico, Morocco, South Korea, Pakistan, Philippines, Russia, Seychelles, South Africa, Thailand, Turkey and Venezuela. The panel data set is a balanced panel and the time period is from 1980 to 2013.

5. Methodology

There are many methodologies used with respect to single country studies and panel studies. Some studies use single equation regression models, time series models, and vector autoregressive models. The panel studies are more efficient than other methodologies. As Poghosyan (2014) argues for panel studies rather than single country studies, because the short time series dimension of the data is particularly acute in studies using macroeconomic determinants of bond yields, which are typically accessible only in low frequencies (annual or quarterly). Poghosyan (2014) applied the pooled mean group estimator of Pesaran et al. (1999) which is a panel data version of the error-correction model. The present study uses a new panel cointegration methodology developed by Pedroni (1999 and 2004).

Given the time series component present in the panel data, first, we determine the order of integration of every data series. As cointegration is related with the long run equilibrium

relationship between two or more variables, once we estimate panel unit root tests, we test for the existence of long run relationship between the variables using cointegration test developed by Pedroni (1999). If the data series are cointegrated, the long run relationship among the variables is estimated by the Dynamic Ordinary Least Square Method (DOLS) developed by Pedroni (2001).

Panel unit root tests: Before turning to the estimations, panel unit root tests are applied on domestic bond yields and other study variables. We have used six unit root tests - the Levin-Lin-Chu (2002), Harris-Tzavalis (1999), Breitung (2000, Breitung and Das 2005), Im-Pesaran-Shin (2003), and Fisher (Choi 2001) and Hadri (2000) panel unit root tests.

If we consider a panel regression model with a first order autoregressive component, the model is written as

$$Y_{it} = \rho_i Y_{it-1} + Z_{it} \gamma_i + \epsilon_{it}$$

where, $i=1$ to N indexes panels, $t = 1$ to T indexes time, Y_{it} indicates the variable under consideration, and ϵ_{it} is a stationary error term. The Z_{it} represents panel specific means. In the panel unit root tests, the null hypothesis is $H_0: \rho_i = 1$ for all i versus the alternative $H_1: \rho_i < 1$.

The first five tests are based on the null hypothesis of all panels contain a unit root and alternative hypotheses of no unit root. The Hadri test is based on the null hypothesis of all panels are trend stationary. The Hadri LM test for panel stationarity instead assumes the null hypothesis that all panels are stationary against the alternative that at least some panels contain unit roots. The Im-Pesaran-Shin (2003), and Fisher (Choi 2001) and Hadri (2000) tests can be applied to both balanced and unbalanced panels, whereas remaining tests can be applied to only balanced panels.

Panel cointegration tests: Next, we test the existence of long run relationship between domestic bond yield and various macro, debt and global factors, using panel cointegration test suggested by Pedroni (1999 and 2004). This test is developed by extending the residual based cointegration test of Engle and Granger (1987) for panel data framework. Pedroni's test accommodates the cross section heterogeneity and allows deterministic time trend, slopes and individual fixed effects across panels.

There are seven panel cointegration estimates in Pedroni (1999) and each estimate is derived from the residuals of the cointegration regression once normalizing the panel statistics with correction terms. The procedures proposed by Pedroni (1999) use estimated residual from the hypothesized long run regression in the following way:

$$y_{i,t} = \alpha_i + \delta_i t + \beta_{1i} x_{1i,t} + \beta_{2i} x_{2i,t} + \dots + \beta_{Mi} x_{Mi,t} + \epsilon_{i,t} \quad (1)$$

for $t = 1, \dots, T$ and $i = 1, \dots, N$.

where T is the number of observations over time, N number of cross-sectional units in the panel, and M number of regressors. Here, α_i is the country specific intercept or fixed effects parameter. This varies across individual cross-sectional units. In the same way, the slope coefficients and member specific time effects, δ_{it} , also vary across cross sectional units.

Pedroni (1999 and 2004) put forward the heterogeneous panel and heterogeneous group mean panel test statistics to estimate panel cointegration. Pedroni (1999) defines two sets of statistics. The first set of three statistics $Z_{\hat{v},N,T}$, $Z_{\hat{\rho},N,T-1}$ and $Z_{tN,T}$ is based on pooling the residuals along the within dimension of the panel. These statistics are as follows

$$Z_{\hat{v},N,T} = T^2 N^{3/2} \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{1li}^2 \hat{e}_{i,t-1}^2 \quad (2)$$

$$Z_{\hat{\rho},N,T-1} = T \sqrt{N} \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{1li}^2 \hat{e}_{i,t-1}^2 \quad \left(\sum_{i=1}^N \sum_{t=1}^T \hat{L}_{1li}^2 (\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} \quad \hat{\lambda}_i) \right) \quad (3)$$

$$Z_{tN,T} = \tilde{\sigma}_{N,T}^2 \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{1li}^2 \hat{e}_{i,t-1}^2 \quad \left(\sum_{i=1}^N \sum_{t=1}^T \hat{L}_{1li}^2 \hat{e}_{i,t-1} \Delta \hat{e}_{i,t} \quad \hat{\lambda}_i \right)^{1/2} \quad (4)$$

where $\hat{e}_{i,t-1}$ is the residual vector of the OLS estimation of equation (1)

The next set of statistics is based on pooling the residuals along the between dimension of the panel. This allows for a heterogeneous autocorrelation of parameters across members. These statistics are:

$$\tilde{Z}_{\hat{\rho},N,T-1} = \sum_{i=1}^N \sum_{t=1}^T \hat{e}_{i,t-1}^2 \quad \left(\sum_{t=1}^T (\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} \quad \hat{\lambda}_i) \right) \quad (5)$$

$$\tilde{Z}_{tN,T-1} = \sum_{i=1}^N \sum_{t=1}^T \hat{e}_{i,t-1}^2 \quad \left(\sum_{t=1}^T (\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} \quad \hat{\lambda}_i) \right)^{1/2} \quad (6)$$

These statistics estimate the group mean of the individual time series statistics. The asymptotic distribution of each of those five statistics is expressed in the following form:

$$\frac{X_{N,T} - \mu \sqrt{N}}{\sqrt{V}} \Rightarrow N(0,1) \quad (7)$$

where $X_{N,T}$ is of the test statistics, μ and V are the mean and variance of each test respectively. They are explained in Table 2 of Pedroni (1999). Under the alternative hypothesis, Panel v statistics diverges to positive infinity. Therefore, this is a one sided test where large positive values reject the null of no cointegration. The remaining statistics diverge to negative infinity, which means that high negative values reject the null.

The DOLS estimation constructed by Pedroni (1996, 2001 and 2004) is used to estimate the precise long run relationship between variables. Kao and Chiang (2000) suggest that the DOLS estimator may be more promising than OLS or fully modified estimators in estimating the cointegrated panel regressions.

Empirical estimation

Table 2 presents the descriptive statistics of the panel data set. The time period of the panel is 1980 to 2013 (with dimensions of $n = 12$ and $T = 34$).

Table 2. Descriptive statistics of the study variables

Variable	Obs	Mean	Std.Dev.	Min.	Max.
dyield	408	9.68133	10.61769	0	95
usyield	408	6.68453	3.11538	1.8	13.9108
cad	408	-1.41784	5.94494	-27.505	17.755
er	408	94.26972	266.1257	0	1401.437
ed2gni	408	37.31356	32.4022	0	222.4289
inf	408	19.54758	51.72374	-2.40730	874.6218
rir	408	6.55926	13.61291	-35.31446	183.2
govd2gdp	408	34.20383	37.51609	0	199.787
gni	408	268.6109	367.3421	0	2016.574
ggni	408	4.00787	5.155548	-15.24504	29.17343
gsav2gdp	407	22.23431	12.02324	-21.83963	60.30717
fedrate	408	5.26392	3.903714	0.1	16.39
oilprice	408	39.90965	30.39227	12.76	111.63
vix	408	14.25265	10.4625	0	32.69

Given the nature of the variables, some of the variables have high standard deviation and this may be due to the long time period and different sizes of the economies.

Panel unit root tests

Before turning to cointegration estimations, six panel unit root tests are applied to all the variables. The panel unit root tests showed mixed results. Given the nature of the panel with large T and small N , tests gave mixed results. The variables are considered as stationary or non-stationary, if more than three tests confirm it to be stationary or non-stationary. The full details of the panel unit root tests are given in Appendix.

The variables which are found to be stationary are: domestic as well as US10 year benchmark bond yields (dyield), inflation (inf), real interest rates (rir), exchange rate (er), current account deficit (cad), federal reserve rate (fedrate), oil price (oilprice), government debt to gdp (govd2gdp) and volatility index (vix). But, external debt to gdp (ed2gdp), gross national income (gni) is found to be non-stationary.

Panel cointegration estimations

Given the panel unit root test results, the panel cointegration tests proposed by Pedroni (1999, 2001 and 2004) are estimated with the variables of domestic yield (dyield), US 10 year benchmark bond yields (usyield), government debt to gdp (govd2gdp), inflation (inf), real interest rates (rir), federal reserve rate (fedrate), oil price (oilprice) and volatility index (vix). In Pedroni residual panel cointegration test, under the null hypothesis (H_0) of no cointegration and trend and deterministic intercept assumption, a total of seven test statistics are estimated. The first four tests, panel v statistic, panel ρ statistic, panel t non-parametric PP statistic and panel t parametric ADF (Augmented Dickey Fuller) statistic, are known as the 'within dimension' panel statistics. While the last three, group ρ statistic, group PP statistic and group ADF statistic, are known as 'between dimensions' group tests. All these statistics are mostly extensions of the Phillips and Perron (1988) or ADF test or group mean panel tests (Im et al., 2003).

Table 3. Estimations of panel cointegration tests

Test	Statistic
Panel v -Statistic	-3.386*
Panel ρ -Statistic	4.141*
Panel t -Statistic: (non-parametric)	2.601*
Panel t -Statistic (<i>adf</i>): (parametric)	2.691*
Group ρ -Statistic	4.787*
Group t -Statistic: (non-parametric)	2.694*
Group t -Statistic (<i>adf</i>): (parametric)	2.697*

Notes: All test statistics are distributed $N(0, 1)$, under a null of no cointegration, and diverge to negative infinity (save for panel v). All statistics are from Pedroni's procedure (1999) where the adjusted values can be associated to the $N(0, 1)$ distribution. The Pedroni (2004) statistics are one-sided tests with a critical value of -1.64 ($k < -1.64$ implies rejection of H_0), except the v -statistic that has a critical value of 1.64 ($k > 1.64$ implies rejection of H_0). * implies rejection of the null of no co-integration at 1% significance level.

The summary of the results of panel cointegration analysis are presented in Table 3. The results show that all seven statistics are found to be significant, in the sense of rejecting the null hypothesis of no cointegration at the 1% significant level. Hence, we can confirm that there exists a long run relation between the domestic bond yields and other explanatory variables.

The DOLS regression model is estimated to capture the long run coefficients of the cointegrating variables and the results are presented in Table 4. It is found that the coefficients for all the variables are with proper sign and statistically significant at the 1 percent level. The coefficients of US 10 year benchmark bond yields (*usyield*), government debt to gdp (*govd2gdp*), real interest rates (*rir*) and volatility index (*vix*) are found to be positive and significant. The coefficients of the variables, Federal Reserve rate (*fedrate*), oil price (*oilprice*) are found to be negative but significant. The coefficient of inflation (*inf*) is negative but insignificant.

Table 4. Dynamic Ordinary Least Squares (DOLS) Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
<i>usyield</i>	10.98882*	4.680811	2.347631	0.0209
<i>govd2gdp</i>	0.240077*	0.060421	3.973418	0.0001
<i>fedrate</i>	-7.224344**	3.750766	-1.926098	0.0571
<i>inf</i>	-0.011705	0.039026	-0.299930	0.7649
<i>vix</i>	0.406465**	0.215137	1.889331	0.0619
<i>oilprice</i>	-0.130806*	0.052852	-2.474950	0.0151
<i>rir</i>	0.519401*	0.097932	5.303693	0.0000

Note: * and ** imply the level of significance at 1% and 5% respectively.

Our results are in conformity with the literature. In most of the earlier studies, the US bond yields and FED rate are implicitly assumed as a proxy for world interest rates. The Lewis and Rosborough (2013), which studied New Zealand economy, found that the global factors explain around 62 % of variation in the interest rates. Moreover, the study found that, an increase of 10 basis points in the world interest rates increased New Zealand's 10 year yield around 10 to 11 basis points. The current study found more strong impact than the above study. A one percent increase in the US bond yields will increase the bond yields of the emerging economies by about 10 percent. This shows that the distortions in the US debt market can be very devastating for the emerging economies' debt markets.

Baldacci and Kumar (2010) found that higher fiscal deficits and public debts will push long term interest rates higher and which eventually determine the bond yields. Poghosyan (2014) found that a one percentage point increase in the debt to gdp ratio range increased the government bond yields somewhere between 2 to 5 points. When it comes to government debt to gdp (govd2gdp), the current study found that a one percentage point increase in the government debt to GDP raises the domestic bond yields by about 2 percentage points.

Many previous studies like Peiris (2010) and Baldacci and Kumar (2010) found that inflation and interest rates are important determining factors of domestic bond yields. But our study could not validate this for inflation. The coefficient of inflation found to be negative and insignificant. The reason may be that now, high inflation is a norm than exception, in many emerging economies. But interest rate (rir) was found to be positively related and significant with respect to domestic bond yields.

Volatility index (vix), a proxy for global risk, is found to be positive and significant at 10% level. This means that the countries with weak fundamentals (fiscal stress) will be subject to more volatile bond yields in the event of sudden upward shift in global risk appetite.

The coefficient of the oil price depends on the nature of the country. If the country is an oil consuming country then the aggregate impact is generally found to be negative. But on the contrary, if it is an oil exporting country, then it will be positive. Since high oil price will increase the cost production of industries and companies and this will affect the growth prospects the firms and countries. So countries have to borrow at higher interest rates, which will increase the bond yields. In our case, oil price is found to be negative and significant, despite of the composition of the countries, which includes major oil producing countries, namely, Russia, Mexico and Venezuela. The reason seems to be the low oil prices prevailing in the global markets since 2006.

Given this empirical evidence, it can be confirmed that there is a presence of a long run relationship between the domestic bond yields and US 10 year benchmark bond yields (usyield), government debt to gdp (govd2gdp), federal reserve rate (fedrate), oil price (oilprice), real interest rates (rir) and volatility index (vix). These are the variables, which best determine the emerging markets bond yields.

6. Conclusion

It is the fact that historically, sovereign market bonds are the major source of fund raising for governments. But, the process of issue of debt and repayment is highly influenced by the various global and domestic events and market sentiments. Moreover, the international financial integration further increased the volatility in the debt markets across the globe. Especially, due to globalization hazard, the emerging market economies have become more vulnerable to exogenous shocks arising from global capital markets. The international financial crisis and zero bound interest rates, further added woes of the emerging economies. The effects are mainly in the form of high capital movements and spillover effects on different markets. The vulnerabilities are translated into higher

borrowing costs, shorter maturity periods, less liquidity in the market etc. At this juncture, there is a need to identify the determinants of the sovereign borrowing and their bond yields.

Given the above arguments, the present study tried to identify the determinants of the sovereign bond yields of twelve emerging economies over the period 1980–2013 using panel regression and panel cointegration techniques. We identified a list of variables from the literature and constructed a balanced panel dataset. First, six panel unit root tests were applied and tested for stationarity. Then, the panel cointegration tests proposed by Pedroni (1999, 2001 and 2004) were estimated on domestic yield (dyield), US 10 year benchmark bond yields (usyield), government debt to gdp (govd2gdp), inflation (inf), real interest rates (rir), federal reserve rate (fedrate), oil price (oilprice) and volatility index (vix). Out of the seven statistics that the tests generated, all seven statistics were found to be significant, which means that there existed a long run relation between the domestic bond yields and other explanatory variables.

Next, the dynamic ordinary least squares (DOLS) regression model was estimated to capture the long run coefficients of the cointegrating variables. The coefficients of US 10 year benchmark bond yields (usyield), government debt to gdp (govd2gdp), real interest rates (rir) and volatility index (vix) were found to be positive and significant. The coefficients of the variables, Federal Reserve rate (fedrate), oil price (oilprice) were found to be negative but significant. The coefficient of inflation (inf) was negative but insignificant. Given this empirical evidence, it can be confirmed that there is a presence of a long run relationship between the domestic bond yields and US 10 year benchmark bond yields (usyield), government debt to gdp (govd2gdp), federal reserve rate (fedrate), oil price (oilprice), real interest rates (rir) and volatility index (vix). These are the variables, which determine emerging markets bond yields and hence, the emerging economies' monetary and fiscal policies have to pay enough attention in controlling these variables to avoid any potential crisis situation.

Notes

- (1) The vix is a measure of the market perception and expectation of stock market volatility over the next 30 days. It is a weighted average of prices for different options on the S&P 500 index. See <http://www.cboe.com/micro/VIX/vixintro.aspx>
- (2) In the literature, vix has been traditionally opted as a measure of global risk appetite. See also for example, McGuire and Schrijvers (2003), Hartelius et al. (2008), Gonzales-Rozada and Yeyati (2008), Bellas et al. (2010), Baldacci and Kumar (2010) and Longstaff et al. (2011).

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Appendix. Panel unit root tests estimations

Variable	LLC		Harris-Tzavalis		Breitung		IPS		Fischer		Hadri		Result
dyield	-3.6487	0.0001	-9.9081	0.0000	-3.80	0.0001	-2.9217	0.0017	-6.5381	0.0000	2.5797	0.0049	Stationary
usyield	-3.6487	0.0001	-35.2943	0.0000	0.7362*	0.7692	-6.0755	0.0000	-6.7711	0.0000	11.5675	0.0000	Stationary
Inflation (inf)	-7.3077	0.0000	-21.2165	0.0000	-3.2851	0.0005	-5.8707	0.0000	-7.1106	0.0000	0.1168*	0.4535	Stationary
Real Interest Rate (rir)	-4.8946	0.0000	-15.1127	0.0000	-4.1351	0.0000	-6.0196	0.0000	-7.6884	0.0000	0.9099*	0.1814	Stationary
Exchange Rate (er)	-3.3836	0.0004	-3.345	0.0004	5.0953*	1.0000	4.8594*	1.0000	-2.0259	0.0214	8.5005	0.0000	Stationary
Current Account Deficit (cad)	-2.8931	0.0019	-11.3896	0.0000	-4.6024	0.0000	-3.5901	0.0002	-5.9934	0.0000	3.4178	0.0003	Stationary
Federal Reserve Rate (fedrate)	-1.8749	0.0304	-30.3171	0.0000	0.619*	0.7320	-1.9916	0.0232	0.278*	0.6095	11.4925	0.0000	Stationary
oilprice	-13.067	0.0000	-39.3039	0.0000	0.2053	0.5813	7.3469*	1.0000	9.6672*	1.0000	6.8784	0.0000	Stationary
Volatility Index (vix)	-3.7457	0.0001	-35.2943	0.0000	-0.7997*	0.2119	-1.6951	0.0450	-6.3091	0.0000	8.5105	0.0000	Stationary
Govt Debt to GDP (govd2gdp)	-2.613	0.0045	-2.7348	0.0031	-3.2164	0.0006	-2.7337	0.0031	1.2289*	0.8904	3.3707	0.0004	Stationary
Gross National Income (gni)	10.322*	1.0000	5.208*	1.0000	10.1948*	1.0000	13.8107*	1.0000	4.2168*	1.0000	10.0586	0.0000	Non-Stationary
External Debt to GNI (ed2gni)	1.8765*	0.9697	3.0797*	0.9990	-0.5021*	0.3078	2.754*	0.9971	-3.3296	0.0004	7.0598	0.0000	Non-Stationary

Source: Note: * indicates NOT significant at 1%, 5% or 10% level.

For LLC: Null: Panels Contains Unit Root.

For Hadri: Null: All Panels are stationary.