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Understanding Common Factors in Domestic and International Bond Spreads*

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Abstract. I study the determinants of changes in credit spreads for U.S. dollar denominated domestic and foreign sovereign bonds using fundamentals specified by structural models to separate spreads into their credit and non-credit components. I find that the non-default portions of spreads have a component that is common for each type of debt. Further, using a vector autoregressive model, I find that domestic spreads are related to the lagged component of sovereign spreads. I also find that some proxies for liquidity are related to the common components, suggesting a liquidity-based explanation for the common component not identified by previous research.

JEL Classification: G10, G15, G19

1. Introduction

In this paper I analyze the determinants of credit spread changes of individual U.S. domestic corporate and foreign sovereign bonds. Credit spreads, computed as the difference between bond yields and the yield of U.S. Treasuries, are a benchmark measure of credit risk.[1] Previous research has focused on either corporate bonds or sovereign bonds at a time, making this paper the first one to bring together the credit spreads on these two types of debt to study their joint dynamics. This is important because if the market for dollar-denominated credit-risky bonds is integrated, we can expect credit and non-credit related shocks to affect all types of bonds alike.

Extant literature in spread changes of U.S. domestic corporate bonds identified a common component unrelated to credit risk (Collin-Dufresne, Goldstein, and Martin, 2001; Huang and Huang, 2003); one goal of this paper is to address the question whether the information present in the time series cross-section of the

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[1] The credit spread is often referred to as yield spread, debt spread or simply spread. These terms are used interchangeably in this paper.

non-default component of U.S. dollar sovereign debt spread changes is related to the domestic corporate component documented in prior research. This should especially be the case if those common components can be explained by liquidity shocks, since such shocks are pervasive across markets (Chen, Lesmond, and Wei, 2007; Chordia, Sarkar, and Subrahmanyam, 2005; Kamara, 1994). To investigate this issue, I study whether common factors that explain credit spread changes for domestic corporate and foreign debt after taking into account fundamentals are related and then analyze the determinants of these common factors.

Existing research investigates separately the existence of common components in changes of credit spreads for domestic credit-risky debt and dollar-denominated sovereign debt. Scherer and Avellaneda (2002) identify the existence of two common factors for foreign sovereign debt spread changes. Westphalen (2003) finds evidence of a common factor for changes in sovereign debt spreads denominated in several currencies after controlling for country risk proxies. Research on changes in domestic corporate bond credit spreads by Collin-Dufresne, Goldstein, and Martin (2001) finds one common component after controlling for fundamentals. The relation between all these common components—domestic and foreign— has not been examined previously in the literature.

I extend the research on common components present in bond spreads by examining whether the information in the dynamics of U.S. dollar denominated sovereign (foreign) debt spreads is associated with the common component found in U.S. corporate bond spreads. Specifically, I estimate different models of spread changes for each type of bonds – domestic corporate and foreign sovereign – because these two groups vary in their source of credit risk. Applying principal component analysis techniques to each debt type, I extract common factors from the unexplained portion of credit spread changes (i.e., the residuals from regressing credit spreads on variables motivated by structural models) and then investigate if the common factor in U.S. dollar denominated sovereign debt is related to the common factor present in U.S. corporate debt. These common factors are then analyzed using a vector autoregressive model of changes in spreads that includes several proxies for liquidity.

The idea that bond spreads suffer from liquidity-based problems has been discussed before, although never simultaneously for both groups of debt. For instance, Berndt, Douglas, Duffie, Ferguson and Schranz (2005) and Driessen (2005) mention that bond spreads are corrupted by tax and liquidity effects. More recently, Hund and Lesmond (2006) show that liquidity risk is an important component of bond spreads for foreign firms and governments, even after controlling for macroeconomic and firms-specific characteristics. In this paper I first set to study if the non-credit components of domestic and sovereign spreads are related, and then I investigate whether these components are related to macro measures of liquidity in bond markets.

To test these ideas, I construct a dataset that is comprised of all domestic industrial and U.S. dollar-denominated sovereign debt. This dataset contains data for 230 non-callable, non-puttable bonds issued by 34 emerging countries and 1,031 domestic corporate bonds issued by 183 different companies that traded between January 1994 and December 2002. This dataset is different from those used by earlier studies because it uses a panel of yields and spreads that I construct using NAIC transaction data, available from the Fixed Income Security Database.

My results help discriminate between competing explanations for the common component previously documented for domestic debt, and also suggest new explanations. I find strong evidence of the existence of a common factor unrelated to credit risk in debt spread changes of U.S. denominated foreign sovereign debt and in the debt spread changes of domestic corporate bonds. While principal component analysis suggests the presence of a contemporaneous correlation between the two factors, a vector auto-regressive (VAR) model shows that domestic spread changes are related to the lagged sovereign spread common component. I also find that the factors are related to a measure of liquidity in international bond markets that I construct using Brady and eurobond issues. My results together suggest that liquidity shocks might affect foreign sovereign bonds first and then are transmitted to domestic issues.

The results I obtain improve our understanding of the determinants of the cost of debt for foreign countries and for domestic firms. For example, these results suggest that the cost of debt for foreign countries and domestic firms is not only a function of their own creditworthiness but also depends on shocks that affect all debt. Further, these results help us understand better the extent to which the sovereign and domestic corporate bond markets are integrated. In a fully integrated dollar debt market, we would expect the relation between domestic corporate credit spreads and sovereign credit spreads to be contemporaneous. My results suggest this is indeed the case, albeit with a twist. The contemporaneous relation between the common components of domestic corporate credit spread changes and foreign sovereign credit spread changes suggests that the cost of debt for emerging markets depends mostly on shocks that are common across countries and less on country and emerging market specific considerations. This paper is the first to provide evidence of integration in bond markets consistent with the literature that emphasizes the impact of developed country developments for capital flows into emerging markets (Calvo, Leiderman, and Reinhart, 1993; Chuhan, Claessens, and Mamingi, 1998).

This paper proceeds as follows. Section 2 describes the literature, sample, and variables used to model credit spread changes for sovereign and domestic bonds. Section 3 investigates, using a variety of techniques, the existence and nature of the factors affecting debt spread changes. Section 4 analyzes the dynamics of the common factors and investigates whether they are related to liquidity and/or demand related variables. Section 5 concludes.

2. Debt spreads of sovereign and corporate bonds

To examine whether the same common factor is associated with the variation in U.S. domestic corporate and U.S. dollar denominated sovereign spreads, the unexplained variation in each spread (i.e., residuals) must be calculated. My choice of variables to compute the credit risk portion of debt spread changes is based on determinants of bond spread changes specified by structural models.[2]

The determinants of sovereign debt spreads have been studied by Eaton and Gersovitz (1981), Bulow and Rogoff (1989), Edwards (1984), and Hernández-Trillo (1995). Cantor and Packer (1996) and Eichengreen and Moody (1998) study the determinants of bond spreads at the issue level, and more recently, Scherer and Avellaneda (2002), Joutz and Maxwell (2002) and Cifarelli and Paladino (2002) study selected series from several emerging markets using principal component analysis and vector-autoregressions.

On the domestic debt side, the first structural model of risky debt is by Merton (1974), using an option pricing approach to include systematic and idiosyncratic risk in the calculation of the value of a put option on the firm's value.[3] Different extensions to this basic model have been introduced by Black and Cox (1976), Longstaff and Schwartz (1995), Anderson and Sundaresan (1996), Mella-Barral and Perraudin (1997), Leland (1994), and Leland and Toft (1996) among many others. Recently, Huang and Huang (2003) calibrate several classes of structural models to be consistent with the recent history of observed defaults and find that different models could generate the wide range of credit spreads observed in the recent past. Elton, Gruber, Agrawal, and Mann (2001) set to explain domestic corporate spreads using explanatory factors that include the probability of default, the loss given default, and the difference in tax regimes. Collin-Dufresne et al. (2001) explain changes in the credit risk portion of domestic corporate spreads using data on spot rates, reference yield curve slope, firms leverage and volatility, estimates for jumps in the firm's value and a proxy for the general business climate. Both papers, using different approaches, conclude that a large portion of the cross-sectional time variation of debt spreads remains unexplained by credit related variables. Further, Collin-Dufresne et al. (2001) find that a single common factor could explain up to 75% of the variation unrelated to credit, yet they fail to identify what this common factor is proxying for.

[2] Another approach is the use of reduced-form models, which are based on an exogenously specified intensity process. See Merrick (2000), Pagès (2001) and Duffie, Pedersen, and Singleton (2003) for applications of this method.

[3] Specifically, Merton's (1974) model states that a risky zero-coupon bond has the same payoff structure as a risk-free bond plus being short a put option on the firm's value with a strike price equal to the face value of the debt.

2.1 DATA DESCRIPTION

The data for this paper comes from the Fixed Investment Securities Database (FISD) which includes debt security issue information from 1994 through 2002. This database consists of two modules. The first one provides issue level information about debt securities issued by corporations, U.S. Agencies, the U.S. Treasury and foreign issuers. The second module provides pricing information from the National Association of Insurance Commissioners (NAIC), and includes the buying and selling activities reported by insurance companies. A more detailed explanation about this database can be found in Cai, Helwege, and Warga (2007), and Campbell and Taksler (2003).

My starting point is the second module mentioned above. Following earlier literature, I eliminate all bonds that were callable and/or puttable at borrower's option, that had an early redemption feature and/or were extendible at the bond holder's option, and that were asset-backed. Further, because this database includes all bonds that have matured since 1990, my sample does not suffer from survivorship bias as do samples collected from databases that only report currently active (or "live") issues.

To form the sample of sovereign bonds, I keep only those classified as type "FGOV", meaning bonds issued by foreign governments and agencies. I then manually filter out bonds issued by agencies. I eliminate observations with less than 60 days to maturity.[4] After all these adjustments, the final sample contains 5,802 monthly observations from 230 bonds issued by 34 different countries that were traded between January 1994 and January 2002.[5] In the case of bonds with multiple observations in one calendar month I consider only the first trade in that month.[6]

To form the domestic sample I include all U.S. denominated bonds issued by industrial domestic firms. Applying the same selection criteria used for the sovereign sample, I end up with 1,031 bonds issued by 183 different firms during the January 1994 – December 2002 period for a total of 32,740 monthly observations.

This sample differs from previous studies in that, with the exception of Campbell and Taksler (2003), previous literature on credit spreads used the old FISD database

[4] Collin-Dufresne, Goldstein and Martin (2001) eliminate observations with less than 4 years to maturity because as these bonds approach their maturity date, they are less traded, which in turn dries up their liquidity and distorts prices and yields. Because I am using actual prices and not dealer quotes, this is not a problem with my data.

[5] I exclude Brady bonds from this part of the analysis because their characteristics are inherently different from regular sovereign bonds. The existence of collateral as well as the existence of value recovery rights attached to Brady bonds makes them difficult to value.

[6] A problem with the NAIC-UD transaction database is that it reports only transactions, and thus there is no regular periodicity in the data. In this paper, I assume that the first observation in a given month reflects all information available to investors at t-1, i.e., the previous month.

provided by Lehman Brothers. Regrettably, that database stopped being updated in 1998. This paper is among the first to construct and analyze a panel of yield spreads using the flat prices available for all actual transactions recorded in the NAIC-UH part of the FISD database. For each bond, I compute the yield to maturity using the information on coupon, maturity and periodicity of payments available in the first module of the FISD database. I then compute debt spreads as the difference between the yield of the bond and the value of a linear interpolation of the U.S. Treasury yield curve to obtain the yield of a U.S. instrument with the same maturity as the bond in question.[7]

Since all the bonds in the dataset are denominated in U.S. dollars, I include as control variables factors that affect the U.S. yield curve term structure. Litterman and Scheinkman (1991) show that the U.S. yield curve level and slope are important in explaining the term structure, so I collect monthly annualized yields for the on-the-run two and ten year Treasury notes.[8]

To capture a country's distance-to-default, i.e., its ability to keep servicing its debt, I collect monthly exports in U.S. dollars from the IMF's International Financial Statistics.[9] To construct a debt-to-exports ratio, I collect data on debt outstanding and foreign reserves from the joint BIS-IMF-OECD-World Bank statistics on external debt (Eaton and Gersovitz, 1981; Bulow and Rogoff, 1989; Krugman, 1985, 1989; Krugman and Rotemberg, 1991; Gibson and Sundaresan, 2005; Westphalen, 2002).[10] As a measure of country risk for emerging markets I use the Economist Intelligence Unit (EIU) countrywide index. It measures political, economic policy, economic structure, currency, sovereign debt and banking sector risks. This index can be used as a guide for the general risk a country

[7] I also collect the monthly U.S. Treasury yield curve using CMT (constant maturity treasuries) to calculate spreads. Results are insensitive to the choice of U.S. benchmark curve.

[8] Another reason to collect U.S. interest rates data is that if a country's wealth follows a stochastic process analogue to a firm's value process, the risk neutral drift will be positively related to the risk-free rate. An increase (decrease) in the risk-free rate should increase (decrease) the country's (or firm) wealth over time, making default less (more) likely to happen. Since an upward-sloping yield curve slope is, according to the expectations hypothesis theory of the term structure, predicting higher interest rates in the near future, I expect this slope to have some effect on spreads today. Also, a positively sloped interest rate term structure is interpreted as a signal of increased economic activity in the near future.

[9] It is important to note that the ability to repay is different from the willingness to pay for sovereign issuers. For example, Gibson and Sundaresan (1999) have a model where sovereign issuers can strategically default when the benefits from doing so outweigh the penalties incurred by the default.

[10] All figures are expressed in current U.S. dollars. One shortcoming of this database is that not all series are available on a quarterly basis and there are some gaps in the data, especially in the earlier 1990s.

Table I Expected signs on explanatory variables for sovereign sample

Variables	Expected sign	Rationale
Debt to foreign reserves ratio and Debt to exports ratio	Positive	A higher ratio of any of these two measures implies a smaller distance-to-default. So, larger values of them should be associated with higher spreads.
Country risk measure	Positive	This measure has a higher value for countries that are perceived to have higher political risks, for instance, higher expropriation risk. The larger the value of this variable, the higher the debt spread.
Local stock market volatility	Positive	This variable is an imperfect proxy of a country's wealth volatility. Still, I expect a positive relation since more volatility makes default more likely.
U.S. Treasury yield curve level	Negative	Assuming that the country's wealth follows a risk-neutral drift, higher rates should be associated with higher drifts which in turn should reduce debt spreads. Also, Stulz (2003) shows how debt value decreases with maturity. This reduces the probability of default, and ergo, spreads.
U.S. Treasury yield curve slope	Negative	A positive slope signals higher future interest rates. The previous arguments then suggest a negative relation between spreads and the interest rate slope.
World return	Negative	A world index return is included as a proxy of the world economic climate or business cycle. On average, I expect smaller spreads when the world as a whole is doing well.

represents because it assesses risks associated with investing in the financial markets (portfolio flows) of those economies as well as risks involved in direct investment.[11,12]

To get a measure of monthly local wealth volatility and local risk, I compute the volatility of Datastream local equity indices. For twenty one countries, I collect daily data for the local Datastream equity index. For eight additional countries, I collect daily data from their own local equity indices. For the remaining countries, the world total return index from Datastream is used. To correct for differences in the scales of the indices I compute the coefficient of variation (sample standard deviation over sample mean). I also collect the available history of Standard &

[11] The values are derived from measuring the risk associated with four aspects of the country. These aspects are: political risk, economic risk, economic structure risk and liquidity risk. The overall risk rating is measured on a scale from 1 to 100 where 1 denotes the least risk and 100 the most risk possible. For example, in December 2002, the value of the index was 78 for Argentina, 63 for Brazil and 48 for Mexico. Unfortunately, this index is available only since March 1997.

[12] I do not include traditional macro measures of economic growth because it has been shown that credit ratings do a good job at capturing their information (Cantor and Packer, 1996). Also, macro variables are available quarterly at best, whereas the EIU index (which includes macro information by construction) is published every month.

Table II Summary statistics for sovereign sample

The sample includes all non-callable, non-puttable sovereign bonds in U.S. dollars that traded between January 1994 and January 2002. The spread over U.S. Treasuries is computed as the difference between the yield of the bond and the value of a linear interpolation of the U.S. Treasury yield curve. Debt/Reserves is computed using all outstanding foreign debt (bank loans, Brady bonds and eurobonds) divided by the total number of international reserves in current U.S. dollars. Political risk is the value of The Economist Intelligence Unit's country index. The U.S. Treasury yield level is the yield of the 10 year U.S. Treasury note. The U.S. Treasury slope is computed as the difference between the yield of the 10 year and the 2 year U.S. Treasury notes. The world stock return is the log return of Datastream's world total return index.

Panel A: Descriptive Statistics for Spreads

Credit Spread (%)	All sample	AAA to BBB-	BB+ to CCC-
Mean	0.046	0.029	0.058
Std. Dev.	0.027	0.020	0.025
Skewness	0.817	1.385	0.851
Kurtosis	3.678	6.060	3.787
Max	0.166	0.143	0.166
90%	0.082	0.125	0.152
10%	0.013	0.010	0.012
Min	0.001	0.001	0.007
No. of observations	2559	1091	1468

Panel B: Means for Selected Country Variables

Mean	All sample	AAA to BBB-	BB+ to CCC-
Debt-to-reserves	4.55	3.69	5.10
Debt-to-exports	41.95	27.33	50.62
Political risk	49.3	44.0	52.5
U.S. Treasury yield level (%)	0.0540		
U.S. Treasury yield slope	0.5919		

Panel C: Other data

Number of bonds	230
Number of countries	34

Poor's (S&P) country ratings from Bloomberg, and follow Eom, Helwege, and Huang (2004) for translating S&P ratings into numerical values, where a rating of AAA has a value of 1, AA+ a value of 2 and so on.

Table I presents the predicted correlation signs between the variables previously mentioned and debt spreads. Table II reports summary statistics for the sovereign sample. Observations are grouped in either investment grade (AAA to BBB-) or high yield (BB+ to CCC-) according to their S&P rating. It is evident from panel A

Table III Expected signs on explanatory variables for domestic sample

Variables	Expected sign	Rationale
Leverage and Equity return volatility	Positive	A higher leverage ratio increases the probability of a firm facing financial distress. This should increase spreads. Also, from a contingent claims approach, equity return volatility can proxy for firm's value volatility. A higher volatility increases the chance of the firm's value process to cross the threshold at which a firm defaults on its debt.
U.S. Treasury yield curve level	Negative	Assuming that the firm's value follows a risk-neutral drift, higher rates should be associated with higher drifts which in turn should reduce debt spreads. Also, Stulz (2003) shows how debt value decreases with maturity. This reduces the probability of default, and ergo, spreads.
U.S. Treasury yield curve slope	Negative	A positive slope to signal higher future interest rates. The previous arguments then suggest a negative relation between spreads and the interest rate slope.
S&P 500 return	Negative	As the economic environment improves, measured by the S&P return, I expect firms to do better and therefore to reduce the probability of defaulting on their debt.

that both groups display a high degree of non-normality. Also, as expected, spreads increase as we move down in ratings. The mean debt spread in the overall sample is 456 basis points, the maximum spread is 16% and the minimum is 0.7 basis points. The standard deviation also increases as the rating deteriorates. There is evidence of extreme movements in each group as the 90% and 10% values are away from the mean by several standard deviations. Panel B reports the mean values, by group and for the overall sample, of some country specific variables. Debt-to-reserves, debt-to-exports and political risk, all increase in value as we move down in rating, signaling a worsening of a country's situation. Also, as expected, these variables have higher values as we move from investment grade to junk ratings.

For the domestic sample, following Collin-Dufresne et al. (2001) I compute leverage and collect information on the VIX index. I expect a negative relation between leverage and debt spreads, since an increase in the former would make default more likely. The inclusion of VIX is to control for market-wide volatility, and has been recently used also in Berndt, Douglas, Duffie, Ferguson and Schranz (2005). To compute the leverage ratio I collect book value of debt from COMPUSTAT (items 45 and 51) and the market value of equity from CRSP. Leverage ratios are then computed as:

$$\frac{\textit{Book Value of Debt}}{\textit{Book Value of Debt} + \textit{Market Value of Equity}}$$

To measure the exposure of firms to the economic cycle I collect monthly returns for the S&P 500 index from Datastream. Table III presents the predicted relations

Table IV Summary statistics for domestic sample

The sample includes all non-callable, non-puttable domestic bonds in U.S. dollars that traded between January 1994 and January 2002. The spread over U.S. Treasuries is computed as the difference between the yield of the bond and the value of a linear interpolation of the U.S. Treasury yield curve. Leverage is computed as the ratio of book value of debt divided by the sum of book value of debt and market value of equity. The U.S. Treasury yield level is the yield of the 10 year U.S. Treasury note. The U.S. Treasury slope is computed as the difference between the yield of the 10 year and the 2 year U.S. Treasury notes.

Panel A: Descriptive Statistics for Debt Spreads						
Credit Spread (%)	All sample	AAA and AA	A	BBB	BB	B and CCC
Mean	0.014	0.009	0.011	0.018	0.034	0.060
Std. Dev.	0.012	0.005	0.006	0.013	0.024	0.033
Skewness	4.203	1.265	2.113	3.010	2.277	1.147
Kurtosis	32.0	6.087	19.508	18.739	9.336	3.904
Max	0.174	0.048	0.123	0.140	0.172	0.174
90%	0.168	0.015	0.019	0.031	0.064	0.109
10%	0.0043	0.0036	0.0054	0.007	0.014	0.026
Min	0.0000	0.0001	0.0000	0.000	0.003	0.002
No. of observations	26269	4341	13384	6927	1332	285
Panel B: Means for Selected Variables						
Mean						
Leverage	0.336	0.244	0.326	0.368	0.484	0.614
U.S. Treasury yield level	0.05706					
U.S. Treasury yield slope	0.00455					
Panel C: Other data						
Number of bonds	1028					
Number of firms	391					

between these variables and domestic spreads. Table IV shows descriptive statistics for the domestic sample, classified by rating. As can be seen in Panel A, credit spreads increase as credit ratings deteriorate. Further, the standard deviation of credit spreads also increases with leverage. The presence of heavy tails in each category is evident from the dispersion observed in the max, min, 10% and 90% values. The values for the descriptive statistics of the domestic sample are in line with those presented in Collin-Dufresne et al. (2001).

2.2 MODELS FOR SOVEREIGN AND DOMESTIC SPREADS

I estimate the following equation for each bond observation in the sovereign sample:

$$\Delta \mathit{Spread}_{i,t} = \mathit{Constant} + \beta_1 \Delta \mathit{Lagged\ spread}_{i,t} + \beta_2 \Delta \mathit{Debt\ to\ foreign\ reserves\ ratio}_{i,t} + \beta_3 \Delta \mathit{Political\ risk\ measure}_{i,t} + \beta_4 \Delta \mathit{Political\ risk\ measure\ lagged}_{i,t} + \beta_5 \Delta \mathit{Local\ volatility}_{i,t-1} + \beta_6 \Delta \mathit{U.S.\ Treasury\ yield\ curve\ level}_t + \beta_7 \Delta \mathit{U.S.\ Treasury\ yield\ curve\ level\ squared}_t + \beta_8 \Delta \mathit{U.S.\ Treasury\ yield\ curve\ slope}_t + \beta_9 \Delta \mathit{Local\ return}_{t-1} + \epsilon_{i,t} \tag{1}$$

and the following equation for each bond in the domestic sample:

$$\Delta \mathit{Spread}_{i,t} = \mathit{Constant} + \beta_1 \Delta \mathit{Lagged\ spread}_{i,t} + \beta_2 \Delta \mathit{Leverage\ ratio}_{i,t} + \beta_3 \Delta \mathit{U.S.\ Treasury\ yield\ curve\ level}_t + \beta_4 \Delta \mathit{U.S.\ Treasury\ yield\ curve\ level\ squared}_t + \beta_5 \Delta \mathit{U.S.\ Treasury\ yield\ curve\ slope}_t + \beta_6 \Delta \mathit{VIX}_t + \beta_7 \Delta \mathit{S\&P\ return}_{t-1} + \epsilon_{i,t} \tag{2}$$

Following extant research, I estimate regressions on debt spread changes.[13] Coefficient are obtained using an OLS model controlling for fixed effects (country or firm, depending on the case) with robust standard errors. Sovereign regressions results are presented in Table V. Goodness-of-fit, measured by R-squared, ranges from 22% to 27%. For brevity, I focus on the results for the overall sample. The debt-to-reserves ratio has the correct sign but is not significant, while the political risk measure has a significant positive coefficient (as expected). One lag of the political risk variable is included to account for autocorrelation in this variable. This political risk variable measures the ability to service debt and the overall political and economic environment of the issuer. An increase in political risk would signal higher instability and/or the possibility of expropriation and therefore should be associated with a higher spread. An increase in the debt-to-reserves ratio could be caused by an increase in the nominal amount of debt or a decrease in international reserves, both of which should be associated with higher spreads. I find that coefficient estimates are not significant for the debt-to-exports variable when it is used in place of debt-to-reserves, so I do not report them.

The coefficient associated with the U.S. Treasury yield curve level is negative and highly significant. Previous work had obtained insignificant positive coefficients (Cline and Barnes, 1997; Kamin and von Kleist, 1999), and significant negative coefficients (Eichengreen and Moody, 1998). One interpretation of these negative

[13] See Collin-Dufresne et al. (2001). Another reason why I use spread changes is that for most series I cannot reject the existence of unit roots.

Table V Sovereign spreads fixed effect regressions

This table shows estimates of Equation (1) by OLS, controlling for country fixed effects and using Newey-West adjusted errors. Debt to reserves is the ratio of total debt outstanding (bank loans, Brady and eurobond issues) denominated in U.S. dollars divided by the total amount of international reserves also denominated in U.S. dollars. Debt to exports is the ratio of total debt outstanding (bank loans, Brady and eurobond issues) denominated in U.S. dollars divided by the nominal monthly value of exports in U.S. dollars. Political risk is the value of The Economist Intelligence Unit's country index. The U.S. Treasury yield level is the yield of the 10 year U.S. Treasury note. The U.S. Treasury slope is computed as the difference between the yield of the 10 year and the 2 year U.S. Treasury notes. The world stock return is the log return of Datastream's world total return index. Absolute values of t statistics are in parentheses; *, **, *** denote significance at the 10%; 5%; and 1% level respectively.

Δ Spread over U.S. Treasury	All sample	AAA to BBB-	BB+ to CCC-
Constant	−0.00062	−0.00142	−0.00053
	(0.94)	(3.70)***	(0.70)
Δ Lagged spread	−0.22283	−0.16979	−0.22575
	(5.25)***	(2.35)**	(4.67)***
Δ Debt to foreign reserves	0.00031	0.00191	0.00126
	(1.29)	(1.27)	(0.73)
Δ Political risk	0.00106	0.00061	0.00114
	(2.68)**	(1.18)	(2.66)**
Δ Political risk lagged	0.00061	0.00031	0.00067
	(1.74)*	(0.77)	(1.63)
Δ Local volatility lagged	0.00028	0.00048	0.00026
	(1.56)	(1.94)*	(1.22)
Δ U.S. Treasury level	−1.02959	−0.73052	−1.08574
	(4.88)***	(5.11)***	(3.55)***
Δ U.S. Treasury level, squared	42.37883	145.24202	42.25936
	(0.91)	(2.01)*	(0.79)
Δ U.S. Treasury slope	0.90406	0.23379	1.08319
	(3.22)***	(1.15)	(2.84)**
Local return lagged	−0.01639	−0.01317	−0.01718
	(4.56)***	(2.43)**	(3.86)***
Observations	891	195	617
R-squared	0.22	0.27	0.22

coefficients is that, as interest rates go up, low rated countries find it less convenient to issue debt. Also, most structural models predict a negative relation because higher interest rates increase the drift of the process followed by the firm's (in this case, country's) value.[14] A higher firm (country) value should be associated with a smaller spread and hence the negative sign.

Interestingly, the coefficient associated with the U.S. Treasury slope term is positive and significant. Following the expectations theory of interest rates, a positively sloped yield curve signals higher future rates, which should be associated with smaller spreads. Two reasons for this effect were previously mentioned. First, we

[14] See Longstaff and Schwartz (1995).

Table VI Domestic spreads fixed effect regressions

This table shows estimates of Equation (2) by OLS, controlling for firm fixed effects and using Newey-West adjusted errors. Leverage is book value of debt divided by the sum of book value of debt + the market value of equity. The U.S. Treasury yield level is the yield of the 10 year U.S. Treasury note. The U.S. Treasury slope is computed as the difference between the yield of the 10 year and the 2 year U.S. Treasury notes. The S&P index return is the log return of the S&P 500 total return index from Datastream. Absolute values of t statistics are in parentheses; *, **, *** denote significance at the 10%; 5%; and 1% level respectively.

Δ Spread over U.S. Treasury	All sample	AAA and AA	A	BBB	BB	B and CCC
Constant	−0.00003	−0.00013	−0.00019	0.00015	0.00216	0.00215
	(0.25)	(0.97)	(1.70)*	(0.54)	(1.39)	(0.84)
Δ Lagged spread	−0.32498	−0.45093	−0.30496	−0.38894	−0.40284	−0.13029
	(3.41)***	(8.10)***	(8.88)***	(4.73)***	(1.84)*	(0.79)
Δ Leverage	0.02197	−0.00015	0.00973	0.0099	0.09287	0.08936
	(3.64)***	(0.04)	(3.27)***	(2.30)**	(2.05)*	(4.07)***
Δ U.S. Treasury level	−0.34036	−0.22391	−0.28933	−0.35939	−0.78654	−1.21269
	(9.21)***	(4.54)***	(7.29)***	(6.10)***	(1.36)	(1.44)
Δ U.S. Treasury level, squared	18.77551	35.12143	30.99838	1.47139	−22.86497	−2.19106
	(2.20)**	(2.07)**	(2.99)***	(0.10)	(0.15)	(0.02)
Δ U.S. Treasury slope	−0.00662	−0.07811	0.00162	0.28512	−2.08719	−1.56681
	(0.08)	(1.16)	(0.02)	(1.27)	(1.40)	(1.12)
Δ VIX	0.0001	0.00012	0.00005	0.00009	0.00049	0.00062
	(4.07)***	(6.33)***	(2.42)**	(1.95)*	(2.42)**	(0.87)
S&P return lagged	0.00492	0.00771	0.00169	0.00838	−0.00911	0.12294
	(2.20)**	(5.14)***	(0.99)	(1.75)*	(0.38)	(1.81)
Observations	4295	680	1885	1046	197	54
R-squared	0.14	0.27	0.18	0.18	0.26	0.17

could expect the average quality of sovereign issuers to increase because low rated countries decide not to issue debt and this increase in overall quality puts downward pressure on spreads. Second, higher rates will mechanically increase the distance to default in most Merton-based structural models which would also lead to a decrease in spreads. Local volatility is positive, as expected, but not significant. The local stock return has the expected (negative) sign and is significant.

Results from the domestic regressions are reported on Table VI. The model has a fit consistent with the results presented in Collin-Dufresne et al. (2001), with R-squared values between 14% and 27%. The coefficients associated to leverage are (in all rating groups but the highest one) positive and strongly significant. It is not surprising that leverage is not a significant determinant of spreads for the highest quality bonds because earlier research has been shown that higher quality spreads are less sensitive to credit variables than credit spreads of lesser quality bonds (Helwege and Turner, 1999).

The sign of the U.S. yield curve level is also as expected and similar to the results obtained by earlier studies. In contrast to the sovereign sample, nothing conclusive can be said about the sign and significance of the coefficient estimated for changes of the U.S. Treasury slope. Coefficients for the VIX measure are in all cases positive and significant, thus establishing a positive relation between volatility in the overall market and credit spreads.

3. Analyzing the common factor

As previously mentioned, a goal of this paper is to investigate whether the common factor identified in domestic credit spread changes also is present in sovereign debt spread changes. In this section, I establish the existence of a common factor in residuals from the regressions on sovereign and domestic debt spread changes using principal components analysis. This is a statistical technique for data reduction whose objective is to find unit-length linear combinations of the original variables that capture the maximum variance. I apply principal component analysis to the residuals obtained from the regressions discussed in the previous section to verify whether the unexplained variation is truly noise or whether there is evidence of a common factor driving this unexplained portion of the variance of credit spread changes.

The first problem faced when applying principal components analysis is how to organize unbalanced panels in the most efficient form. Boivin and Ng (2006) show that more data is not necessarily better when conducting this type of factor analysis. In fact, they show that in their sample of 147 series, factors extracted from as few as 40 variables could be more informative than factors extracted from all series. Their result obtains because of large cross-correlation in errors and of small variability of the common components. The conclusion from work in this area is that there is no clear rule on the optimal number of series to include when conducting principal component or factor analysis. It is clear, though, that applying principal component analysis to all the bonds in my sample is not a good idea because that would most likely increase the amount of statistical noise while adding little or no new information at all.

I follow the approach implemented by Collin-Dufresne et al. (2001) and create groups or 'bins' of data to efficiently summarize the information content of the residuals. I divide each sample (sovereign and domestic) into three maturity categories and five leverage categories (three debt-to-reserves categories, in the sovereign case), creating a total of nine 'bins' in the sovereign sample and fifteen in the domestic sample. Each observation is assigned to a bin. I estimate again Equations (1) (for the sovereign bins) and (2) (for the domestic bins), compute the residuals, and calculate averages across residuals for each bin. It is on these bins that I conduct principal component analysis.

Table VII shows the results of applying this eigenvalue decomposition to the bins constructed earlier. Panel A shows strong evidence of the existence of a common factor in sovereign spreads. The first common factor explains 68% of the variation, as shown by the proportion of the first eigenvalue. The second common component explains the remaining variance that is orthogonal to the first common component. It is difficult to interpret the second eigenvalue as evidence of a second component because its value is well below the value of the first eigenvalue and is much closer to the third eigenvalue. According to Scherer and Avellaneda (2002), a number between 65% and 80% for the first common component would be considered to be indicative of strong co-movement characterized by a high correlation in the spread changes. My results support theirs.

Panel B of Table VII also shows strong evidence of the existence of a common factor to all domestic spreads. The first common component explains 88% of the variance. The existence of a first common factor that explains such a large portion of the variance is consistent with previous research, e.g., Collin-Dufresne et al. (2001). Panel C displays results of analyzing residuals from sovereign and domestic bonds together. As expected, I find evidence suggesting the existence of a factor common to both groups of bonds which explains 64% of the variation across both groups of debt. The result I obtain can be interpreted as evidence that the market for dollar-denominated credit-risky bonds is integrated, and if the common component I find can be explained by liquidity shocks, then such shocks should be pervasive across markets (Chen, Lesmond, and Wei, 2007; Chordia, Sarkar, and Subrahmanyam, 2005; Kamara, 1994).

In order to shed more light on the issue of whether the common factor identified in both samples is indeed the same in both groups, I extract the common component of each sample to compare them. The common factors are plotted in Figure 1. The interpretation of the units in the y-axis is as follows. To compute the principal components, I analyzed the correlation matrix. This is equivalent to all the variables to having mean 0 and standard deviation 1. Thus, the common factors are expressed in terms of these standardized variables.

The pattern seems to suggest a lead-lag relation between the factor from the domestic sample and the factor extracted from the sovereign sample, with the latter leading the former. I investigate these issues further in the next section.

4. The information content of the common factors

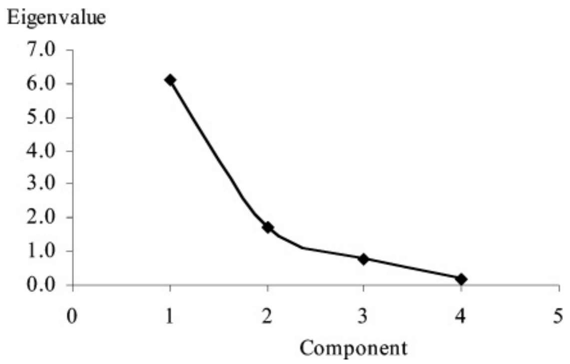
The principal component analysis conducted in the previous section does not provide information on the dynamics of the factors identified nor provides an economic interpretation of them. In this section I investigate the contemporaneous and intertemporal relation between factors and also investigate whether these factors might be capturing liquidity and/or supply-demand shocks.

Table VII Principal component analysis of residuals

This table presents the results of applying principal components analysis to the residuals. The sovereign sample was divided in three maturity and three debt to reserves categories, for a total of nine bins. The domestic sample was divided in three maturity and five leverage categories, for a total of fifteen bins. Each observation is then assigned to a category, and the regressions from tables 5 and 6 are applied to them. Residuals for each bond were computed and averaged across bins. For ease of interpretation, only the first four components are shown for each panel.

Panel A: Sovereign bins

Component	Eigenvalue	Difference	Proportion	Cumulative
1	6.110	4.365	0.679	0.679
2	1.745	0.987	0.194	0.873
3	0.758	0.562	0.084	0.957
4	0.196	0.113	0.022	0.979



Panel B: Domestic bins

Component	Eigenvalue	Difference	Proportion	Cumulative
1	13.236	12.524	0.882	0.882
2	0.711	0.215	0.047	0.930
3	0.496	0.184	0.033	0.963
4	0.313	0.152	0.021	0.984

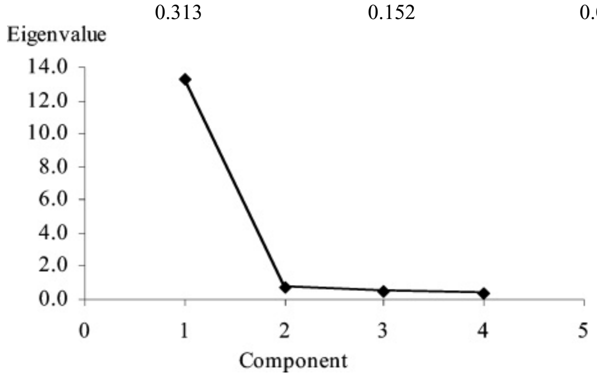
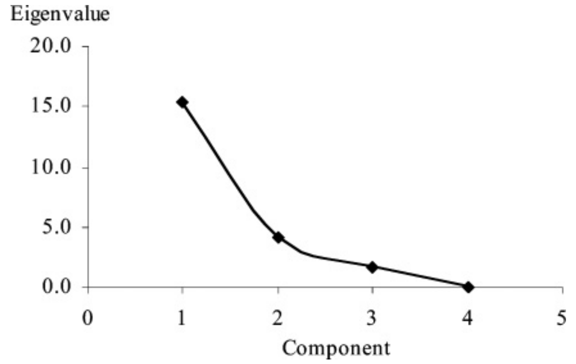


Table VII (*Continued*)

Panel C: Domestic and Sovereign bins				
Component	Eigenvalue	Difference	Proportion	Cumulative
1	15.388	11.177	0.641	0.641
2	4.211	2.511	0.176	0.817
3	1.700	0.930	0.071	0.887
4	0.770	0.073	0.032	0.920



4.1 LEAD-LAG RELATIONS

The picture shown in Figure 1 suggests the possibility of an intertemporal relation between the factor extracted from the sovereign sample and the factor extracted from the domestic sample. Using a vector-autoregressive approach (VAR), I investigate the possibility of one of these markets reacting before the other in response to potential problems that can affect the bond market in general. Previous research like Joutz and Maxwell (2002) and Cifarelli and Paladino (2002) have applied VAR procedures in a credit spread framework to study the relation between credit spreads from different countries. More recently, Longstaff, Mithal, and Neis (2005) applied a VAR framework to study the relation between bond and credit derivatives markets. To explore a potential lead-lag relation between the sovereign and the domestic factors, I use the following vector-autoregressive specification:

$$FacSov_t = a_1 + \sum_{j=1}^{k} \beta_{1j} FacSov_{t-j} + \sum_{j=1}^{k} \gamma_{1j} FacDom_{t-j} + \delta_1 X_t + \varepsilon_1 \quad (3)$$

$$FacDom_t = a_2 + \sum_{j=1}^{k} \beta_{2j} FacSov_{t-j} + \sum_{j=1}^{k} \gamma_{2j} FacDom_{t-j} + \delta_2 X_t + \varepsilon_2 \quad (4)$$

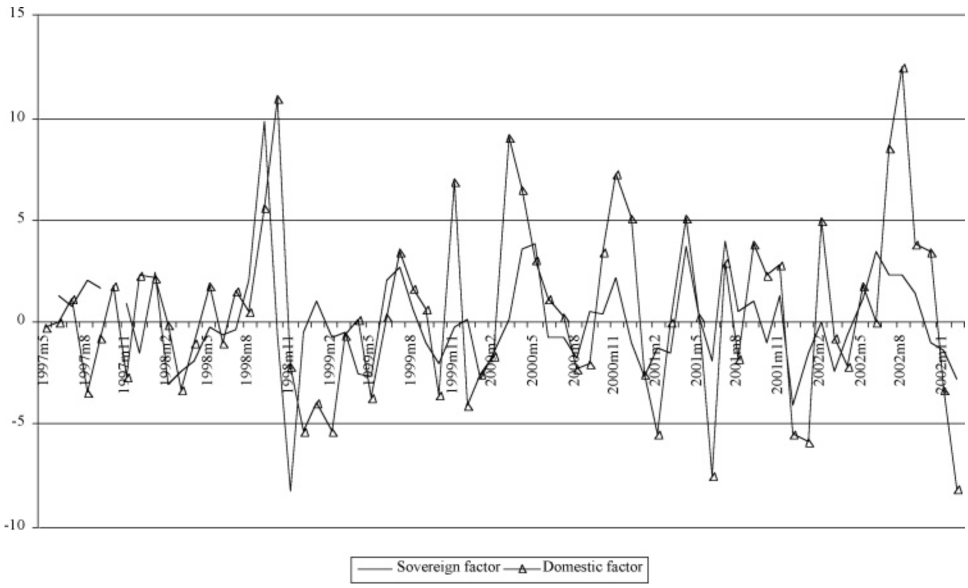


Figure 1. Common factors from the domestic and sovereign sample

Table VIII shows the results for the case when *k* is equal to two. Both the Akaike Information and Schwartz criteria suggest that a VAR system of two lags is warranted by the data. I first run the VAR model without exogenous variables to have an initial idea of the lead-lag structure. We can see in the first two columns of Table VIII the basic lead-lag relation, where the sovereign factor leads the domestic factor.

The following two columns include exogenous variables in the VAR system. These variables are chosen to capture macro liquidity and supply/demand effects. Most previous studies dealing with credit spreads specifically abstain from incorporating liquidity effects because of the lack of consensus on how to measure and model liquidity that affects spreads (Chen, Lesmond, and Wei, 2007). Longstaff, Mithal, and Neis (2005) study the consistency of the price of credit risk between the bond and derivatives markets. They find that the implied cost of credit is higher in the bond market than in the credit derivative market, and advance a possible explanation for this based on the existence of a liquidity component affecting negatively debt spreads. Their measure for this liquidity premium is the difference between the price of credit risk in the bond and credit derivative markets.[15]

[15] Collin-Dufresne et al. (2001) point that Chakravarty and Sarkar (1999), Hotchkiss and Ronen (2002) and Schultz (2001) found evidence of the existence of relatively high transaction costs and low volume in bond markets, and therefore, Collin-Dufresne et al. (2001) interpret these results as evidence of a liquidity premium.

Table VIII VAR system and OLS regressions of the common factors

This table shows estimates a vector autoregression in the first two columns and from OLS regressions in the last two columns. The domestic factor is extracted from the principal component analysis of the residuals of the equation (4) applied to the domestic bins. The sovereign factors is extracted from the principal component analysis of the residuals of the equation (3) applied to the sovereign bins. Net borrowed reserves are computed as total borrowing minus extended credit minus excess reserves, divided by total reserves. Onoff is the difference between the on-the-run thirty year U.S. Treasury bond and the most recent off-the-run bond. Spread brady is the difference in yield between a Brady bond and a Eurobond issue from the same issuer with similar maturities. Flowstocks is from the IFC's statistics and is the amount of money flowing into equity mutual funds. Flowbonds is from the same source and represents the flows into bond funds. z-values are in parenthesis for the VAR system, t-stats are in parenthesis for the OLS regressions. *, **, *** denote significance at the 10%; 5%; and 1% level respectively.

	VAR system				OLS	
	Domestic factor	Sovereign factor	Domestic factor	Sovereign factor	Domestic factor	Sovereign factor
Constant	0.6054	0.0770	0.4856	−0.1489	0.3811	−0.1503
	(1.240)	(0.240)	(1.000)	(0.560)	(0.850)	(0.570)
Δ flowstocks			0.0245	0.0022	0.0290	0.0041
			(0.750)	(0.120)	(0.860)	(0.210)
Δ flowbonds			−0.0794	−0.0070	−0.0751	−0.0010
			(0.800)	(0.130)	(0.890)	(0.020)
Δ netreserves			−9.3887	−4.4789	−3.2092	−2.9855
			(0.790)	(0.680)	(0.630)	(0.780)
Δ onoff			−1.4400	2.6695	−9.0806	2.0167
			(0.080)	(0.260)	(0.410)	(0.240)
Δ spread brady			**−1.2415**	**−2.3075**	**−1.4283**	**−2.1876**
			(1.670)*	**(5.650)*****	**(2.500)*****	**(4.050)*****
1st factor domestic						
Lag 1	0.1112	−0.0590	0.1432	0.0077		
	(0.840)	(0.680)	(1.060)	(0.100)		
Lag 2	−0.0788	−0.0604	−0.0693	−0.0575		
	(0.600)	(0.700)	(0.530)	(0.800)		
1st factor sovereign						
Lag 1	**0.5232**	0.2306	**0.4446**	0.0605		
	(2.660)***	(1.580)	**(2.180)****	(0.540)		
Lag 2	−0.3025	−0.1116	−0.3321	−0.0803		
	(1.470)	(0.820)	(1.610)	(0.710)		
Obs	62	62	62	62	74	66
R-squared	0.1538	0.0765	0.3103	0.4422	0.0719	0.3443

Since all the bonds in the sample are denominated in U.S. dollars and they all trade in U.S. financial markets, I am interested in variables that could measure liquidity in these markets. I use three measures of macro liquidity. The first proxy is the difference in yield between the on-the-run thirty year U.S. Treasury bond and the most recent off-the-run bond.[16] Off-the-run bonds are bonds that whilst not being the most recently issued in a certain maturity range, are almost identical to the on-the-run issue in all respects. Therefore, any differences in prices for these bonds—and therefore in their yields—are usually attributed to differences in liquidity. As liquidity dries up, this difference is expected to decrease.

The second proxy for macro liquidity in the market is a measure of the net borrowed reserves from the Federal Reserve. This is considered a measure of the monetary stance.[17] A loose monetary policy usually implies an increase in liquidity via the decrease of credit constraints. Harvey and Huang (2002) showed that the Federal Reserve, through its ability to change the money supply, impacts the trading of bonds and currencies. Following Chordia, Sarkar, and Subrahmanyam (2005) I define net borrowed reserves as total borrowing minus extended credit minus excess reserves, divided by total reserves. Since borrowed reserves represent the amount that banks are short to satisfy the Fed's requirements, a lower value of this measure indicates looser monetary conditions.

The third proxy for liquidity that I use is the difference in yield between a Brady bond and a regular eurobond issue for a given country. This was a popular hedge fund strategy in the 1990s, known as the Brady-bond/eurobond puzzle. The idea is a simple one and involved taking offsetting positions in dollar-denominated Brady bonds and dollar-denominated sovereign bonds traded in euro market. Following on this idea, I compute a natural proxy for liquidity by taking the difference between the implied sovereign yield of eurobonds and the sovereign yield of Bradys (stripped yield) and then averaging across countries.[18] Because Eurobonds and Brady bonds are both dollar denominated and have the same underlying credit risk, differences between the stripped Brady yield and the Eurobond yield can be attributed to a measure of sentiment that effectively produces differences in liquidity between bonds. The countries for which this measure is available are Argentina, Brazil, Bulgaria, Dominican Republic, Ecuador, Mexico, Nigeria, Peru, Philippines, Poland, and Venezuela.[19]

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[16] An on-the-run bond is the most recently issued (and typically the most liquid) government bond with a given maturity.

[17] See Chordia, Sarkar, and Subrahmanyam (2005).

[18] As mentioned earlier, the Brady bond program allowed attaching value recovery rights that were different across countries. In the case of Mexico, for instance, the bonds had long-term oil options embedded that were very difficult to value. The use of stripped yields alleviates this problem by "stripping" the bond from the option and providing an estimate of the yield for the bond portion only.

[19] In the early 2000s there was a tendency for sovereigns to retire par and discount Brady bonds, mostly to free up the Treasuries pledged as collateral. For instance, Mexico's Ministry of Finance and Public Credit announced on April 7, 2003 that it was calling US $3,839 million of its dollar-denominated Series A and B Brady Par Bonds, which were the last outstanding series of Mexican Brady Bonds denominated in dollars. This trend does not affect substantially this paper as my sample ends in June 2003.

To capture possible supply/demand shocks I collect data from the Investment Company Institute (ICI) on the monthly flows into mutual funds. ICI's statistics are collected from approximately 8,300 mutual funds, and are divided in flows into equity funds and bond funds. These measures could potentially capture changes in investor's attitudes towards risk or any other supply/demand shocks unrelated to overall market liquidity.[20]

Columns 3 and 4 of Table VIII report the results of the VAR model with the exogenous variables. The results for the domestic common factor equation are in column 3. The coefficient associated with the first lag of the sovereign factor remains significant, suggesting that the sovereign factor still leads the domestic factor. For both factors, the domestic and the sovereign, the only liquidity proxy that is significant is the variable I constructed with Brady bonds, with the expected negative sign. The R2 values of both equations increase substantially, from 15% to 31% in the domestic case and from 7% to 44% in the sovereign case.

The picture that emerges from the VAR system is that at least one of the exogenous variables (Spread Brady) is capturing a large portion of the time series variation of the common factors. Also, the lead-lag relation (sovereign leading domestic) seems robust to the inclusion of other variables. As mentioned above, the liquidity proxy I construct from Brady and euro issues is negative significant for both factors. Because of the way the Brady spread variable is constructed, this negative sign is what I expect. Recall that this variable is constructed as the difference between euro and Brady yields, averaged across countries. A smaller (more negative) value means less liquidity, because either the Brady issue was trading at a discount (higher yield) or the eurobond was trading at a premium (lower yield). Since I am using changes in all regressions, a positive value for this variable means more liquidity which in turn should be reflected in a smaller non-credit portion of debt spreads.

Overall, these results support the idea that traditional measures of macro liquidity do not capture the cross-sectional variation of credit spreads. A more ad-hoc measure, namely the Brady measure that I construct, does a much better job in the VAR equations. However, it remains unclear what this variable is proxying for. It can be argued that it is measuring some preference for certain issues for a given issuer, and this preference translates into differences in liquidity. For instance, practitioners tend to designate "flagship" issues for each issuer that are used as a quick and dirty benchmark for determination of spreads of individual issuers. The issue selected as flagship becomes the most traded one, and therefore the most liquid. A recent paper

[20] There is a potential endogeneity problem in these variables, since for instance, a change in the Fed's stance could make certain markets more attractive and influence the flows into those markets. No effort is made at this time to address this issue.

by Dittmar and Yuan (2008) documents the positive effects of sovereign bonds on their own corporate issues by extending or defining the yield curve, facilitating price discovery and issuance, and by lowering yields overall. The results presented in Table VIII suggest the possibility that some of the effects documented by Dittmar and Yuan (2008) spill over from foreign sovereign bonds into U.S. domestic corporate bonds, and this would be consistent with a liquidity-based explanation for the pattern I uncover. It is left for future research to look into what exactly the Spread Brady variable is proxying for.

5. Conclusions

In this paper I regress debt spreads of corporate bonds and of dollar denominated sovereigns on credit-related variables, and interpret the residual as the non-default portion of spreads. I then proceed to examine the extent to which the non-default component of corporates and sovereigns are related.

My key findings are as follows. First, I find evidence of a contemporaneous relation between the non-default portion of sovereign and corporate debt spreads. I document that the domestic non-default spread correlates with lagged sovereign non-default spread, and that both non-default spreads are linked to a proxy of liquidity in sovereign debt markets constructed from Brady bonds and eurobonds.

I also contribute to the literature by showing that current structural models of debt spreads can be improved if liquidity variables are incorporated. To the extent that investors depend on these models to hedge the credit risk of their bond positions, they can benefit from a better understanding of the determinants of credit spreads changes. My research also shows that, after taking into account the dynamics of the common components in credit spreads across debt types, the cost of debt for firms and countries depends on liquidity shocks that affect all types of debt.

There are issues left for future research. The asymmetric lead–lag relation between the domestic common factor and the sovereign factor needs to be investigated further. For instance, one would like to analyze if differences in liquidity across debt issues and/or infrequent trading help explain that relation. An alternate approach to measuring the size of the default related component may be to consider using credit default swaps (CDS) levels as a proxy for the default related component (Longstaff, Mithal, and Neis (2005), Berndt, Douglas, Duffie, Ferguson, and Schranz (2005), Blanco, Brennan, and Marsh (2005)). It would be interesting to analyze if this lead-lag relation also exists between bond and CDS data. If that is the case, this could suggest that a possible mechanism for the transmission of shocks during periods of heightened volatility could be through the non-credit portion of debt and swap spreads.

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