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Non-default Component of Sovereign Emerging Market Yield Spreads and its Determinants: Evidence from Credit Default Swap Market*

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Abstract

In this paper, I show that a sizable component of emerging market sovereign yield spreads is due to factors other than default risk such as liquidity. I estimate the non-default component of the yield spreads as the basis between the actual credit default swap (CDS) premium and the hypothetical CDS premium implied by emerging market bond yields. On average, the basis is large and positive for speculative grade bonds and slightly negative for investment grade bonds. Large positive basis for speculative grade bonds support the existence of speculation in the CDS market when the underling's credit quality is bad. I study the effects of bond liquidity, liquidity in the CDS market, equity market performance and macroeconomic variables on the non-default component of the emerging market yield spreads. I show that bond liquidity has a significant and positive effect on the CDS-bond basis of investment grade bonds. The results suggest that the liquid bonds of investment grade bonds are more expensive relative to the prices implied their CDS premiums. However, the results are somewhat mixed and even contrary for the speculative grade bond sample.

JEL Classifications: G10, G12, G15

Keywords: Emerging Market Sovereign Bonds, Credit Risk, Credit Default Swaps, Basis, Liquidity, Emerging Market Equity Markets

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1 Introduction

Over the past 10 years, emerging market sovereign bonds handily outperformed not only U.S. corporate bonds, but the S&P 500 equity index as well. Emerging market bonds are a very large and fast growing asset class; their trade volume in the world is expected to approach $8 trillion in 2008. Since emerging market economies carry a considerable default risk, they offer a yield a significant spread relative to their riskless counterparts. However, not the entire yield spread of an emerging market bond can be explained by the default risk alone. Recent studies on the US corporate bond market have noted that factors such as liquidity, taxes, and aggregate market risk also play important roles in corporate yield spreads. Therefore, it is interesting to explain; to what extent sovereign bond yield spreads reflect default risk and how much of their spreads relative to their riskless counterparts stems from factors such as liquidity and other market risk factors.

A derivative instrument called Credit Default Swap (CDS) has become very popular in the last decade. Since CDS prices default risk explicitly, they are a considered as a good benchmark for the pure credit risk of the underlying entity. In this paper, I use CDS premiums to estimate the default and non-default component of emerging market sovereign bond yields and examine the link between the non-default component and liquidity. I study the difference between the CDS premium and the CDS premium as implied by the bond yields as a measure of the non-default component of the bond yield.[3] I refer to the difference between the CDS premium and the implied CDS premium as the CDS-bond basis, and I relate the CDS-bond basis to bond liquidity, speculation in the CDS market, CDS liquidity, equity market performance and world macroeconomic factors.

My research has a number of significant contributions to both emerging market debt literature and to the literature on the non-default component of bond yields. First, to the best of my knowledge, this work is the first attempt to identify the non-default components of sovereign bond yield spreads. I use the data on US Dollar denominated bonds, which are issued by 21 emerging market countries and their CDS premiums between January 2004 and May 2008. Second, I improve the literature on calculating the basis between actual CDS and implied CDS

[3] The implied CDS premium is premium calculated using the same maturity, default probability and recovery rate implied by the bond yields.

premiums by relaxing the restrictive assumption of a "flat term structure of credit curves".[4] (Figure 1 and 2)

Third, my results on the distribution of the basis, i.e. the non default component, suggest clues about the *speculation* in the CDS market. This paper is the first one to present evidence on the speculation in the CDS market. My results confirm a large positive basis for speculative grade bonds, which suggests that on average, the CDSs are more expensive than what is implied by their underlying bond yields. When the news about a sovereign is bad, speculators -without owning the underlying bond- might speculate on worsening of the credit conditions of the underlying asset by buying the CDS contract. The excess demand to CDSs would increase the CDS premium while bond prices do not fall as much since the speculation is not directly related to the risk premium of the underlying.

Fourth, I show that liquid bonds investment grade sovereigns are more expensive relative to the price implied by their CDS premiums. For speculative grade bond sample, the results suggest a mixed and even contrary relationship between the bond liquidity and the CDS basis. I use direct bond liquidity proxies such as bid-ask spreads and turnover ratios. I divide the bonds into two rating groups, as investment and speculative grade, in order to distinguish the effects of liquidity on bonds with different credit quality. I illustrate that liquidity has a significant positive effect on the CDS-bond basis of investment grade bonds. Nevertheless, liquidity has a mixed and even contrary effects on the CDS-bond basis of speculative grade bonds. Some possible reasons include; limits to arbitrage due difficulty of short selling the bond and speculation in the CDS market. These are dealt with deeply throughout the paper.

As a novelty for this literature, I report that the domestic stock market performance of emerging markets have a significant negative impact on non-default component of bond yields. The reason for the negative effect seems to be related to credit risk and to the lead-lag relationship between the CDS and bond markets.[5]

The important thing to note is that the focus of this research is emerging market sovereign bond yield spreads. There are some main differences between the US corporate bond market and

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[4] Longstaff et. Al (2005) and Nashikkar et al. (2007) assume a flat term structure. However, credit curves are far from being flat (Figure. 1). Therefore, the results established by assuming a flat term structure are prone to be biased.

[5] Blanco et. al. (2006) and Zhu, H. (2006)

emerging market sovereign bond markets. These main differences include: Emerging market sovereigns use only bond financing. By providing large issue sizes and longer maturities in different currencies, they are among the world's largest actors in fixed income markets. The credit event in their CDS contracts is defined differently from those of corporate borrowers since they do not enter directly into the asset liquidation process; instead they rely on debt restructuring processes.

This paper is organized as follows: Section 2 provides a literature review; Section 3 describes the data source and sampling schemes; Section 4 shows the methodology of calculation for the implied CDS premium and the CDS-bond basis; Section 5 discusses the results of my study showing the effects of bond liquidity, CDS liquidity, equity market performances, macroeconomic variables on the non-default component; and finally, Section 6 concludes.

2 Literature Review

Early researches have studied the determinants of US corporate yield spreads. On the emerging market literature side, a number of articles have also focused on the determinants of yield spreads.[6] Some important papers on the determinants of US corporate yield spreads include Jones & Rosenfeld (1984), Longstaff & Schwartz (1995), Duffie D. (1999), Elton, Gruber, Mann, & Mann (2001), Collin-Dufresne, Goldstein, & Spencer (2001) and Liu, Longstaff, & Mandell (2006) However, these studies were unable to explain a significant component of the yield spreads, which is not attributable to default risk alone.

Longstaff, Mithal, & Neis (2005) and later Nashikkar et. al. (2007), Han & Zhou (2008), Ericsson and Reneby, & Wang (2007) attempts to identify the default and non default components of the US corporate yield spreads. Longstaff et. al (2005), assuming CDS premiums capture the default related component of the bond yields, use a common credit risk model for both corporate bonds and CDS to indentify the non-default component of the bond yields. They find evidence on the existence of a significant non-default component. Moreover, they show that the bond liquidity as measured by the bid-ask spreads, outstanding amount and coupon rate has a significant explanatory power on the non-default component of bond yields. Nashikkar et. al. (2007) also investigate the relationship between the liquidity and US corporate bond yields and liquidity. They estimate the non-default component, as the basis between the actual CDS and the

[6] For researches on emerging market sovereign bond spreads see, Ammer & Cai (2007), Hund & Lesmond (2006) and Longstaff, Pan, Pedersen, & Singleton (2006)

“par-equivalent” corporate bond yield spread. They also find a strong explanatory power of liquidity on the CDS basis. One common drawback of the models used by Longstaff et. al. (2005) and Nashikkar et. al. (2007) is that they assume a flat term structure of credit risk curves. However, the term structure of credit curves is far from being flat. My paper contributes to this literature on identifying and analyzing the determinants of non-default component of yields spreads by examining this relationship in the emerging market debt for the first time. I improve the literature on calculating the basis between actual CDS and implied CDS premiums by relaxing the restrictive assumption of “flat term structure of credit curves” by making full use of CDS maturities from 1 to 10 years.

Blanco et al. (2005) and Zhu H. (2006) document on the co-integration relationship between the corporate bond spreads and CDS premiums. They argue that in the short run, the CDS market leads the corporate bond market in the price discovery process. Zhu, H. (2006) further argues that the short run deviation in is largely due to different responses of the two markets to changes in credit conditions.

The literature on the emerging market bond yield spreads and CDS market is limited. Even though none of the articles are directly related to my research, I present a very brief literature review on the sovereign CDS market. Pan and Singleton (2006), using the CDS pricing model suggested by Duffie and Singleton (2003), show an effort to distinguish between the default risk and the recovery risk in CDS premiums. Chan-Lau and Kim (2004) analyse the co-integration relationship between emerging market CDS premiums and the Emerging Markets Bond Index (EMBI), which is an index covering U.S. Dollar-denominated Brady bonds, loans and Eurobonds. Ammer and Cai (2007) also analyze a co-integration relationship between bond yields and CDS premiums, and report the possibility of the significant impact of cheapest to deliver optionality in CDS premiums. Duffie (1999) shows that under certain conditions, there is an equivalence relationship between CDS premiums and yield spreads on a floating par bond with the same credit risk and maturity. However, since most emerging market bonds are straight fixed-rate, this equivalence does not hold precisely in practice. Therefore, searching for a price discovery relationship between the CDS premiums and the EMBI index or similar indices would result in biased conclusions.

3 Data Description and Sampling

My bond data source is ISMA (the International Securities Market Association), which is the self-regulatory organization and trade association for the international securities market (including the Eurobond market). ISMA TRAX is the ISMA trade matching and regulatory reporting system for the over the counter (OTC) markets. Traded prices, yields and durations are also available on the Datastream system.

I obtain all emerging “traded bond prices” from ISMA TRAX for all traded international US Dollar denominated bonds issued by sovereigns and find the corresponding yield to maturity to use in my par-equivalent bond yield spread calculation.

My bond liquidity variables also come from ISMA TRAX. Bid-ask spreads of sovereign bond prices, average traded daily volume, outstanding market value of bonds and bond specific variables are obtained in a reliable way. Average daily volume for the previous month is calculated by taking the total nominal turnover for an individual bond in the previous month and dividing it by the number of working days in the month.

Since CDS data coverage of CMA via Datastream started on January 2004, my bond data starts from this date as well. The total number of international US Dollar denominated straight fixed rate bonds by emerging market countries reaches t180. In order to include a particular bond in my sample, the issuer country’s CDS contracts must be available for its US Dollar denominated bonds. However, most east European countries have their CDS contracts issued for their Euro denominated bonds, although they have also issued many international bonds on the US Dollar. This fact reduces my sample size of bonds to 107. The daily data availability together with the fact that 90% of the bonds cover my entire sample time period provides a sample size of more than 100.000 days.

My CDS data are collected from the Datastream start in January 2004 until May 2008. Quoted CDS mid rate premiums along with their bid-ask spreads are available as daily variables. Data on interest rates, such as swap rates and treasury rates are obtained from Datastream. In my analysis, I use swap rate as the risk free rate, which is now widely believed to be closer to the risk free rate benchmark used by market participants in pricing derivatives.

MSCI is the index used for examining the effects of equity market performances of sovereigns on non-default component of bond yield spreads. MSCI is an index created by Morgan Stanley Capital International (MSCI) that is designed to measure equity market performance in global emerging markets. The Emerging Markets Index is a float-adjusted market capitalization index. As of May 2005, it consisted of indices in 26 emerging economies: Argentina, Brazil, Chile, China, Colombia, Czech Republic, Egypt, Hungary, India, Indonesia, Israel, Jordan, Korea, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Poland, Russia, South Africa, Taiwan, Thailand, Turkey and Venezuela

With the purpose of accounting for macroeconomic conditions, the level and slope of US treasury term structure, the return and implied volatilities on the S&P500 index are exploited. Moody's long term liability ratings for sovereigns are used to group the sample by investment and speculative rating grades. These variables are also available via Datastream.

4 Methodology

4.1 Par-equivalent Bond Yield Spread

There have been two main approaches to estimate the default component of the bond yield spreads; one uses an explicit model for pricing credit risk while the other relies on CDS premiums. The former approach relies on calibrating a corporate bond pricing model matching historical data on corporate bonds (Huang and Huang, (2003)). The main disadvantage of this approach is that these models are very sensitive to model selection on both default process and risk premium. Considering default events occur at a much smaller frequency in sovereign markets, it becomes even more difficult to estimate the default component by relying on calibration with historical data.

On the other hand, the existence of an efficient and liquid CDS market allows us to isolate default risk in bonds issued by a certain issuer without relying too much on a particular model selection or historical data, since a direct market pricing of credit risk is available in the CDS market.

In fact, Duffie (1999) showed that under certain conditions there is *an equivalence* relationship between CDS premiums and yield spreads on a *floating-rate par bond* with the same credit risk. Since most emerging market bonds are *fixed-rate bonds*, the equivalence suggested by Duffie (1999) does not hold precisely in practice. Longstaff et al. (2005) showed that the basis between the pure corporate bond spread and CDS is a biased measure of the non-default component.

Another factor complicating the above equivalence relationship stems from the delivery of the reference obligation in the case of a default. In the case of a default, the buyer of the insurance has to deliver an eligible bond to the protection seller in order to get the face value of the bond. Obviously, this deliverable bond will be the cheapest among all deliverable bonds. Moreover, if the deliverable bonds are illiquid, the buyer of the CDS protection may bear additional costs to obtain the bond.

One CDS based approach used to determine default and non-default components of corporate bonds is to use the difference between the CDS premium and the corporate bond yield as a proxy for the non-default component. Han and Zhou (2008) take this approach one step further. They add swap rates to CDS premiums to estimate a CDS-implied par yield curve, and use this curve to bootstrap the zero yield curves and discount the cash flows of each bond to obtain a CDS-implied bond price. They call the difference between actual and CDS-implied bond prices as the basis, i.e. non-default component. However this approach may lead to errors, because the above relationship between CDS premiums and par yields holds only for *floating-rate* par yield bonds. Considering most of the emerging market bonds have high *fixed coupon* rates, the majority of the time they sell at a premium. However, CDS protects only up to a bond's face value. So, discounting bonds' cash flows with a zero curve obtained by CDS premiums will most probably be biased.

Longstaff et al. (2005) used a credit risk model to price the CDS and corporate bonds. While this approach addresses the problems of bonds selling at par or discount, it is heavily model-dependent. The literature on credit risk models demonstrates that there remain significant pricing errors in all the models that have been used so far (Nashikkar and Subrahmanyam and Mahanti (2007)).

This paper follows the market participants and uses a method called par-equivalent CDS spread of the bond in order to isolate the non-default component of the bond yields. The problem of deviations of the bond price from its par value is addressed in this method. Since this model does not require any explicit calibration of a credit risk model, it is model independent. In the related paper by Nashikkar and Subrahmanyam, Mahanti (2007), although the authors used a similar method to isolate the non-default component of yield spreads on corporate bonds, they assumed a flat term structure of credit curves. Due to poor CDS maturity diversity, they use only 5 year CDS premium data, although their bond sample included bonds maturing from 1 month to

40 years. This assumption leads to a major error. As the Mexico example in Figure 1 shows, the term structure of credit risk is far from being flat for emerging markets; rather, its slope is steeply positive. The assumption of flat term structure will lead to biased results of the basis for the bonds with maturities not equal to 5 years. For instance, think about a bond with a maturity of 10 years and a steep upward sloping credit curve. In this case, calculating the 5-year hypothetical par-equivalent CDS spread using the default rates extracted from a 10-year bond assuming constant default rates will cause result in upwards biased hypothetical 5-year CDS premiums. As a result, the basis between the actual 5 year CDS and the par-equivalent CDS premiums will be downwards biased, which will cause errors when measuring the effects of liquidity.

My methodology of isolating the non-default component allows for non-flat credit curve term structures. The details of the methodology of par-equivalent CDS premium and CDS-bond basis is provided in the following section. The methodology to compute the basis is briefly as follows: First, I back out the average probability of default from the market prices of bonds, using swap rates as a risk free curve. Second, using this average probability of default, I compute the expected payoffs of the protection buyer and seller in a hypothetical CDS contract, which has the same maturity as the corresponding bond's remaining maturity. By applying no arbitrage condition, the CDS premium, which makes the expected payoffs of protection buyer and seller equal, is my hypothetical par equivalent CDS premium.

The important virtue of this hypothetical CDS contract is that it has the same maturity of the corresponding bond from which the default probabilities are extracted. Since all emerging market countries in my data sample have CDS dates of maturity from 1 to 10 years, I am able to control for the non-flat term structure of credit curves. The basis for a specific bond is then computed as follows:

$$Basis_i = CDS_{Actual,i} - CDS_{Hypothetical,i}$$

where $i \in (0,10]$ is the maturity of the corresponding bond. $CDS_{Actual,i}$ is the market premium of a CDS contract with a maturity of i years. $CDS_{Hypothetical,i}$ is the implied CDS premium, which is computed by extracting the default probabilities from a bond maturing in i years. Actual CDS premiums for intermediate dates are found by linear interpolation.

Considering the above definition, without liquidity risk, when the basis is negative an arbitrage strategy would involve buying the bond and the CDS together with the same maturity.

In this way, credit risk is hedged and the basis, i.e. non default component, is earned. This arbitrage strategy is feasible when the bond market is liquid. When the basis is positive, the arbitrage strategy would sell the CDS protection and short sell the corresponding bond. As argued in Duffie (1999) and Duffie et al. (2002b) and Nashikkar and Subrahmanyam, Mahanti (2007), shorting a bond is costly because it is difficult to find it in the securities borrowing and lending market. If the bond is illiquid, then shorting that bond will be even more costly.

4.2 Pricing of Risky and Risk-free Bonds and Extracting the Probability of Default

The price of a defaultable bond today P_0 is obtained as the sum of (risk-neutral) expected discounted cash flows.[7]

$$P_0 = E_0\left[\sum_{t=1}^{T} \frac{CF_t}{(1+r_t)^t}\right] \quad (1)$$

If the bond defaults at time $\tau < T$, the following cash-flows are zero, $\text{i.e}\ \text{CFi} = 0, \text{i} \geq \tau$.

When valuing a risk-free bond, one does not need the expectation operator, since the cash flows are certain. The price of a risk-free bond B_0 is then given:

$$B_0 = \sum_{t=1}^{T} \frac{CF_t}{(1+r_t)^t} \quad (2)$$

Note that, the difference between the prices of a risk-free bond and a risky bond, both having the same promising cash flows, is equal to the discounted expected loss from holding the risky bond. Therefore we can generalize this relationship for coupon bonds as:

$$B_0 - P_0 = \sum_{\tau} \frac{PD_{\tau}^{0}(F_{\tau} - C_{\tau}.R)}{(1+r_{\tau})^{\tau}} \quad (3)$$

The assumptions and the properties in above formula are :

τ: Default is assumed to occur at coupon dates, which are semiannually in US dollar denominated emerging market bonds.

P_0: Is the observed market price of the emerging market bond.

[7] In this analysis, the probability of default estimation and CDS valuation follow the risk-neutral valuation approach discussed in Hull, J and White, A., 2001

B_0: The price of the risk-free bond with the same cash flows as the risky bond. It is found by discounting the cash flows of risky bond by the risk-free spot rate implied by *Libor swap rates*.

PD_τ^0: Is the risk-neutral probability of default as seen from time 0. In my analysis I assume the probability of default is step wise constant.

F_τ: This is the price of the risk-free bond that is expected to prevail at date τ. It is found by using the implied forward rates.

C_τ: It is the claim that a bondholder has in case of a default.

R: R is known as the recovery rate. It is the percentage of the claim that bondholders receive in case of a default.

r: r represents the spot rates used to discount the cash flows. In this paper, Libor swap rates are used as risk-free spot rates.

Note that in equation (3), F_τ is the forward price of the riskless bond. Then, $\frac{F_\tau}{(1+r_\tau)^\tau}$ is simply the forward price of a riskless bond discounted by risk-free rate. A discounted forward price from time τ is nothing but today's present value of the payments from time τ onwards. Then, we can rewrite (3) as:

$$B_0 - P_0 = \sum_\tau PD_\tau^0 \left(B_o^\tau - \frac{C_\tau R}{(1+r_\tau)^\tau}\right) \tag{4}$$

where B_o^τ is the price of the riskless bond at time τ discounted to today's value. Finally, we can solve for PD assuming it is step-wise constant.

4.3 The Hypothetical CDS Premium Implied by the Probability of Default and Maturity of a Risky Bond:

In a CDS contract, the protection buyer pays a fee in regular intervals until the contract expires or a credit event occurs. Upon a default, the protection buyer receives the difference between the face value and the recovery value of the defaulted bonds.

T is the life of the CDS contract. T is taken as the life of the corresponding risky bond, from which the probability of default, PD, is extracted. If p denotes the annual CDS fee percentage paid to the protection seller, then the expected fee is:

$$E[fee] = F.\frac{p}{f}.\sum_\tau \left[\frac{1-\sum_{t=1}^{\tau-1} PD_t^0}{(1+r_\tau)^\tau}\right] \tag{5}$$

The expected gain of the protection buyer is then:

$$E[gain] = F.\sum_{\tau}(1 - R - A(\tau)R)\,\frac{PD_{\tau}^{0}}{(1+r_{\tau})^{\tau}} \qquad (6)$$

Where, A(t) is the accrued interest as a percentage of the notional principal, F is the face value of the reference bond and *f* is the frequency of premium payment in a year..

Therefore in a CDS contract, by no-arbitrage argument, one would expect p, the CDS premium, to be such that expected gains from buying the protection is equal to expected fees paid for the protection. Equating (5) and (6) we get:

$$\textit{Par-equivalent CDS premium} = p^{*} = \frac{\sum_{\tau}(1-R-A(\tau).R).\frac{PD_{\tau}^{0}}{(1+r_{\tau})^{\tau}}}{\frac{1}{f}.\sum_{\tau}\left[\frac{1-\sum_{t=1}^{\tau-1}PD_{t}^{0}}{(1+r_{\tau})^{\tau}}\right]} \qquad (7)$$

p is then the hypothetical T year CDS contract implied by the probability of a default of the corresponding emerging market sovereign US dollar denominated straight, fixed coupon bond maturing exactly in T years.

Finally, the CDS-bond basis is defined by the difference between the actual CDS premium and the above hypothetical CDS spread where their life equals the remaining maturity of the underlying bond.

$$Basis_{i} = CDS_{Actual,i} - CDS_{Hypothetical,i}$$

where $i \in (0,10]$ is the maturity of the corresponding bond. $CDS_{Actual,i}$ is the market premium of a CDS contract with a maturity of *i* years. $CDS_{Hypothetical,i}$ is the implied par-equivalent CDS premium, which is computed by extracting the default probabilities from a bond maturing in *i* years.

Figure 2 is presented as an illustration of the calculated hypothetical par-equivalent CDS premium and resulting basis for one of Mexico's international bonds issued in 2003 and maturing in 2014.

4.4 Distribution of CDS-Par equivalent bond yield Basis and Bond Specific Variables

Figure 3 is presented to give our audience a flavor of the distribution of the CDS-bond basis. As seen from the first histogram, the basis distribution in the overall sample has a positive mean and is right-skewed. This right skewness comes from the speculative grade bond side. The histogram for the speculative bond basis shows a high degree of right skewness. In other words, the basis tends to be positive for the bonds issued by speculative grade emerging markets. On the other hand, for the investment grade sample, the distribution is more symmetric and even skewed a little bit to the left, causing a negative mean of the basis.

These results suggest that the bonds of speculative grade emerging sovereigns are more expensive relative to their CDS contracts. However on the investment grade emerging markets side, the bond prices and the CDS premiums are more balanced, and in some cases CDS premiums are cheaper relative to their bonds. The situation for speculative grade emerging markets brings arbitrage opportunities to mind. An arbitrage strategy for positive basis would involve selling the CDS contract and short selling the bond. Shorting emerging market bonds is costly. Moreover, the cost is likely to peak just prior to default, since the demand from those who intend to deliver the bonds to the protection seller would exceed the supply. It is important to note that speculative grade sovereign issuers carry a very significant amount of credit risk. Therefore, arbitrage of the positive basis of bonds by speculative grade sovereigns carries much friction, which justifies the right skewness of the basis distribution for speculative grade issuers.

Another reason for a large positive basis in the speculative grade bonds might be the speculative buys on CDSs written on bad credit quality bonds. When the news about a sovereign is bad, speculators, without owning the underlying bond, might speculate on the just by buying the CDS contract and waiting. The speculation could be either by betting on the occurrence of a credit event such as default or widening of the CDS premium. In either case, if the credit quality of the underlying worsens, the speculator would lock in a positive profit. The excess demand to CDSs would increase the CDS premium while bond prices do not fall as much as the speculation is not directly related to the risk premium of the underlying.

The above frictions are expected to be smaller in size and number for the investment grade emerging bond market. My results in Figure 3 for investment grade bonds support this hypothesis. It is seen that the mean of the basis is negative for investment grade bonds, meaning their bonds are cheaper relative to their credit risk implied by CDS contracts. Due to absence of short-sale constraints and its unfunded nature, the CDS market is thought to be more liquid compared to the bond market. Therefore it is natural to think of liquidity premiums included in the prices of investment grade bonds, which would cause bond yield spreads to be higher relative to CDS premiums, resulting in a negative basis. This main hypothesis is analyzed in the following sections.

The distribution of bond characteristics is presented in Figure 4. One would find the distribution of age, remaining maturity and issue amount of the bonds at the beginning of a regression sample period.

4.5 Bond and Credit Default Swap Liquidity Variables

The first bond market proxy is the average percentage bid-ask spread of the emerging market sovereign bonds. The bid-ask spread for each bond is calculated by taking the time series average of the daily bid-ask spread reported by Datastream. The second liquidity proxy is the average daily volume for the previous month. It is calculated by taking the total nominal turnover for an individual bond in the previous month and dividing it by the number of working days in the month. The third proxy is the notional amount outstanding for each bond. The amount outstanding is used to measure general availability of the bond in the market. The fourth proxy is the age of the bond. This proxy is similar to the notion of on-the-run and off-the-run bonds in Treasury markets. There is extensive evidence that on-the-run Treasury bonds are much more liquid than off-the-run Treasury bonds. If there is a similar effect in the emerging bond market, then older bonds may be less liquid than more-recently issued bonds (Longstaff et al. (2005)).The fifth proxy is the time to maturity of the bond. In the emerging market debt market there might be a high level of maturity clientele portfolio behavior, which may cause shorter maturity bonds to be more liquid. Moreover, academic literature reports that high coupon bonds tend to be more liquid than bonds with lower coupon bonds.

When the basis is negative, an arbitrage strategy involves buying the credit default swap protection and holding the bond until its maturity. However for an arbitrageur to benefit from the negative basis, CDS market liquidity is relevant as well. For hedging of a long position on a bond, the demand for bonds with higher liquidity in their CDS markets is expected to be higher. Therefore, one should also take into consideration the CDS market liquidity. In order to analyse this issue, I include the daily CDS bid-ask spread and the daily percentage CDS bid-ask spread to its mid-value as proxies for the liquidity in the CDS market, and relate these variables to the CDS-bond basis.

5 Results

5.1 Correlations among liquidity variables:

To check the consistency of the liquidity variables, Table 4 presents the correlations between bond and CDS market liquidity variables. The theory on liquidity suggests that while bond liquidity is negatively associated to bid-ask spread and the bond's age, it is positively correlated to the turnover rate, coupon rate and issue amount.

My findings suggest a negative correlation between bid-ask percentage and turnover rate, issue amount and coupon rate for all the rating groups. These results are consistent with the literature on bond liquidity.

The correlation between bond market liquidity and CDS market liquidity is also examined. If we assume that increasing bid-ask spread and/or bid-ask percentage spread in CDS market represents its illiquidity, the signs of the correlation coefficients in Table 4 would allow for the existence a positive relationship between CDS and bond market liquidity.

5.2 Determinants of Bond Illiquidity:

In Table 5, I present results of the panel regressions of the bond price bid-ask percentage on various bond liquidity variables, CDS market liquidity and world macroeconomic variables. The purpose of these regressions is to analyze the determinants of bond illiquidity in different rating groups assuming bid-ask percentage spread and turnover by volume capture bond liquidity to a significant extend.

Regressions of bid-ask spread on bond specific liquidity variables alone, such as turnover rate, coupon rate, bond life and bond age show expected results most of the time. Including CDS liquidity variables in the regressions, one can see a positive relationship between CDS and bond market illiquidity in all the samples. In speculative grade emerging markets, when the CDS market is illiquid, i.e. the CDS bid-ask spread is large, the bond market is also illiquid. This result is consistent with the perspective of the investors who, in search of hedging the credit risk of their long positions on the bond, buy the CDS contracts written on the same bond. When the credit risk is high, as in speculative grade bonds, this relationship is expected to hold strongly, as my results suggest. The possible spill-over effects from the CDS market to the bond market are analyzed in the following sections.

Regressions also search for the effects worldwide macroeconomic variables such as US 6-month T-bill and US term spreads between 6-month and 10-year T-bill yields on bond illiquidity. My results indicate that an increase in the 6-month T-bill rate or term spread is associated with an increase in the illiquidity of the bond markets. This can be either because an increase in the US treasury yields reduces the demand for emerging market bonds, or because the world economy gets hit by a negative shock, which may increase instability in the emerging market economies.

5.3 Determinants of CDS-Bond Basis:

In order to asses the determinants of the CDS-bond basis, I use unbalanced panel regressions of the CDS-bond basis on various bond market liquidity variables, CDS market liquidity variables, corresponding issuer equity market indices and worldwide macroeconomic variables. Thirty-day averages of variables are taken to run this pooled regression. Regressions are run for three different rating groups in order to analyze possible differences between different credit risk groups. Data for bond, CDS, equity market and world macroeconomic indicators collected from Datastream allow me to reach a sample size of, at most, 90,000 data points for each variable.

As discussed in Petersen (2008), in the financial data sets the residuals may be correlated across firms or across time, and OLS standard errors can be biased. Petersen (2008) shows that the standard errors clustered by firm are unbiased and produce correctly-sized confidence intervals independently on the firm effect to be permanent or temporary. Extending the literature on corporate finance data to emerging bond market data, I cluster the standard errors by each bond. Therefore, I assume the standard errors are correlated among each bond group.

5.3.1 Emerging Market Bond Liquidity

To check the individual effects of each bond liquidity variable on the CDS-par equivalent bond basis, I first run univariate regressions for different rating groups. Since the CDS market is expected to be more liquid compared to the bond market, one would expect the bond prices to bear a liquidity premium. My hypothesis is that the liquid bonds of investment grade emerging markets should be more expensive in the cross section, which would be indicated by a positive relationship between the CDS-bond basis and liquidity. As mentioned in section **3.2,** the relationship between liquidity and the basis might even be inverse for speculative bonds, i.e. illiquid bonds of speculative grade emerging markets might be more expensive.

Consistent with the above hypothesis, the bid-ask spread, turnover by volume and coupon variables have the expected signs, and their magnitudes are significant for investment grade and pooled samples. For speculative grade bonds however, the bid-ask percentage variable has a positive sign and is statistically significant at a 95% significance level, which signals a positive impact of bond illiquidity on risky bond prices.

In Table 7, the first column of regressions presents the results of the panel regressions of the monthly average CDS-bond basis to monthly averages of bond price bid-ask spreads, bond turnover rates by volume and other bond specific liquidity variables. As mentioned in the previous section, t-statistics are robust t-statistics with standard errors clustered by each bond.

I find a significant correlation between almost all bond market liquidity variables and investment grade emerging market bonds. All the variables except bond issue size have the expected signs. Results show that bond bid-ask spread, bond age and ratings have negative impact on basis. As argued before, bond age and bid-ask spreads are associated with illiquidity in the bond market. As the bond market becomes more illiquid, i.e. an increase in the bid-ask spread, one would expect the liquidity premium to be included in the emerging market bond yields, which would increase the bond yields and reduce the CDS-bond basis. My results show that a one percent increase in the bond bid-ask spread decreases the basis by fourteen basis points, which shows that the bid-ask spread variable is economically significant as well.

Since turnover rate by volume and coupon rate are expected to positively affect bond market liquidity, their signs are expected to be the opposite of bid-ask spread and bond age. This is in fact the case. My results show that the non-default component, i.e. the basis, of the liquid investment grade bonds tend to be smaller; in other words, *ceteris paribus*, liquid bonds tend to be more expensive in the cross section.

Unlike the corporate debt market, emerging market sovereign debt relies mostly on debt issued in the form of bonds. Countries with high debt need to acquire more debt by issuing larger bonds. So, the issue size of the bonds might have misleading results for our purposes. While bonds may become more liquid as the issue size increases, the credit quality may decrease at the same time, which would explain why the issue size variable has a negative sign.

The effect of the bond market liquidity of speculative grade emerging markets on the non-default component of their yield spreads is ambiguous. The bid-ask spread, turnover by volume and issue amount variables have contradictory signs and insignificant t-statistics. Liquidity of speculative grade emerging market countries does not have much correspondence to the non-default component of the yield spreads. Moreover the signs of the variables suggest that illiquidity (liquidity) in the bond market increases (decreases) the basis, which would mean that illiquid bonds of speculative grade emerging market countries might be more expensive relative to their liquid counterparts. In a CDS contract in the case of a credit event, the protection buyer has to provide the underlying bond to the protection seller to get the face value of the bond. When the bond market is illiquid, in the case of a default it might be difficult to find the underlying bond in the market to provide to the CDS seller. This could explain why when credit quality is low (speculative grade bonds), illiquid bonds might become more expensive.

The results on remaining maturity are consistent with the previous studies suggesting that a large fraction of yield spreads, especially at the long end of the maturity range, cannot be solely explained by credit risk (Longstaff et al. (2005)).

Table 10 shows the results of unbalanced panel regressions of the par-equivalent basis on various bond liquidity variables, MSCI equity market indices and ratings controlling for country fixed effects. As can be seen from the table, the results show the impact of bond liquidity on the CDS-bond basis is robust for country fixed effects.

5.3.2 Emerging Market CDS Market Liquidity

The results in the Table 7 report that liquidity in the CDS market has significant effects on the non-default component over the bond liquidity variables. A one basis point increase in the CDS bid-ask spread leads to a increase in basis of 1 basis points in the overall pooled bonds, two basis points in the investment grade bond basis and one basis point in the speculative grade bonds. In other words, if one assumes level bid-ask spread as a proxy for CDS market illiquidity, bonds with higher illiquidity in their CDS market are more expensive in the cross section.

The above result might stem from two reasons (Nashikkar and Subrahmanyam and Mahanti (2007)). First, less liquidity in the CDS market is likely to drive investors towards the bond market, causing the bonds` prices to increase. The correlations between the turnover by volume and CDS bid-ask spreads in Table 4 provides some counter support for this explanation. One might note the negative correlation between CDS bid-ask spread and turnover by volume. This means that when CDS illiquidity is high, the trade volume is low, which is the opposite of the above explanation. The second explanation states that episodes of illiquidity in the CDS market are often associated to negative news about the issuers on whom the CDS contracts are traded. It is generally difficult to short bonds, which leads to bonds becoming more expensive relative to their CDS contracts especially during the illiquid periods in the market.

The CDS bid-ask as a percentage has also positive sign and it is significant for speculative grade bonds and in pooled bonds. For investment grade bonds however the sign is negative. Assuming a percentage bid-ask spread as a proxy for illiquidity, the investment grade bonds with liquid CDS market have higher prices in the cross section. The problem of whether assuming bid-ask spread or bid-ask percentage spread as representing illiquidity in the CDS market is not easy. Both measures are subject to be affected by the level of the CDS premium. Taking the ratio of the bid-ask spread might reduce the explanatory power of the bid-ask spread variable. On the other hand there is a high correlation between CDS premium and CDS bid-ask spread, which makes level bid-ask spread a biased proxy for illiquidity in the CDS market. The interesting fact here is that, CDS liquidity variables have significant effects on the non-default component of bond yield spreads even when bond market variables are in the regression. This provides evidence of a liquidity spill-over effects from the CDS market into the bond market (Nashikkar and Subrahmanyam and Mahanti (2007)).

5.3.3 Equity Markets

In addition to bond market and CDS market liquidity, equity market performance of emerging markets has explanatory power for the non-default component of bond yields. The effect of equity markets has not been documented in this literature before. In order to analyse the possible effects of equity markets on bond yields, the MSCI index is used. The MSCI index was created by Morgan Stanley Capital International (MSCI) to measure equity market performance in global emerging markets.

As Table 8 shows, the MSCI index for each country’s equity market has explanatory power over bond liquidity variables. According to my regression results, equity market performance has a negative impact on the non-default component. One reason for this would be equity market performance might be negatively correlated with an emerging market sovereign’s credit risk. In other words, as the MSCI index increases, the credit risk and associated CDS premium should go down, which would reduce the basis (note that CDS-bond Basis $=CDS_{actual} - CDS_{implied}$). In order to eliminate this possibility I include actual CDS premiums in the regression. Even though the robust t-statistics decrease, the MSCI index variable still has a significant and negative impact on the basis for overall sample and speculative bonds, while on investment grade bonds the same negative effect has no significance. The explanation for this result is in line with the findings of Blanco et al. (2005) and Zhu, H. (2006) where the authors analyze the co-integration relationship between bond yields and CDS premiums. They find that in the short run, the CDS market leads the corporate bond market in the price discovery process. Zhu, H. (2006) further argues that the short run deviation in is largely due to different responses of the two markets to changes in credit conditions. Since the equity market is more volatile in the short run, it is possible that CDS premiums internalize these equity market movements in its price earlier than the bond market; as a result, high equity market performance decreases both CDS premiums and their basis before the bond market reacts. I leave this lead-lag relationship for CDS and bond markets for future study.

Table 10 shows the results of unbalanced panel regressions of the par-equivalent basis on various bond liquidity variables, MSCI equity market indices and ratings, controlling for country fixed effects. As seen from the table, the results of the impact of equity market performances on the CDS-bond basis are robust for country fixed effects.

5.3.4 Effects of World-wide Macroeconomic Conditions

It has been shown that the credit risk on sovereigns depends highly on the world's macroeconomic conditions. For instance, Longstaff et al.(2007) argue that sovereign credit spreads are generally more related to the U.S. stock and high-yield bond markets, global risk premia, and capital flows than they are to their own local economic measures. Moreover they state that a significant amount of the variation in sovereign credit returns can be used to forecast using U.S. equity, volatility, and bond market risk premia.

I control for the credit risk of the sovereigns, to check whether macroeconomic conditions affect the yields only through the credit risk channel. I included the CDS premiums of the sovereigns in the regression to control explicitly for the credit risk and see whether world macroeconomic conditions have explanatory power over and above the credit risk of the sovereigns. As seen in Table 9, while the 6-month T-bill rate and the US term spread keep their significance, the S&P500 return index and its volatility lose their significance for investment grade and pooled samples. On the speculative grade bond sample, the significance of the variables decrease but do not vanish when I include the CDS premiums. So, even if it is true that world macroeconomic conditions affect speculative grade emerging market bond yield spreads through the non-default component, the effects seem to be through the contingent credit risk channel for investment grade bonds, non-default components seem to not be affected by macroeconomic variables to a great extent.

5.3.4 Credit Risk and CDS-Bond Basis:

The impact of credit quality proxied by ratings is analyzed in Table 7 and Figure 3. Table 7, which reports the regressions of the CDS-bond basis on various liquidity variables and ratings, shows that ratings have a negative and significant impact on the CDS-bond basis. As ratings escalate from B1 to Aaa, the CDS-bond basis declines. Moreover, as presented in section 3.2, the average basis for investment grade bonds, i.e. ratings equal to or higher than Baa, is negative.

The hypothesis is that liquidity and the cost of short selling have important impacts on the CDS-bond basis. When short selling is feasible, one would expect higher liquidity is associated with higher bond prices, thus the higher basis. However, the opposite can be the case under high short selling costs. The results in Figure 3 and Table 7 together suggest the following. First, the average basis is positive for speculative grade bonds, and negative for investment grade bonds. Second, as ratings increase the basis decreases and becomes negative for investment bonds. So, as credit risk increases, the CDS-bond basis increases, making the bonds more expensive relative to what would be implied by their CDS contracts. An arbitrage strategy for the positive basis would involve selling the CDS contract and short selling the bond. Shorting emerging market bonds is costly and this cost is likely to peak just prior to default, since the demand from those who intend to deliver the bonds to the protection seller would exceed the supply. Since speculative grade sovereigns carry a very significant amount of credit risk, positive basis arbitrage might be unfeasible.

Therefore, the illiquid bonds of *highly risky sovereigns* might be more expensive relative to their liquid counterparts. In Table 7, illiquidity captured by bid-ask spread has a positive sign on the basis, and turnover by volume has a negative sign with insignificant t-statistics. These results for speculative grade bonds in Table 7 justify the hypothesis that with a considerable deterioration of credit quality the illiquid bonds may become more expensive.

The above effects of friction in the *investment grade emerging bond market* are expected to be smaller since short selling is easier with higher credit quality and liquidity. Due to the absence of short-sale constraints and its unfunded nature, the CDS market is thought of being more liquid compared to the bond market. Therefore, it is natural to think of liquidity premiums included in the prices of bonds of investment grade bonds, which would force bond yield spreads to be higher relative to CDS premiums and cause a negative basis. This main hypothesis is justified by the results in Figure 3 and Table 7. First, the mean of the basis is negative for investment grade bonds; in other words, bond prices carry a liquidity premium and they are relatively cheaper compared to what is implied by their CDS premiums. Second, as ratings increase, the average CDS-bond basis decreases. Third, liquidity has a positive and significant impact on the basis for investment grade sovereign bonds and this effect carries through to the non-default component.

6 Conclusion

In this research, I estimate the non-default component of emerging market bond yields and analyze the relationship between the non-default components of yield spreads with liquidity. I calculate the CDS-bond basis, which is the difference between the actual CDS premium of a bond and its hypothetical par equivalent CDS premium, as a measure of the non-default component, allowing for a non-flat credit curve term structure. I exploit nearly all available straight-fixed rate emerging market bonds denominated in US dollars between January 2004 and May 2008, which amount to 107 bonds. The data from Datastream allows me to use bid-ask spread and turnover by volume as my main liquidity variables. Moreover, I include coupon rate, remaining maturity, age, and issue amount as liquidity-related variables in my empirical analysis.

My results show that while the basis is mainly positive for speculative grade, it is negative for investment grade bonds. In other words, the bonds of speculative grade emerging sovereigns are more expensive then what is implied by their CDS premiums. For investment grade, bond prices and CDS premiums are more balanced, and CDS premiums may even be cheaper relative to their bonds. So, CDS premiums of investment grade bonds imply higher prices for their existing bonds. The positive basis for speculative grade bonds is justified by the difficulty of arbitrage. It is difficult to arbitrage away the positive basis in a market with friction caused by short selling costs, which peaks with the increase of credit risk. Another reason for a large positive basis in the speculative grade bonds might be the speculative buys on CDSs written on bad credit quality bonds. When the news about a sovereign is bad, speculators, without owning the underlying bond, might speculate on worsening of the credit conditions of the underlying just by buying the CDS contract. This speculation could be either by betting on the occurrence of a credit event or widening of the CDS premium. The excess demand to CDSs would increase the CDS premium while bond prices do not fall as much since the speculation is not directly related to the risk premium of the underlying.

On the other hand, there are fewer frictional elements in the investment grade bond market. The fact that the non-default components of investment grade bond yields are negative gives us a clue that bond prices might include liquidity premiums, since the CDS market is expected to be more liquid than the bond market due to the absence of short-sale constraints and its unfunded nature ,

I find significant the power of liquidity in explaining the non-default components of investment grade emerging market bonds. However, the effects of liquidity on speculative grade emerging market bonds are ambiguous or contrary to what I find for the investment grade bonds. These results are in line with my initial hypothesis that investment grade emerging market bond prices include liquidity premiums. On the other hand, I expect normal shorting costs, peaking with worsening credit conditions, might render the illiquid bonds of risky speculative emerging market bonds more expensive. My results also confirm this hypothesis; liquidity has counter effects on non-default components with increasing credit risk.

As a novelty to this literature, I report that the domestic stock market performance of emerging markets has a significant negative impact on the non-default component of bond yields. The reason for the negative sign seems to be related to the credit risk and lead-lag relationship between the CDS and bond markets.

CDS liquidity measured as bid-ask spread and percentage bid-ask spread also has explanatory power for the basis over the bond liquidity variables. Since higher liquidity in the CDS market would mean easier hedging of a long position on a bond, it is natural to think of bond market participants taking CDS liquidity into account when pricing the emerging market bonds.

Another contribution to the literature is to explain whether the world macroeconomic conditions affect the emerging market bond yields solely through credit risk or through their non-default components. Depending on the results, without explicitly controlling for credit risk, one can say that good short term macroeconomic conditions have a negative effect on the basis. In other words, better macroeconomic conditions may cause bonds to become cheaper than what is implied by their CDS contracts. After explicitly controlling for credit risk, while the significance of the variables decrease but do not vanish for speculative grade bonds, the variables become insignificant for investment grade bonds. So, even if it is true that world macroeconomic conditions affect speculative grade emerging market bond yield spreads through the non-default component, the effects seem to be through the contingent credit risk channel for investment grade bonds; non-default components seem to not be affected by macroeconomic variables to a great extent.

To summarize, this paper is a first attempt to isolate the non-default component of emerging market bond yield spreads and relate it with liquidity. Thanks to availability of reliable transaction data in bond and CDS markets, I aim to offer some interesting and novel results on emerging market bond yields and on CDS market, liquidity, and stock market performances.

Bibliography

Acharya, V. V., & Pedersen, L. H. (2005). Asset pricing with liquidity risk. *Journal of Financial Economics* , 175-410.

Alexander, G., Edwards, A., & Ferri, M. (2004). The determinants of trading volume of high-yield corporate bonds. *Journal of Financial Markets* , 177-204.

Amihud, Y. (2002). Illiquididy and stock returns: Cross-section and time-series effects. *Journal of Financial Markets* , 31-56.

Amihud, Y., & Mendelson, H. (1986). Asset pricing and bid-ask spreads. *Journal of Financial Economics* , 223-249.

Ammer, J., & Cai, F. (2007). Sovereign CDS and bond pricing dynamics in emerging markets: Does the cheapest-to-deliver option matter? *FRB International Finance Discussion Paper* .

Blanco, R., Brennan, S., & March, I. (2005). An empirical analysis of the dynamic relationship between investment-grade bonds and credit default swaps. *Journal of Finance* , 60, 2255-2281.

Chakravarty, S., & Sarkar, A. (2003). Trading costs in three US bond markets. *Journal of Fixed Income* , 39-48.

Chen, L., Lesmond, D., & Wei, J. (2007). Corporate yield spreads and bond illiquidity. *Journal of Finance* , 119-149.

Collin-Dufresne, P., Goldstein, R., & Spencer, M. (2001). The determinants of credit spread changes. *Journal of Finance* , 56, 2177-2207.

Deliandeis, G., & Geske, R. (2001). The components of corporate credit spreads: Default, recovery, tax, jumps, liquidity and marcet factors. *UCLA* .

Duffee, G. (1999). Estimationg the price of default risk. *Review of Financial Studies* , 12, 197-226.

Duffee, G. (1996). Idiosyncratic variations in treasury bill yields. *Journal of Finance* , 51, 527-551.

Duffie, D. (1999). Credit swap valuation. *Financial Analysts Journal* , 73-87.

Duffie, D., & Liu, J. (2001). Floating-fixed credit spreads. *Financial Analyst Journal* , 76-87.

Edwards, A., Harris, L., & Piwowar, M. (2007). Corporate bond market transaction costs and transparency. *Journal of Finance* , 62, 1421-1431.

Elton, E., Gruber, M., Mann, A., & Mann, C. (2001). Explaining the rate spread on corporate bonds. *Journal of Finance* , 56, 247-277.

Eom, Y. H., Helwege, J., & Huang, J. (2004). Structural models of corporate bond pricing: an empirical analysis. *Review of Financial Studies* , 17, 499–544.

Ericsson, J., & Renault, O. (2006). Liquidity and credit risk. *Journal of Finance* , 61, 2219–2250.

Ericsson, J., Reneby, J., & Wang, H. (2007). Can structural models price default risk? Evidence from bond and credit derivative markets. *McGill University Working Paper* .

Fisher, L. (1956). Determinants of the risk premiums on corporate bonds. *Journal of Political Economy* , 67, 217–237.

Fleming, M. J. (2003). Measuring treasury market liquidity. *Federal Reserve Bank of New York Economic Policy Review* , 9, 83–108.

Han, S., & Zhou, H. (2008). Effects of Liquidity on the Nondefault Component of Corporate Yield Spreads: Evidence from Intraday Transactions Data. *Federal Reserve Discussion Working Paper* .

Hong, G., & Warga, A. (2000). An empirical study of corporate bond market. *Financial Analyst Journal* , 56, 32–46.

Hotchkiss, E., & Jostiva, G. (n.d.). Determinants of corporate bond trading: A comprehensive analysis. *Boston College Working Paper* .

Hotchkiss, E., & Ronen, T. (2002). The informational efficiency of the corporate bond market: an intraday analysis. *Review of Financial Studies* , 15, 1325–1354.

Houweling, P., & Vorst, T. (2005). Pricing default swaps: Empirical evidence. *Journal of International Money and Finance* , 24, 1200–1225.

Houweling, P., Mentink, A., & Vorst, T. (2005). Comparing possible proxies of corporate bond liquidity. *Journal of Banking and Finance* , 29, 1331-1358.

Huang, J., & Zhou, H. (2007). Specification analysis of structural credit risk models. *Pennsylvania State University Working Paper* .

Hull, J., & White, A. (2001). Valuing Credit Default Swaps I: No counterparty risk' Journal of Derivatives. *Journal of Derivatives* , 8, 29-40.

Hull, J., Predescu, M., & White, A. (2004). The relationship between credit default swap spreads, bond yields, and credit rating announcements. *Journal of Banking and Finance* , 28, 2789–2811.

Hund, J., & Lesmond, D. (2006). Liquidity and Credit Risk in Emerging Debt Markets. *Working Paper* .

Jones, E. P., & Rosenfeld, E. (1984). Contingent claims analysis of corporate capital structures:An empirical investigation',. *Journal of Finance* , 39, 611–625.

Kyle, A. (1985). Continuous auctions and insider trading. *Econometrica* , 53, 1315-1335.
Lando, D. (2004). Credit risk modeling. Theory and applications. *Princeton University Press*.

Liu, J., A., L. F., & Mandell, R. (2006). The market price of risk in interestrate swaps: The roles of default and liquidity risks. *Journal of Business* , 79(5), 2337–59.

Lo, A. W., Mamaysky, H., & Wang, J. (2004). Asset prices and trading volume under fixed transactions costs. *Journal of Political Economy* , 112, 1054–1090.

Loffler, G., & Peter, P. (2007). *Credit Risk Modeling Using Excel and VBA.* Wiley Finance.
Longstaff, F. A. (2004). The flight-to-liquidity premium in u.s. treasury bond prices. *Journal of Business* , 77, 511–526.

Longstaff, F. A., Mithal, S., & Neis, E. (2005). Corporate yield spreads: Default risk or liquidity? new evidence from the credit default swap market. *Journal of Finance* , 60, 2213-53.

Longstaff, F., & Schwartz, E. (1995). A simple approach to valuing risky fixed and floating rate debt. *Journal of Finance* , 50, 789–820.

Longstaff, F., Pan, J., Pedersen, L., & Singleton, K. (2006). How sovereign is sovereign credit risk? *NBER Working Paper* .

Nashikkar, A., & Subrahmanyam, M. (2007). Latent liquidity and corporate bond yield spreads. *School of Business, New York University. Working Paper* .

Norden, L., & Weber, M. (2004). The comovement of credit default swap, bond and stock markets: an empirical analysis. *Working paper. University of Mannheim, Germany* .

Petersen, M. (2008). Estimating standard errors in finance panel data sets: comparing approaches. *The Review of Financial Studies* .

Roll, R. (1984). A simple implicit measure of the effective bid-ask spread in an efficient market. *Journal of Finance* .

Schultz, P. (2001). Corporate bond trading costs: A peek behind the curtain. *Journal of Finance* , 56, 677-698.

Tang, D., & Hong, Y. (2007). Liquidity and credit default swap spreads. *University of South Carolina Working Paper* .

Vayanos, D. (1998). Transaction costs and asset prices: A dynamic equilibrium model',. *Review of Financial Studies* , 11, 1-58.

Zhu, H. (2006). An empirical comparison of credit spreads between the bond market and the credit default swap market. *Journal of Financial Services Research* , 29(3), 211–35.

Tables and Figures

Emerging Countries, Ratings and Number of Bonds		
	Moody`s Rating	# of Bonds
Brazil	Ba1	12
Chile	A2	3
China	A1	5
Colombia	Ba2	10
Egypt	Ba1	2
Korea	A2	4
Lebanon	B3	6
Malaysia	A3	4
Mexico	Baa1	9
Pakistan	B2	3
Panama	Ba1	2
Peru	Ba2	5
Philippines	B1	5
Poland	A2	5
Qatar	Aa2	4
Russia	Baa2	3
South Africa	Baa1	4
Thailand	Baa1	1
Turkey	Ba3	9
Ukraine	B1	4
Venezuela	B2	7

Table 1: This table shows emerging market countries, their Long term liability ratings assigned by Moody's and number of fixed-rate international US dollar denominated bonds included in the paper.
The bonds in the sample are straight maturity and have fix coupon rates.
Bond prices and yield to maturities are calculated again to check the correctness of the data.
Among our sample of bonds, nearly 90% of them have bid-ask spreads, and 97% have either bid-ask spreads or turnover by volume data available.
This data availability allows me to use direct liquidity proxies of bid-ask spreads and turnover ratios. All bond data is collected from Datastream and double checked by comparing the data from Bloomberg terminals.

Distribution of Emerging Market Bonds by Moody`s Credit Rating			
	Number of Countries	Number of Bonds	Regression Codes #
Aaa	0	0	21
Aa1	0	0	20
Aa2	1	4	19
Aa3	0	0	18
A1	1	5	17
A2	2	12	16
A3	1	4	15
Baa1	3	14	14
Baa2	1	3	13
Baa3	1	0	12
Ba1	2	16	11
Ba2	3	15	10
Ba3	1	9	9
B1	2	9	8
B2	2	10	7
B3	1	6	6
Investment Grade	10	42	# > 11
Speculative Grade	11	65	# < 12
TOTAL	21	107	

Table 2: This table shows the distribution of United States Dollar denominated International Bonds Issued by Emerging Market Sovereigns by Moody's Long term obligation ratings.

A total of 107 US dollar denominated international bonds is issued by 21 emerging countries. The countries rated Baa3 and above are considered as investment grade while Ba1 and below are speculative grade. In the regression analysis, I number bonds with a B3 grade as 6. The numbers given to bonds increased with each rating to a maximum of 21, which corresponds to the rating Aaa. While 42 bonds are issued by investment grade emerging countries, the rest are issued by speculative grade emerging countries.

Data is collected from Datastream and its validity is double checked with the data obtained from Bloomberg.

Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
CDS-Par Equivalent Basis	85393	40	60	-100	500
Bid-Ask Percent	79991	0.7	0.6	0.0	6.4
Par Equivalent CDS	85383	122	105	-177	625
Turnover by Volume (in millions)	79973	9.1	0.2	0.0	340.0
Amount (in millions)	85393	999	491	2	3000
Maturity (yrs)	85393	6.0	2.6	0.4	13.2
Coupon	85393	8.2	2.4	2.0	14.5
Age (yrs)	85393	4.2	2.6	0.0	14.0
CDS Bid-Ask Sprd	85393	4.88	5.14	0.00	48.75
CDS B-A Pct	85296	8.5	23.7	0.4	415.4
MSCI index	68007	670	294	34	1742
Moody`s Rating	85393	11.7	3.6	6.0	19.0
6 month US Treasury	85329	3.9	1.3	1.0	5.3
10 yr US Treasury	85329	4.5	0.4	3.5	5.1
CBOEVIX	85329	15.3	4.5	10.5	26.4
COMIX	85329	370	69	265	547
S&P Composite Pr Index	85329	1309	125	1091	1536

Table 3 : This table shows the summary statistics of the average values of the CDS-par equivalent bond basis, percentage bid ask spread of bond prices, issue amount, monthly average turnover by volume, remaining maturity in years for each bond, coupon rate, age of the bonds in years, bid-ask spread of 5-year CDS premiums, 6-month and 10-year US Treasury bill rate, Chicago Board of Exchange VIX index, CRN Commodity Price Index and S&P 500 composite price index. The MSCI index is the equity market index of the sovereigns produced by Morgan Stanley.

While Bid-Ask Percentage, CDS Bid-Ask, Computed Par-equivalent CDS premium, Treasury Bill yields, CBOVIX, COMIX and S&P500 Composite index variables are daily, Turnover rate by volume is only available monthly.

Computation of the Par-equivalent CDS premium and CDS-Par Equivalent CDS basis is explained in the text. Turnover Ratio is the ratio of monthly average turnover to the amount of bonds available for trade.

Rating variable is Moody’s Long-term obligation ratings. Numbers starting from 6 are given to long term obligation ratings starting with B1 in our sample and continues to 21, which is the highest rating, Aaa.

The CBOE Volatility Index (VIX) is a key measure of market expectations of near-term volatility conveyed by S&P 500 stock index option prices. Since its introduction, VIX has been considered by many to be the world's premier barometer of investor sentiment and market volatility. The data is collected from DataStream

Correlations between liquidity related variables in the sample : Pooled Sample

	Bid-Ask Pct	Turnover	Issue Amt	Maturity(yrs)	Coupon	Age(yrs)	CDS Bid-Ask	CDS B-A Pct
Bid-Ask Pct	1.00							
Turnover	-0.20	1.00						(obs=76336)
Issue Amt	-0.20	0.15	1.00					
Maturity (yrs)	0.06	0.16	0.09	1.00				
Coupon	-0.33	0.11	-0.12	-0.17	1.00			
Age (yrs)	-0.11	-0.01	-0.29	-0.45	0.33	1.00		
CDS Bid-Ask	0.29	-0.10	-0.25	0.16	0.08	-0.28	1.00	
CDS B-A Pct	0.01	-0.02	-0.01	-0.03	-0.01	-0.12	0.01	1.00

Correlations between liquidity related variables in the sample : Investment Grade Sample

	Bid-Ask Pct	Turnover	Issue Amt	Maturity (yrs)	Coupon	Age (yrs)	CDS Bid-Ask	CDS B-A Pct
Bid-Ask Pct	1.00							
Turnover	-0.20	1.00						(obs=30713)
Issue Amt	-0.15	-0.06	1.00					
Maturity (yrs)	-0.02	0.09	0.02	1.00				
Coupon	-0.65	0.36	0.00	-0.22	1.00			
Age (yrs)	-0.15	0.17	-0.30	-0.58	0.58	1.00		
CDS Bid-Ask	-0.12	-0.05	-0.25	0.26	0.10	-0.19	1.00	
CDS B-A Pct	0.02	-0.25	-0.34	0.09	-0.19	-0.18	0.57	1.00

Correlations between liquidity related variables in the sample: Speculative Grade Sample

	Bid-Ask Pct	Turnover	Issue Amt	Maturity (yrs)	Coupon	Age (yrs)	CDS Bid-Ask	CDS B-A Pct
Bid-Ask Pct	1.00							
Turnover	-0.20	1.00						(obs=45623)
Issue Amt	-0.25	0.53	1.00					
Maturity (yrs)	0.13	0.32	0.16	1.00				
Coupon	-0.19	-0.16	-0.12	-0.27	1.00			
Age (yrs)	-0.05	-0.35	-0.33	-0.35	0.46	1.00		
CDS Bid-Ask	0.50	-0.16	-0.26	0.14	-0.20	-0.28	1.00	
CDS B-A Pct	0.01	0.03	0.04	-0.05	0.02	-0.14	-0.02	1.00

Table 4: These tables show the correlations between liquidity-related variables in the whole bond sample, investment grade bond sample, and speculative grade bond sample.

Samples have observation numbers reported in the corresponding tables. There are a total of 107 bonds issued by 21 emerging countries included in the sample. All the variables are 3-month averages of their values. While Bid-Ask Percentage and CDS Bid-Ask are daily, Turnover rate by volume is a monthly figure. As in the regressions, we use monthly averaged values of the variables.

Data is obtained from Datastream

Bid-Ask Percent									
	All Rating Grades			Investment Grade			Speculative Grade		
	# 1	# 2	# 3	# 1	# 2	# 3	# 1	# 2	# 3
T.over(mils)	-4.46	-3.63	-3.61	1.37	0.72	0.79	0.00	0.00	0.00
	(4.41)**	(3.83)**	(3.76)**	(1.3)	(0.73)	(0.90)	(2.8)**	(2.24)*	(2.31)*
Coupon	-0.08	-0.10	-0.10	-0.29	-0.30	-0.31	-0.05	-0.04	-0.06
	(2.02)*	(2.44)*	(2.43)*	(4.54)**	(5.09)**	(5.38)	(1.79)	(1.63)	(1.41)
Mat.(yrs)	0.006	0.002	0.003	-0.010	-0.020	-0.023	0.035	0.027	0.031
	(0.27)	(0.09)	(0.12)	(0.29)	(0.58)	(0.70)	(1.35)	(0.91)	(1.12)
Age (yrs)	-0.017	0.015	0.015	0.090	0.094	0.108	-0.010	0.030	0.030
	(0.61)	(0.52)	(0.53)	(2.34)*	(2.23)*	(2.48)	(0.27)	(0.77)	(0.75)
Amt(mils)	-0.316	-0.184	-0.182	-0.080	-0.130	-0.120	0.000	0.000	0.000
	(3.74)**	(2.08)*	(2.05)*	(0.62)	(0.87)	(0.81)	(2.37)*	(0.86)	(0.82)
CDS B-Ask		0.018	0.018		0.029	0.010		0.019	0.021
		(2.96)**	(2.76)**		(2.06)*	(0.68)		(3.70)**	(3.47)**
CDS B-A%		0.0001	0.0001		-0.012	-0.009		0.0004	0.001
		(0.13)	(0.19)		(2.75)*	(1.88)*		(1.31)	(1.74)
6 M. T-bill			0.026			0.277			-0.061
			(0.59)			(6.18)**			(1.19)
US Term			0.015			0.450			-0.145
			(0.19)			(6.02)**			(1.59)
_cons	1.78	1.49	1.37	2.23	2.47	1.16	1.34	0.75	0.94
	(3.97)**	(3.06)**	(3.03)**	(4.07)***	(3.88)**	(1.93)	(3.50)***	(2.21)**	(2.06)*
Obs	76420	76331	76282	30714	30712	30690	45706	45619	45592
R-sqrd	0.19	0.26	0.26	0.51	0.53	0.56	0.15	0.30	0.32

* significant at 5%
** significant at 1%

Robust t-statistics are in parentheses

Table 5: Pooled and Rating-Grouped Regressions of Percentage Bid Ask Spread of Bonds on Various Liquidity Related and Macroeconomic Variables.

This table shows the results of the pooled, investment grade and speculative grade bond samples of bid ask percentage variables on bond specific liquidity related variables, CDS liquidity variables and main macroeconomic variables such as 6-month and term spread between 6-months and 10-year US treasury yields. Above regressions are unbalanced panels consisting of 76420, 30714 and 45706 observations respectively. The t-statistics reported in parentheses are robust t-statistics with standard errors clustered by bond. Data is obtained from Datastream..

CDS- bond Basis

	All Rating Grades						Investment Grade						Speculative Grade					
Bid-Ask%	-6.35						-29.50						13.97					
	(0.61)						(6.2)**						(2.3)*					
T.ovr(ml)		1.06						1.28						0.79				
		(7.9)**						(11.1)**						(3.3)**				
Mat.(yrs)			10.50						4.50						13.82			
			(6)**						(4.2)**						(14.1)**			
Coupon				10.40						8.48						-1.02		
				(6.4)**						(2.4)*						(0.5)		
Age (yrs)					-5.97						0.53						-7.04	
					(2.6)**						(0.2)						(2.5)**	
Amt(ml)						-1.17						-0.66						0.01
						(0.1)						(0.1)						(1.4)
_cons	46.60	33.00	-23.20	-44.69	65.46	41.63	21.12	49.52	-24.60	-55.71	-1.27	-31.57	59.04	64.13	79.10	95.48	76.84	60.20
	(5.59)**	(6.33)**	(2.4)*	(3.48)**	(6.84)**	(3.48)**	(2.66)**	(1.93)	(2.82)**	(2.65)**	(0.11)	(0.65)	(8.63)**	(12.9)**	(3.9)**	(10.7)**	(6.8)**	(6.5)**
Obs	79983	79967	85384	85384	85384	85384	32613	32842	36508	36508	36508	36508	47370	47125	48876	48876	33192	48876
R-sqrd	0.005	0.120	0.200	0.170	0.069	0.000	0.240	0.610	0.078	0.200	0.001	0.000	0.020	0.030	0.001	0.090	0.034	0.006

* significant at 5% , ** significant at 1%

Robust t-statistics are in parentheses

Table 6 : Univariate Pooled and Rating-Grouped Regressions of Average CDS - Par Equivalent Bond Basis on Bond Specific Liquidity Related Variables: This table shows the unvaried pooled and rating grouped unbalanced panel regressions of monthly-averaged CDS-Par Equivalent Bond Basis on bond specific liquidity variables.

The distribution of bonds by rating and country are reported in Tables 1 and 2.

The t-statistics reported in parentheses are robust t-statistics with standard errors clustered by bond.

Data is obtained from Datastream.

Average CDS- bond Basis						
	All Rating Grades		Investment Grade		Speculative Grade	
	#1	#2	#1	#2	#1	#2
Bid Ask Percent	0.09	-4.24	-14.29	-17.40	4.93	-4.54
	(0.02)	(0.91)	(4.69)**	(6.85)**	(1.18)	(0.78)
Turnover	0.79	0.82	1.02	1.02	-0.03	0.06
	(3.70)**	(3.98)**	(6.06)**	(5.79)*	(0.15)	(0.33)
Coupon	7.02	5.93	3.25	2.21	6.93	6.53
	(6.91)**	(5.13)**	(2.45)*	(1.75)	(4.42)**	(3.93)**
Maturity (yrs)	9.38	9.50	3.77	3.60	13.34	13.63
	(6.93)**	(6.58)**	(5.03)**	(4.41)**	(10.38)**	(11.25)**
Age (yrs)	-2.21	-0.02	-1.13	-0.65	-3.96	-1.37
	(1.60)	(0.01)	(1.34)	(0.86)	(3.13)**	(1.38)
Amount	-0.01	0.00	-0.01	-0.01	0.00	0.00
	(2.47)*	(0.91)	(1.76)	(1.82)	(0.97)	(0.22)
Moody`s Rating	-6.85	-6.50	-3.11	-0.18	-5.02	-5.26
	(9.23)**	(10.87)**	(2.34)*	(0.10)	(2.73)**	(3.01)**
CDS Bid Ask		1.07		1.78		0.93
		(3.11)**		(4.73)**		(2.76)**
CDS Bid Ask Pct		0.14		-0.70		0.14
		(6.53)**		(4.59)**		(6.14)**
_cons	19.35	-1.96	18.74	-16.27	-16.69	-35.59
	(1.06)	(0.11)	(0.61)	(0.49)	(0.87)	(1.91)
Observations	76420	76331	30714	30712	45706	45619
R-squared	0.65	0.69	0.80	0.82	0.48	0.53

* significant at 5%
** significant at 1%

Robust t-statistics are in parentheses

Table 7 : Pooled and Rating-Grouped Regressions of Average CDS - Par Equivalent Bond Basis

This table shows pooled and rating-grouped regressions of average CDS-Par Equivalent Bond Basis on various bond liquidity variables, CDS liquidity variables and ratings. While regression #1 excludes CDS related liquidity variables, #2 includes them.
A brief explanation of the variables is provided in Table 3. The distributions of bond samples can be found in Table 1 and Table 2 and Figure 4.
Above regressions are unbalanced panels consisting of observations numbers reported in the tables. The t-statistics reported in parentheses are robust t-statistics with standard errors clustered by bond.
Data is obtained from Datastream.

Average CDS- bond Basis : Effects of Equity Market						
	All Ratings		Investment Grade		Speculative Grade	
	# 1	# 2	# 1	# 2	# 1	# 2
Bid-ask Pct	-2.08	-7.18	-16.05	-17.52	12.35	3.34
	(0.38)	(1.43)	(6.0)**	(7.48)**	(2.2)*	(0.63)
Turnover	0.83	0.83	1.02	0.99	0.00	-0.08
	(3.81)**	(3.77)**	(0.05)	(5.56)**	(0)	(0.52)
Coupon	4.61	3.65	1.89	2.02	9.05	4.98
	(3.1)**	(2.01)*	(1.13)	(1.31)	(5.75)**	(2.73)*
Maturity (yrs)	8.15	7.58	3.49	3.64	11.99	10.93
	(5.81)**	(5.99)**	(4.09)**	(4.41)**	(7.92)**	(7.69)**
Age (yrs)	-1.10	-0.54	-0.31	-0.20	-4.60	-2.92
	(0.9)	(0.38)	(0.46)	(0.31)	(3.39)**	(1.92)
Amount	-0.01	-0.01	-0.01	-0.01	0.00	0.01
	(1.81)	(1.42)	(1.86)	(1.8)	(0.7)	(1.18)
Rating	-9.01	-4.02	-4.10	0.73	-13.27	-4.26
	(7.73)**	(3.12)**	(1.79)	(0.31)	(5.27)**	(3.14)**
Log Equity Mkt	-13.34	-5.68	-9.14	-2.74	-12.27	-5.33
	(4.41)**	(2.03)*	(1.71)	(0.59)	(4.08)**	(2.30)*
CDS premium		20.07		24.25		15.83
		(4.86)**		(4.75)**		(3.96)**
_cons	87.62	-0.03	49.46	-42.48	66.54	-17.35
	(2.51)*	(0)	(1.01)	(0.85)	(1.89)	(0.57)
Obs	61691.00	61667.00	29704.00	29702.00	31987.00	31965.00
R-sqrd	0.72	0.78	0.81	0.83	0.64	0.72

* significant at 5%
** significant at 1%

Robust t-statistics are in parentheses

Table 8 : Regressions of Average CDS- Par Equivalent Bond Basis : Effects of Equity Markets.
This table shows unbalanced panel regressions of the average basis on liquidity variables and MSCI emerging market equity indices by Morgan Stanley. Regression #2 controls for CDS premiums. The index created by Morgan Stanley Capital International (MSCI) is designed to measure equity market performance in global emerging markets. The Emerging Markets Index is a float-adjusted market capitalization index.
The t-statistics reported in parentheses are robust t-statistics with standard errors clustered by bond.
Data is obtained from DataStream.

Average CDS- bond Basis : World-wide Macroeconomic Variables						
	Pooled Sample		Investment Gr. Sample		Speculative Gr. Sample	
	# 1	# 2	# 1	# 2	# 1	# 2
Bid Ask %	-2.69	-7.39	-15.72	-17.48	1.58	4.93
	(0.6)	(1.46)	(5.82)**	(7.81)**	(0.34)	(0.91)
Turnover	0.78	0.83	1.03	0.99	0.00	-0.06
	(3.74)**	(3.78)**	(6.11)**	(5.49)**	(0.02)	(0.41)
Coupon	5.34	3.60	2.41	2.35	3.56	3.79
	(5.42)**	(2.05)*	(2.0)*	(1.51)	(2.92)**	(1.91)*
Mat. (yrs)	8.46	7.53	3.59	3.69	11.57	10.57
	(6.84)**	(5.86)**	(4.44)**	(4.49)**	(11.76)**	(7.95)**
Age (yrs)	-0.64	-0.49	-0.52	-0.35	-0.94	-1.89
	(0.49)	(0.37)	(0.72)	(0.55)	(1.06)	(1.78)
Amount	-0.01	-0.01	-0.01	-0.01	0.00	0.01
	(2.03)**	(1.39)	(1.78)	(1.86)	(0.58)	(1.22)
Rating	-7.91	-3.77	-3.21	1.92	-4.89	-4.56
	(10.61)**	(2.11)*	(2.41)*	(0.75)	(3.25)**	(2.61)**
6m T-Bill	14.69	11.04	3.22	5.20	29.00	22.60
	(4.55)**	(4.24)**	(1.55)	(2.36)*	(7.03)**	(4.86)**
US Term S.	20.71	12.07	5.64	4.73	43.06	32.35
	(4.51)**	(2.84)**	(1.7)	(1.56)	(8.14)**	(3.54)**
S&P500	-0.07	0.00	-0.02	0.02	-0.10	-0.05
	(5.79)**	(0.01)	(2.2)*	(0.77)	(6.52)**	(1.69)
CBOEVIX	0.71	0.10	0.57	0.04	0.30	-0.84
	(2.27)*	(0.34)	(1.94)	(0.13)	(0.7)	(2.38)*
CDS		21.10		29.88		12.67
		(3.65)**		(4.05)**		(1.95)
Equity Ind.		-0.01		-0.01		0.00
		(1.5)*		(0.69)		(0.18)
_cons	52.34	-56.03	20.75	-104.33	3.55	-34.67
	(1.93)	(1.05)	(0.62)	(1.76)	(0.11)	(0.54)
Obs	76369	61625	30691	29680	45678	31945
R-sqrd	0.68	0.79	0.82	0.84	0.59	0.74

** significant at 1%
* significant at 5%
Robust t-statistics are in parentheses

Table 9 : Regressions of Average CDS- Par Equivalent Bond Basis : Controlling for Macroeconomic Variables.

This table shows unbalanced panel regressions of the average basis on liquidity variables and macroeconomic variables including the 6-months T-bill rate, the term spread between 6-month and 10-year T-bill rates, S&P500 Composite Index, Chicago Board of Exchange S&P 500 Option Volatility Index.

Regression #2 controls for CDS and MSCI country equity market returns. A brief variable description is in Table 3. The t-statistics reported in parentheses are robust t-statistics with standard errors clustered by bond. Data is obtained from Datastream.

Par-Equivalent Basis with Fixed Effects						
	Pooled Sample		Investment Grade		Speculative Grade	
	# 1	# 2	# 1	# 2	# 1	# 2
Bid-ask Pct	4.39	0.39	-17.86	-18.76	17.87	19.40
	(0.63)	(0.05)	(3.72)**	(4.32)**	(3.1)**	(3.13)**
Turnover	0.74	0.76	0.96	0.96	-0.12	-0.16
	(2.93)**	(3.09)**	(4.25)**	(4.31)**	(0.74)	(1.23)
Coupon	6.64	4.39	4.59	3.50	6.83	5.44
	(4.91)**	(2.78)**	(2.34)*	(1.61)	(4.15)**	(4.89)**
Maturity (yrs)	8.91	7.32	4.18	3.88	12.01	10.59
	(10.69)**	(8.58)**	(4.23)**	(3.41)**	(14.11)**	(13.91)**
Age (yrs)	-3.37	-1.24	-1.35	-0.58	-6.58	-4.64
	(3.33)**	(1.26)	(1.68)	(0.86)	(6.88)**	(5.46)**
Amount	-0.01	-0.01	-0.01	-0.01	0.00	0.00
	(2.12)*	(1.43)	(1.93)	(1.93)	(0.65)	(0.56)
Rating	-39.34	-87.50	-3.51	-5.75	-18.89	-43.31
	(3.19)**	(4.56)**	(1.59)	(2.67)**	(2.64)**	(2.95)**
Equity Mkt		-0.04		-0.01		-0.06
		(5.46)**		(1.06)		(6.88)**
Country Fix	YES	YES	YES	YES	YES	YES
_cons	668.74	1627.09	20.63	63.01	52.74	471.39
	(2.86)**	(4.40)**	(0.48)	(1.58)	(1.08)	(2.81)**
Obs	76420	61691	30714	29704	45706	31987
R-sqrd	0.69	0.75	0.82	0.82	0.55	0.71

* significant at 5%, ** significant at 1%

Robust t-statistics are in parentheses

Table 10 : This table shows the results of unbalanced panel regressions of the par-equivalent basis on various bond liquidity variables , MSCI equity market indices controlling for country fixed effects. A brief variable description is on Table 3.
The t-statistics reported in parentheses are robust t-statistics with standard errors clustered by bond.
Data is obtained from Datastream.

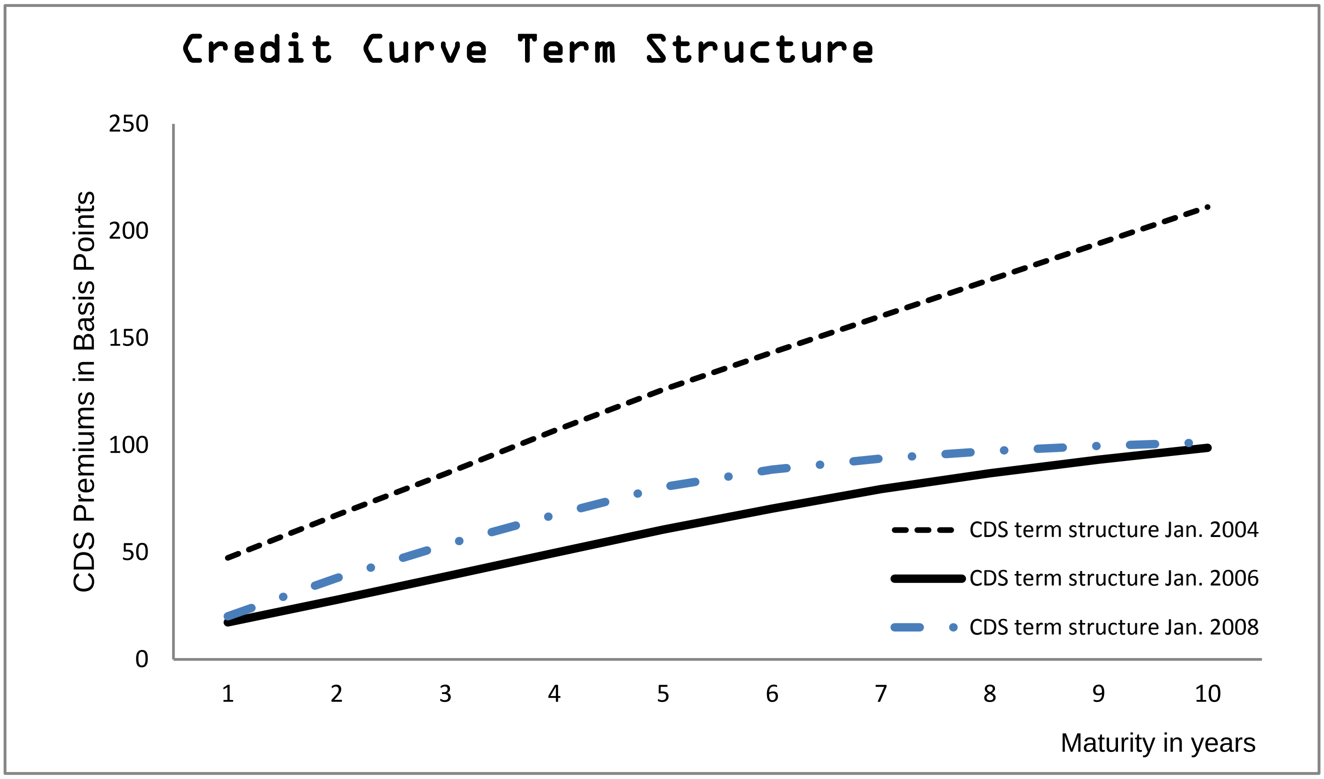

Figure 1: : Mexico 2004 and 2008 CDS term structure curves:
The purpose of this figure is to illustrate a common example of the term structure of credit curves of emerging market countries. As is clear from the credit curves, term structure of CDS is almost always positive. That is why it is extremely crucial to relax the "flat credit curve term structure" assumption.
The CDS data is collected from Datastream, which distributes data from CMA.

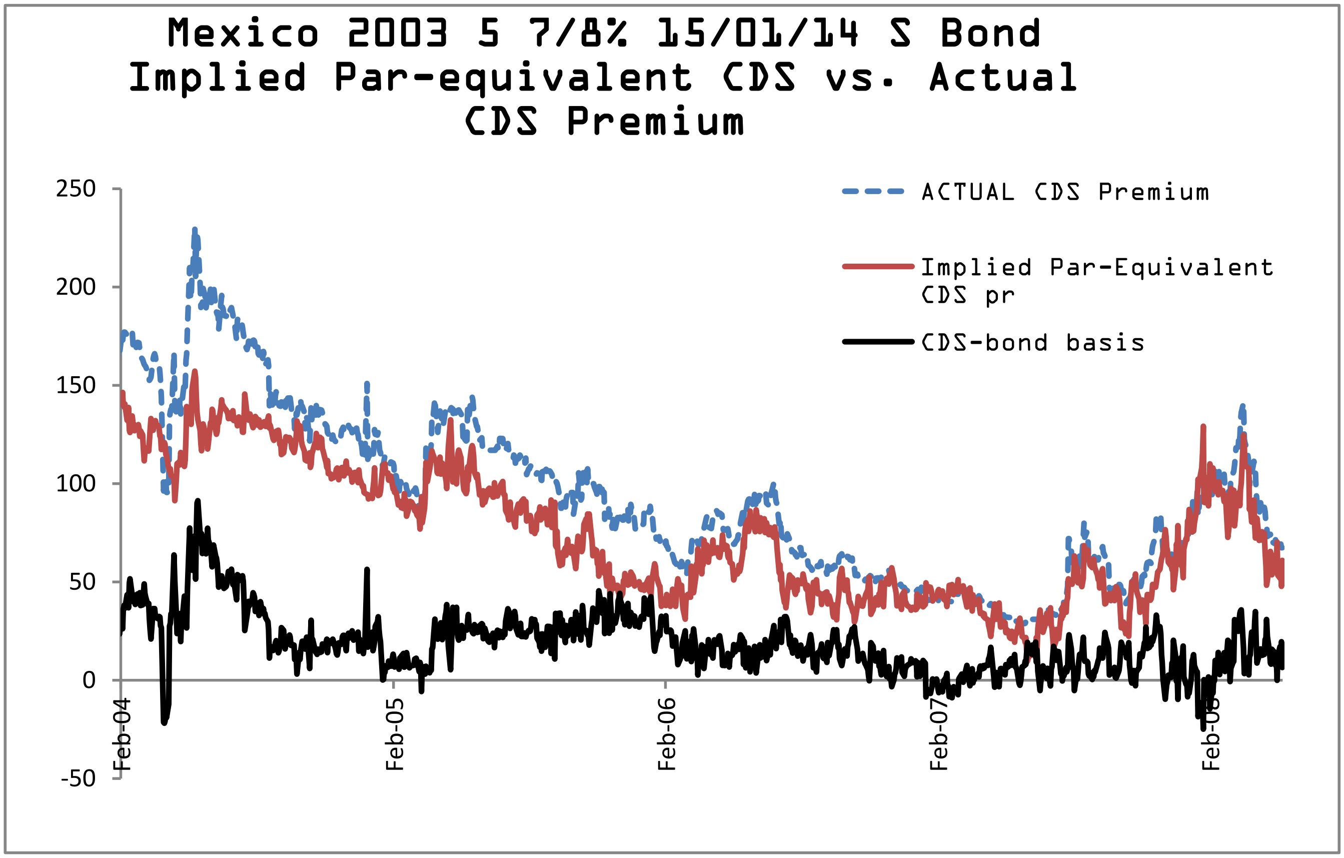

Figure 2: MEXICO. 2003 5 7/8% 15/01/14 S Bond Implied Par-equivalent CDS premium vs. Actual CDS Premium.

This figure is an illustration of the calculated hypothetical par-equivalent CDS premium for one of Mexico's international bonds issued in 2003 and maturing in 2014. As explained in the text, for each day starting from January 1st 2004 until May 2008, I extract the average probability of default for the remaining maturity of the bond from bond yields using US swap curves as a risk free curve. Then, I calculate the par-equivalent CDS premium using the extracted default probability and maturity, which results in the blue dashed line in the above graph.

In my data set I have CDS maturities from 1 to 10 years. In order to compute the non-default component of the bond yields, I interpolate the CDS curve for the intermediate maturities, which results in the solid red line. My estimate of the non-default component is the difference between these two lines, i.e. the solid black line at the bottom is the CDS-bond basis.

The data is obtained from Datastream

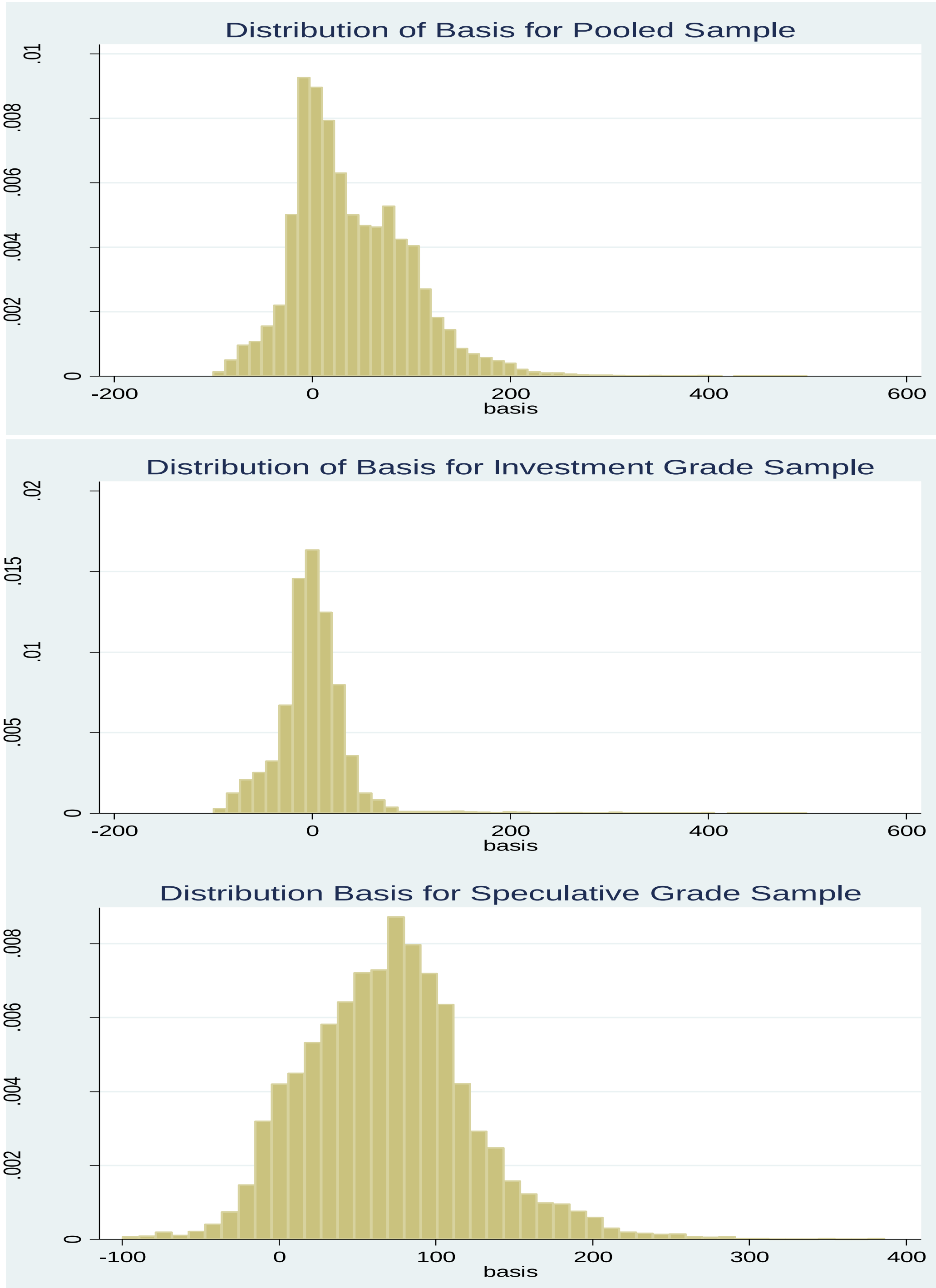

Figure 3: Distribution of CDS-Par Equivalent CDS Basis by Rating Groups.
These graphs show the distribution of the calculated CDS-bond basis, which is an estimate of the non-default component of the emerging market sovereign bond yield spreads.
The data is obtained from Datastream.

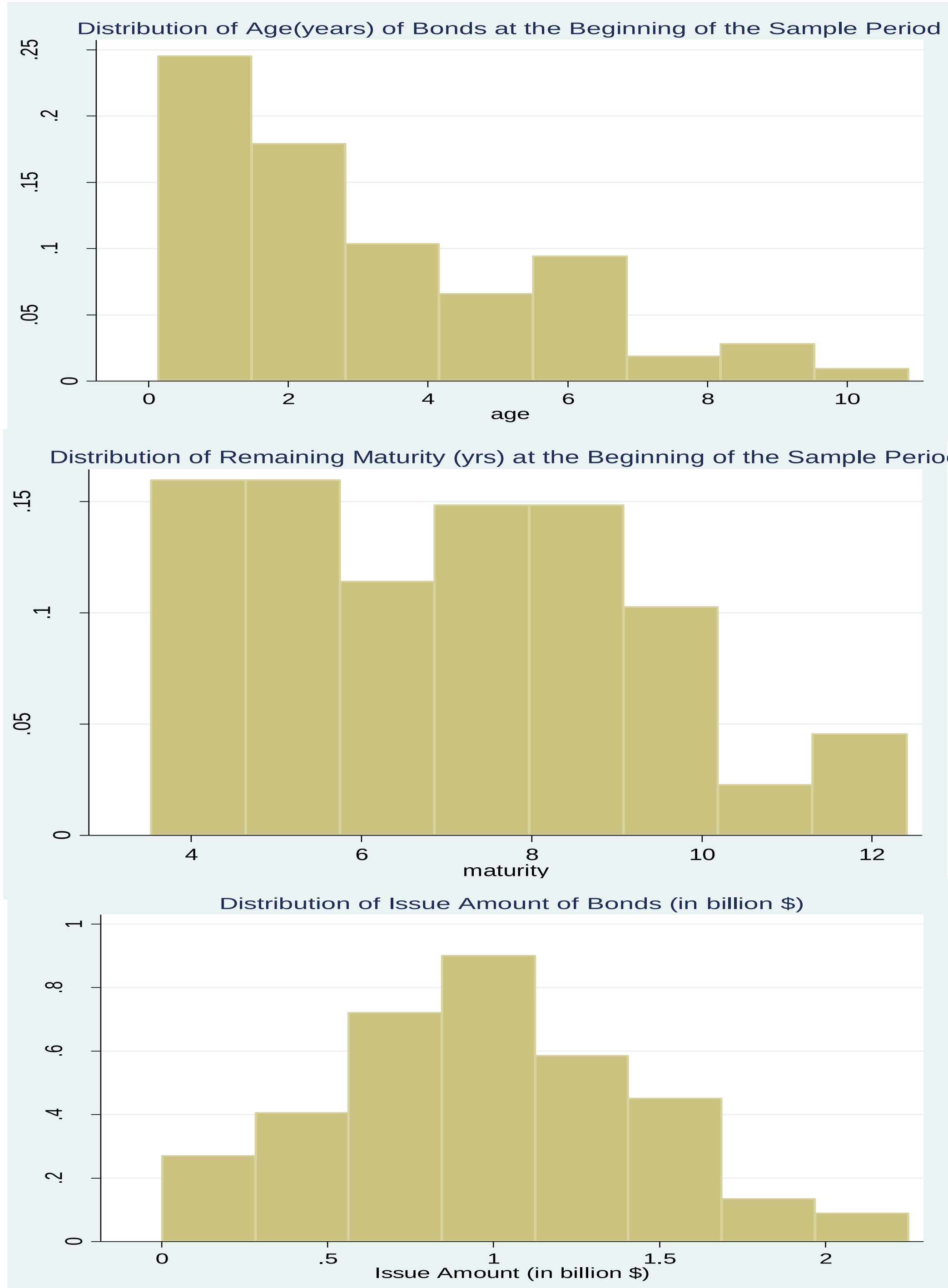

Figure 4: Distribution of Age, Remaining Maturity and Issue Amount of the Bond Sample. The purpose of this table is to present the audience a flavor of the distribution of the bond sample used in the regression analyses. Age variable is the time in years passed until the sample starting time of 2004. Remaining maturity is the remaining time in years until the bond expires. Issue amount variable is the amount of the bond issued by the emerging market sovereign in billions of US Dollars.
Data is collected from Datastream terminals.

Emerging Market Local Currency Bond Market, Too Risky to Invest?*

Ugur N. Kucuk[†]

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Abstract

Over the last decade, local currency emerging market (EM) debt has been developing to become an attractive and complementary investment category as many EM countries have been successful to reduce currency mismatches and maturity problems by implementing sound fiscal and monetary policies. Analyzing the period from 2002 to July 2009, we show that the local currency EM debt investments provide significant additional alpha and diversification to traditional bond portfolios. In particular, first, EM local currency bond returns are less correlated to the US stock market, treasury and high-yield bond markets, and global risk premia compared to the a case of EM equity and US dollar-denominated bond markets. Second, yields and excess returns on local currency debt depend largely on expected depreciation of the exchange rate against US dollar, while excess returns on dollar-denominated EM debt are for the most part compensation for bearing the global risk. Third, EM sovereign local currency bond returns beat other emerging and mature market asset classes by providing higher risk adjusted excess returns and diversification. In light of our findings, we suggest that the development of local currency bond markets in EM countries could contribute to global financial stability by reducing currency mismatches and reliance on foreign currency debt, which in turn is linked to growth and poverty reduction.

JEL Classifications: G10, G11,G15

Keywords Sovereign Bond Market, Local Currency Bonds, Emerging Markets, Bond Portfolio, Excess Returns

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1 Introduction

The importance of diversification and favorable return-risk profile of equity and fixed income portfolios are well defined in financial literature. Literature on diversification documents that spreading out investments with low correlations helps to reduce risks. Emerging market (EM)countries are geographically dispersed and each having different economic and political situations attracts much attention from international investors seeking diversification and high yields. Over the last decade, EM debt has been widely accepted as a soundly established strategic asset class by global institutional investors. Asset flows to EM's have increased as many of these countries have implemented sound fiscal and monetary policies, resulting in a structural improvement in overall creditworthiness. Many EM countries have taken advantage of this favorable environment to improve their debt structure by increasing the maturity of their debt and develop local currency debt markets.

The literature on the benefits of international diversification of equity portfolios is very large. Some important examples, among many others, are Grubel (1968), Solnik (1974),Lessard (1974),Heston and Rouwenhorst (1994,), Levy and Sarnat (1970), French and Poterba (1991), De Santis and Gerard (1997), Das and Uppal (2004), and Campa and Fernandes (2006) . The low correlations among international equity markets are the main ingredients for internationally diversified portfolios. These correlations are low as long as the local equity markets reflect the effects of country-specific factors such as the local monetary and fiscal policies, differences in institutional and legal regimes, and local economic shocks (Longstaff, Pan, Pedersen, H., and Singleton (2008)).

While EM governments have been improving their debt structure by developing local-currency bond markets, investors are watching more closely at local markets in search for higher yield and greater diversification. Given that EM sovereigns are famous of providing high yields on their debt securities, therefore the question of whether EM local-currency bond markets provide diversification benefits becomes extremely crucial. This issue has become exceptionally relevant as the correlations between asset returns have drastically increased due to the recent financial turmoil.

Improved debt management practices, better macroeconomic conditions as well as widening and diversification of the investor base facilitated the emergence and the fast growth of EM local currency-denominated sovereign bond markets.[1] The growing interest of global investors in EM

[1] BIS (2007), BIS (2008), IMF (2006) and IMF (2009)

sovereign debt reflects the improved risk-return profile of these assets. Market capitalization of JP Morgan Global Bond Index-Emerging Markets (Gbi-Em) [2] has shown an average annual growth rate of circa 30% to $990 Billion as of July 2009 from $116Billion in 2002. Meanwhile, market value of dollar-denominated EM debt securities proxied by JP Morgan Embi Global Index [3] has increased from $184 Billion from 2002 to only $290 Billion as of July 2009.

In this paper we examine sources and the degree of co-movement of yields and excess returns, vulnerability of EM debt investment to contagion and the determinants of yields of the local currency-denominated EM sovereign bonds. We provide several contributions to the literature. First, we show that EM sovereign local currency bond returns are notably less correlated across countries compared to returns in other EM asset classes, i.e. dollar-denominated bonds and stock market indices. Average partial correlation coefficient for local currency bond US Dollar return across countries is 33%, while it is 44% for dollar-denominated debt returns and 51% for local stock market returns between January 2002 and July 2009. [4] Literature on the benefits of international diversification found a low correlation among *developed equity markets*, and it attributes the low correlation to the predominance of country specific factors. However, our results suggest something contrary; unlike equity markets in developed countries, EM equity markets are highly correlated and possibly largely affected by global factors such as variation in credit risk premia, market liquidity and trading movements of international investors. On the other hand, local currency bond returns reflect much lower correlations signaling the effects of various country specific factors such as political risk, inflation and exchange rate expectations on returns.

Second, to further investigate the correlation and co-movement in the returns of EM asset classes, we use principal component analysis. We find that first principal component explains 37% of the variance in the local-currency bond returns while it explains 49% and 54% of the variance in the dollar-denominated debt and local stock market returns, respectively. Further, we show that the first principal components are highly correlated to the US stock and bond market returns and the spread between US corporate investment grade and high yield bonds.

[2]GBI-EM indices are comprehensive emerging market debt benchmarks that track local currency bonds issued by Emerging Market governments.

[3]The JP Morgan Emerging Markets Bond Index Global (EMBI Global or EMBIG) tracks total returns for traded external debt instruments in the emerging markets, and is an expanded version of the JP Morgan EMBI+. As with the EMBI+, the EMBI Global includes U.S. dollar-denominated Brady bonds, loans, and Eurobonds with an outstanding face value of at least $500 million.

[4]Important thing to note here is that, when we mention returns we always mean US Dollar returns.

Third, we regress the changes in yields of local currency and dollar-denominated bond yields on three categories of explanatory variables: local economic variables, global financial market variables and global risk premia. As a local variable, expected depreciation in the exchange rate, has significant explanatory power on local currency bond yield changes. Local stock market index return and Credit Default Swap (CDS) premium changes have significant t-statistics in 9 out of 16 countries. In explaining dollar-denominated yield changes however, the coefficients of the US Treasury and corporate investment grade bond yields together with CDS premium changes are significant. This is a striking result as it suggests, while local-currency bond yields largely move along with exchange rate expectations, dollar-denominated bond yields reflect the changes in the global financial market risk premia.

Next task is to examine the implications of this result in the excess returns of EM bond portfolios. Even though the financial world has been facing one of the biggest crises in its history, both bond markets (local currency and dollar-denominated) provided positive excess returns above the traditional asset classes such as US Treasury, US corporate and high yield bond markets, and US equity markets (See Table 10-11). Sharpe ratios of EM local currency bond index are the highest from 2002 to 2008 and it is only negative in 2008. Note even in 2008 this ratio is always higher than all other asset classes except for the US Treasury (See Figures 6-7).

We regress changes in EM excess returns of EM local currency and dollar-denominated bond portfolios on changes in the excess returns of US equity and bond portfolios. The results confirm that US market variables explain a large variation in dollar-denominated bond excess returns. Strikingly enough, R-squared of the regression of EMBI Global Composite index on the US market excess returns is 0.818. On the other hand, global market factors explain a much lower variation in local currency-denominated bond portfolio returns, which have an average R-squared half of that of dollar-denominated bond portfolio returns. Longstaff, Pan, Pedersen, H., and Singleton (2008) examine the sovereign credit excess returns implied by their CDS premia. Their results are related to our study for dollar-denominated bond returns, as CDS premia are comparable to spreads on similar maturity bond yields. Our findings that dollar-denominated bond returns are explained largely by global financial market variables are consistent with the results of Longstaff, Pan, Pedersen, H., and Singleton (2008) where the authors conclude that sovereign credit returns are primarily compensation for bearing the risk of the global factors.

This paper is organized as follows: Chapter II will describe the data and provide the definitions of the variables used in our empirical analysis. Chapter III will give a synopsis of the recent improvements in the emerging market sovereign debt structure. Chapter IV will explain the methodology and document the results of various empirical analyses on risk versus return structure of local currency debt instruments. Finally, chapter V will conclude.

2 Data

2.1 EM Local Currency Denominated Bond Returns

We use JP Morgan Government Bond Index-Emerging Markets (GBI-EM($)) for the returns and yields in the EM local currency denominated bonds. Even though GBI-EM tracks the local currency bonds, in our analysis the returns are all expressed in terms of US Dollars, so that local currency returns can be compared to returns from other investments. GBI-EM indices are comprehensive emerging market debt benchmarks that track local currency bonds issued by emerging market governments. The index was launched in June 2005 and it is the first comprehensive global local currency EM index. As the historical prices of GBI-EM indices are provided from the year 2002, our sample period for EM local currency denominated bond returns is between January 2002 and July 2009. The GBI-EM indices are composed of 17 countries from four regions. The regional subdivision of the indiex consists of Asia, Europe, Latin America, and Middle East/Africa. Table 2 exhibits the list of countries in our analysis. The data is available at Thomson Financial Datastream.

2.2 EM US Dollar-denominated Bond Returns

For the returns, yields and spreads of the EM dollar-denominated bonds we use JP Morgan Emerging Markets Bond Index Global (EMBI Global). EMBI Global tracks total returns for traded external debt instruments of emerging market sovereigns, and is an expanded version of the JP Morgan EMBI+. The EMBI Global includes dollar-denominated Brady bonds, loans, and Eurobonds with an outstanding face value of at least $500 million issued by 27 emerging market sovereigns. In order to do a matching comparison, we include only the countries on which there is GBI-EM Broad index for the sample period of January 2002 to July 2009.

2.3 EM Money Market Returns (Local Currency)

For local money market returns in emerging markets, we use the JP Morgan Emerging markets Plus Index (ELMI+). ELMI + tracks total returns for local-currency-denominated money market instruments of maturities up to 3 months. The ELMI + was back built to December 31, 1993, using the same base date as that of the EMBI+. To date, 24 countries are included in the ELMI representing Asia, Emerging Europe, Latin America and the Middle East / Africa. Note that, as in the case of GBI-EM index, we use the dollar returns of ELMI+ indices in order to be able to do a healthy comparative study.

2.4 EM Equity Market Returns

In order to assess the performance of EM local equity markets we use Morgan Stanley Capital International Emerging Markets Index (MSCI-EM). The MSCI Emerging Markets Index is a free float-adjusted market capitalization index that is designed to measure equity market performance of emerging markets. As of June 2009 the MSCI Emerging Markets Index consisted of the following 22 emerging market country indices: Brazil, Chile, China, Colombia, Czech Republic, Egypt, Hungary, India, Indonesia, Israel, Korea, Malaysia, Mexico, Morocco, Peru, Philippines, Poland, Russia, South Africa, Taiwan, Thailand, and Turkey. The returns of MSCI-EM are expressed in US Dollars.

2.5 EM Credit Default Swap Premia

Credit Default Swap (CDS) premia are used to control for the credit risk of the underlying sovereign in the section to analyze the determinants of sovereign bond yields. The CDS data are downloaded from Thomson Financial Datastream stations. As discussed in Duffie (1999) and Hull and White (2001), a CDS contract is an insurance like contract against the event that an entity such as a firm or a sovereign default on its debt. Since CDS prices the default risk explicitly it is a good benchmark for the pure credit risk of the sovereign. We use the CDS contracts with 5 years to maturity as they are the most frequently traded CDS contracts.

2.6 Global Risk and US Market Variables

We choose widely accepted global risk and liquidity factors and US bond and equity market variables in the section where we search for the determinants of yields and sources of communality. Specifically, we have three Fama - French factors, US Treasury bond yields and returns, S&P500 index returns, CBOE-VIX -implied volatility of the options written on S&P500-, US corporate high-yield and investment grade indices by Merrill Lynch and Barclay's Capital. For global liquidity we use the spread between 3-month Overnight Indexed Swap and US T-bill (OIS-Treasury).For global risk premia, among others mentioned above, we use the spread between 3 month Libor and OIS. The justification and significance of these variables are discussed extensively in the results section.[5]

The Fama/French factors are constructed using the 6 value-weight portfolios formed on size and book-to-market. SMB (Small Minus Big) is the average return on the three small portfolios minus the average return on the three big portfolios. HML (High Minus Low) is the average return on the two value portfolios minus the average return on the two growth portfolios. Rm-Rf, the excess return on the market, is the value-weight return on all NYSE, AMEX, and NASDAQ stocks (from CRSP) minus the one-month Treasury bill rate (from Ibbotson Associates). Rm-Rf includes all NYSE, AMEX, and NASDAQ firms. SMB and HML for July of year t to June of t+1 include all NYSE, AMEX, and NASDAQ stocks for which we have market equity data for December of t-1 and June of t, and (positive) book equity data for t-1. [6]

3 Recent Improvements in the Emerging Market Sovereign Debt

In the last decade, many emerging market countries have made impressive improvements in their debt management capability and macroeconomic fundamentals by implementing necessary structural reforms. These improvements have led to a sustained and significant upgrading of the EM sovereign debt class, about half of which is now investment grade. The low yields in developed countries‘ assets coupled with enhanced quality and performance of EM assets gave rise to a significant increase of developed world‘s investor interest in EM assets. Several EM's have proactively taken advantage of this benign environment to lock in longer-term funding, improve debt structures, and develop local currency markets. Overall, emerging debt markets have been resilient to recent fluctuations in mature financial markets.

The exchange rate, interest rate, and rollover risks are the key risk types that the EM countries are exposed. Indeed, several EM countries have focused on reducing these risks. Exchange rate risk, the risk of the possibility of a sharp increase in the local currency value of foreign currency debt obligations, can be managed by reducing the share of foreign currency-denominated debt. Interest

[5]See Caballero, Farhi, and Pierre-Olivier (2008) for detailes on TED, and Libor minus OIS spreads.

[6]See Fama and French (1993) for a complete description of the factor returns

rate risk, the risk of rising in the interest payments because of an increase in the expected interest rates, can be reduced by increasing the share of fixed-rate debt and the average maturity of the debt. Rollover risk, the risk of facing a very high cost of new funding, can be managed by increasing the maturities of the debt stock.[7]

Many EM countries have been successful in coping with the these three key risks in the last decade. Several EM countries managed to increase the share of local currency-denominated debt in their debt structure. Figure 1 to Figure 6 display the market value of emerging market sovereign local currency (GBI-EM Broad) and dollar-denominated (EMBI Global) EM sovereign bond markets. Figures clearly reveal that the market capitalization of local currency-denominated bonds has been growing at a much faster pace, which increases the share of domestic currency-denominated debt in the EM balance sheets. Besides the success of increasing the share of local currency-denominated debt, many EM governments have also achieved to increase the average maturity of their debt (see Table 1). [8] In other words, a shift away from short-term variable rate towards medium/long term fixed rate borrowing was facilitated by improved macroeconomic fundamentals and debt management. In summary, these results suggest that many EM countries have been succesful at dealing with the problem of *"domestic original sin"* - the inability of a sovereign to borrow in its own currency at long tenors and fixed rate, which is closely related to, high inflation, high-service-to-GDP ratio, and narrow investor base Mehl and Reynaud (2005).

Another improvement for EM countries is the widening and diversification of the investor base for the sale of their debt instruments. [9] Studies by IMF (2006) and BIS (2008) report a growing participation of foreign strategic investors in external debt, a significant increase in foreign investors' willingness to take exposures in local currency debt, and an exposition of the domestic institutional investor base. On the other hand, as a result of the reforms on social security systems and financial deregulation, new long-term local institutional investors, such as insurance companies, pension funds and mutual funds have emerged. These institutional investors have a natural demand for long-duration assets, which enables governments to successfuly auction medium and long-term local-currency debt. Another gain is to reduce exchange rate induced shocks by insulating debt financing from volatile international capital flows.

[7]IMF (2006)
[8]BIS (2008)
[9]IMF global outlook 2006

4 Analysis and Results

4.1 Descriptive Statistics and Correlation Matrices of Local Currency and Dollar-denominated Bond Returns

Tables 2 and 3 present the descriptive statistics of weekly returns of local currency and dollar-denominated bond indices. In general, local-currency bonds provide higher absolute USD returns. In fact, GBI-EM indices provide higher returns than S&P 500, US Treasury, corporate high-yield and investment-grade bonds.

Tables 4 and 5 exhibit the matrices of pairwise correlations of weekly returns in sovereign GBI-EM and EMBI-Global indices. Since the time series of observations for the countries are not equal in length, the correlation between each pair of countries is based on the weeks in which the data overlap. When we compare the two correlation matrices we see that local-currency bond returns are notably less correlated across countries than in the case of the returns in dollar-denominated bonds. Average pairwise correlation coefficient for local-currency bond return across countries is 33%, while it is 44% for dollar-denominated debt returns between January 2002 and July 2009.

We present the correlation coefficients between the weekly returns in EM composite bond and equity market indices, US equity and bond markets in Table 6. Comparing to other indices, GBI-EM composite index returns are remarkably less correlated to other global bond market returns including US Treasury, corporate high-yield and investment grade bond index returns. Note that the GBI-EM Broad Composite index is composed of only 17 EM countries while EMBI Global Composite index contains 32 EM countries. This coverage difference is not against our findings of GBI-EM providing more diversification; to the contrary, it follows the same direction. As EMBI Global Composite is composed of nearly twice as many countries, if anything, one would expect to observe a lower correlation.

The literature on the international portfolio diversification suggests a low correlation among developed equity markets, and it attributes the low correlation to the predominance of country specific factors. However, our results suggest something contrary. Unlike equity markets in developed countries, EM equity markets are highly correlated and possibly largely affected by global factors such as variation in credit risk premia, market liquidity and trading movements of international investors. On the other hand, we observe much lower correlations for local currency bonds, which signals that the effects of several country specific factors such as political risk, inflation and exchange rate expectations outweighs when forming the local currency bond returns.

4.2 Principal Component Analysis

The aim of this section is to analyze whether the correlations of EM asset classes can be explained by some common factors. Table 7 presents the results for principal component analysis (PCA) of the correlation matrix of weekly percentage returns of portfolios formed by Gbi-Em, Embi Global, Elmi+ and Msci indices for emerging market countries in our sample. This table is divided into two parts, i.e. all observations and overlapping observations. All observations section presents the results of the PCA analysis using the pairwise correlation matrix calculated by using all the observations available. Overlapping observations section, however, inputs the correlation matrix calculated by making use of the sample period for which the data is available for all the sovereigns in our sample.

The results indicate that there is a significant amount of commonality in the returns of EM asset classes regardless of whether we analyze all or overlapped observations. However, this commonality is the least in the portfolios of local currency bond and local money market returns. We see that the first principal component captures 37% of the variation in the correlation matrix of local currency bond returns. This percentage rises to 49% and 54% for EM dollar-denominated bond and equity market returns.

Moreover, the first three principal components cumulatively explain 56%, 53%, 75% and 66% of variation in the correlation matrices of local currency bond, money market, dollar-denominated bond and equity market portfolio returns, respectively. Again, the commonality measured by the PCA analysis is the smallest among local currency bond and money market portfolio returns.

We further calculate the time series of the first principal components of the country indices. Table 8 reports the regression results of the first principal components of Gbi-Em Broad, Embi Global, Elmi+, Msci return indices on various US bond and equity market variables. The regression results indicate that S&P 500, US high yield and investment grade bond returns, and the return difference between BB and BBB rated corporate bonds have significant explanatory powers for all of the first components of EM asset classes. As expected, US equity and corporate bond market performances are positively associated with the returns in the EM assets. Besides, the return differences among BB-BBB and BBB-AAA have positive and significant explanatory powers on the first principal components.

We compare the R-Squareds of the regressions in order to evaluate which first factor is explained the most by the US equity and bond markets. Higher R-Squareds in the regressions of equity market and USD denominated bond market returns suggest that they are better fitted by US equity and bond market performances.

4.3 Determinants of EM Bond Yield Changes

In this section, we analyze the dynamic sources of EM local currency and dollar-denominated bond yields. Using panel data analysis, we regress the changes in yields of local currency and dollar-denominated bond yields on three categories of explanatory variables: local economic variables, global financial market variables and global risk premia. Local market variables include the expected depreciation rate of exchange rates versus US Dollar, Credit Default Swap premium and local equity market index. As a novelty in this literature, we use the weekly percentage change in forward rates of exchange rates against USD as a proxy for the change in the depreciation expectations. By definition, EM local currency bond holders bear an additional risk comparing to dollar-denominated bond holders, i.e. currency risk. As forward exchange rates reflect the market expectations for the depreciation rate, percentage change forward rate would provide the change in the expected depreciation rate of the underlying's exchange rate. We have the data for the one year forward rates against USD for all 16 countries in our analysis provided by Reuters.

Table 9 reports the regression results of weekly percentage change in the yields of sovereign local currency bond indices on the weekly changes of local and global financial market variables. As the most important local variable, expected depreciation of exchange rate has a significant and sizable positive effect on local-currency bond yield changes. Interestingly, this variable is more significant for the countries that implement a floating exchange regime. During our sample period, the countries, Argentina, Brazil, Colombia, Hungary, Indonesia, Mexico, Poland, South Africa and Turkey were following a floating exchange rate regime, while other countries were implementing a heavily managed floating or fixed exchange rate regime.[10] For all the countries listed above, the

[10]See IMF (April-2008) for the classification of exchange rate arrangements and monetary frameworks of emerging

change in expected depreciation variable has significant explanatory power in bond yields at 1% level. This is a striking result as it suggests while local currency bond yields largely move along with the exchange rate expectations when the exchange rate movements are determined by the market.

Moreover, Table 9 reports that local stock market index return and 5-year Credit Default Swap premium changes have significant robust t-statistics for most of the countries. A CDS contact written on sovereign debt is essential because it is considered as a measure of the underlying country's credit risk. As a higher CDS premium reflects a higher credit risk, we expect to observe that the CDS premium has a positive and significant sign in the regression, which is indeed what we find for most of the countries. On the other hand, local stock markets are believed to be affected by various country specific factors such as political risk, inflation and exchange rate expectations. As expected, local stock market performances have negative coefficients. In contrast, global financial market variables do not have significant explanatory power over local market variables on local currency bond yields for a major number of the countries in Table 9.

Table 10 reports a similar regression analysis for the determinants of Eurodollar bond yields by EM sovereigns. CDS premiums measuring the underlying's credit risk have significant betas for most of the countries. Coefficients of equity market performances have the expected negative signs and they are significant for 6 out of 16 EM countries. Change in expected depreciation rate variable however seem not to be as important as in the case of local currency bond yields. It is apparent that dollar-denominated bond yields are affected mostly by the country credit risk as a local component.

Contrary to local currency bonds, dollar-denominated bond yields are affected heavily by global financial market performance. US corporate investment grade yield changes are significantly associated with dollar-denominated EM bond yields in 12 out of 16 countries. US corporate high-yield and Treasury bond yield changes are also important factors affecting the yields for majority of the countries. This is remarkable as it suggests: while local currency bond yields largely move along with exchange rate expectations, foreign currency denominated bond yields reflect the changes in the global financial market conditions and risk premia. In brief, these results reinforce the findings in the previous sections on the correlation matrices and the principal component analysis. That is, the dependence on global financial market performance and risk factors is larger for hard currency

market and developed countries by the International Monetary Fund.

denominated bonds.

4.4 EM Sovereign Excess Returns

Tables 11 and 12 provide the descriptive statistics for average monthly excess returns of local and foreign currency-denominated bond portfolios for the period of January 2002 to July 2009. The excess return is defined as the monthly return of the underlying emerging market bond portfolio minus the risk free return, which we assume as US 3 month T bill return. High excess returns presented in these tables suggest that EM bonds whether foreign or local currency denominated have provided superior returns comparing to traditional fixed income asset classes. In the previous sections, we showed that these returns are correlated and a major source of this correlation is their common dependence on global financial market and risk premia. Moreover in a comparative analysis, we have also documented that this dependence is the smallest among the local currency-denominated bonds. Since, what really matters to investors is the combination of excess returns and risk, the next step is to analyze the implications of these results for the excess returns.

Not surprisingly, all of the EM countries except for Argentina have provided large and positive average excess returns on their local and foreign currency denominated bonds between January 2002 and July 2009 as reported in Tables 11 and 12. When we form regional portfolios, Middle East and African local currency-denominated bond portfolios provide the highest average excess returns while Asian EM bond portfolios offer the lowest excess returns. As expected, average monthly standard deviation of excess returns is the highest for Middle East and African and the lowest for Asian sovereigns, as an increasing standard deviation being an indicator of a greater risk. On the contrary, differences in regional excess returns and standard deviations are smaller in the case of foreign currency denominated bond portfolios.

Since what is really important for investors is the risk adjusted excess returns, in Figures 7 and 8 we provide ex post Sharpe Ratios for EM sovereign bonds and various traditional investment classes for the time period between 2002 and 2009. While Sharpe Ratios illustrated in Figure 7 are calculated for the whole period of 8 years, Figure 8 graphs the annual Sharpe Ratios.

The calculation Sharpe Ratio follows[11]: Let R_{Bt} be the dollar return on the EM sovereign bond

[11]See Sharpe (1994)

in *month* t, , R_{Ft} the return on the risk-free bond in period t and E_t the excess return in period t:

$$E_t = R_{Bt} - R_{Ft} \tag{1}$$

If $\overline{E}$ is the average value of excess return over the historic period from time $t = 1$ to T then,

$$\overline{E} = \frac{1}{T}\sum_{t=1}^{T} E_t \tag{2}$$

And σ_E is the standard deviation of the excess return over the period,

$$\sigma_E = \sqrt{\frac{\sum_{t=1}^{T}(E_t - \overline{E})}{T-1}} \tag{3}$$

Then, the ex post Sharpe Ratio S_h is given by:

$$S_h = \frac{\overline{E}}{\sigma_E} \tag{4}$$

Sharpe Ratio in the form of S_h, indicates the ex post average monthly excess return per unit of monthly ex post variability of the excess return. Assuming that the excess return over T months is measured by simply summing the one-month excess returns and that the latter have zero serial correlation, the Sharpe Ratio for T periods is found by:

$$\overline{e_T} = Te_1 \tag{5}$$

$$\sigma_{e_T}^2 = T\sigma_{e_1}^2 \tag{6}$$

then,

$$\sigma_{e_T} = \sqrt{T}\sigma_{e_1} \tag{7}$$

hence,

$$S_T = \sqrt{T}S_1, \tag{8}$$

where e_1 and e_T are one-month and T-months excess returns, S_1 and S_T are one-month and T-months Sharpe Ratios.

Analyzing Figures 7 and 8 calculated using above formulation; it is evident that EM debt provides superior risk adjusted returns in the period of January 2002 to July 2009. In particular, the local-currency bond portfolio of Asia (GBI-Asia) provided the highest Sharpe Ratio during our sample period, while S&P500 has showed a negative risk-adjusted excess return. It is apparent that the US equity and corporate bond markets have been affected the most by the financial turmoil between 2007 and 2009 contrary to the general view that they are less volatile than EM financial instruments. Analyzing Sharpe Ratio's annually, we document that the EM local currency bond portfolio provided large and positive risk-adjusted excess returns for all years except for the year 2008. Even in 2008 it performs better than other asset classes, providing a higher Sharpe Ratio.

Even though the results in this section are appealing, risk-adjusted Sharpe Ratios should be taken into account with caveats. The ex post version takes into account both the average differential return and the associated variability. However it does not incorporate information about the correlation of a fund or strategy with other assets, liabilities, or previous realizations of its own return.

4.5 Regressions of Excess Returns

Naturally, large excess returns of EM debt reported in the previous section stem from various risk premia, to which the emerging market sovereigns are exposed. Excess returns include a risk premium as compensation for credit risk inherent in sovereign debt. Furthermore, investors might require a premium for currency depreciation risk and various types of liquidity risk such as flight to quality episodes following a negative market sentiment. Therefore in this section, we attempt to analyze the exposition of EM bond portfolios to these risk premia by regressing the excess returns of EM sovereign local and foreign currency-denominated bond portfolios on excess returns of various the US equity and bond market portfolios.

Table 13 reports the regression results of excess returns of sovereign local currency bond portfolios (converted to US Dollars) on the three Fama-French Factors, and the excess returns on: five-year US Treasury bonds, US corporate investment grade and high-yield bond indices by Barclay's Capital, detailed explanation of which is provided in the Data section of this paper. In line with the findings on determinants of yields, regression results of local currency bond excess returns show that the US market factors do not have significant explanatory powers for majority of the countries. In particular, 9 sovereigns have significant coefficients for weighted US equity market index by Fama-French, 6 have significant coefficients for investment grade bond index, and 2 have significant coefficients for US Treasury index. While all of the alphas are positive, 7 of them are significant, which might be an indicator of some important omitted variables explaining the variations in the excess returns. The mean alpha of 16 countries adds up to 0.58 per month. Average alpha is high when we think of the average monthly excess returns is only 0.75(Table 11). For the portfolio of all the local currency bonds of all of the 16 EM sovereigns (GBI-EM Composite), only US equity market and investment grade bond index have significant coefficients, while its alpha is significantly positive and R-squared is 52%.

Table 14 reports the regression results of excess returns of sovereign dollar-denominated bond portfolios on the excess returns of the US market factors. The results suggest that US market factors explain a larger variation in the excess returns of foreign currency bonds. Mainly, the US corporate investment grade bond, US Treasury bond and the US equity market index excess returns explain a large part of deviation in the dollar-denominated bond excess returns. R-Squareds are high with an average of 64%, ranging from 29% for Brazil to 84% for Malaysia. Although all of 16 sovereigns have positive alphas, only one of these is significant, which suggests that the model does relatively well explaining the variations in the excess returns. US equity market, Treasury, investment grade and high-yield bond indices have all significant explanatory powers on the portfolio of 32 emerging market dollar-denominated bond indices (EMBI Global). Furthermore, the R-squared of the regression of EMBI global is as high as 82%. Thus, after controlling for global risk factors as proxied by U.S. equity and bond market excess returns, there is little or no evidence of an individual risk premium, which makes it more difficult to diversify away the risk. In other words, the positive mean excess return from taking sovereign dollar-denominated bond positions appears to be, to a large part, compensation for bearing the risk of global factors that drive sovereign spreads; a diversified portfolio of the US stock and bond positions reproduces a substantial portion of the historic excess returns in the sovereign dollar-denominated debt market.

Emerging market local currency-denominated bond excess returns show little dependence on US market factors comparing to the case for dollar-denominated bond excess returns. At a first glance, an analysis comparing the large portfolios of all the bonds of all the countries suggests a significant difference in the reliance of two EM bond markets to the global market. While 4 of 6 US market variables have significant explanatory power on dollar-denominated portfolio; in explaining the local-currency denominated portfolio, only the US equity market variable has a significant beta coefficient. Furthermore, the R-Squared of foreign currency-denominated large portfolio is 82%, which is 50% larger than that of local currency-denominated large bond portfolio.

5 Conclusion

Emerging market sovereign debt has become a firmly established strategic asset class. Besides dollar-denominated debt, local currency emerging market debt has also been developing to become an attractive and complementary investment to traditional fixed income instruments. EM countries have been successful to reduce currency mismatches and maturity problems by implementing sound fiscal and monetary policies, which in return allowed them to extend the maturity of their borrowings denominated in local currency. While many EM governments have been improve their debt structure by developing local-currency bond markets, international investors are watching more closely at local markets in search for higher yield and greater diversification. In our paper, therefore, we try to answer the question whether EM local-currency bond markets diversification benefits provide higher risk adjusted excess returns . This issue has become even exceptionally relevant as the correlations between asset-returns have drastically increased due the recent financial turmoil.

Analyzing the period from 2002 to July 2009, we show that the local currency debt provides significant additional alpha and diversification to traditional bond portfolios. In particular, first, EM local currency bond returns are less correlated to the US stock market, treasury and high-yield bond markets and global risk premia comparing to the a case of emerging market equity and dollar-denominated bond markets. Contrary to the literature suggesting a low correlation between the equity markets in developed countries, EM equity markets are highly correlated and possibly largely affected by global factors such as variation in credit risk premia, market liquidity and trading movements of international investors. On the other hand, local-currency bonds reflect significant lower correlations, which signals that the effects of various country specific factors such as political risk, inflation and exchange rate expectations predominates when determining the returns.

In order to analyze the common factors that cause the correlation between the returns of EM assets, we perform a principal component analysis. The results indicate that there is a significant amount of commonality in the returns of EM asset classes. However, this commonality is the least in the local-currency bond and money market returns. We see that the first principal component captures 37% of the variation in the correlation matrix of local-currency bond returns. This percentage rises to 49% and 54% for EM foreign currency denominated bond and equity market returns.

Furthermore, we document that yields and excess returns on local currency debt depend largely on expected depreciation of the exchange rate, while excess returns on foreign currency denominated debt are for the most part compensation for bearing the global risk. As a novelty in this literature, we use the weekly percentage change in forward rates of exchange rates against USD as a proxy for the change in the depreciation expectations. By definition, EM local currency bond holders bear an additional risk comparing to dollar-denominated bond holders, i.e. currency risk. In particular, unlike local currency bonds, dollar-denominated bond yields are affected heavily by global financial market performance. This is an important result as it suggests while local-currency bond yields largely move along with exchange rate expectations, dollar-denominated bond yields reflect the changes in the global financial market conditions and risk premia.

Last but not the least, we report that EM sovereign local currency bond returns beat other emerging market and traditional investment classes by providing higher annual and long term risk adjusted excess returns, providing added alpha and diversification to bond portfolios. Consistent with the previous sections, emerging market local-currency denominated bond excess returns show little dependence on excess returns of US market factors comparing to the case for foreign currency bond excess returns.

In summary, we argue that local currency bond returns are determined primarily by idiosyncratic or country-specific factors, which allows standard portfolio diversification methods to manage sovereign local currency bond portfolios. Indeed, our results suggest that there exists a large country specific premium in the local-currency bond returns even after controlling for global risk factors. These country specific premia might stem from various country specific factors such as political risk, inflation and exchange rate expectations. On the other hand, after controlling for global risk factors as proxied by the US equity and bond market excess returns, there is little or no evidence of an individual risk premium in the dollar-denominated bond returns, which makes it more difficult to diversify away the risk. In other words, the positive mean excess return from taking sovereign dollar-denominated bond positions appears to be, to a large part, compensation for bearing the risk of global factors that drive sovereign spreads; a diversified portfolio of US stock and bond positions reproduces a substantial portion of the historic excess returns in the sovereign debt market.

We believe that our results will have important policy implications not only for market participants but also for the governments and the international institutions. We suggest that the development of local currency bond markets in EM countries could contribute to global financial stability by reducing reliance on foreign currency debt and currency mismatches, which in turn is linked to growth and poverty reduction.

References

BIS, 2007, Financial stability and local currency bond markets, *CGFS Papers* 28.

———, 2008, International banking and financial market developments, *BIS Quarterly Review* June 2008.

Bordo, Michael D., Christopher M. Meissner, and Angela Redish, 2005, How original sin was overcome: The evolution of external debt denominated in domestic currencies in the united states and the british dominions, 18002000, *University of Chicago Press*.

Broner, Fernando, R. Gaston Gelos, and Carmen Reinhart, 2004, When in peril, retrench: Testing the portfolio channel of contagion, *Federal Researve Bank of San Francisco Working Paper No. 2004-28*.

Bulow, Jeremy, and Kenneth Rogoff, 1989, Sovereign debt: Is to forgive to forget?, *American Economic Review* 79, 43–50.

Bunda, Irina, A. Javier Hamann, and Subir Lall, 2004, Correlations in emerging market bonds: The role of local and global factors, *Emerging Markets Review* 10.

Burger, John D., Francis E. Warnock, and Veronica Warnock, 2009, Global financial stability and local currency bond markets, *Working Paper*.

Caballero, Ricardo J., Emmanuel Farhi, and Pierre-Olivier, 2008, Financial crash, commodity prices and global imbalances, *NBER Working Paper*.

Campa, Jose, and Nuno Fernandes, 2006, Sources of gains from international portfolio diversification, *Journal of Empirical Finance* 13, 417–443.

Campanaro, Alessandra, and Dimitri Vittas, 2004, Greco-roman lessons for public debt management and debt market development, *World Bank Policy Research Paper No. 3414*.

Chamon, Marcos, 2003, Why cant developing countries borrow from abroad in their currency?, *International Monetary Fund*.

Claessens, Stijn, Daniela Klingebiel, and Sergio Schmukler, 2003, Government bonds in domestic and foreign currency: The role of macroeconomic and institutional factors, *CEPR Discussion Paper No. 3789*.

Co., JPMorgan Chase &, 2006, Global market outlook strategy, .

Cochrane, John H., and Monika Piazzesi, 2005, Bond risk premia, *American Economic Review* 98, 138–160.

Das, Sanjiv, and Raman Uppal, 2004, Systemic risk and international portfolio choice, *Journal of Finance* 59, 2809–2834.

De Santis, Giorgio, and Bruno Gerard, 1997, International asset pricing and portfolio diversification with time-varying risk, *Journal of Finance* 52, 1881–1912.

Dooley, Michael P., and Lars E. O. Svensson, 1994, Policy inconsistency and external debt service, *Journal of International Money and Finance* 13, 364–374.

Duffie, Darrell, 1999, Credit swap valuation, *Financial Analysts Journal* January February, 73–87.

——— , Pedersen Lasse H., and Kenneth J. Singleton, 2003, Modeling sovereign yield spreads: A case study of russian debt, *Journal of Finance* 58, 119–159.

Erb, Claude B, Campbell R. Harvey, and Tadas E. Viskanta, 1996, The influence of political, economic, and financial risk on expected fixed-income returns, *Journal of Fixed Income* pp. 7–31.

——— , 1997, Emerging market bonds: A global perspective, proceedings of the association for investment management and research, Financial Analysts Seminar, Northwestern University, July 24.

——— , 1999, New perspectives on emerging market bonds, *The Journal of Portfolio Management* Winter, 83–92.

Fabozzi, Frank J., Lionel Martellini, and Philippe Priaulet, 2006, *Advanced Bond Portfolio Management, Best Practices in Modeling and Strategies,* (Wiley & Sons, Inc.,: Hoboken, New Jersey).

Fama, Eugene F., and Kenneth R. French, 1993, Common risk factors in the returns on stocks and bonds, *Journal of Financial Economics* 33, 3–56.

French, Kenneth, and James Poterba, 1991, Investor diversification and international equity markets, *American Economic Review* 81, 222–226.

Glick, Reuven, and Andrew Rose, 1999, Contagion and trade: Why are currency crises regional?, *Journal of International Money and Finance* 18, 60317.

Goetzmann, William, Lingfeng Li, and Geert Rouwenhorst, 2005, Long-term global market correlations, *Journal of Business* 78, 1–31.

Gracio, De Alessi, Glenn Hoggarth Cristiana, and Jing Yang, 2005, Capital flows to emerging markets: Recent trends and potential financial stability implications, *Bank of England* pp. 94–102.

Griffin, John, and G. Andrew Karolyi, 1998, Another look at the role of the industrial structure of market for international diversification strategies, *Journal of Financial Economics* 50, 351–373.

Grubel, Herbert, 1968, Internationally diversified portfolios: Welfare gains and capital flows, *American Economic Review* 58, 1299–1314.

Hauner, David, and Manmohan S. Kumar, 2005, financial globalization and fiscal performance in emerging market, *IMF Working Paper 05/212*.

Heston, Steven, and K. Geert Rouwenhorst, 1994,, Does industrial structure explain the benefits of international diversification?, *Journal of Financial Economics* 36, 3–27.

Hostland, Doug, and Philippe Karam, 2005, Assessing debt sustainability in emerging market economies using stochastic simulation methods, *IMF Working Paper 05/226.*

Hull, John, and Allen White, 2001, Valuing credit default swaps i: No counterparty risk journal of derivatives, *Journal of Derivatives.*

IMF, 2006, Financial stability report, *World Economic and Financial Surveys* April.

——— , 2009, Global financial stability report, *World Economic and Financial Surveys* April.

——— , April-2008, De facto classification of exchange rate regimes and monetary policy frameworks, Country Reports, April.

Jeanne, Olivier, 2004, Debt maturity and the international financial architecture, *IMF Working Paper 04/137.*

Kaminsky, Graciela, Richard Lyons, and Sergio Schmukler, 2004, Managers, investors, and crises: Mutual fund strategies in emerging markets, *Journal of International Economics* 64, 113–34.

Kucuk, Ugur N., 2008, Estimating the non-default component of sovereign emerging market yield spreads and its determinants: Evidence from credit default swap market, *University of Rome II, Working Paper.*

Lessard, Donald, 1974, World, national and industry factors in equity returns, *Journal of Finance* 29, 379–391.

Levy, Haim, and Marshall Sarnat, 1970, International diversification of investment portfolios, *American Economic Review* 60, 668–675.

Longstaff, Francis A., 2004, The flight to liquidity premium in u.s. treasury bond prices, *Journal of Business* 77, 51526.

——— , Sanjay Mithal, and Eric Neis, 2005, Corporate yield spreads: Default risk or liquidity? new evidence from the credit default swap market, *Journal of Finance* 60, 2213–2253.

Longstaff, Francis A., Jun Pan, Pedersen, Lasse H., and Kenneth J. Singleton, 2008, How soverign is sovereign credit risk?, *NBER Working Paper 13658.*

Mehl, Arnaud, and Julien Reynaud, 2005, The determinants of domestic original sin in emerging market economies, *ECB Working Paper No. 560.*

Pan, Jun, and Kenneth J. Singleton, 2008, Default and recovery implicit in the term structure of sovereign cds spreads, *Journal of Finance* 63-October, 2345–2384.

Remolona, Eli, Michela Scatigna, and Eliza Wu, 2007, The dynamic pricing of sovereign risk in emerging markets: Fundamentals and risk aversion, Working paper, The Bank for International Settlements.

Rozada, Martin, and Eduardo Yeyati, 2005, Global factors and emerging market spreads, Working paper, Universidad Torcuato Di Tella.

Sachs, Goldman, 2005, *Global Economics Weekly*November30.

Sharpe, William. F., 1966, Mutual fund performance, *Journal of Business* 39, 119138.

——— , 1994, The sharpe ratio, *Journal of Portfolio Management* 21, 4958.

Solnik, Bruno, 1974, 1974, Why not diversify internationally rather than domestically?, *Financial Analysts Journal* 30, 48–54.

Tirole, Jean, 2002, *Financial Crises, Liquidity, and the International Monetary System* (Princeton University Press: Princeton, New Jersey).

White, Halbert, 1980, A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity, *Econometrica* 48, 817–838.

Table 1: **Maturity of domestic central government debt outstanding. Average original and remaining maturity in years** Government debt outstanding includes bonds, notes and money market instruments. Regional totals based on the countries listed in the table and weighted by the corresponding amounts outstanding. Asia larger economies and total emerging markets exclude China for all periods. These estimates should be regarded as indicative and may not be strictly comparable across countries. Industrial countries consist of Australia, Belgium, Canada, Germany, Spain, the United Kingdom and the United States.

	2002		2003		2004		2005		2006		2007		2008	
	Original	Remaining	Orig.	Remain.	Orig.	Remain.	Orig.	Remain.	Orig.	Remain.	Orig.	Remain.	Orig.	Remain.
Argentina	...	...	1	0.7	1.3	1	1.1	12	17	11	16.5	10.3	16.7	10.6
Brazil	...	2.9	...	2.7	...	2.4	...	2.3	...	2.6	...	3	...	3.3
Chile	5.6	13	7.6	5.4	7.2	6.9	8.4	6.7	5.6	7.8	7.8	6.8	10.2	9.2
Colombia	6.4	4.5	6.5	4.2	6.8	4.1	6.8	3.8	7.5	3.9	7.7	4.1	8.2	4.4
Czech Rep.	7.3	5.2	7.9	5.7	8.5	6	8.6	5.7	9.3	6.3	8.5	5.6	9.3	5.8
Hungary	...	3.7	...	4	...	4.1	...	4.1	...	4	6.8	4	7.1	3.8
India	14	8	14	9	15	10	14	10	16.9	10	14.7	10	14.9	10.6
Indonesia	13.1	7.6	7.8	7.8	7.9	8.4	7.6	7.6	11.5	7.1	13.3	12.7	4.8	4.1
Korea	5.4	3.7	5.5	3.7	5.8	4	6.1	4.1	6.6	4.2	7	4.4	7.5	4.5
Malaysia	...	4	...	5	...	5	8.6	5	8.4	5.2	10	5.4	9.7	5.3
Mexico	...	2.3	...	2.5	...	3	...	3.4	...	4.3	...	5.7	...	6.5
Peru	2.5	1.2	3.3	2.1	6.5	5.5	11	9.9	13.9	12.2	18.5	16.5	19.4	16.6
Philippines	7.1	4.2	7	4.2	7	3.9	7.2	4.1	7.9	4.7	7.8	5	8.1	4.9
South Africa	17.4	8.9	16.6	8.2	15.4	8.2	16	8.1	16.8	8.3	17.3	8.3	18.3	9.9
Poland	4.3	2.7	4.4	2.7	5.4	3.2	6.2	3.6	6.9	3.9	8	4.3	8.6	4.2
Russia	3.8	1.7	5.6	4.1	10.8	8.9	11.1	8.6	11.9	9	12.9	9.7	13.4	9.7
Thailand	9.4	...	8.5	6	8.7	6	8.6	5.6	8.8	5.4	9.7	5.8	10.2	5.8
Turkey	3.2	2.4	2.9	1.9	2.8	1.6	3.3	1.8	3.5	1.9	3.8	1.1	3.9	1.9
Industrial Count.	9.9	5.2	10	5	10.2	4.9	10.4	5.9	10.6	5	10.9	5.4	11	5
Central Europe	4.8	3.3	5.1	3.5	6	3.8	6.6	4	7.4	4.3	7.8	4.4	8.4	4.4
Asia, L. Econs.	10.9	7	10.6	7.1	10.7	7.3	10.1	7	11.2	6.9	10.9	7.1	11.5	7.6
Latin America	5.5	2.8	2.6	2.5	3.4	2.7	3.5	3.9	13.7	4	13.6	4.4	14	4.9
Total EM's	9.4	5.1	8.1	4.8	8.4	4.9	8.2	5	9.9	5.1	9.9	5.2	10.2	5.5

Source: BIS Working Group Survey

Table 2: **Descriptive Statistics and first order serial correlations for JP Morgan GBI-EM Broad Index.** This table reports summary statistics for week-end percentage total US-dollar returns for JP Morgan GBI-EM Broad Bond Indeces for emerging market sovereigns.

	Mean	Std Dev.	Minimum	Maximum	Obs.	Serial Corr.
Argentina	-0.11	6.49	-29.97	20.62	107	0.196
Brazil	0.33	2.64	-13.33	10.26	393	0.111
Chile	0.24	1.75	-10.01	6.16	350	-0.023
China	0.15	0.62	-4.73	3.18	289	-0.045
Colombia	0.36	2.36	-10.26	10.11	341	-0.038
Egypt	0.14	1.55	-6.84	5.46	93	0.242
Hungary	0.26	2.86	-17.79	12.06	393	-0.015
Indonesia	0.29	3.22	-25.58	24.63	341	0.037
Malaysia	0.09	0.79	-3.36	3.74	393	0.045
Mexico	0.11	1.94	-9.30	12.07	393	0.012
Peru	0.24	2.02	-6.86	14.48	145	0.074
Poland	0.23	2.38	-14.35	10.73	393	-0.124
Russia	0.05	1.57	-10.37	8.08	232	0.010
South Africa	0.34	3.11	-16.67	13.01	393	-0.052
Thailand	0.18	1.09	-3.87	3.94	393	0.178
Turkey	0.34	2.89	-15.18	9.93	276	0.050
Gbi-Em Composite	0.23	1.10	-4.78	5.31	393	0.023
Gbi-Em Europe	0.26	2.19	-12.22	10.16	393	-0.068
Gbi-Em Latin America	0.33	2.80	-16.36	21.00	393	-0.017
Gbi-Em Mid E/Afr	0.22	1.76	-10.57	7.00	393	0.009
Gbi-Em Asia	0.16	0.62	-2.38	3.09	393	0.156

Table 3: **Descriptive Statistics for JP Morgan EMBI Global Index.**This table reports summary statistics for week-end percentage total returns for JP Morgan EMBI Global Bond Indeces for emerging market sovereigns.

	Mean	Std Dev.	Minimum	Maximum	Obs.	Serial Corr.
Argentina	0.12	3.81	-22.09	19.28	393	0.075
Brazil	0.30	2.29	-15.58	10.24	393	0.080
Chile	0.14	0.89	-4.06	2.95	393	-0.006
China	0.12	0.80	-5.64	4.87	393	0.102
Colombia	0.21	1.49	-5.90	10.70	393	0.079
Egypt	0.16	0.57	-2.01	2.88	393	0.020
Hungary	0.08	1.47	-16.66	10.52	393	0.078
Indonesia	0.23	2.92	-15.36	31.56	267	0.015
Malaysia	0.15	0.98	-8.84	5.74	393	-0.038
Mexico	0.16	1.13	-7.40	6.80	393	0.188
Peru	0.21	1.60	-7.70	13.13	393	0.055
Poland	0.13	0.92	-5.51	5.39	393	0.162
Russia	0.23	1.69	-10.50	17.36	393	-0.015
South Africa	0.16	1.15	-8.25	10.15	393	0.106
Thailand	0.11	0.47	-1.23	1.84	222	0.031
Turkey	0.25	2.07	-10.83	20.73	393	-0.010
EmbiG Composite	0.20	1.34	-7.08	12.83	393	0.094
EmbiG Europe	0.22	1.60	-10.34	18.10	393	0.006
EmbiG Latin America	0.21	1.03	-9.35	6.30	393	0.076
EmbiG Middle East	0.20	1.49	-7.61	9.78	393	0.124
EmbiG Asia	0.17	1.29	-7.97	15.60	393	0.007

Source: JP Morgan, Datastream

Table 4: **Correlation Matrix of Weekly Returns in GBI-EM Index of Sovereigns.** This table reports the pairwise correlation coefficients for weekly percentage returns in the local currency GBI-EM Broad Bond Indices converted to US Dollars.

	Argentina	Brazil	Chile	China	Colombia	Egypt	Hungary	Indonesia	Malaysia	Mexico	Peru	Poland	Russia	S.Africa	Thailand	Turkey
Argentina	1															
Brazil	0.47	1														
Chile	0.26	0.24	1													
China	-0.02	-0.05	-0.01	1												
Colombia	0.37	0.48	0.29	-0.01	1											
Egypt	0.31	0.3	0.26	-0.14	0.23	1										
Hungary	0.37	0.27	0.06	0.02	0.35	0.18	1									
Indonesia	0.43	0.36	0.21	0.04	0.38	0.34	0.4	1								
Malaysia	0.23	0.25	0.1	0.17	0.33	0.07	0.39	0.41	1							
Mexico	0.36	0.45	0.27	0.05	0.38	0.22	0.43	0.38	0.22	1						
Peru	0.34	0.49	0.26	0.02	0.5	0.23	0.43	0.54	0.29	0.56	1					
Poland	0.41	0.32	0.11	0.07	0.35	0.06	0.8	0.4	0.45	0.42	0.46	1				
Russia	0.24	0.34	-0.03	0.1	0.26	0.09	0.64	0.24	0.35	0.4	0.25	0.64	1			
S.Africa	0.3	0.24	0.07	0.04	0.29	0.17	0.53	0.31	0.33	0.32	0.46	0.53	0.41	1		
Thailand	0.1	0.18	0.18	0.11	0.17	-0.05	0.29	0.33	0.42	0.19	0.23	0.31	0.2	0.23	1	
Turkey	0.41	0.58	0.12	0.05	0.48	0.23	0.67	0.45	0.45	0.6	0.51	0.62	0.37	0.66	0.29	1

Source: JP Morgan, Datastream

Table 5: **Correlation Matrix of Weekly Returns in EMBI Global Index for sovereigns.** This table reports the pairwise correlation coefficients for weekly percentage returns in the EMBI Global Indices.

	Argentina	Brazil	Chile	China	Colombia	Egypt	Hungary	Indonesia	Malaysia	Mexico	Peru	Poland	Russia	S.Africa	Thailand	Turkey
Argentina	1															
Brazil	0.42	1														
Chile	0.22	0.36	1													
China	0.13	0.15	0.74	1												
Colombia	0.52	0.66	0.3	0.21	1											
Egypt	0.24	0.34	0.33	0.35	0.34	1										
Hungary	0.34	0.15	0.41	0.38	0.27	0.14	1									
Indonesia	0.59	0.67	0.4	0.28	0.76	0.2	0.47	1								
Malaysia	0.26	0.23	0.81	0.86	0.29	0.36	0.38	0.43	1							
Mexico	0.49	0.61	0.5	0.4	0.68	0.33	0.45	0.68	0.44	1						
Peru	0.46	0.68	0.34	0.29	0.76	0.41	0.27	0.71	0.36	0.65	1					
Poland	0.15	0.15	0.66	0.8	0.16	0.33	0.4	0.03	0.73	0.38	0.21	1				
Russia	0.52	0.53	0.42	0.39	0.63	0.34	0.44	0.83	0.49	0.68	0.66	0.26	1			
S.Africa	0.45	0.37	0.58	0.53	0.57	0.34	0.55	0.79	0.65	0.7	0.59	0.44	0.76	1		
Thailand	0.04	-0.06	0.66	0.78	0.04	0.27	0.55	0.24	0.72	0.39	0	0.58	0.26	0.57	1	
Turkey	0.49	0.55	0.35	0.28	0.62	0.27	0.36	0.85	0.37	0.61	0.62	0.18	0.74	0.67	0.07	1

Source: JP Morgan, Datastream

Table 6: **Correlation Matrix of Weekly Returns in Gbi-Em Composite, Embi Global Composite, Elmi+ Composite, Msci-Em Composite, S&P 500 Composite, Merrill Lynch US Corporate High Yield and Barclays Capital US Corporate Investment Grade Indeces and the current 5 year US Treasury Bond.**

	Local	Dollar	Money	Equity	S&P500	US Trsy	High Yield	Inv Grade
Local Curr.	1							
Dollar Curr.	0.6	1						
Money Mkt	0.89	0.62	1					
Equity Mkt	0.67	0.61	0.72	1				
S&P500	0.38	0.31	0.42	0.63	1			
US Trsy 5-Year	0.03	0.13	-0.03	-0.25	-0.38	1		
High Yield	0.37	0.58	0.37	0.52	0.4	-0.14	1	
Inv Grade	0.23	0.44	0.17	0.07	-0.12	0.67	0.42	1

Source: JP Morgan, Merrill Lynch, Datastream

Table 7: **Principal Component Analysis.** This table presents the results for the principal component analysis (pca) of the correlation matrix of weekly percentage returns of local currency denominated bond indices(Gbi-Em), USD denominated bond indices (Embi Global), local currency money market indices (Elmi+) and equity market indices (Msci) for emerging market countries in our sample. All observations section presents the results of the pca analysis using the pairwise correlation matrix calculated by using all the observations available. Overlapping observations section reports the pca analysis using the correlation matrix calculated by using the sample period for which the data is available for all sovereigns.

Principal Component	**All Observations**		**Overlapping Observations**	
	Percentage Explained	**Cumulative Percentage Explained**	**Percentage Explained**	**Cumulative Percentage Explained**
Local Curr.				
First	0.37	0.37	0.45	0.45
Second	0.11	0.48	0.11	0.57
Third	0.08	0.56	0.10	0.66
Dollar Curr.				
First	0.49	0.49	0.59	0.59
Second	0.19	0.68	0.19	0.79
Third	0.07	0.75	0.06	0.85
Money Mkt.				
First	0.36	0.36	0.50	0.50
Second	0.09	0.45	0.10	0.61
Third	0.08	0.53	0.09	0.70
Equity Mkt.				
First	0.54	0.54	0.66	0.66
Second	0.06	0.61	0.07	0.73
Third	0.06	0.66	0.06	0.79

Source: Datastream and JPMorgan

Table 8: **Regression of First Principal Components on Global Financial Market Variables.** This table reports the regression results of the first principal components of Gbi-Em Broad(Local Currency), Embi Global (Foreign Currency), Elmi+ (Money Market), Msci (Equity Market) sovereign indices on weekly changes in: S&P500 total return index, volatility index of options written on S&P500 by CBOE, US Corporate high yield and investment grade bond indices, 5 year US Treasury bond index, return difference BB and BBB and return difference between BBB and AAA rated US corporate bonds.

	Local Curr.		Foreign Curr.		Money Mkt		Equity Mkt	
S&P 500	0.52***	0.58***	0.27***	0.25**	0.51***	0.60***	0.70***	0.71***
	(9.20)	(7.79)	(4.57)	(3.31)	(9.25)	(8.21)	(11.77)	(8.90)
Treasury	0.11	0.68*	1.35***	2.10***	-0.19	0.44	-0.22	0.46
	(0.39)	(2.20)	(4.59)	(6.73)	(-0.68)	(1.46)	(-0.73)	(1.41)
High Yield	0.12	-0.62**	0.54***	-0.30	0.07	-0.74***	0.25*	-0.53*
	(1.06)	(-3.04)	(4.48)	(-1.44)	(0.65)	(-3.69)	(2.02)	(-2.48)
Inv. Grade	0.39	1.04***	0.84***	1.49***	0.41	1.09***	0.25	0.88**
	(1.67)	(3.90)	(3.51)	(5.49)	(1.81)	(4.19)	(1.03)	(3.14)
BB-BBB		1.58***		1.75***		1.67***		1.65***
		(4.47)		(4.87)		(4.82)		(4.42)
BBB-AAA		0.26		0.57**		0.42*		0.46*
		(1.39)		(2.99)		(2.25)		(2.31)
VIX		0.01		-0.02		0.01		-0.01
		(0.73)		(-1.39)		(1.02)		(-0.79)
Constant	-0.02	-0.10	-0.20	-0.26*	0.00	-0.08	0.01	-0.05
	(-0.19)	(-0.83)	(-1.59)	(-2.17)	(0.04)	(-0.66)	(0.07)	(-0.43)
Observations	227	227	231	231	231	231	231	231
R^2	0.407	0.457	0.510	0.568	0.402	0.459	0.545	0.586

Robust t statistics in parentheses

Source: JP Morgan, Merryl Lynch, Barclays Capital, Datastream

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9: **Regressions of the Determinants of Local-Currency-Denominated Bond Yields.** This table reports the regression results of weekly percentage change in the yields of sovereign local currency bond indices on the weekly changes of: the expected depreciation rate of exchange rates versus US Dollar, Credit Default Swap premium, Local Equity Market Index (MSCI), S&P500 total return, yields of 5 year Us Treasury Bonds, yields of US corporate High Yield and Investment Grade bond indices by Barclays Capital, CBOE Volatility index of options written on S&P500, changes in yield spread between BB and BBB rated US corporate bonds, the spread between three month Libor and T-bill rate (TED).

	Local Variables			Global Financial Market				Global Risk Premia					
	Exp. Exch.	Equity	CDS	US Equity	US Treasury	HY	us IG	VIX	BB-BBB	TED	α	Obs	R-sqrd
Argentina	0.23**	-0.44***	0.29***	0.26	-0.02	-0.62	0.30	0.03	0.06	0.72	-1.77	106	0.482
	(2.67)	(-3.91)	(3.69)	(0.78)	(-0.15)	(-1.67)	(0.71)	(0.41)	(0.57)	(1.36)	(-1.05)		
Brazil	0.24**	-0.09*	0.00	0.31***	0.09*	0.06	-0.01	0.04**	0.04	0.18*	-0.45*	271	0.265
	(2.90)	(-2.31)	(0.23)	(3.42)	(2.59)	(0.71)	(-0.13)	(3.19)	(1.87)	(2.31)	(-2.31)		
Chile	-0.03	-0.17	0.00	0.38*	0.02	-0.02	0.02	0.01	0.03	-0.02	0.10	271	0.024
	(-0.12)	(-1.34)	(0.09)	(2.08)	(0.19)	(-0.12)	(0.09)	(0.46)	(0.62)	(-0.09)	(0.23)		
China	0.16	-0.03	-0.02	-0.04	-0.03	-0.16	0.12	-0.00	0.04	-0.29*	0.47	271	0.042
	(0.90)	(-0.55)	(-1.15)	(-0.32)	(-0.53)	(-1.25)	(0.82)	(-0.24)	(1.28)	(-2.43)	(1.57)		
Colombia	0.13*	-0.13***	0.05**	0.13	0.04	-0.02	0.13	0.02	0.01	-0.08	0.07	271	0.357
	(2.02)	(-4.47)	(3.24)	(1.74)	(1.16)	(-0.26)	(1.32)	(1.72)	(0.75)	(-0.99)	(0.40)		
Egypt	0.28	-0.08	0.02	0.47**	-0.01	0.37*	-0.03	0.08	-0.03	0.74*	-2.21*	93	0.342
	(1.22)	(-1.25)	(0.77)	(2.89)	(-0.14)	(2.02)	(-0.12)	(1.99)	(-0.47)	(2.43)	(-2.23)		
Hungary	0.58***	-0.09*	0.06***	-0.04	0.03	-0.05	0.16	-0.02	0.02	-0.04	0.05	271	0.515
	(6.44)	(-2.10)	(3.70)	(-0.42)	(0.67)	(-0.48)	(1.30)	(-1.42)	(0.96)	(-0.37)	(0.20)		
Indonesia	0.45***	-0.31***	0.07**	-0.01	-0.04	-0.21	0.19	-0.02	0.04	0.00	0.18	249	0.525
	(3.39)	(-6.70)	(2.73)	(-0.13)	(-0.90)	(-1.73)	(1.38)	(-0.89)	(1.34)	(0.04)	(0.67)		
Malaysia	0.42	0.00	0.01	-0.06	0.03	-0.39**	0.36*	0.02	0.05	-0.01	0.05	207	0.110
	(1.32)	(0.02)	(0.36)	(-0.57)	(0.52)	(-2.93)	(2.40)	(1.16)	(1.61)	(-0.09)	(0.17)		
Mexico	0.54***	-0.06	0.00	-0.02	0.11***	-0.11	0.16	0.01	0.02	0.03	-0.11	271	0.370
	(5.26)	(-1.13)	(0.05)	(-0.22)	(3.44)	(-1.44)	(1.75)	(1.10)	(1.17)	(0.37)	(-0.62)		
Peru	0.04	-0.12**	0.06*	-0.05	0.09*	0.02	0.05	-0.00	0.02	0.01	-0.07	145	0.411
	(0.32)	(-3.28)	(2.36)	(-0.50)	(2.30)	(0.16)	(0.46)	(-0.23)	(0.65)	(0.09)	(-0.23)		
Poland	0.21**	-0.09*	0.02	0.01	-0.05	-0.18	0.39***	-0.01	0.03	-0.17	0.26	271	0.255
	(2.60)	(-2.30)	(1.93)	(0.15)	(-1.39)	(-1.93)	(3.55)	(-0.61)	(1.34)	(-1.91)	(1.23)		
Russia	0.04	0.08	0.12***	-0.29	-0.00	-0.08	0.07	-0.07*	-0.01	0.09	0.03	232	0.108
	(0.27)	(1.42)	(3.91)	(-1.64)	(-0.06)	(-0.42)	(0.32)	(-2.49)	(-0.24)	(0.50)	(0.08)		
S. Africa	0.43***	0.06	0.03*	0.03	0.08*	-0.12	0.07	0.02	0.01	-0.09	0.08	271	0.335
	(6.75)	(1.35)	(2.13)	(0.45)	(2.43)	(-1.59)	(0.77)	(1.44)	(0.58)	(-1.31)	(0.49)		
Thailand	-0.04	-0.04	-0.01	-0.51***	0.12*	-0.43**	0.34*	-0.03	0.06*	-0.11	0.26	271	0.142
	(-0.17)	(-0.65)	(-0.33)	(-3.89)	(2.09)	(-3.14)	(2.11)	(-1.29)	(1.99)	(-0.83)	(0.81)		
Turkey	0.54***	-0.08	0.09***	0.34***	0.05	0.16	-0.02	0.03*	-0.03	-0.10	-0.05	269	0.565
	(5.84)	(-1.87)	(3.35)	(3.56)	(1.24)	(1.58)	(-0.17)	(2.21)	(-1.19)	(-1.05)	(-0.21)		

Robust t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: JP Morgan, Merrill Lynch, Barclays Capital, Datastream

Table 10: **Regressions of the Determinants of Dollar-Denominated Bond Yields.** This table reports the regression results of weekly percentage change in the yields of EMBI Global bond indices on the weekly changes of: the expected depreciation rate of exchange rates versus US Dollar, Credit Default Swap premium, Local Equity Market Index (MSCI), S&P500 total return, yields of 5 year Us Treasury Bonds, US corporate High Yield and Investment Grade bond Indices by Barclays Capital, CBOE Volatility index of options written on S&P500, changes in yield spread between BB and BBB rated US corporate bonds, the spread between three month Libor and T-bill rate (TED).

	Local Variables			Global Financial Market				Global Risk Premia					
	Exp. Exch.	Equity	CDS	US Equity	US Treasury	HY	us IG	VIX	BB-BBB	TED	α	Obs	R-sqrd
Argentina	0.17*	-0.13	0.00	-0.08	0.02	0.59*	-0.35	0.02	0.04	0.17	-0.58	271	0.168
	(2.22)	(-1.59)	(0.66)	(-0.30)	(0.15)	(2.30)	(-1.12)	(0.60)	(0.74)	(0.67)	(-0.96)		
Brazil	0.07	-0.10**	0.05***	0.02	0.08**	0.26***	0.18*	0.02	-0.02	-0.10	0.01	271	0.574
	(0.93)	(-2.85)	(6.85)	(0.29)	(2.76)	(3.74)	(2.19)	(1.51)	(-1.26)	(-1.46)	(0.05)		
Chile	0.16*	0.05	0.00	-0.04	0.19***	0.07	0.50***	0.01	-0.02	-0.04	0.03	271	0.642
	(2.19)	(1.26)	(0.06)	(-0.72)	(6.84)	(1.12)	(6.63)	(1.44)	(-1.64)	(-0.66)	(0.22)		
China	-0.09	-0.05	-0.02	0.02	0.26***	0.08	0.51***	0.00	-0.01	-0.09	0.10	271	0.630
	(-0.81)	(-1.76)	(-1.48)	(0.30)	(8.03)	(0.99)	(5.66)	(0.27)	(-0.32)	(-1.29)	(0.57)		
Colombia	-0.02	-0.08**	0.14***	-0.17*	0.10**	0.11	0.28**	-0.01	0.02	-0.06	0.01	271	0.633
	(-0.31)	(-2.79)	(9.46)	(-2.46)	(3.24)	(1.38)	(3.09)	(-0.72)	(1.01)	(-0.83)	(0.07)		
Egypt	-0.28	0.18	-0.03	0.22	-0.01	0.48	0.24	-0.04	0.03	0.35	-1.74	117	0.206
	(-0.86)	(1.97)	(-0.65)	(0.99)	(-0.13)	(1.88)	(0.82)	(-0.76)	(0.39)	(1.02)	(-1.68)		
Hungary	0.11	-0.22*	0.05	0.11	-0.12	-0.60*	1.54***	-0.04	0.05	0.13	0.21	271	0.269
	(0.58)	(-2.42)	(1.39)	(0.49)	(-1.26)	(-2.56)	(5.74)	(-1.20)	(0.86)	(0.61)	(0.40)		
Indonesia	0.12	-0.09*	0.20***	-0.26**	0.09*	0.02	0.26*	-0.01	0.04	-0.07	0.14	249	0.650
	(1.09)	(-2.35)	(9.43)	(-2.85)	(2.30)	(0.20)	(2.23)	(-0.88)	(1.83)	(-0.74)	(0.62)		
Malaysia	-0.48	-0.25**	0.03*	0.23*	0.32***	0.29*	0.22	0.03	-0.05	0.09	-0.22	207	0.552
	(-1.69)	(-3.22)	(2.05)	(2.30)	(7.22)	(2.41)	(1.66)	(1.95)	(-1.52)	(0.91)	(-0.89)		
Mexico	0.28**	-0.05	0.08***	-0.15*	-0.01	-0.16*	0.63***	-0.01	-0.01	-0.10	0.14	271	0.602
	(3.12)	(-1.22)	(6.38)	(-2.04)	(-0.31)	(-2.33)	(8.13)	(-1.25)	(-0.53)	(-1.65)	(0.89)		
Peru	-0.10***	-0.04	0.13***	-0.03	0.09**	0.15*	0.28**	-0.00	0.00	-0.06	-0.04	271	0.590
	(-3.80)	(-1.37)	(9.37)	(-0.45)	(2.93)	(1.99)	(3.13)	(-0.01)	(0.18)	(-0.80)	(-0.24)		
Poland	0.16	-0.03	-0.01	0.08	0.14***	-0.08	0.90***	-0.01	-0.00	0.01	-0.04	271	0.564
	(1.93)	(-0.69)	(-1.01)	(0.78)	(3.47)	(-0.80)	(7.87)	(-0.63)	(-0.02)	(0.10)	(-0.18)		
Russia	0.29***	-0.07**	0.15***	0.17*	-0.05	0.04	0.57***	0.02	-0.02	-0.09	0.03	265	0.647
	(3.62)	(-2.66)	(10.36)	(1.98)	(-1.22)	(0.45)	(5.38)	(1.39)	(-1.00)	(-1.07)	(0.15)		
S. Africa	0.15*	-0.02	0.10***	0.10	0.08*	0.20*	0.45***	0.02	-0.02	-0.00	-0.09	271	0.529
	(2.03)	(-0.34)	(6.05)	(1.05)	(2.20)	(2.22)	(4.30)	(1.18)	(-0.98)	(-0.05)	(-0.43)		
Thailand	1.22	-0.17	0.39	1.10	1.42	-0.16	-1.21	-0.10	-0.02	1.33	-3.30	101	0.141
	(0.64)	(-0.37)	(1.82)	(0.78)	(1.28)	(-0.20)	(-0.76)	(-0.48)	(-0.13)	(1.50)	(-1.64)		
Turkey	0.06	-0.06	0.20***	0.12	0.09*	0.14	0.23*	0.01	0.02	-0.07	0.00	269	0.631
	(0.77)	(-1.64)	(8.28)	(1.42)	(2.31)	(1.56)	(2.23)	(0.86)	(1.02)	(-0.79)	(0.01)		

Robust t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: JP Morgan, Merryl Lynch,Barclays Capital, Datastream

Table 11: **Descriptive Statistics for Excess Returns of Local Currency Bond Indices.** This table reports the summary statistics for monthly excess returns of local currency JP Morgan Gbi-Em Broad Bond Indices (converted to US Dollars) for individual and clustered emerging market sovereigns.

	Mean	Std Dev	Ex Ret /Std Dev	Minimum	Maximum	Obs.
Argentina	0.07	19.33	0.004	-56.84	52.04	24
Brazil	1.35	7.07	0.191	-26.44	28.11	90
Chile	0.88	3.79	0.232	-16.61	8.85	80
China	0.46	1.34	0.343	-5.19	3.78	66
Colombia	1.33	5.24	0.254	-12.37	16.24	78
Egypt	0.45	4.57	0.098	-10.25	8.82	20
Hungary	0.92	5.96	0.154	-22.07	16.31	90
Indonesia	1.03	7.21	0.143	-29.03	33.25	78
Malaysia	0.21	1.77	0.119	-5.22	6.65	90
Mexico	0.31	3.58	0.087	-14.40	12.85	90
Peru	0.85	5.21	0.163	-10.19	16.22	33
Poland	0.77	4.60	0.167	-15.46	9.54	90
Russia	0.12	4.00	0.030	-17.09	13.36	53
S. Africa	1.36	6.58	0.207	-16.37	15.99	90
Thailand	0.57	2.74	0.208	-6.80	9.42	90
Turkey	1.27	6.36	0.200	-22.42	13.13	63
Gbi Composite	0.82	2.52	0.325	-7.60	8.42	90
Gbi Europe	0.93	4.47	0.208	-16.96	10.06	90
Gbi L.America	0.79	3.88	0.204	-15.07	11.21	90
Gbi Mid E/Africa	1.33	6.44	0.207	-15.99	28.04	90
Gbi Asia	0.53	1.56	0.340	-3.48	8.16	90

Source: JP Morgan, Thomson Financial Datastream

Table 12: **Descriptive Statistics for Excess Returns of US Dollar Denominated Bond Indices.** This table reports the summary statistics and Sharpe Ratios for monthly excess returns of JP Morgan Embi Global Bond Indices (converted to US Dollars) for individual and clustered emerging market sovereigns.

	Mean	Std Dev	Ex Ret/Std Dev	Minimum	Maximum	Obs.
Argentina	0.49	9.24	0.053	-43.99	33.80	90
Brazil	1.18	6.15	0.192	-19.29	26.62	90
Chile	0.42	2.12	0.198	-8.05	6.37	90
China	0.35	2.20	0.159	-9.53	13.03	90
Colombia	0.76	3.58	0.212	-12.62	12.10	90
Egypt	0.49	1.25	0.392	-2.81	3.79	90
Hungary	0.16	2.90	0.055	-19.69	9.91	90
Indonesia	0.67	4.89	0.137	-21.81	20.43	61
Malaysia	0.46	2.41	0.191	-13.15	8.39	90
Mexico	0.49	2.44	0.201	-8.75	10.80	90
Peru	0.73	3.57	0.204	-14.73	9.72	90
Poland	0.35	2.15	0.163	-10.70	7.06	90
Russia	0.81	3.22	0.252	-13.29	7.24	90
S. Africa	0.51	2.61	0.195	-14.28	9.31	90
Thailand	0.07	0.87	0.080	-2.38	3.05	90
Turkey	0.88	4.39	0.200	-16.22	12.19	90
Embi Composite	0.67	2.93	0.229	-14.23	7.78	90
Embi Europe	0.75	3.17	0.237	-15.88	8.60	90
Embi L. America	0.69	3.44	0.201	-14.05	8.72	90
Embi Mid E/Africa	0.73	2.44	0.299	-12.81	6.48	90
Embi Asia	0.54	2.34	0.231	-12.27	8.06	90

Source: JP Morgan, Thomson Financial Datastream

Table 13: **Regressions of Excess Returns of Gbi-Em Local Currency Bond Indices on Global Risk Factors.** This table reports the regression results of Sharpe style excess returns for sovereign local currency bond indices (converted to US Dollars) on the three Fama-French Factors, and the excess returns on: five-year US Treasury bonds, US corporate investment grade and high-yield bond indices by Barclays Capital.

	Mkt-Rf	SMB	HML	Treasury	HY	IG	α	N	Adj R.sqrd
Argentina	-1.72*	-2.28	1.65	-4.81	0.43	6.99***	0.14	23	0.509
	(-2.53)	(-1.02)	(1.30)	(-1.19)	(0.37)	(3.47)	(0.03)		
Brazil	0.73**	-0.40	-0.04	-0.40	0.10	0.65	1.45*	89	0.314
	(2.92)	(-1.11)	(-0.15)	(-0.55)	(0.28)	(1.08)	(2.50)		
Chile	0.18	-0.06	-0.28	0.34	0.29	0.27	0.57	79	0.220
	(1.16)	(-0.30)	(-1.55)	(0.57)	(1.33)	(0.52)	(1.46)		
China	-0.00	0.19*	0.07	0.24	-0.13*	0.06	0.41*	65	0.147
	(-0.02)	(2.22)	(1.22)	(1.04)	(-2.06)	(0.42)	(2.37)		
Colombia	0.55**	-0.19	0.22	-0.95	-0.40	1.54*	1.30**	77	0.425
	(2.91)	(-0.74)	(0.87)	(-1.44)	(-1.23)	(2.43)	(2.73)		
Egypt	0.16	-0.24	-0.34	-0.22	-0.16	1.15***	0.37	19	0.774
	(1.42)	(-0.87)	(-1.89)	(-0.52)	(-0.76)	(4.08)	(0.68)		
Hungary	0.45*	0.07	0.67**	-0.60	-0.54	1.97***	0.54	89	0.416
	(2.35)	(0.38)	(2.68)	(-1.06)	(-1.40)	(4.23)	(1.10)		
Indonesia	0.14	0.42	0.39	-0.12	0.56	1.22	0.36	77	0.425
	(0.51)	(1.12)	(1.54)	(-0.14)	(1.25)	(1.56)	(0.58)		
Malaysia	0.12*	-0.02	0.10	0.18	-0.04	0.19	0.13	89	0.139
	(2.01)	(-0.20)	(1.36)	(0.73)	(-0.28)	(0.97)	(0.76)		
Mexico	0.51***	-0.21	0.13	0.97*	0.35*	-0.36	0.07	89	0.513
	(5.57)	(-1.78)	(1.14)	(2.32)	(2.17)	(-1.07)	(0.29)		
Peru	0.46*	0.22	-0.13	1.27	0.10	0.22	0.67	32	0.306
	(2.03)	(0.40)	(-0.35)	(1.56)	(0.18)	(0.23)	(0.76)		
Poland	0.55***	0.03	0.48**	0.49	-0.19	0.43	0.47	89	0.367
	(4.14)	(0.20)	(2.99)	(1.11)	(-0.75)	(1.11)	(1.18)		
S. Africa	0.33	0.35	0.16	-0.02	0.10	1.01*	0.91	89	0.234
	(1.28)	(1.04)	(0.51)	(-0.04)	(0.22)	(2.07)	(1.52)		
Thailand	0.18*	0.12	0.20*	1.22***	0.11	-0.28	0.18	89	0.278
	(2.39)	(1.04)	(2.36)	(3.97)	(0.82)	(-1.22)	(0.78)		
Turkey	0.60**	0.31	0.10	-0.27	-0.45	1.70***	1.32*	62	0.422
	(2.66)	(0.81)	(0.32)	(-0.45)	(-1.53)	(3.47)	(2.15)		
Gbi Comp.	0.26***	0.10	0.13	0.50*	0.11	0.23	0.54**	89	0.524
	(3.31)	(0.92)	(1.40)	(2.38)	(0.83)	(1.56)	(3.16)		

Robust t statistics in parentheses

Source: K.R. French, JP Morgan, Barclays Capital, Merrill Lynch, Datastream

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 14: **Regression Excess Returns of Embi Global Sovereign Bond Indices on Global Risk Factors.** This table reports the regression results of Sharpe style excess returns for sovereign US Dollar denominated bond indices on the three Fama-French Factors, and the excess returns on: five-year US Treasury bonds, US corporate investment grade and high-yield bond indices by Barclays Capital.

	Mkt-Rf	SMB	HML	Treasury	HY	IG	α	N	Adj. R.sqrd
Argentina	0.27*	-2.28	1.65	-4.81	0.43	6.99***	0.14	89	0.533
	(0.21)	(-1.02)	(1.30)	(-1.19)	(0.37)	(3.47)	(0.03)		
Brazil	0.66*	-0.44	-0.22	0.96	0.41	-0.08	1.04	89	0.294
	(2.49)	(-1.35)	(-0.69)	(1.29)	(1.00)	(-0.12)	(1.81)		
Chile	0.13	-0.01	0.06	0.45	-0.18	0.73**	0.17	89	0.686
	(1.68)	(-0.23)	(0.59)	(1.67)	(-1.28)	(3.23)	(1.26)		
China	0.02	0.06	-0.00	0.04	-0.34	1.19***	0.17	89	0.789
	(0.40)	(1.63)	(-0.05)	(0.18)	(-1.75)	(3.30)	(1.30)		
Colombia	0.37*	0.07	-0.08	0.11	-0.02	0.79**	0.56	89	0.505
	(2.50)	(0.49)	(-0.44)	(0.29)	(-0.11)	(2.73)	(1.80)		
Egypt	0.00	-0.02	-0.10	0.36***	0.17*	0.12	0.35**	89	0.449
	(0.06)	(-0.33)	(-1.83)	(3.35)	(2.36)	(1.06)	(3.23)		
Hungary	0.00	-0.07	0.05	-0.59	-0.23	1.44*	0.11	89	0.479
	(0.02)	(-0.75)	(0.34)	(-1.17)	(-0.93)	(2.45)	(0.45)		
Indonesia	0.14	0.30	0.22	0.59	0.61**	0.80***	0.30	60	0.796
	(0.99)	(1.54)	(1.73)	(1.41)	(2.90)	(3.34)	(1.10)		
Malaysia	0.04	0.03	0.08	0.30	-0.13	1.06***	0.13	89	0.844
	(1.34)	(1.11)	(1.50)	(1.30)	(-1.34)	(3.73)	(1.17)		
Mexico	0.14*	-0.06	0.08	0.58**	0.16	0.54**	0.17	89	0.769
	(2.11)	(-0.83)	(0.97)	(3.01)	(1.36)	(3.11)	(1.40)		
Peru	0.19	0.01	-0.11	-0.24	0.09	1.06**	0.55	89	0.538
	(1.75)	(0.08)	(-0.84)	(-0.63)	(0.48)	(3.05)	(1.87)		
Poland	0.06	-0.04	-0.01	0.39	-0.09	0.82**	0.12	89	0.769
	(1.65)	(-0.89)	(-0.12)	(1.83)	(-1.06)	(3.22)	(1.04)		
S. Africa	-0.04	0.11*	-0.09	0.03	0.08	1.11***	0.19	89	0.793
	(-0.94)	(2.04)	(-1.38)	(0.15)	(0.93)	(5.00)	(1.41)		
Thailand	-0.003	0.04	0.04	0.78***	-0.002	-0.15	0.19	51	0.863
	(-0.16)	(1.27)	(1.48)	(6.04)	(-0.01)	(-1.01)	(3.11)		
Turkey	0.43***	0.01	-0.05	0.55	0.18	0.62	0.55	89	0.482
	(4.02)	(0.06)	(-0.31)	(1.29)	(0.50)	(1.20)	(1.48)		
Embi Glob.	0.26***	-0.10	-0.01	0.43*	0.26***	0.58***	0.38*	89	0.818
	(4.28)	(-1.50)	(-0.16)	(2.53)	(3.57)	(4.62)	(2.44)		

Robust t statistics in parentheses

Source: K.R. French, JP Morgan,Barclays Capital, Merrill Lynch, Datastream

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 1: Maturity of Domestic Central Government Debt Outstanding in Years.

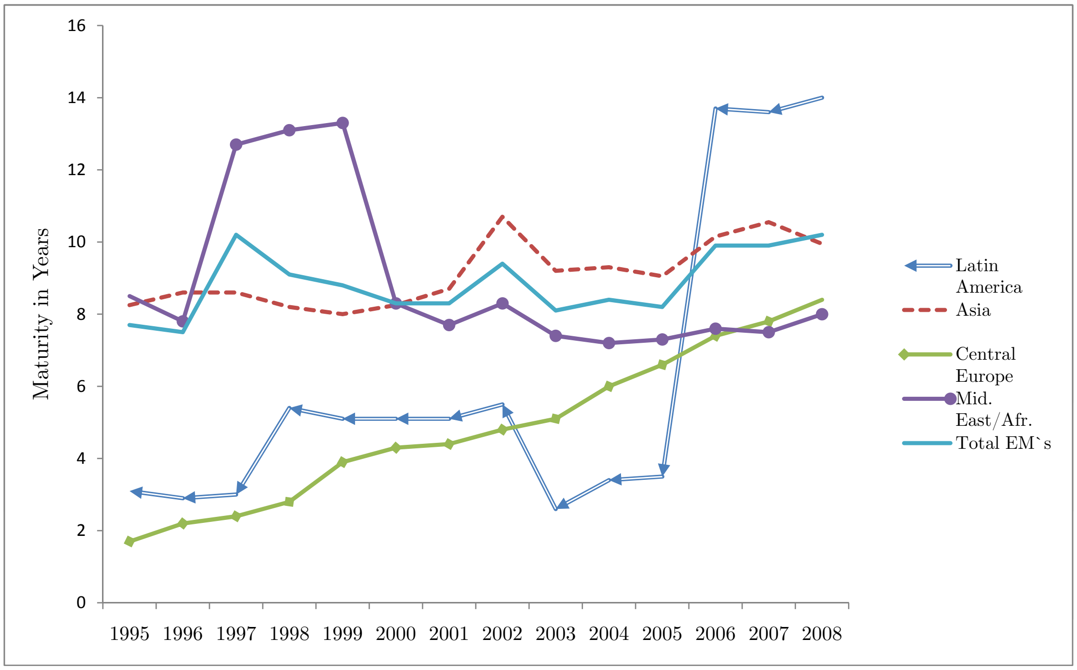


Figure 2: Market Value of Emerging Market Sovereign Local Currency and US Dollar Denominated Bond Markets.

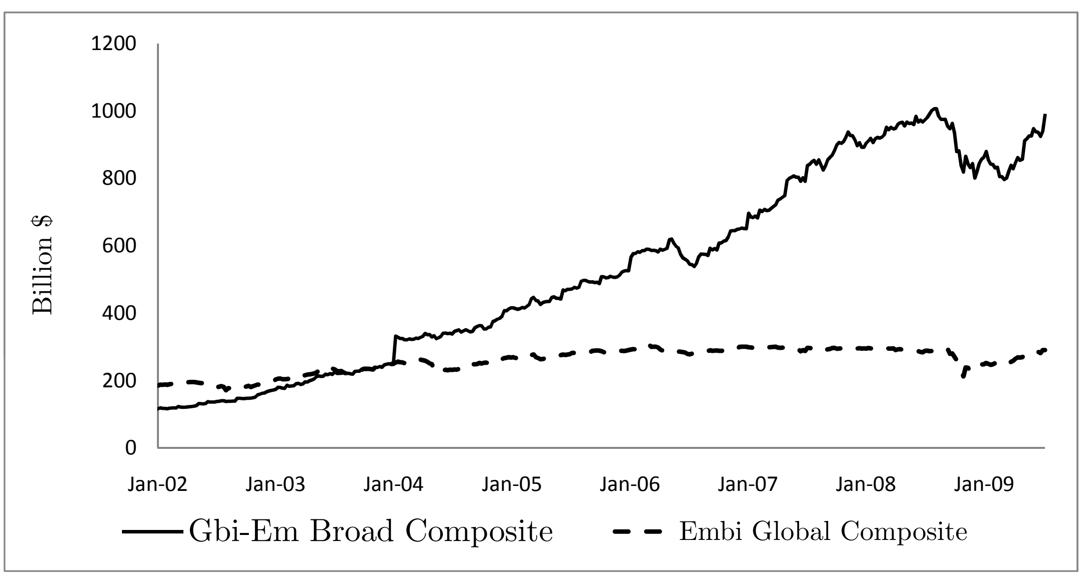


Figure 3: European EM Sovereign Bond Market

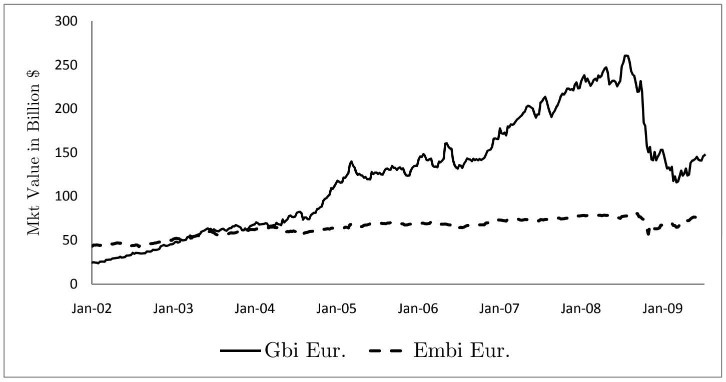


Figure 4: L. American EM Sovereign Bond Market

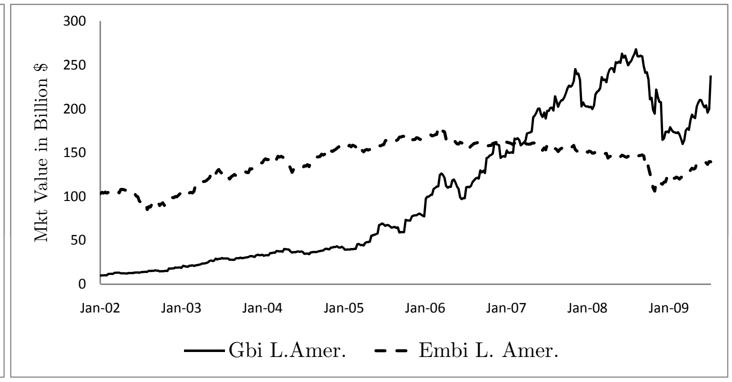


Figure 5: Asian EM Sovereign Bond Market

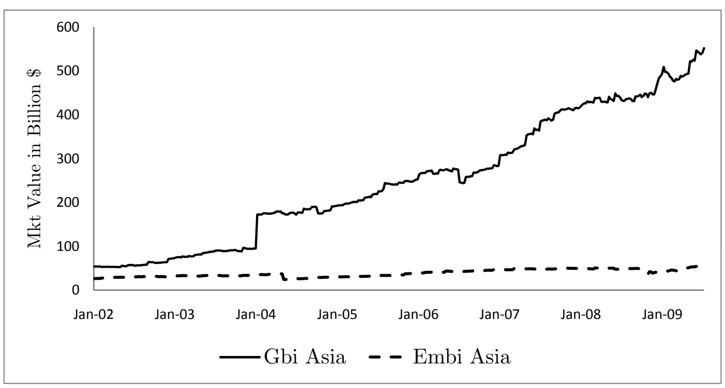


Figure 6: M. East and African EM Bond Market

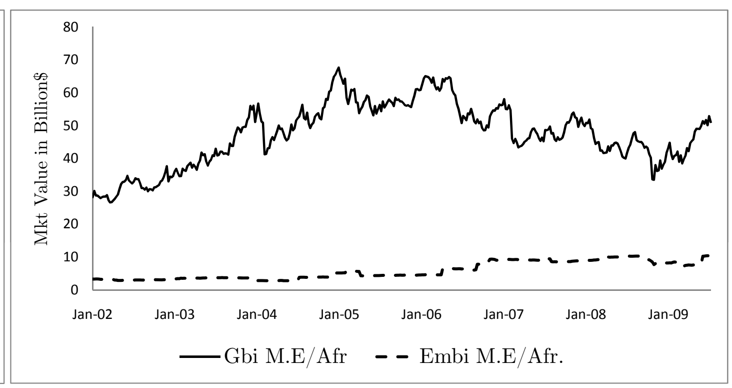


Figure 7: **Sharpe Ratios of Various Investment Classes for the Period 2002-2009** This figure illustrates the Sharpe Ratios calculated as the ratio of excess returns over the whole period of 2002-2009 to standard deviation of the excess returns.

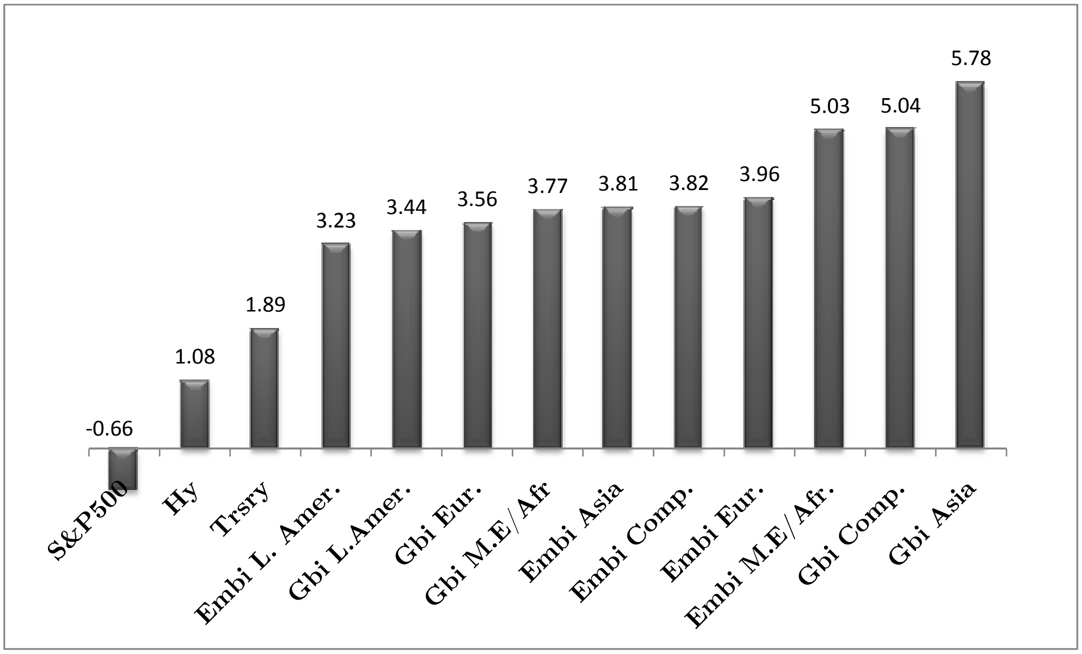
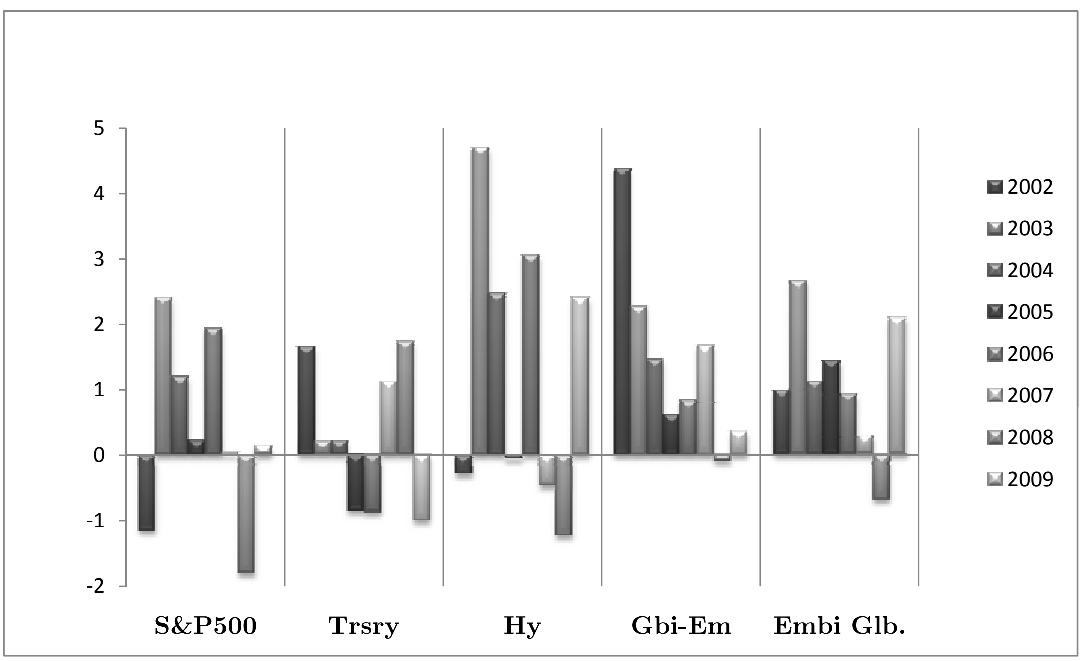


Figure 8: **Annual Sharpe Ratios from 2002 to 2009** This figure illustrates the annual Sharpe Ratios calculated as the ratio of annual excess returns between 2002-2009 to annualized standard deviation of the excess returns.



Dynamic Sources of Sovereign Bond Market Liquidity*

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Abstract

Using 482 US Dollar and Euro denominated bonds issued by 72 sovereigns, we examine the dynamic sources of time-series and cross-sectional variations in *market-wide liquidity* of sovereign bonds as a novelty in the sovereign fixed income literature. Vector autoregression analysis shows that macroeconomic fundamentals and the financial market variables play a substantial role in the movements of aggregate liquidity throughout the whole sample period (1999-2010), although their effects are stronger during the financial crisis. Specifically, US industrial production growth rate and inflation rate have significant informative powers on the sovereign bond market liquidity. An increasing shock to the TED spread (the spread between 3-Month Libor and US T-bill), a measure of distrust in the banking system, has detrimental impact, while on the other side equity market performance is positively linked to market-wide bond liquidity. Furthermore, the direction of causality from the world financial and macroeconomic variables towards the aggregate bond market liquidity is confirmed by Granger causality tests. Finally, impulse response functions show that these relationships are persistent up to one-year forecast horizon.

JEL Classifications: G10,G15, E4, E44

Keywords Sovereign Bond Market, Liquidity, Financial Markets

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Contents

1 Introduction

Recent studies on the sovereign and corporate bond markets show that a sizable component of bond yield spreads is due to factors other than default risk (Chen, Lesmond, and Wei (2007), Collin-Dufresne and Martin (2001), Huang and Huang (2003), Kucuk (2010)). Liquidity, the ability of investors to buy or sell large quantities of securities quickly at low cost and without substantially influencing the price, is found to be essential in explaining the variations in yield spreads across different bonds (Kucuk (2010), Ferrucci (2003), Duffie, Pedersen, and Singleton (2003), and Beber, Brandt, and Kavajecz (2006)). Although, there is extensive research on the relationship between the liquidity and the yield spreads of corporate bonds, researchers have done little to explain the sources of time series variation in the bond market liquidity. To fill this gap therefore, this paper analyzes the sources of time-series and cross-section variation in aggregate sovereign bond market liquidity.

The studies by Chordia, Roll, and Subrahmanyam (2000) and Chordia, Roll, and Subrahmanyam (2001) identified the concept of *liquidity commonality*. Their results have introduced the research on the effects of market-wide liquidity. Indeed, Pastor and Stambaugh (2003) investigate whether market-wide liquidity is an important state variable for asset pricing and find that expected stock returns are related cross-sectionally to the sensitivities of returns to fluctuations in aggregate liquidity. As an attempt to determine the sources of liquidity, Fujimoto (2004) using a long time-span data set finds that macroeconomic sources play important role in determining the the time-series variation in the US stock market liquidity. Studies including Chordia (2005) and Goyenko and Ukhov (2009) go one step further to analyze the joint dynamics of US stock and US Treasury bond market liquidity.

In this paper, we examine the sources of time-series and cross-sectional variation in the aggregate liquidity of sovereign bond market by analyzing the joint dynamics of world financial and macroeconomic variables and aggregate bond liquidity. Our research has a number of significant contributions to both sovereign debt literature and to the literature on the aggregate bond market liquidity. First, to the best of our knowledge, this work is the first attempt to identify the sources of aggregate liquidity in the sovereign bond market.

Second, we investigate the time-series link between aggregate sovereign bond market liquidity, the financial market variables and the macroeconomic fundamentals by employing vector autoregression (VAR) analysis. VAR results reveal that macroeconomic fundamentals play a substantial role in the movements of liquidity throughout the whole sample period while their effects are stronger during the financial crisis, i.e. 2006 to 2010. We find that US industrial production growth and inflation rates are positively associated with the aggregate bond market liquidity. Positive relationship between the inflation rate and market-wide liquidity could be due to the fact that inflation reflects the demand side of the economy and an increase in the inflation would be a sign of improving demand and thus recovery during recessions. Similarly, the market variables, TED spread (3-Month Libor - T-bill Spread) and equity market performance have bigger impacts on bond liquidity during the current crisis.

Third, we exploit the Granger causality tests in order to test the direction of causality. Further, we use impulse response functions to quantify the persistence of the effects of the macroeconomic and the financial market variables on the aggregate bond liquidity. The findings of this section confirm the VAR results that the innovations in industrial production, equity market performance and TED spread are particularly important during the period of 2006 to 2010.

Fourth, variance decomposition results reveal that sovereign bond market liquidity is more responsive to real sector and financial market shocks than the monetary shocks. This is a striking result as it has been documented that the US Federal Reserve, through its ability of changing the money supply, significantly influences the trading of T-bills (Harvey and Huang (2001)). In our case however, 81% of the variance in the bond liquidity measured as bid-ask spread is explained by US industrial production growth rate, TED spread and S&P500 performance index.[1]

We further analyze the cross-section determinants of the bond market liquidity across all the eligible bonds 72 sovereigns traded during 1999 to 2010. We use balanced panel regressions of bond liquidity variables on bond specific variables, the financial market and the macroeconomic variables. While an expansionary monetary policy by the FED turns out to be positively related to the sovereign bond liquidity, the episodes of distrust among the banking system, i.e. a substantial increase in Libor and a decrease in T-bill yields, are negatively associated with the bond liquidity. Contrary to our VAR analysis in the previous sections, in general, the panel regression results are robust to estimating the regression with different sub-sample time periods.

The rest of this paper is organized as follows. Section II describes our bond data, the financial market indicators and macroeconomic fundamentals used in our analysis. Section III presents our bond liquidity measures and their summary statistics. Section IV introduces our VAR model and its results together with the results of the Granger causality tests, variance decompositions and impulse response functions. Section V presents our panel regressions of bond liquidity on bond specific variables, the market and the macroeconomic variables. Finally , Section VI concludes.

[1] This is the result of variance decomposition analysis with *one-year forecast horizon*.

2 Data

2.1 Bond Sample

Our sample uses 482 internationally traded bonds, which were issued by 72 sovereigns. We include all of the US Dollar and Euro denominated sovereign bonds, for which the price, bid-ask and transaction volume data are available by the ISMA via Thomson Financial Datastream. By using the data from January 1999 to December 2009, a maximum of 132 monthly data points is reached to use in our vector autoregression analysis.

Table 1 presents the bond sample used in our analysis. The first column is the name of the borrower country, the second column is the number of its bonds, third column is the total issued amount of its bonds in our sample and the last column is the borrower country's long term rating by Moody‘s as of December 2009. For countries whose Moody‘s rating is not available we use the corresponding long term borrower rating from Standard and Poor‘s. Number of bonds per country varies from a minimum of one [2] to a maximum of 33 by Austria with an average of 6.8 bond per country. Moody‘s long term ratings vary from C to Aaa with median rating of Baa1.

Table 2 presents the summary statistics of internationally traded bonds of the sovereigns listed in Table 1. Rating variable is a number given to letter rating of Moody‘s Long Term Sovereign Debt Rating. Rating number 5 is given to the lowest rating C and the number 25 is given to the highest rating AAA.

[2]There is only one internationally traded bond for countries Abu Dhabi, Australia, Fiji Islands, Finland, France, Georgia, Ghana, Hong Kong, Iraq, Ireland, Luxembourg, Macedonia, Malaysia, Morocco, New Zealand, Serbia and Thailand.

2.2 Financial Market and Macroeconomic Variables

We employ commonly agreed financial and macroeconomic variables as candidates for the sources of market-wide sovereign bond liquidity movements. Below, we provide short explanations of the candidate variables used in our empirical analysis.

- *Libor-OIS Spread*: The Libor-Overnight Index Swap spread is the difference between the 3-month Libor(what banks pay to borrow US Dollars) and 3-month overnight index swap rate. It is commensurate with the amount of perceived credit and liquidity risk in the interbank lending market. Mainly during the crisis periods, when banks are unsure of the creditworthiness of other banks, they charge higher interest rates to compensate them for the greater risk.

We expect to see a negative relationship between Libor-OIS spread market-wide bond liquidity. The reasoning is the following. During the periods of distress, the interbank lending market declines as interbank lending interest rate, Libor, increases. Then banks are forced to hold more cash to conduct business; as a result, they lend less, not only to other banks, but also to consumers. Less lending means there is less money in the economy, which we think might hamper the bond market liquidity. Figure 2 depicts the relationship between bond Bid-Ask and Libor-OIS spreads from 2004 to 2009.

- *TED Spread*: The TED spread is the difference of interest rates paid on 3-month United States Treasury bills (T-bills) and the 3-month Libor for the United States dollar. The TED spread generally indicates confidence in the banking system, i.e. a narrow spread indicates confidence while a wide spread indicates generalized fear, and usually results from a flight to quality. We expect to see a negative relationship between the TED spread and bond market liquidity as in the case of Libor-OIS spread, following the same reasoning.

- *Cboe Volatility Index*: Cboe VIX is the Chicago Board Options Exchange Volatility Index, a popular measure of the implied volatility of S&P 500 index options. It measures the implied volatility, rather than the historical volatility, of the S&P 500 index. A high value corresponds to a more volatile market and therefore more costly options, which can be used to defray risk from this volatility by selling options. Often referred to as the fear index, it represents one measure of the market's expectation of volatility over the next 30 day period.

Market volatility is an important measure of market sentiment, as market volatility is the amount that prices of an index or security at a particular time deviates from the mean price as measured over a specified time period. The greater the volatility, the greater the anxiousness of the traders, and traders feel more anxious when the market is declining or at the bottom than when it is rising. Therefore, market volatility measured by Cboe VIX index is expected to be negatively associated with bond market liquidity. Figure 3, presents a snapshot of Cboe Volatility index with bond market price volatility during 1999 to 2009. It is clear to see the high correlation between the bond market and equity market volatilities.

- *US Money Supply and FED Funds Rate*: The recent search for an appropriate way to measure the impact of monetary policy has followed two paths: interest rates and monetary aggregates. Therefore, as indicators of the monetary policy stance, we include the US Fed Funds rate (FED) and money supply M1 following Bernanke and Blinder (1992), Harvey and Huang (2001), and Goyenko and Ukhov (2009)

A loose monetary policy usually implies an increase in liquidity via the decrease of credit constraints. Harvey and Huang (2001) showed that the Federal Reserve, through its ability of changing the money supply, impacts the trading of bonds and currencies. If we consider money supply as an exogenous variable, an expansionary policy should have a positive impact on the bond market liquidity. So, one can expect a positive relationship between the bond liquidity and the money supply growth. On the other hand, during the crisis periods Federal Reserve might intervene to the financial markets by injecting liquidity into the system when there is a liquidity problem. We suggest that the relationship between the bond market liquidity and the money supply growth should be interpreted differently during normal and distressed periods. Therefore, while we expect to see a positive relationship between the money supply and bond liquidity during normal times, a contrary sign should not be surprising during the crisis periods.

- *Industrial Production and Consumer Price Indices*: We use the growth rate of US industrial production (IP) and US inflation (the growth rate of the consumer price index, CPI) as macroeconomic variables. While during normal times there is no direct relationship between the bond market liquidity and these macroeconomic variables, during crisis periods their relevance is accepted to be increased dramatically. A higher-than-expected IP growth rate during a time of economic downturn could trigger the purchase of equities on the hope of a recovery. On the other hand, during an expansionary period, a higher-than-expected IP growth rate could cause inflationary fears. Therefore, in the current crisis period it is natural to expect to see a positive relationship between IP and CPI growth rate and the bond market liquidity.

3 Liquidity Measures

3.1 Bond Market Liquidity

Numerous previous papers use different direct and indirect measures of liquidity. Bid-Ask spreads, trade sizes, trade frequencies and trade volume are main examples of direct bond liquidity measures

(Houweling, Mentink, and Vorst (2003)). Bid-Ask spreads and trade volume are available in our data set. Additionally, inline with the literature, we construct two indirect measures of bond liquidity, i.e. price volatility and missing prices. Table 3 presents the summary statistics of the liquidity proxies used in our time series analysis of the liquidity of internationally traded sovereign bonds.

3.2 Bid-Ask Spread

Bid-Ask spread is our main liquidity estimate for the internationally traded sovereign bonds. The quoted percentage spread for a sovereign bond is computed as

$$Bid - Ask = 100 * \frac{Ask - Bid}{\frac{1}{2}(Ask + Bid)} \tag{1}$$

where Ask and Bid are quoted ask and bid prices for a particular day. We compute the monthly average of daily bid-ask spreads and finally we obtain the equally-weighted average across all the sovereign bonds traded in that particular month. Figure 1 presents the time series graph of bid-ask spread. Bid-ask spread peaks to a level of 2% at the end of 2001, then falls back to a mean around 1% until 2007. It peaks to its historical maximum of more than 3% in September 2008 , after which it gradually shows a tendency to return to 1% level.

In the next figure, we present the time series lines of bid-ask spread and Libor-OIS spread where the Libor-OIS spread is the difference between the 3-month Libor and the overnight index swap rate, which is associated with the amount of perceived credit and liquidity risk in the interbank lending market. This Figure depicts a clear relationship between Libor-OIS spread and bid-ask spread and that Libor-OIS spread precede the bid-ask spread through 2007 and 2009.

3.3 Bond Price Volatility

We consider *price volatility* as a measure of price uncertainty. When trading bonds, an important source of uncertainty is the predictability of bond prices. Hence, higher price volatility might be associated with higher Bid-Ask spread and higher illiquidity. It is computed as the equally-weighted standard deviation of bond price in a particular month across all the traded bonds of sovereigns. Note that, in our analysis, we consider price volatility both as a separate liquidity measure and a determinant of bid-ask spread for robustness checks.

Figure 3 presents the time series graph of bond price volatility together with Cboe Volatility Index.[3] It is clear in the graph that there is a significant positive correlation between the bond market and equity market volatilities, therefore, there is a negative relationship between the market-wide bond liquidity and equity market volatility. Moreover, equity market option volatility turns out to be preceding the bond market price volatility.

3.4 Missing Prices

As argued by Warga (1992) if the liquidity of a bond is sufficiently low, it might be the case that on some business days there is no trading activity on that bond. In our analysis, we consider as a missing price if the price in two consecutive days is the same. The ratio of missing prices to working days in a month is our measure of illiquidity for the particular bond in a given month (Houweling, Mentink, and Vorst (2003)). Then, as we do in other liquidity measures, we take the equally-weighted average of missing price ratios across all the bonds traded in that month. As the

[3]Cboe VIX is the Chicago Board Options Exchange Volatility Index, a popular measure of the implied volatility of S&P 500 index options. A high value corresponds to a more volatile market and therefore more costly options, which can be used to defray risk from this volatility by selling options. Often referred to as the fear index, it represents one measure of the market's expectation of volatility over the next 30 day period.

ratio missing prices increase we expect the liquidity of that bond to decrease.

3.5 Volume Traded

It is natural to think that volume traded of a given bond in a particular month is positively associated to the bond liquidity. Since this direct measure is available in our data set, we include it as our forth liquidity measure. However the relationship between the liquidity and volume traded should be taken with caveat. We find a big correlation between *volume traded* and *amount issued* of a particular bond. So, higher issue size bonds are traded the most. Then, one can check to see if turnover ratio (the ratio of volume traded to amount issued) does better than volume traded to proxy the bond liquidity. We check the correlations of volume traded and turnover ratio with other bond liquidity measures, i.e. bid-ask spread, price volatility and missing prices. Since the former measures are associated with the illiquidity in the bond market, one should expect to see a negative relationship between the trading variables and other measures. We loose this negative sign in the case of turnover ratio, which forces us to prefer volume traded over turnover ratio.

4 VAR Analysis with Macroeconomic Variables

We study how sovereign bond liquidity is intertemporarily related to world financial market and macroeconomic conditions. For instance, world-wide shocks such as unanticipated increase the Libor causes a decline interbank lending market. Then banks are forced to hold more cash to conduct business; as a result, they lend less, not only to other banks, but also to consumers. Less lending means there is less money in the economy, which we think might hamper the bond market liquidity. Similarly, factors such as unexpected industrial productivity declines and excessive inflationary pressures are likely to influence liquidity indirectly by inducing fund outflows, price declines and increased volatility for the stock and bond market. In our paper therefore, we analyze the impacts of world-wide shocks on sovereign bond market liquidity by testing if financial market indicators and macroeconomic factors are dynamically linked to market-wide liquidity of sovereign international bonds.

To study the intertemporal relationship between bond market liquidity, financial market and the macroeconomic variables, for each of our four bond liquidity measure, we estimate estimate seven variable VAR model consisted of US Industrial Production growth (IP), US Consumer Price Index growth (CPI), US Money Supply M1 growth (M1), FED funds rate (FED), S&P500 total return (Equity), TED Spread (TED) and finally a bond liquidity variable. Bond Liquidity variables are monthly averages of Bond Price Bid-Ask Spread, Price Volatility, Percentage of Missing Prices and Volume Transacted, respectively. It is estimated with two lag and a constant term according to AIC and BIC criteria and it uses 132 observations as monthly averages from January 1999 to December 2009. We consider the following VAR:

$$X_t = c + A_1 X_{t-1} + A_2 X_{t-2} + u_t \tag{2}$$

where X is a 7×1 vector that represents IP, CPI, M1, FED, Equity, TED and Bond Liquidity, i.e one of Bid-Ask Spread, Price Volatility, Missing Prices and Trade Volume. c is a 7×1 vector of constants, A_1 and A_2 are 7×7 matrices of parameters and u_t is assumed to be white noise; that is

$$E(u_t) = 0 \quad E(u_t u_t\prime) = \Sigma \quad \text{and,} \tag{3}$$

$$E(u_t u_s\prime) = 0 \; for \; t \neq s \tag{4}$$

where σ is the covariance matrix. Note that, VAR is a dynamic system of equations where the current value of each endogenous variable is regressed on the past values of itself and the other endogenous variables in the VAR. With the VAR model, we are able to observe causalities between the variables in the system and quantify the effects of shocks in each variable on itself and the others. We test the stationarity of our seven endogenous variables using the augmented Dickey-Fuller and Phillips-Perron unit root tests. According to our results, the null hypothesis of non-stationarity is rejected for all the variables.

4.1 VAR Results

Based on the conventional practice in the macroeconomic literature, the standardized economic series are ordered as follows: IP, CPI, M1 and FED are placed ahead of the market variables whose ordering is Equity, TED Spread and Bond Liquidity. From the resulting VAR table, we report only the equations explaining the bond liquidity to save from space. Table 7 presents the VAR table for the bond liquidity equations, namely Bid-Ask Spread, Price Volatility, Missing Prices and Volume Traded for the data between 1999 and 2010. Considering the impact of macroeconomic variables on bond liquidity, we see that the industrial production and inflation have negative and significant parameters explaining the liquidity measured by the bid-ask spread, which is our main liquidity measure. Therefore, a positive shock to industrial production has a significant positive affect on bond liquidity as expected, considering both the bid-ask spread and price volatility measures are associated with the **illiquidity** of the bond market. Negative sign of the parameter of inflation means that an inflationary shock is negatively associated with the bid-ask spread and thus positively related to bond liquidity. A possible explanation to this result could be the following. Since, inflation is positively associated with the aggregate demand of the economy, an increase in the inflation would be a sign of improving demand and thus a recovery during the crisis. Therefore, an increasing inflation news could result in an increase in the confidence in the overall financial market, which would lead to an improving market liquidity. On the other hand, we are unable to accept an impact of monetary variables, M1 and FED, on neither measure of bond liquidity at any level of confidence.

The financial market variables, S&P 500 growth rate and TED spread have significant parameters with expected signs. A positive performance of S&P 500, which can be thought indicator of overall confidence in the market, is negatively related to bid-ask spread and bond price volatility. Thus, it positively affects the bond market liquidity. Similarly, the negative sign in front of the parameter of TED spread was also expected as a thick TED spread (Libor-T-bill) indicates the distrust in the banking system. Therefore, a distrust in the banking system or in general in financial markets could significantly hamper the liquidity of international sovereign bond market.

4.2 Granger Causality Tests

We employ Granger causality tests in order to asses the direction of causality of VAR results in the previous section. Granger causality tests in Table 8 indicate that industrial production and inflation have informative power on bond liquidity measured as both bid-ask spread and price volatility. However, the reverse is not true, meaning we are unable to accept the hypothesis that the bond liquidity has significant informative power on industrial production and inflation. Moreover, we do not to observe any significant Granger-causal relationship between the monetary variables and the bond market liquidity. This result for sovereign international bonds is different than that of the US T-bills, as it has been documented that the Federal Reserve, through its ability of changing the money supply, significantly impacts the trading of T-bills (Harvey and Huang (2001)).

Table 8 also confirms that financial market variables, S&P500 growth and TED spread Granger-cause bond liquidity with 99% confidence level. We are unable to reject the hypothesis that bond liquidity does not Granger-cause Equity with 90% confidence level only in the case of bid-ask spread. Overall, Granger causality results suggest that there is a significant relationship between the bond liquidity, macroeconomic variables (IP and CPI) and financial market variables. Moreover, the direction of causality points towards bond market liquidity.

4.3 Variance Decompositions

In Table 9, we report the variance decompositions after VAR analysis of the sovereign bond market liquidity variables. Industrial production, equity market performance, and TED spread seem to play the most important roles in explaining the variance of bond liquidity. Indeed, in one-year horizon, while industrial production (IP) explains 31% of the variation in bond liquidity, equity market performance‘s (Equity) and TED spread‘s shares in explaining the variance is 29% and 21%. This is a striking result as 81% of the variance of bond liquidity measured as bid-ask spread is explained by IP, TED and Equity. We obtain similar results when we choose price volatility as our bond market liquidity proxy. In one-year horizon, IP, Equity and TED explain 21%, 22% and 44% of the variance in price volatility, respectively. Overall, these results are consistent with the view that macroeconomic variables explain an important part of the variation in market-wide liquidity

(Fujimoto (2004), Goyenko and Ukhov (2009)). Another important finding here is that sovereign bond market liquidity is more sensitive to real economy and financial market surprises than the monetary shocks.

4.4 Persistence of the Effects of Shocks to Liquidity: Impulse Response Functions

The results of the orthogonal impulse response functions (IRF), given in Figure 2, indicate that innovations in industrial production, equity market performance and TED spread are persistent in 12 month horizon. Figure 2 implies that an orthogonal positive unit standard deviation shock in IP decreases bid-ask spread (increases liquidity) by one standard deviation in 3 months and its effect remains continuously significant even 10 months after the shock. Similarly, a positive shock to TED spread, i.e. in case of a distrust among the banking sector, increases immediately the bid-ask spread, thus hampers the bond market liquidity, and its impact is persistent even 10 months after the shock. Shocks to FED and M1 have smaller but interesting effects on bond liquidity. A positive shock to money supply first increases the bid-ask spread, and then its effect becomes negative (increasing liquidity) after 2 months. When the FED funds rate increases, it has an immediate negative but small effect on the bond liquidity, which die out in a couple of months.

An inflationary shock decreases the bid-ask spread in the first 5 months horizon, increasing the bond liquidity. As explained in the previous sections, this could be due to the fact that an increasing inflation news is seen to be associated with increasing aggregate demand and thus a sign of recovery. Then after 5 months, the impact of inflationary shock changes its sign, thereafter an inflationary shock has a persistent damaging effect on sovereign bond market liquidity, which is what we expect to see in the middle and long run. As one might notice easily, the IRF graphs with price volatility as the response variable has similar characteristics. Other bond liquidity measures, Volume Traded and Percentage Missing Prices, which we use for robustness check, have similar IRF graphs. Of course, Volume Traded IRF should be interpreted reversely since unlike other measures it is positively related to bond liquidity.

4.5 Sub-sample Analysis, Before and After Financial Market Crisis

In order to test the robustness of our results in the previous section we re-estimate the same VAR models in two sub-periods, 1999 to 2006 (pre-crisis) and 2006 to 2010 (during crisis). This exercise is crucial since the stability of the interactions between liquidity and the market and the macroeconomic factors is our main concern. However, due to short time span of our sub-samples, the results should be taken into account with caution. Indeed, for bid-ask spread as our bond liquidity measure, from 2006 to 2010 we have only 46 monthly observations.

Tables 12 and 13 present the results of the VAR estimation results for bond liquidity equations for the sub-samples. In general, we see that bond liquidity is less sensitive to the market and the macroeconomic variables during 1999 to 2006. US industrial production growth rate and monetary variables have significant explanatory powers on bond liquidity measured by bid-ask spread, and non of the variables have significant impact on bond price volatility. The picture is entirely different in the VAR estimated using the data from the financial crisis period. VAR estimation results for the sub-period 2006 to 2010 indicate that all of the market and the macroeconomic variables except for CPI and FED have explanatory powers on the bond bid-ask spread.

Granger causality tests and impulse response functions for the sub-periods in Table 10, 11 and

Figure 3 confirm the VAR results that the market and the macroeconomic shocks play greater role on determining bond liquidity during the financial crisis.

5 Panel Regression Analysis: Cross-Section of Bond Liquidity

Up to now, we analyzed dynamic time-series link between the market-wide sovereign bond liquidity, financial market and macroeconomic variables. For that, we used monthly equal-weighted average of daily variables across all the sovereign bonds traded in that particular month. Next, we would like to investigate the cross-section determinants of sovereign bond market liquidity by exploiting panel regressions.

In order to examine the determinants of the bond market liquidity, we use balanced panel regressions of bond liquidity variables on coupon rate (Coupon), remaining maturity (Maturity), amount outstanding in billion US Dollars (AOS), Standard and Poor‘s long term borrower rating (Rating), 3 month Libor minus T-bill (TED) spread and percentage growth of US M1 money supply (M1). Bond Liquidity variables are monthly averages of bond price bid-ask spread and price volatility. Rating variable is the number assigned to the letters of Standard and Poor‘s long term ratings ranging from 5 for CCC- and 23 for AAA. Our sample uses 482 bonds issued by 72 sovereigns and traded internationally during January 1999 and December 2009, which allows to reach a sample size of 23000 data points. Regressions are run for three different time sub-periods in order to analyze the possible different dynamics in before and during the financial crisis period.

The academic literature on bond liquidity suggests the following relationships between the bond liquidity and bond characteristics. High coupon bonds tend to be more liquid than the bonds with lower coupons. Higher issue size bonds are expected to be more liquid since the amount outstanding is used to measure general availability of the bond in the market. The bond liquidity also increases with the remaining maturity as the concept is similar to the notion of on-the-run and off-the-run bonds in US T-bill markets. There is extensive evidence that on-the-run Treasury bonds are much more liquid than off-the-run Treasury bonds. If there is a similar effect in sovereign international bond market, then older bonds may be less liquid than more-recently issued bonds (Longstaff, Mithal, and Neis (2005)).

Regressions of bid-ask spread on bond specific variables remaining maturity and ratings show expected significant signs (see Table 14). However, coupon and amount outstanding have unexpected signs, i.e. they seem to be positively associated with the bid-ask spread, hence negatively with the bond liquidity. The market variable TED, and monetary supply have significant explanatory power on bond liquidity. In general, the results are robust to estimating the regression with different subsample time periods. Indeed, the signs of the coefficients are the same both in before and during the crisis periods. In the episodes of distrust among the banking system, i.e. a substantial increase in Libor and a decrease in T-bill yields, the sovereign international bond liquidity declines. An expansionary monetary policy by the USA, increases the sovereign bond liquidity as M1 growth is negatively related to bid-ask spreads.

6 Conclusion

In this paper, we have examined the financial market and macroeconomic sources of time-series and cross sectional variation in market-wide liquidity of internationally traded sovereign bonds in the last decade. Vector autoregression analysis have shown that macroeconomic fundamentals play a substantial role in the movements of liquidity throughout the whole sample period while their effects are stronger during the current financial crisis. Specifically, positive shocks in US industrial production growth rate and inflation are positively related to sovereign bond market liquidity. Financial market variables have also significant impacts. While a increasing shock to the TED spread, which generally indicates confidence in the banking system, has detrimental impact, US equity market performance has positive impact on the aggregate bond liquidity.

Further, Granger causality tests indicate that the direction of the causality is from the financial and macroeconomic variables towards the aggregate bond liquidity. The results of the orthogonal impulse response functions (IRF) imply that innovations in industrial production, equity market performance and TED spread are persistent in 12 month forecast horizon throughout the whole sample period. The IRFs and Granger causality tests also confirm the VAR results that the effects of macroeconomic fundamentals and the financial market variables are stronger during the financial turmoil, 2006 to 2010.

Lastly, to examine the *cross-section* determinants of the bond market liquidity, we used panel regressions of bond liquidity variables on bond specific variables, the financial market and the macroeconomic variables. We found that TED spread and US money supply have significant *cross-section* explanatory powers on aggregate liquidity. An expansionary monetary policy by the US Federal Reserve increases the sovereign bond liquidity as M1 growth is negatively related to bid-ask spreads. In the episodes of distrust among the banking system, i.e. a substantial increase in Libor and a decrease in T-bill yields, the sovereign international bond liquidity declines.

References

Acharya, Viral V., and Lasse Heje Pedersen, 2005, Asset pricing with liquidity risk, *Journal of Financial Economics* 77, 375–410.

Amihud, Yakov, 2002, Illiquidity and stock returns: cross-section and time-series effects, *Journal of Financial Markets* 5, 31 – 56.

———, and Haim Mendelson, 1986, Asset pricing and the bid-ask spread, *Journal of Financial Economics* 17, 223–249.

———, 1989, The effects of beta, bid-ask spread, residual risk, and size on stock returns, *The Journal of Finance* 44, 479–486.

———, 1991, Liquidity, maturity, and the yields on u.s. treasury securities, *The Journal of Finance* 46, 1411–1425.

Beber, Alessandro, Michael W. Brandt, and Kenneth A. Kavajecz, 2006, Flight-to-quality or flight-to-liquidity? evidence from the euro-area bond market, Working Paper 12376 National Bureau of Economic Research.

Bekaert, Geert, Campbell Harvey, and Christian T. Lundblad, 2006, Liquidity and expected returns: Lessons from emerging markets, CEPR Discussion Papers 5946 C.E.P.R. Discussion Papers.

Benston, George J., and Robert L. Hagerman, 1974, Determinants of bid-asked spreads in the over-the-counter market, *Journal of Financial Economics* 1, 353 – 364.

Bernanke, Ben S., and Alan S. Blinder, 1992, The federal funds rate and the channels of monetary transmission, *The American Economic Review* 82, 901–921.

Brennan, Michael J., and Avanidhar Subrahmanyam, 1996, Market microstructure and asset pricing: On the compensation for illiquidity in stock returns, *Journal of Financial Economics* 41, 441 – 464.

Bulow, Jeremy, and Kenneth Rogoff, 1989, Sovereign debt: Is to forgive to forget?, *American Economic Review* 79, 43–50.

Caballero, Ricardo J., Emmanuel Farhi, and Pierre-Olivier, 2008, Financial crash, commodity prices and global imbalances, *NBER Working Paper*.

Campa, Jose, and Nuno Fernandes, 2006, Sources of gains from international portfolio diversification, *Journal of Empirical Finance* 13, 417–443.

Chen, Long, David A. Lesmond, and Jason Wei, 2007, Corporate yield spreads and bond liquidity, *Journal of Finance* 62, 119–149.

Chordia, Tarun, 2005, An empirical analysis of stock and bond market liquidity, *Review of Financial Studies* 18, 85–129.

———, Richard Roll, and Avanidhar Subrahmanyam, 2000, Commonality in liquidity, *Journal of Financial Economics* 56, 3 – 28.

———, 2001, Market liquidity and trading activity, *The Journal of Finance* 56, 501–530.

Claessens, Stijn, Daniela Klingebiel, and Sergio Schmukler, 2003, Government bonds in domestic and foreign currency: The role of macroeconomic and institutional factors, *CEPR Discussion Paper No. 3789*.

Cochrane, John H., and Monika Piazzesi, 2005, Bond risk premia, *American Economic Review* 98, 138–160.

Collin-Dufresne, P., R. Goldstein, and S. Martin, 2001, The determinants of credit spread changes, *Journal of Finance* 56, 21772207.

Duffie, Darrell, 1999, Credit swap valuation, *Financial Analysts Journal* January February, 73–87.

——— , Pedersen Lasse H., and Kenneth J. Singleton, 2003, Modeling sovereign yield spreads: A case study of russian debt, *Journal of Finance* 58, 119–159.

Duffie, Darrell, Lasse Heje Pedersen, and Kenneth J. Singleton, 2003, Modeling sovereign yield spreads: A case study of russian debt, *The Journal of Finance* 58, 119–159.

Erb, Claude B, Campbell R. Harvey, and Tadas E. Viskanta, 1996, The influence of political, economic, and financial risk on expected fixed-income returns, *Journal of Fixed Income* pp. 7–31.

Fama, Eugene F., and Kenneth R. French, 1993, Common risk factors in the returns on stocks and bonds, *Journal of Financial Economics* 33, 3–56.

Ferrucci, Gianluigi, 2003, Empirical Determinants of Emerging Market Economies' Sovereign Bond Spreads, *SSRN eLibrary*.

Fujimoto, Akiko, 2004, Macroeconomic sources of systematic liquidity, *Working Paper*.

Gmez-Puig, Marta, 2006, Size matters for liquidity: Evidence from emu sovereign yield spreads, *Economics Letters* 90, 156 – 162.

Goetzmann, William, Lingfeng Li, and Geert Rouwenhorst, 2005, Long-term global market correlations, *Journal of Business* 78, 1–31.

Goodhart, Charles A. E., and Maureen O'Hara, 1997, High frequency data in financial markets: Issues and applications, *Journal of Empirical Finance* 4, 73–114.

Goyenko, Ruslan Y., and Andrey D. Ukhov, 2009, Stock and bond market liquidity: A long-run empirical analysis, *Journal of Financial and Quantitative Analysis* 44, 189–212.

Harvey, Campbell R., and Roger D. Huang, 2001, The Impact of the Federal Reserve Bank's Open Market Operations, *SSRN eLibrary*.

Houweling, Patrick, Albert Mentink, and Ton Vorst, 2003, How to measure corporate bond liquidity?, Tinbergen Institute Discussion Papers 03-030/2 Tinbergen Institute.

Huang, J., and M. Huang, 2003, How much of the corporate-treasury yield spread is due to credit risk, Working paper, Stanford University.

Kamara, Avraham, 1994, Liquidity, taxes, and short-term treasury yields, *The Journal of Financial and Quantitative Analysis* 29, 403–417.

Kucuk, Ugur N., 2010, Non-default component of sovereign emerging market yield spreads and its determinants: Evidence from credit default swap market, *The Journal of Fixed Income* Spring 2010, Vol. 19, 44–66.

Longstaff, Francis A., 2004, The flight to liquidity premium in u.s. treasury bond prices, *Journal of Business* 77, 51526.

——— , Sanjay Mithal, and Eric Neis, 2005, Corporate yield spreads: Default risk or liquidity? new evidence from the credit default swap market, *Journal of Finance* 60, 2213–2253.

Longstaff, Francis A., Jun Pan, Pedersen, Lasse H., and Kenneth J. Singleton, 2008, How soverign is sovereign credit risk?, *NBER Working Paper 13658.*

Pastor, L'ubos, and Robert F. Stambaugh, 2003, Liquidity risk and expected stock returns, *Journal of Political Economy* 111, 642–685.

Rozada, Martin, and Eduardo Yeyati, 2005, Global factors and emerging market spreads, Working paper, Universidad Torcuato Di Tella.

Solnik, Bruno, 1974, 1974, Why not diversify internationally rather than domestically?, *Financial Analysts Journal* 30, 48–54.

Thorbecke, Willem, 1997, On stock market returns and monetary policy, *The Journal of Finance* 52, 635–654.

Tirole, Jean, 2002, *Financial Crises, Liquidity, and the International Monetary System* (Princeton University Press: Princeton, New Jersey).

Warga, Arthur, 1992, Bond returns, liquidity, and missing data, *The Journal of Financial and Quantitative Analysis* 27, 605–617.

White, Halbert, 1980, A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity, *Econometrica* 48, 817–838.

Table 1: **Bond Sample.** This table presents bond sample used in our analysis. Our sample uses 482 bonds issued by 72 sovereigns and traded internationally during January 1999 and December 2009. We include all of the sovereign bonds for which the price, bid-ask and transaction volume data are available by ISMA (the International Securities Market Association) via Thomson Financial Datastream. The first column is the name of the borrower country, the second column is the number of its bonds, third column is the total issued amount of its bonds in our sample and the last column is the borrower country's long term rating by Moody's as of December 2009. For countries whose Moody's rating is not available we use the corresponding long term borrower rating by Standard and Poor's. The bond data are available at Thomson Financial Datastream

Borrower Name	Number of Bonds	Amount Issued in Billions	Borrower Long Term Rating
Abu Dhabi	1	1.00	
Argentina	20	56.35	Ca
Australia	1	0.15	Aaa
Austria	33	14.30	Aaa
Bahamas	1	0.10	A3
Barbados	4	0.59	Baa1
Belgium	3	2.60	Aa1
Belize	2	0.65	B2
Brazil	28	61.01	Baa3
Bulgaria	3	1.36	Ba2
Chile	2	1.75	A1
China	4	3.10	A1
Colombia	14	9.27	Ba1
Costa Rica	7	1.75	Ba1
Croatia	4	2.61	Baa3
Cyprus	2	1.05	Aa3
Czech	3	4.50	A1
Denmark	2	5.25	Aaa
Dominican Republic	4	1.82	B2
Ecuador	6	14.88	C
Egypt	2	2.00	Ba1
El Salvador	6	3.89	Ba1
Fiji Islands	1	0.15	B1
Finland	1	0.10	Aaa
France	1	0.00	Aaa
Georgia	1	0.50	
Germany	10	5.08	Aaa
Ghana	1	0.75	
Greece	15	14.70	A1
Grenada	1	0.10	B3
Guatemala	4	1.28	Ba2
Hong Kong	1	1.25	Aa1
Hungary	11	12.00	Baa1

Bond Sample: Table 1 continuing...

Borrower Name	Number of Bonds	Amount Issued in Billions	Borrower Long Term Rating
Iceland	3	1.45	Baa3
Indonesia	8	11.20	Ba3
Iraq	1	2.66	
Ireland	1	0.50	Aa1
Israel	6	4.25	A1
Italy	25	38.13	Aa2
Jamaica	9	2.68	Caa1
Korea	5	3.28	A2
Latvia	2	0.80	Baa3
Lebanon	18	12.66	B2
Lithuania	4	3.60	Baa1
Luxembourg	1	2.00	
Macedonia	1	0.15	
Malaysia	1	1.75	A3
Mexico	23	42.32	Baa1
Morocco	1	0.50	Ba1
New Zealand	1	0.20	Aaa
Pakistan	3	1.55	B2
Panama	10	8.84	Ba1
Peru	11	11.00	Ba1
Philippines	18	20.83	Ba3
Poland	18	23.93	A2
Qatar	2	2.80	Aa2
Romania	3	2.15	Baa3
Russia	6	34.49	Baa1
Serbia	1	1.02	Ba3
Slovakia	5	3.74	A1
Slovenia	4	2.95	Aa2
South Africa	5	5.00	A3
Spain	4	5.61	Aaa
Sweden	7	5.02	Aaa
Thailand	1	0.04	Baa1
Trinidad Tobago	2	0.40	
Turkey	20	28.50	Ba3
Ukraine	6	4.40	B1
Uruguay	21	7.77	Ba3
Venezuela	23	32.18	B2
Vietnam	3	1.03	Ba3
AVERAGE	6.8	7.8	Baa1
TOTAL	482	557.3	

Source: Thomson Financial Datastream

Table 2: **Summary statistics for all internationally traded sovereign bonds during the period 1998-December 2009.** This table presents the summary statistics of internationally traded bonds of the sovereigns listed in Table 1. Rating variable is a number given to letter rating of Moody's Long Term Sovereign Debt Rating. Rating number 5 is given to the lowest rating C and the number 25 is given to the highest rating AAA. The amount outstanding variable is presented in millions. The bond data are available at Thomson Financial Datastream.

	Mean	Standard Deviation	Minimum	Maximum
Price	101.26	23.51	4.83	186.83
Redemption Yield	7.28	4.72	-24.19	86.28
Coupon	7.52	2.47	2.70	13.63
Maturity	12.94	8.83	0.25	75.94
Life	11.25	8.06	0.24	50.00
Amount Out.(millions)	1131.35	1378.40	11.95	12489
Rating	16.19	4.90	5.00	25.00

Source: Thomson Financial Datastream

Table 3: **Summary statistics of the liquidity proxies for all internationally traded sovereign bonds during the period 1998-November 2009.** This table presents the summary statistics of liquidity variables for the internationally traded bonds of the sovereigns listed in Table 1. Variable definitions are presented in the text. The bond data are available at Thomson Financial Datastream.

	Mean	Standard Deviation	Minimum	Maximum	Obs.
Bid-Ask Spread	1.28	0.51	0.68	3.10	102
Price Volatility	1.20	0.55	0.43	4.92	131
Missing Prices	0.54	0.08	0.23	0.81	132
Volume Traded	34.91	24.00	3.59	135.21	130

Source: Thomson Financial Datastream

Table 4: **Summary Statistics for the World Financial and Macroeconomic Variables for the period of 1998-November 2009** This table presents the summary statistics for the monthly averages of the world financial and macroeconomic variables. For S&P 500, Cboe VIX, Money Supply, Industrial Production and Consumer Price Index the monthly growth variables are used. T-bill, Libor, OIS, TED Spread and Libor-OIS Spread are 3 month rates for which the definitions are presented in the text. The data are available at Thomson Financial Datastream.

	Mean	Standard Deviation	Minimum	Maximum	Obs.
S&P 500 RI Growth	0.01	0.23	-1.27	0.56	132
CboeVix	0.18	1.02	-1.54	5.2	132
Tbill	2.96	1.91	0.04	6.36	132
Libor US	3.47	1.95	0.26	6.81	132
OIS US	2.82	1.9	0.14	5.4	73
TED Spread	0.51	0.49	0.12	3.26	132
Libor-OIS	0.37	0.48	0.05	2.37	73
Policy Int Rate US	3.2	1.97	0.25	6.5	131
Money Supply M1	0.33	1.01	-3.16	4.73	130
Industrial Production	0.02	0.72	-3.96	1.37	130
CPI	0.21	0.34	-1.67	1.38	130

Source: Thomson Financial Datastream

Table 5: **Correlation Matrix of Bond Liquidity Variables** This table presents the correlation matrix of the liquidity variables for the internationally traded bonds of the sovereigns listed in Table 1. Variable definitions are presented in the text. Values specified with **bold numbers** are statistically significant at 1% level. The bond data are available at Thomson Financial Datastream.

	Bid-Ask Spread	Price Volatility	Pct Missing Prices	Volume Traded
Bid-Ask Spread	1.00			
Price Volatility	**0.65**	1.00		
Pct Missing Prices	**0.37**	-0.04	1.00	
Volume Traded	**-0.19**	0.13	**-0.41**	1.00

Source: Thomson Financial Datastream

Table 6: **Correlation Matrix of World Financial and Macroeconomic Variables.** This table presents the correlation matrix of the monthly averages of the world financial and macroeconomic variables. For S&P 500, Cboe VIX, Money Supply (M1), Industrial Production (IP) and Consumer Price Index (CPI) the monthly growth variables are used. T-bill, Libor, OIS, TED Spread and Libor-OIS Spread are 3 month rates for which the definitions are presented in the text. The data are available at Thomson Financial Datastream.

	S&P500	CboeVIX	T-bill	Libor	OIS	TED Sprd	Libor-OIS	FED	M1	IP	CPI
S&P500	1										
CboeVIX	-0.78***	1.00									
T-bill	0.04	0.03	1.00								
Libor	-0.05	0.09	0.97***	1							
OIS	0.06	0.05	0.99***	0.97***	1						
TED Sprd	-0.35***	0.25**	-0.05	0.21*	-0.14	1					
Libor-OIS	-0.50***	0.29*	-0.46***	-0.15	-0.39***	0.93***	1				
FED	0	0.05	0.99***	0.98***	0.99***	0.06	-0.35**	1			
Money Supply	-0.18*	0.14	-0.32***	-0.24**	-0.36**	0.27**	0.50***	-0.28**	1		
Industrial Prd	0.26**	-0.15	0.20*	0.1	0.24*	-0.38***	-0.52***	0.15	-0.33***	1	
CPI	-0.04	0.06	0.18*	0.12	0.19	-0.20*	-0.40***	0.16	-0.24**	0.12	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Thomson Financial Datastream

Table 7: **Vector Autoregression Table for Bond Liquidity Equations.** The table presents the result table of Vector Autoregressions of endogenous variables Industrial Production (IP), Consumer Price Index (CPI), Money Supply (M1), FED Funds Rate, S&P500 Equity Market Total Return Index, Libor - T-bill (TED) Spread and Bond Liquidity. Note that for the sake of saving from space, we report only one equation for each VAR, i.e. only the equations explaining the bond liquidity. Bond Liquidity variables are monthly averages of Bond Price Bid-Ask Spread, Price Volatility, Percentage of Missing Prices and Volume Transacted, respectively. It is estimated with two lag and a constant term according to AIC and BIC criteria and uses 132 observations as monthly averages from January 1999 to December 2009. The prefixes "L." and "L.2" stand for the first lag and the second lag of the variables respectively. The numbers in parentheses are t-statistics.

	Bid-Ask Spread	Price Volatility	Missing Prices	Transaction Volume
L.IP	-0.097***	-0.203***	0.002	-1.207
	(-5.64)	(-4.63)	(0.22)	(-0.45)
L2.IP	0.027	0.080	-0.004	1.545
	(1.61)	(1.76)	(-0.48)	(0.56)
L.CPI	-0.077*	-0.177	-0.005	-4.203
	(-2.15)	(-1.82)	(-0.26)	(-0.69)
L2.CPI	0.024	0.162	-0.008	1.220
	(0.60)	(1.58)	(-0.43)	(0.18)
L.M1	-0.038	-0.033	-0.009	0.569
	(-1.57)	(-0.49)	(-0.71)	(0.13)
L2.M1	-0.021	-0.039	-0.012	5.207
	(-0.96)	(-0.63)	(-1.11)	(1.35)
L.FED	-0.039	-0.050	-0.021	-5.206
	(-0.79)	(-0.41)	(-0.92)	(-0.66)
L2.FED	0.023	0.029	0.021	6.102
	(0.46)	(0.24)	(0.91)	(0.78)
L.Equity	-0.196***	-0.458***	0.001	4.551
	(-3.73)	(-3.70)	(0.06)	(0.57)
L2.Equity	0.039	0.188	-0.016	-3.708
	(0.68)	(1.39)	(-0.67)	(-0.43)
L.TED Spread	0.146***	0.492***	0.017	-5.441
	(3.32)	(4.15)	(0.80)	(-0.72)
L2.TED Spread	-0.127**	-0.549***	0.004	-8.488
	(-2.88)	(-4.69)	(0.19)	(-1.16)
L.Bond Liquidity	1.231***	0.741***	0.613***	0.354***
	(11.70)	(8.90)	(6.92)	(3.97)
L2.Bond Liquidity	-0.360***	-0.021	-0.081	0.114
	(-3.82)	(-0.26)	(-0.87)	(1.31)
Constant	0.228***	0.459***	0.255***	20.863**
	(3.42)	(3.69)	(5.30)	(3.18)
R Squared	0.965	0.732	0.434	0.375
Obs.	99	128	128	128

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Thomson Financial Datastream

Table 8: **Granger Causality Tests. Chi-square statistics and P-values (in parenthesis) from Granger causality tests. Null hypothesis: Row variable does not Granger-cause column variable** This table presents Granger Causality tests after the Vector Autoregressions of endogenous variables Industrial Production (IP), Consumer Price Index (CPI), Money Supply (M1), FED Funds Rate, S&P500 Equity Market Total Return Index, Libor - T-bill (TED) Spread and Bond Liquidity using the data from January 1999 to December 2009. Bond Liquidity variables are monthly averages of Bond Price Bid-Ask Spread and Price Volatility. The numbers in parentheses are p-values.

Bond Liquidity as Bid-Ask Spread							
	IP	CPI	M1	FED	Equity	TED	Bond Liq.
IP		1.22	1.80	5.86	12.70	2.50	33.80
		(.544)	(.406)	(.053)*	(.002)*	(.286)	(.000)*
CPI	3.11		37.97	6.70	1.06	4.48	4.82
	(.211)		(.000)*	(.035)*	(.588)	(.107)	(.09)*
M1	0.43	0.34		7.70	2.87	2.18	2.87
	(.808)	(.846)		(.021)*	(.238)	(.336)	(.238)
FED	0.17	1.27	2.16		2.26	0.62	4.43
	(.92)	(.529)	(.34)		(.323)	(.732)	(.109)
Equity	2.09	1.91	12.48	6.27		10.02	15.36
	(.351)	(.386)	(.002)*	(.043)*		(.007)*	(.000)*
TED	11.26	3.64	0.30	20.61	9.87		11.18
	(.004)*	(.162)	(.859)	(.000)*	(.007)*		(.004)*
Bond Liquidity	4.84	15.56	0.05	1.40	7.69	2.67	
	(.189)	(.120)	(.977)	(.497)	(.021)*	(.263)	
Bond Liquidity as Price Volatility							
IP		3.80	4.78	4.96	14.67	0.96	22.92
		(.149)	(.092)*	(.084)*	(.001)*	(.62)	(.000)*
CPI	2.30		32.61	3.27	1.36	7.96	5.48
	(.317)		(.000)*	(.195)	(.507)	(.019)*	(.065)*
M1	0.21	0.84		2.97	2.05	1.56	0.53
	(.898)	(.659)		(.227)	(.36)	(.459)	(.767)
FED	1.58	2.11	10.46		0.17	0.05	2.24
	(.453)	(.348)	(.005)*		(.917)	(.974)	(.326)
Equity	1.13	0.44	19.40	3.20		9.75	16.67
	(.569)	(.803)	(.000)*	(.202)		(.008)*	(.000)*
TED	10.80	3.26	1.67	15.45	7.17		22.14
	(.005)*	(.196)	(.434)	(.000)*	(.028)*		(.000)*
Bond Liquidity	4.40	15.53	17.78	3.01	2.12	3.79	
	(.111)	(.000)*	(.000)*	(.223)	(.347)	(.15)	

Table 9: **Variance Decompositions for Bond Liquidity** The table presents the variance decomposition computed from a VAR with endogenous variables Industrial Production (IP), Consumer Price Index (CPI), Money Supply (M1), FED Funds Rate, S&P500 Equity Market Total Return Index, TED Spread and Bond Liquidity. Bond Liquidity variables are monthly averages of Bond Price Bid-Ask Spread, Price Volatility, Percentage of Missing Prices and Volume Transacted . It is estimated with two lag and a constant term, and uses 132 observations as monthly averages from January 1999 to December 2009. The numbers in parentheses are asymptotic standard errors. The bond data are available at Thomson Financial Datastream.

Forecast Horizon	IP	CPI	M1	FED	Equity	TED Sprd.	Bond Liq.
Bid-Ask Spread							
1	0.017	0.015	0.005	0.000	0.266	0.036	0.662
	(.026)	(.024)	(.014)	(.031)	(.075)	(.031)	(.077)
2	0.229	0.010	0.002	0.000	0.328	0.073	0.358
	(.076)	(.019)	(.003)	(.038)	(.077)	(.038)	(.064)
6	0.328	0.010	0.004	0.001	0.346	0.112	0.199
	(.118)	(.01)	(.013)	(.074)	(.113)	(.074)	(.068)
12	0.310	0.030	0.003	0.001	0.289	0.209	0.157
	(.123)	(.033)	(.009)	(.01)	(.115)	(.107)	(.056)
Volatility							
1	0.003	0.008	0.052	0.000	0.094	0.010	0.833
	(.01)	(.015)	(.038)	(.016)	(.048)	(.016)	(.06)
2	0.180	0.010	0.031	0.005	0.198	0.075	0.501
	(.061)	(.017)	(.028)	(.038)	(.063)	(.038)	(.067)
6	0.212	0.022	0.027	0.009	0.223	0.061	0.446
	(.082)	(.018)	(.026)	(.039)	(.083)	(.039)	(.081)
12	0.212	0.022	0.028	0.012	0.223	0.064	0.440
	(.083)	(.018)	(.026)	(.016)	(.083)	(.042)	(.083)
Missing Prices							
1	0.001	0.003	0.001	0.001	0.000	0.020	0.974
	(.005)	(.009)	(.006)	(.025)	(.002)	(.025)	(.028)
2	0.001	0.002	0.001	0.004	0.000	0.032	0.960
	(.006)	(.008)	(.004)	(.034)	(.002)	(.034)	(.037)
6	0.010	0.013	0.007	0.004	0.008	0.072	0.886
	(.019)	(.016)	(.014)	(.059)	(.019)	(.059)	(.072)
12	0.012	0.018	0.008	0.008	0.008	0.087	0.860
	(.022)	(.021)	(.015)	(.012)	(.019)	(.068)	(.092)
Transaction Volume							
1	0.005	0.002	0.001	0.011	0.026	0.022	0.933
	(.012)	(.008)	(.004)	(.025)	(.027)	(.025)	(.043)
2	0.005	0.009	0.001	0.012	0.023	0.030	0.920
	(.012)	(.017)	(.007)	(.032)	(.024)	(.032)	(.047)
6	0.013	0.040	0.022	0.018	0.019	0.092	0.796
	(.024)	(.04)	(.027)	(.059)	(.02)	(.059)	(.084)
12	0.015	0.049	0.023	0.020	0.018	0.117	0.758
	(.029)	(.045)	(.028)	(.022)	(.019)	(.072)	(.103)

Table 10: **Sub-Sample 1999 to 2006 Granger Causality Tests. Chi-square statistics and P-values (in parenthesis) from Granger causality tests. Null hypothesis: Row variable does not Granger-cause column variable** This table presents Granger Causality tests after the Vector Autoregressions of endogenous variables Industrial Production (IP), Consumer Price Index (CPI), Money Supply (M1), FED Funds Rate, S&P500 Equity Market Total Return Index, Libor - T-bill (TED) Spread and Bond Liquidity using the data from January 1999 to January 2006. Bond Liquidity variables are monthly averages of Bond Price Bid-Ask Spread and Price Volatility. The numbers in parentheses are p-values. The bond data are available at Thomson Financial Datastream.

Bond Liquidity as Bid-Ask Spread (1999-2006)							
	IP	CPI	M1	FED	Equity	TED	Bond Liquidity
IP		2.72	15.57	5.91	8.05	3.37	6.56
		(.257)	(.000)*	(.052)*	(.018)*	(.186)	(.038)*
CPI	0.26		7.90	2.41	0.07	2.74	0.01
	(.876)		(.019)*	(.3)	(.964)	(.255)	(.993)
M1	0.23	1.96		4.53	0.25	1.75	10.72
	(.893)	(.376)		(.104)	(.884)	(.417)	(.005)*
FED	6.96	7.90	1.68		1.40	13.12	4.09
	(.031)*	(.019)*	(.432)		(.496)	(.001)*	(.129)
Equity	1.11	2.21	0.90	0.05		2.79	2.81
	(.574)	(.331)	(.639)	(.975)		(.248)	(.245)
TED	5.63	0.93	14.26	10.31	9.23		3.69
	(.060)*	(.628)	(.001)*	(.006)*	(.01)*		(.158)
Bond Liquidity	0.83	3.80	1.51	0.02	2.15	3.64	
	(.661)	(.149)	(.47)	(.988)	(.341)	(.162)	
Bond Liquidity as Price Volatility (1999-2006)							
IP		1.62	13.30	15.65	3.59	6.92	1.15
		(.445)	(.001)*	(.)*	(.166)	(.031)*	(.562)
CPI	1.05		7.52	4.68	2.06	16.98	1.11
	(.592)		(.023)*	(.096)*	(.358)	(.000)*	(.574)
M1	0.63	3.56		4.44	0.52	0.25	0.15
	-0.73	(.169)		(.108)	(.772)	(.882)	(.926)
FED	9.40	4.97	0.17		2.63	22.37	0.58
	(.009)*	(.083)*	(.919)		(.269)	(.000)*	(.747)
Equity	1.49	0.41	2.72	2.93		0.89	1.30
	(.474)	(.815)	(.257)	(.231)		(.642)	(.523)
TED	7.94	0.06	1.49	1.43	17.36		0.71
	(.019)*	(.971)	(.476)	(.488)	(.000)*		(0.70)
Bond Liquidity	0.23	7.13	5.53	0.19	0.85	2.90	
	(.892)	(.028)*	(.063)*	(.908)	(.653)	(.235)	

Table 11: **Sub-Sample 2006 to 2010 Granger Causality Tests. Chi-square statistics and P-values (in parenthesis) from Granger causality tests. Null hypothesis: Row variable does not Granger-cause column variable** This table presents Granger Causality tests after the Vector Autoregressions of endogenous variables Industrial Production (IP), Consumer Price Index (CPI), Money Supply (M1), FED Funds Rate, S&P500 Equity Market Total Return Index, Libor - T-bill (TED) Spread and Bond Liquidity using the data from January 2006 to December 2009. Bond Liquidity variables are monthly averages of Bond Price Bid-Ask Spread and Price Volatility. The numbers in parentheses are p-values. The data are available at Thomson Financial Datastream.

Bond Liquidity as Bid-Ask Spread (2006-2010)							
IP		3.64	4.00	6.22	16.10	3.90	36.07
		(.162)	(.135)	(.045)*	(.000)*	(.142)	(.000)*
CPI	7.30		17.69	4.70	2.48	7.82	4.95
	(.026)*		(.000)*	(.095)*	(.29)	(.02)*	(.084)*
M1	2.28	1.31		3.71	7.48	4.97	8.42
	(.32)	(.518)		(.156)	(.024)*	(.083)*	(.015)*
FED	0.06	5.85	2.76		5.26	3.61	5.67
	(.973)	(.054)*	(.252)		(.072)*	(.164)	(.059)*
Equity	2.98	2.11	13.31	6.26		9.58	19.84
	(.225)	(.348)	(.001)*	(.044)*		(.008)*	(.000)*
TED	7.02	5.01	2.77	31.30	11.51		6.19
	(.03)*	(.082)*	(.25)	(.000)*	(.003)*		(.045)*
Bond Liquidity	4.38	23.31	4.88	6.70	16.21	4.49	
	(.112)	(.000)*	(.087)*	(.035)*	(.000)*	(.106)	
Bond Liquidity as Price Volatility (2006-2010)							
IP		0.62	0.25	2.04	11.38	1.67	26.48
		(.732)	(.884)	(.36)	(.003)*	(.434)	(.000)*
CPI	4.88		18.66	1.30	2.30	6.57	10.61
	(.087)*			(.522)	(.317)	(.037)*	(.005)*
M1	3.00	0.16		2.65	7.12	4.51	5.41
	(.223)	(.923)	(.)*		(.029)*	(.105)	(.067)*
FED	0.24	6.43	5.98		2.03	1.31	5.46
	(.888)	(.04)*	(.05)*	(.266)		(.519)	(.065)*
Equity	0.85	0.96	20.10	2.80		11.85	21.60
	(.653)	(.617)	(.000)*	(.247)	(.362)		(.)*
TED	3.98	11.09	3.75	26.07	11.07		16.80
	(.136)	(.004)*	(.154)	(.000)*	(.004)*	(.003)*	
Bond Liquidity	4.59	18.30	11.82	2.68	6.86	2.28	
	(.101)	(.000)*	(.003)*	(.262)	(.032)*	(.319)	(.000)*

Table 12: **Vector Autoregression Table for on Bond Liquidity Equations Estimated for the Period 1999-2006.** The table presents the result table of Vector Autoregressions of endogenous variables Industrial Production (IP), Consumer Price Index (CPI), Money Supply (M1), FED Funds Rate, S&P500 Equity Market Total Return Index, Libor - T-bill (TED) Spread and Bond Liquidity using the data from January 1999 to January 2006. Note that for the sake of saving from space, we report only one equation for each VAR, i.e. only the equations explaining the bond liquidity. Bond Liquidity variables are monthly averages of Bond Price Bid-Ask Spread, Price Volatility, Percentage of Missing Prices and Volume Transacted, respectively. It is estimated with two lag and a constant term according to AIC and BIC criteria and uses 132 observations as monthly averages from January 1999 to January 2006. The prefixes "L." and "L.2" stand for the first lag and the second lag of the variables, respectively. The numbers in parentheses are t-statistics.

	Bid-Ask Spread	Price Volatility	Missing Prices	Transaction Volume
L.IP	-0.051*	-0.051	0.007	-3.203
	(-2.31)	(-0.79)	(0.52)	(-0.64)
L2.IP	0.015	0.091	0.007	-3.400
	(0.59)	(1.30)	(0.47)	(-0.62)
L.CPI	-0.003	-0.132	0.000	-8.011
	(-0.08)	(-1.01)	(0.01)	(-0.81)
L2.CPI	-0.003	0.018	-0.024	-9.091
	(-0.06)	(0.13)	(-0.81)	(-0.84)
L.M1	-0.033	0.020	-0.004	-1.021
	(-1.39)	(0.27)	(-0.27)	(-0.19)
L2.M1	-0.064**	-0.008	-0.019	7.031
	(-3.18)	(-0.12)	(-1.32)	(1.38)
L.FED	-0.134*	-0.115	-0.051	1.238
	(-2.00)	(-0.66)	(-1.36)	(0.09)
L2.FED	0.135*	0.130	0.060	-1.435
	(2.01)	(0.73)	(1.58)	(-0.10)
L.Equity	0.056	-0.223	-0.031	9.566
	(0.91)	(-1.31)	(-0.85)	(0.71)
L2.Equity	-0.084	-0.080	-0.026	-9.170
	(-1.41)	(-0.48)	(-0.72)	(-0.71)
L.TED	-0.351	-0.131	-0.037	-19.205
	(-1.54)	(-0.42)	(-0.56)	(-0.77)
L2.TED	-0.049	-0.119	-0.042	25.184
	(-0.19)	(-0.34)	(-0.56)	(0.92)
L.Bond Liquidity	1.315***	0.643***	0.592***	0.152
	(11.01)	(5.47)	(5.45)	(1.33)
L2.Bond Liquidity	-0.423***	-0.027	-0.217*	-0.024
	(-3.64)	(-0.24)	(-1.99)	(-0.21)
Constant	0.252**	0.548***	0.335***	40.574***
	(2.79)	(3.43)	(5.62)	(4.19)
R squared	0.950	0.491	0.373	0.123
Obs.	52	81	81	81

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Thomson Financial Datastream

Table 13: **Vector Autoregression Table for on Bond Liquidity Equations Estimated for the Period 2006-2010.** The table presents the result table of Vector Autoregressions of endogenous variables Industrial Production (IP), Consumer Price Index (CPI), Money Supply (M1), FED Funds Rate, S&P500 Equity Market Total Return Index, Libor - T-bill (TED) Spread and Bond Liquidity using the data from January 2006 to December 2090. Note that for the sake of saving from space, we report only one equation for each VAR, i.e. only the equations explaining the bond liquidity. Bond Liquidity variables are monthly averages of Bond Price Bid-Ask Spread, Price Volatility, Percentage of Missing Prices and Volume Transacted, respectively. It is estimated with two lag and a constant term according to AIC and BIC criteria and uses 132 observations as monthly averages from January 2006 to December 2009. The prefixes "L." and "L.2" stand for the first lag and the second lag of the variables respectively. The numbers in parentheses are t-statistics.

	Bid-Ask Spread	Price Volatility	Missing Prices	Transaction Volume
L.IP	-0.152***	-0.296***	0.008	-0.328
	(-6.20)	(-4.62)	(0.92)	(-0.16)
L2.IP	0.057*	0.162*	0.003	0.714
	(2.27)	(2.40)	(0.37)	(0.39)
L.CPI	-0.075	-0.378**	-0.005	-2.706
	(-1.41)	(-2.66)	(-0.26)	(-0.59)
L2.CPI	0.047	0.163	-0.000	-8.182
	(0.82)	(1.05)	(-0.01)	(-1.51)
L.M1	-0.100*	-0.227	-0.017	-1.816
	(-2.23)	(-1.88)	(-0.87)	(-0.42)
L2.M1	0.052	0.074	0.003	-4.506
	(1.41)	(0.68)	(0.19)	(-1.26)
L.FED	0.001	0.056	0.008	8.606
	(0.02)	(0.31)	(0.29)	(1.42)
L2.FED	-0.031	-0.120	-0.013	-7.365
	(-0.49)	(-0.64)	(-0.45)	(-1.25)
L.EQUITY	-0.228**	-0.650***	0.028	1.035
	(-3.23)	(-4.01)	(1.15)	(0.19)
L2.EQUITY	0.135	0.311	-0.014	-3.127
	(1.53)	(1.37)	(-0.42)	(-0.43)
L.TED	0.098*	0.494***	0.035	-5.362
	(2.15)	(4.02)	(1.79)	(-1.21)
L2.TED	-0.089	-0.446**	-0.004	5.667
	(-1.80)	(-3.01)	(-0.21)	(1.19)
L.Bond Liquidity	1.449***	0.815***	0.288	0.452**
	(8.85)	(6.22)	(1.86)	(3.13)
L2.Bond Liquidity	-0.623***	-0.241*	0.198	0.094
	(-4.57)	(-1.99)	(1.20)	(0.62)
Constant	0.333*	0.677**	0.302*	7.308
	(2.31)	(2.79)	(2.55)	(1.29)
R squared	0.985	0.91	0.473	0.6
Obs.	46	46	46	46

t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Thomson Financial Datastream

Table 14: **Panel Regressions of Bond Liquidity.** This table presents the results from balanced panel regressions of bond liquidity variables,Bid-Ask Spread and Price Volatility, on coupon rate (Coupon), remaining maturity (Maturity), amount outstanding in billion US Dollars (AOS), Standard and poor's long term borrower rating (Rating), 3 month Libor minus T-bill (TED) spread and percentage growth of US M1 money supply (M1). Bond Liquidity variables are monthly averages of Bond Price Bid-Ask Spread and Price Volatility. Rating variable is the number assigned to the letters of Standard and Poor's long term ratings ranging from 5 for CCC- and 23 for AAA. Our sample uses 482 bonds issued by 72 sovereigns and traded internationally during January 1999 and December 2009. We include all of the sovereign bonds for which the price, bid-ask and transaction volume data are available by ISMA (the International Securities Market Association) via Thomson Financial Datastream.

	Bid-Ask Spread			Price Volatility		
	1999-2009	1999-2007	2007-2010	1999-2009	1999-2007	2007-2010
Coupon	0.06**	0.08***	0.07*	0.22	0.105***	0.284*
	(2.89)	(5.66)	(2.39)	(1.90)	(8.86)	(2.07)
Maturity	-0.04***	-0.01	-0.07***	0.06***	0.029***	-0.092***
	(-4.04)	(-1.31)	(-4.87)	(6.07)	(6.72)	(-7.59)
AOS	0.01***	0.00***	0.00***	-0.01	-0.001***	-0.003*
	(5.62)	(5.42)	(4.19)	(-1.75)	(-4.18)	(-2.03)
Rating	-0.08***	-0.04***	-0.09***	0.046	0.004	-0.007
	(-7.10)	(-5.26)	(-6.41)	(1.11)	(0.56)	(-0.12)
TED	0.30***	0.38	0.30***	0.472***	0.941***	0.511***
	(11.27)	(1.82)	(10.98)	(16.93)	(7.30)	(17.87)
M1	-0.01***	-0.01*	-0.01***	-0.014***	-0.038***	-0.009***
	(-4.46)	(-2.09)	(-3.57)	(-9.14)	(-6.49)	(-7.52)
Constant	1.97***	1.08***	2.42***	-2.138	0.043	-0.074
	(6.64)	(4.82)	(6.19)	(-1.54)	(0.23)	(-0.04)
R-squared	0.124	0.296	0.111	0.054	0.03	0.153
Obs.	21898	8483	13415	23246	10221	13025

Figure 1: **Bond Market Liquidity Variables and World Financial Market Indicators.** These graphs present the time series graphs of bond market liquidity as average bid-ask spread versus 3 month Libor-OIS (Overnight Indexed Swap) Spread and bond price volatility versus Cboe VIX index. Bond variables are monthly averages of bond price bid-ask spread and price volatility of all internationally traded sovereign bonds issued in Euros and United States Dollars between January 1999 and December 2009. The Libor-OIS spread is the difference between the Libor and the overnight indexed swap rate, and is commensurate with the amount of perceived credit risk in the interbank lending market. Cboe VIX is the Chicago Board Options Exchange Volatility Index, a popular measure of the implied volatility of S&P 500 index options. A high value corresponds to a more volatile market and therefore more costly options, which can be used to defray risk from this volatility by selling options. Often referred to as the fear index, it represents one measure of the market's expectation of volatility over the next 30 day period. The data are available at Thomson Financial Datastream.

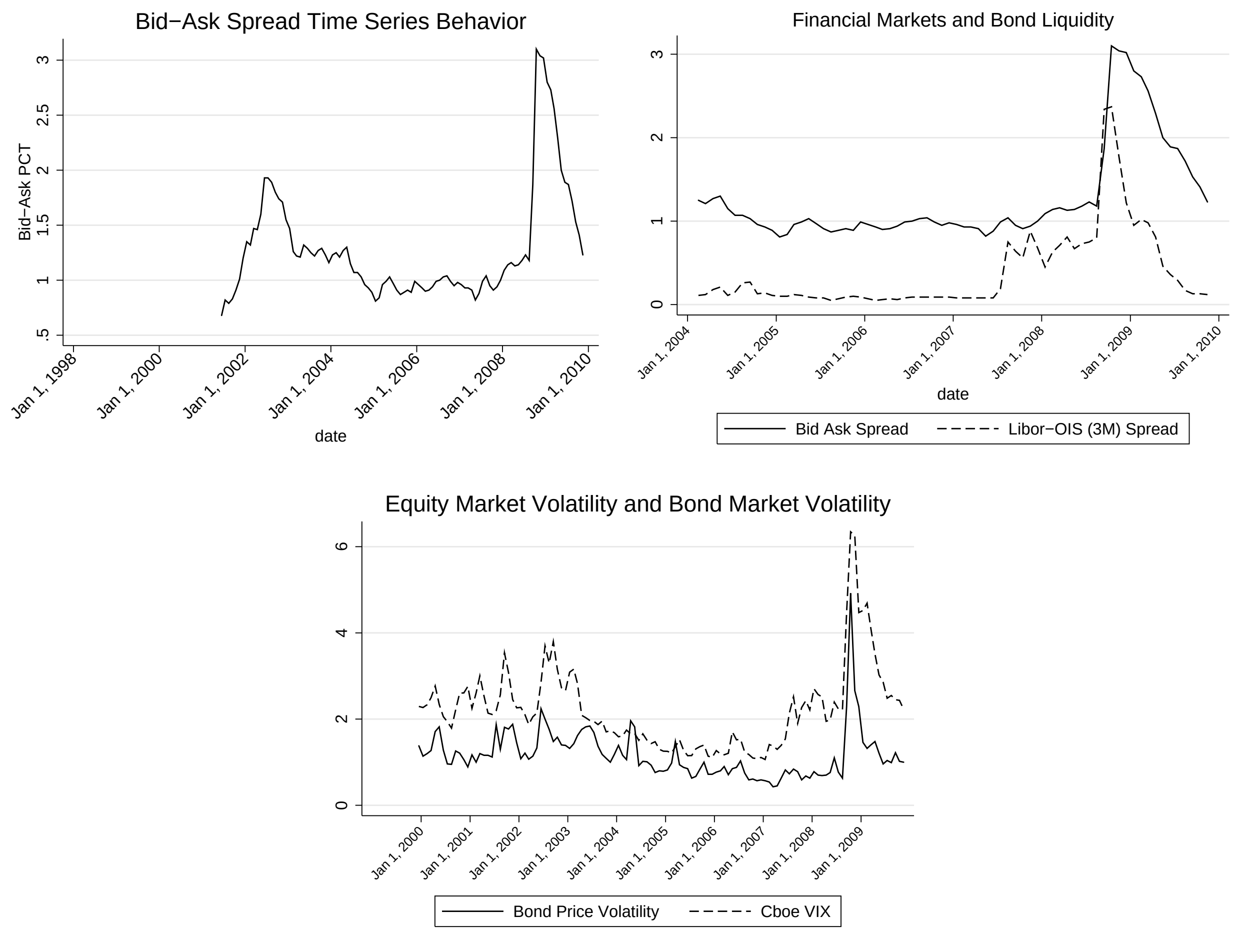

Figure 2: **Impulse Response Functions** These figures document dynamic responses of sovereign international bond liquidity to orthogonalized one-time unit standard deviation shocks in itself and the other variables. They are computed using standard Cholesky decompositions of the VAR residuals and assuming that innovations in the variables placed earlier in the VAR have greater effects on the following variables. The variable definitions can be found in the Data section of the text. The data are available at Thomson Financial Datastream.

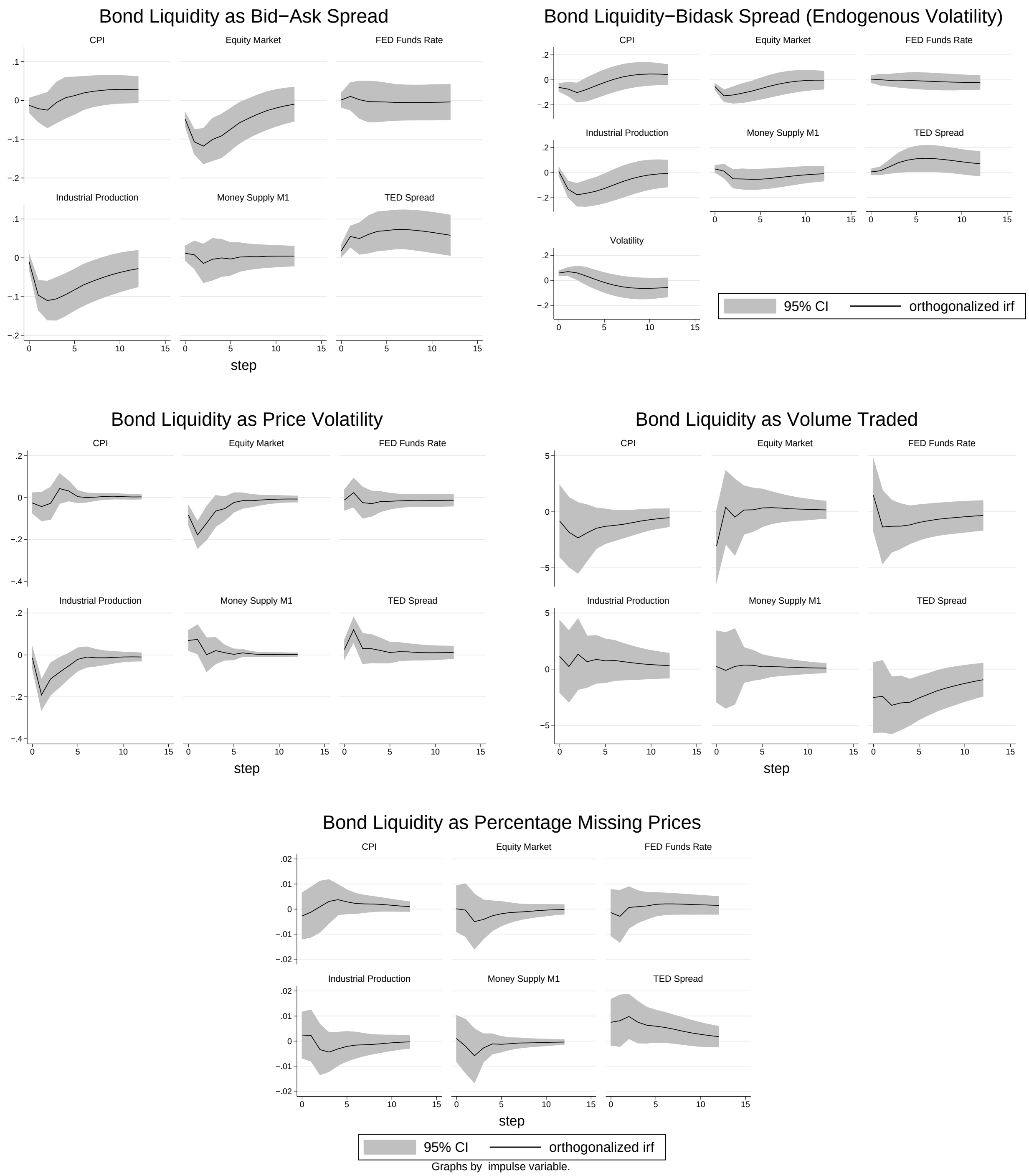

Figure 3: **Sub-Sample 1999 to 2006 and 2006 to 2009 Impulse Response Functions** These figures document dynamic responses of sovereign international liquidity in two sub-samples of time to orthogonalized one-time unit standard deviation shocks in itself and the other variables. They are computed using standard Cholesky decompositions of the VAR residuals and assuming that innovations in the variables placed earlier in the VAR have greater effects on the following variables. The variable definitions can be found in the Data section of the text. The data are available at Thomson Financial Datastream.