# Liquidity risk and market shock: an event study on emerging market corporate bonds

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**Abstract**

The 19th June 2013 markets were hit by the unexpected news of a potential early termination of the asset purchase program of the U.S. Federal Reserve Bank. A widespread market shock followed in various asset classes, particularly emerging market corporate bonds. This study focus on the price impact on corporate bonds issued by firms based in three emerging markets (Brazil, Mexico and Russia) and the behaviour of the liquidity risk component of their yields.

*Keywords:* liquidity risk corporate bonds emerging markets

## 1. Introduction

Emerging market corporate bonds are considered more illiquid than developed markets ones. Illiquidity is reflected in an additional premium demanded by investor for firms having similar credit risk characteristics. Huang (2003) shows that this stems from the premium demanded by agents to hold illiquid assets in their portfolio, due to their aversion to potential lower returns in case of adverse market conditions. Huang and Huang (2012) in fact demonstrated how credit risk accounts for a small fraction of yield spreads for investment grade bonds (so called "credit spread puzzle") and that the additional return required is driven mainly driven by asset's relative illiquidity.

This study investigates the impact of a market shock event, the unexpected news of a potential earlier termination of the US Federal Bank asset purchase program, on the behaviour of the liquidity component of EM corporate bond prices. This news emerged by a comment made by the Chairman of the Federal Reserve, Ben Bernanke, during the press conference of the Federal Open Market Committee (FOMC) that was held in Washington D.C. on 19th June 2013 at 2p.m. EST. During the end of the press conference, describe how the US economic conditions were improving and "[T]he Committee currently anticipate that it would be appropriate to moderate the monthly pace of purchases later this year". The unexpected earlier termination of the program generated an immediate price reaction across many asset classes, in particular bond yields, FX rates, equity and commodity prices. Anecdotal evidence shows that emerging market assets experienced a particular severe shock.

This particular event was chosen as it presents an unique natural experiment to assess the impact of the asset liquidity on their price during a sudden market shock.

There is currently no accepted measure able to capture the various dimension of liquidity. The approach followed in this paper is to decompose the observed bond yields spreads (i.e. the difference between a bond yiled and the yield of an equivalent riskless security) into a credit and a liquidity, or nondefault, yield component. This study use the methodology developed by the seminal paper of Longstaff et al. (2005), which used credit risk information incorporated in Credit Default Swaps (CDS) spreads to identify the liquidity risk component of U.S. corporate bond. The analysis of Longstaff et al. (2005) interpreted the default yield component based on CDS spread either as pure measure of risk or the liquidity differential between CDS and corporate bonds.

More recent studies have identified that CDS spreads can present wide bid-offer spread (Hui et al. (2014) and Tang and Yan (2007)), normally considered a measure of asset lack of liquidity. However as this study consider the mid CDS spread and therefore average any transactional CDS liquidity impact, this aspect is relatively less relevant as it focus on a theoretical ”pure” measure of credit risk.In order to address this the recent work of Helwege et al. (2014) estimated liquidity premium by analysing bond yields difference between matched pairs of corporate bonds, therefore ignoring the uncertainty linked to modelling credit risk and bond price as these bonds were issued by same firm at the same time, and therefore having the same credit risk profile.

The literature on emerging market bond liquidity is still relatively scarce, due in part to availability of market data. Hund and Lesmond (2008) have perform a study of emerging bond price changes for a panel of corporate and sovereign bonds of emerging market firms of countries.

## 2. The data

In this section I will discuss the data used in my empirical research.

### *2.1. Data*

Corporate bond and CDS information are sourced from Thompson Reuters and Bloomberg. Time series for each security price data have been constructed from 1st January to 1st July 2013, in order to include the date of the event under study (18 June 2013). Prices in particular are based on “generic” prices, signifying a consensus among market participants regarding the value of the bond, excluding so-called “fair value" prices, where a bond is priced using matrix-pricing techniques, and therefore not linked directly to observable market prices.

Bonds and CDS were selected based on the following geographical location of issuers: Brazil, Mexico and Russia.

The identification of the bonds to include in the sample for my study was based on criteria similar to those used by Longstaff et al. (2005):

1 - the issuer have observable CDS spreads,

2 - bonds have fixed coupons,

3 - bonds and CDSs are denominated in USD,

4 - bonds have a time to maturity less than 10 years and more than 1 year.

Credit Default Swaps pricing information has been sourced for all available tenors, generally 6 months, 1 year, 2 years, 3 years, 4 years, 5 years, 7 years, 10 years. Each curve has been interpolated daily with quarterly frequency through a cubic spline method .

The risk free rate is calculated on the basis of two parameters: the US constant maturity treasury data and on US Libor swap rate curve. Riskless rates have been calculated using Constant Maturity Treasury (CMT) data was sourced from the Federal Reserve Economic Data, published by the Federal Reserve Bank of St. Louis. CMT tenors collected are 3 month, 6 months, 1 year, 2 years, 5 years, 7 years, 10 years, 20 years and 30 years. A standard cubic splice algorithm was used to interpolated these par rates at quarterly intervals, that were then bootstrapped to provide a zero curve at quarterly intervals.

The US swap rated I have gather data for 3 months, 6 months, 1 year, 5 years, 7 years, 10years and 20 years par swap rates. These rates have been interpolated through an algorithm similar to the one used for the CMT.

The summary statistic regarding the sample under analysis are illustrated in the table below.

Table 1: Summary statistics of research sample

| Variable | Mean | (Std. Dev.) | Min. | Max. | N |
|---|---|---|---|---|---|
| Bond mid price | 107.282 | (7.74) | 80.971 | 133.249 | 23695 |
| Bond Yield-to-maturity | 0.042 | (0.018) | 0.008 | 0.17 | 23671 |
| Time to maturity | 5.469 | (2.09) | 1.233 | 10.03 | 23695 |
| Coupon | 5.944 | (1.433) | 2.375 | 9.25 | 23695 |

## 3. The research methodology

### *3.1. Default and liquidity risk estimation methodology*

As per Longstaff et al. (2005), corporate bond yield spreads are calculated as the yield on a corporate bond mines the yield on a riskless bond with identical coupon rate and maturity date. This then represents the premium over a riskless bond with same expected future cash flows.

Following Duffie and Singleton (1997) let define:

- $r_t$ is the riskless rate,
- $\lambda_t$ is the intensity of the Poisson process governing default,mat
- $\gamma_t$ is the convenience yield or liquidity process that is used to capture the extra return required by investors, above and beyond compensation for credit risk, from holding a corporate rather than riskless securities.

The three processes $\lambda_t$, $r_t$ and $\gamma_t$ are stochastic, although they are assumed in the original model to be independent. In case of a default event, bondholders receive the $1 - w$ fraction of the notional, calculated on the basis of the expected loss given default ($w$).

Given the in dependency assumption, the parameter $r_t$ is estimated only on the basis of observed values of riskless zero-coupon bond $D(T)$ with maturity $T$, calculated on the following expression:

$$D(T) = \mathbb{E}\left[\exp\left(-\int_0^T r_t dt\right)\right] \tag{1}$$

The risk-neutral dynamic of the intensity process $\lambda_t$ is specified as:

$$d\lambda = (\alpha - \beta\lambda)\, dt + \sigma\sqrt{\lambda} dZ_\lambda \tag{2}$$

where $\alpha, \beta$ and $\sigma$ are positive constants, and $Z_\lambda$ is a standard Brownian motion. The default intensity process allow for both mean reversion and conditional heteroskedasticity in corporate spreads.

The risk-neutral dynamic of the convenience yield $\gamma_t$ (liquidity process) is defined as :

$$d\gamma = \eta dZ_\gamma \tag{3}$$

where $\eta$ is a positive constant and $Z_\gamma$ is also a standard Brownian motion.

Following Duffie (1998), Lando (1998), Duffie and Singleton (1999), and others, it is then possible to calculate both the value of a corporate bond and of the premium leg of a Credit Default Swap as simple expectations under the risk-neutral measure.

For a continuously compounded corporate bond coupon $c$, the price of a corporate bond $CB(c, w, T)$ can be expressed as the sum of the present value of three component:

- promised coupons by the bond,
- promised principal payment ,
- expected recovery payments in the event of default.

as summarised in the following equation:

$$
\begin{aligned}
CB(c,w,T) = \mathbb{E}\left[c\int_0^T \exp\left(-\int_0^t r_s+\lambda_s+\gamma_s ds\right)dt\right] \\
+\mathbb{E}\left[\exp\left(-\int_0^T r_t+\lambda_t+\gamma_t dt\right)\right] \\
+\mathbb{E}\left[(1-w)\int_0^T \lambda_t \exp\left(-\int_0^t r_s+\lambda_s+\gamma_s ds\right)dt\right]
\end{aligned} \tag{4}
$$

Each cash flow stream is then discounted at an adjusted discount rate $r_t + \lambda_t + \gamma_t$.

Longstaff et al. (2005) assume that the price of credit default swap does not include the convenience yield of illiquidity process $\gamma_t$ due to the characteristic of the credit default swap market, especially in terms of liquidity and cash flow replicability. Denoting $s$ as the premium paid by the buyer of a default protection, the equation to calculate the CDS premium leg can be expressed as:

$$
P(s,T) = \mathbb{E}\left[s\int_0^T \exp\left(-\int_0^t r_s+\lambda_s ds\right)dt\right] \tag{5}
$$

The value of the protection leg of a credit default swap $PR(w,T)$ can then be expressed as:

$$
PR(w,T) = \mathbb{E}\left[w\int_0^T \lambda_t \exp\left(-\int_0^t r_s+\lambda_s ds\right)dt\right] \tag{6}
$$

Solving for the premium that equalises the two legs of the credit default swap gives:

$$s = \frac{\mathbb{E}\left[w\int_0^T \lambda_t \exp\left(-\int_0^t r_s + \lambda_s ds\right) dt\right]}{\mathbb{E}\left[\int_0^T \exp\left(-\int_0^t r_s + \lambda_s ds\right) dt\right]} \tag{7}$$

Closed-form solutions of equations (4) and (7) can be then expressed as per original paper of Longstaff et al. (2005) as

$$\begin{aligned} CB(c,w,T) = c\int_0^T A(t)\exp\left(B(t)\lambda\right)C(t)D(t)e^{-\gamma t}dt \\ +A(T)\exp\left(B(T)\lambda\right)C(T)D(T)e^{-\gamma T} \\ +(1-w)\int_0^T \exp\left(B(t)\lambda\right)C(t)D(t)\left(G(t)+H(t)\lambda\right)e^{-\gamma t}dt \end{aligned} \tag{8}$$

where $\lambda$ and $\gamma$ denote the current values of the default intensity and the convenience yield / liquidity process at time zero and where:

$$A(t) = \exp\left(\frac{\alpha\left(\beta+\phi\right)}{\sigma^2}t\right)\left(\frac{1-\kappa}{1-\kappa e^{\phi t}}\right)^{\frac{2\alpha}{\sigma^2}}$$

$$B(t) = \frac{\beta-\phi}{\sigma^2} + \frac{2\phi}{\sigma^2\left(1-\kappa e^{\phi t}\right)}$$

$$C(t) = \exp\left(\frac{\eta^2 t^3}{6}\right)$$

$$G(t) = \frac{\alpha}{\phi}\left(e^{\phi t}-1\right)\exp\left(\frac{\alpha\left(\beta+\phi\right)}{\sigma^2}t\right)\left(\frac{1-\kappa}{1-\kappa e^{\phi t}}\right)^{\frac{2\alpha}{\sigma^2}+1}$$

$$H(t) = \exp\left(\frac{\alpha(\beta+\phi)+\phi\sigma^2}{\sigma^2 t}\right)\left(\frac{1-\kappa}{1-\kappa e^{\phi t}}\right)^{\frac{2\alpha}{\sigma^2}+2}$$

$$\phi = \sqrt{2\sigma^2 + \beta^2}$$

$$\kappa = (\beta+\phi) / (\beta-\phi)$$

The closed form solution for the CDS spread calculation is then given by:

$$s = \frac{w\int_0^T \exp\left(B(t)\lambda\right) D(t) \left(G(t) + H(t)\lambda\right) dt}{\int_0^T \exp A(t) \left(B(t)\lambda\right) D(t) dt} \tag{9}$$

The authors empirical approach was based on the closed-form solutions to match simultaneously the CDS premium and the prices of corporate bonds with maturities straddling the 5-year maturity of the credit default swap.

*3.2. Event study methodology*

An event study aims at measuring the impact of a corporate or market event to the valuation of a security by examining the behaviour of the security's price during the period around the event. The base assumption is that prices in an efficient market adjust following emergence of new informations. Key source for a methodological perspective is Campbell et al. (1997), MacKinlay (1997)and Kothari and Warner (2007).

As indicated earlier, this study focused on the impact of the market disruption followed the announcement of a potential early termination of the US Federal Bank asset purchase program. The unexpected news created a sudden and significant reaction reflected in asset prices.

Event study methodology in equity markets is currently mature and it has been applied to a variety of financial aspect. Of particular interest for my research is the paper of Krishnamurthy and Vissing-Jorgensen (2011) that analysed the channels of U.S. Federal Reserve quantitative easing programs to the wider economy, particularly the signalling, liquidity and default risk channels.

Corporate bond event study methodology is currently less developed due to various historical reasons. First of all, corporate bond have historical lacked transparent data however this has changed following the introduction in 2002 of over-the-counter bond reporting in the U.S. through the Trade Reporting and Compliance Engine (TRACE) introduced by National Association of Securities Dealers (NASD). This has improved dramatically the amount and quality of data available regarding trades for corporate bonds and improve the general market price discovery. Other complexities in performing event studies with corporate bonds are the significant heteroskedasticity linked to bond returns, especially related to bond rating (returns of speculative grade bonds are more volatile than investment grade ones) and maturity (returns of longer dated bond are more volatile than shorter term bonds). Further complicating the above analysis is that bond price volatility also varies over time. Finally, it is important to note that corporate bond trading is less frequent than equity, with evidence that median of corporate bond trading across TRACE is of three trades per day.

Methodology for corporate bond study was recently analysed in the seminal paper of Bessembinder et al. (2009), while a more recent paper of Ederington et al. (2015) reviewed various methodological aspects of statistical testing for this kind of studies.

Following Ederington et al. (2015) bond returns are calculated as

$$BR\,(t-1, t+1)_n = \frac{P_{n,t+1} - P_{n,t-1} + \Delta AI_n}{P_{n,t-1} + AI_{n,t-1}} \tag{10}$$

where $P_{n,t}$ is the trade-size-weighted average "clean" price of bond $n$ on day $t$, $AI_{n,t}$

is accrued interest on bond $n$ on day$t$, and $\Delta AI_{n,t}$ is the change in accrued interest from day $t-1$ to day $t+1$.

Bessembinder et al. (2009) study investigate the power and specification of different approaches to determine abnormal returns. In particular, the authors analyse three types of methodologies: mean-adjusted models (calculated as historical return on the security less the return to the matched Treasury security with closer maturity date), matching portfolio models (calculated as difference between portfolios of homogeneous bonds based on rating and time to maturity) and factor models (five factor model develop by Fama and French (1993) and the model based on Elton et al. (1995)). Matching portfolio models seemed to provide the best approach to identifying monthly abnormal returns, especially if calculated with weighting index relying on non-parametric test statistics , with the mean-adjusted model coming close second in terms of distribution of returns and size of the tests.

Given lack of sufficient benchmark instrument with relevant country and credit risk profile, this study relies on the mean-adjusted model, that is nevertheless the most frequently used method of calculating abnormal returns, both for daily and monthly data, and also it does produce results in line to the preferred Bessembinder et al. (2009) method. Under this approach, a premium holding period return (*PBR*) is calculated for bond $i$ during period $t$ as the bond's return (*BR*), less the return on an equivalent Treasury security:

$$PBR_i = BR_i - TR_i \tag{11}$$

The mean expected excess return (*EBR*) for bond $i$ is equal to the *PBR* for the previous y periods (the estimation period):

$$EBR_i = \left( \sum_{t=-1}^{-y} PBR_{i,t} \right) \frac{1}{y} \tag{12}$$

The abnormal bond returns (*ABR*) for bond $i$ is then calculated as:

$$ABR_i = PBR_i - EBR_i \tag{13}$$

One methodological issue in corporate bond event studies at individual bond level is that companies with higher number of outstanding debt, typically the larger firms, can bias the analysis due to the correlation between their returns. Bessembinder et al. (2009) proposed to combine individual firm's bond returns into a single averaged firm-bond return weighted by the volume of bond outstanding.

In terms of determination of event window, compared to other studies this analysis can benefit from a clear identification of the event date (19th of June 2013, the date of the press release of the FOMC). The estimation window is set up at two different intervals (2 weeks and 10 weeks), to assess if return dispersion can be smoother through a longer pre-event window.

**4. Calculating the default and liquidity component**

The methodology for calculating the credit and liquidity parameters follows the same approach taken by the study of Longstaff et al. (2005). First of all, an initial trial value is set for the key model input parameters $\alpha, \beta$, $\sigma$ and $\eta$.

The parameter $\lambda$ is then calculated based on the interpolated daily mid observable CDS spread of the same maturity in order to exactly match the CDS.

Next step is to calculate the liquidity factor, as the parameter that solve for the observed mid bond yields spreads, the observable risk free rate and the calculated $\lambda$.

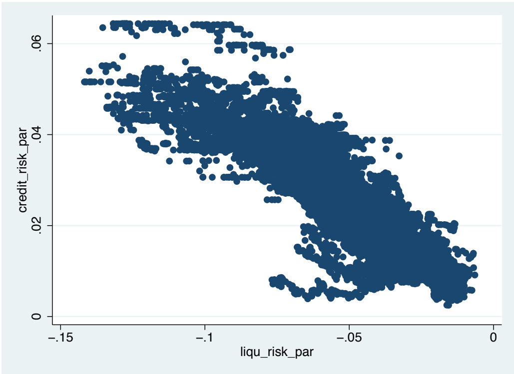
The initial model input parameters are then iteratively calculated on the basis of:

1 - the root mean square error of the regression between CDS and *lambda* for the input parameters linked to credit process ($\alpha, \beta$, $\sigma$),

2 - the root mean square error of the regression between observed bond yields and modelled bond yields for the input parameters linked to the liquidity process ($\eta$).

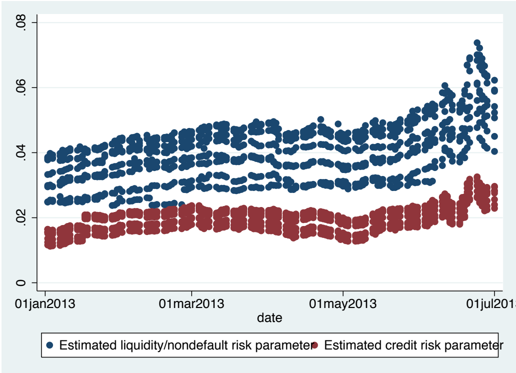
The resulting liquidity factor is negatively highly correlated with the related credit risk factor, as expected by theory. The figure 1 illustrates the relationship between the two risk factors

Figure 1: Plot of credit risk and liquidity risk parameters of bonds in sample




Each liquidity parameter is then regressed on his time to maturity to have a single liquidity parameter per company. An arbitrary maturity of 5 years was selected. Same approach is followed for the default factor.The figure 2 below illustrated the time plot of the gamma and lambda parameters in the period 1 January 2013 and 1 July 2013 of the Petrobras bonds that are part of our bracketing test.

Figure 2: Petrobras credit and liquidity risk parameter over the period under analysis




Similar to Longstaff et al. (2005), we performed a cross-sectional analysis of the liquidity parameter or nondefault component for individual bonds on explanatory variables suggested by economic theory. The first variable under consideration is the bond coupon, as the illiquidity parameter magnitude is directly related both the bond's issuance pricing and the potential tax impact of the credit spread as interest rates are taxable and therefore the required investors' yield will take the marginal tax rate into consideration.

The second variables used in the cross-sectional analysis is the bid-offer spread, that is normally considered directly proportional to the liquidity of an asset. The third variable considered takes into account the maximum theoretical availability of the bond in the market and it is proxied by the notional amount outstanding of each bond, whereby a larger notional is expected to increase the liquidity of a bond. Another variable considered is the age of the bond, in order to mirror the concept of on-the-run and off-the-run series of Treasury bonds. If there is a similar effect in corporate bond market, we should expect that older bonds should be less liquid than bonds issued more recently. It was also included the time to maturity variable, in order to capture a potential maturity clientele for corporate bonds. This regressor will then capture the fact that shorter-maturity bonds may be more liquid than longer-maturity bonds. It was also included a dummy variable for bonds issued by financial firms, given the ability for such companies to be more connected with capital market and therefore enjoy greater liquidity than securities of firms operating in different sectors. The paper of Longstaff et al. (2005) includes also another dummy variable linked to highly rated bonds (AAA or AA). Given that none of the bonds considered in this analysis have rating at such level, this variable was not included. The regression equation of the non-default component (*NDC*) on the above sample of explanatory variables is then:

$$NDC = \beta_0 + \beta_1 Coupon + \beta_2 BOspread + \beta_3 Principal$$
$$+\beta_4 Age + \beta_5 Maturity + \beta_6 Financialcompany \qquad (14)$$

The results of the regression of the liquidity parameters on all the above control variables indicates that they are all statistically significant:

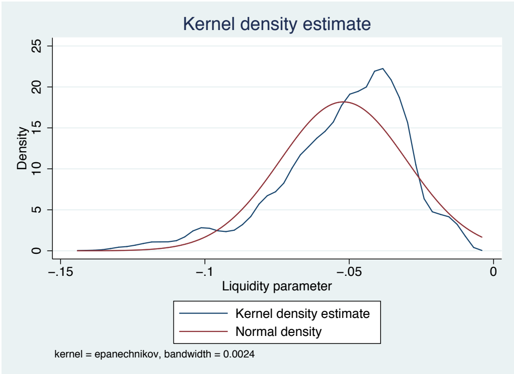
Table 2: Regression of nondefault component on liquidity variables

| | (1)<br>liqu_risk_par<br>$\beta$ |
|---|---|
| Bid/Offer spread | −0.009***<br>(0.000) |
| Coupon | −0.007***<br>(0.000) |
| semesters_to_mat | −0.000***<br>(0.000) |
| Principal amount | 0.000***<br>(0.000) |
| Age | 0.004***<br>(0.000) |
| Financial | −0.016***<br>(0.000) |
| N | 23695 |
| r2 | 0.509 |

Table 2 reports the results from the regression of the liquidity parameter for each bond in the sample on the liquidity variables.

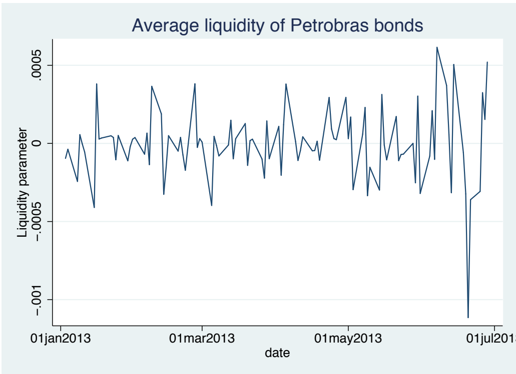
Figure 3 shows the distribution of the average liquidity parameter for the panel under analysis:

Figure 3: Kernel density of Petrobras liquidity parameter during the analysis period (1st Jan 2013 - 1 July 2013)




The liquidity factor series is non stationary as confirmed by the Dickey Fuller test result p-value of 0.1916. Taking the first difference of the time series, makes the series stationary, as illustrated graphically by the figure 4. To note the liquidity jump in correspondence of the event under analysis and the rapid recovery afterwards.

Figure 4: First difference of Petrobras liquidity parameter during the analysis period (1st Jan 2013 - 1 July 2013)



In line whit the methodology described by Bessembinder et al. (2009), growth rates have been calculated for the bonds in the data set. The figure 5 illustrates a sample of individual bond returns for the company Petrobras for the period 1st of January - 1st July 2013, to illustrate the dispersion of individual bond returns during the period.

Figure 5: Daily price return of individual Petrobras bonds during the analysis period (1st Jan 2013 - 1 July 2013)

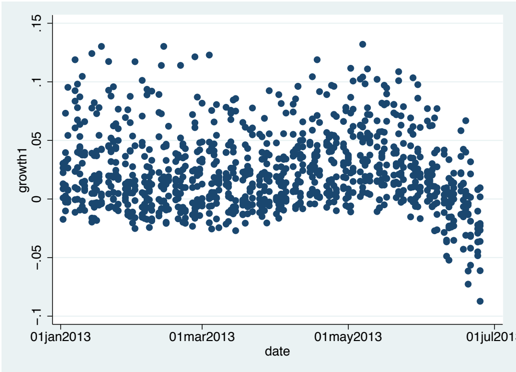
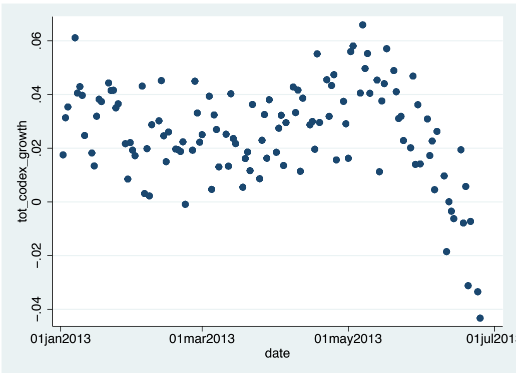



Figure 6: Average daily price return of Petrobras bonds during the analysis period (1st Jan 2013 - 1 July 2013)




Returns have been averaged on the basis of the total debt outstanding. The figure 6 illustrates the evolution of average Petrobras returns over the same period of figure figure 5 .

## 5. Results of the event study

### *5.1. Normal and Abnormal return analysis*

The normal return associated with the bonds in the sample was calculated through a mean-adjusted morel, as described in section 3.2. For each bond of each issuer the bond's return was compared with an equivalent treasury return to compute the premium holding period return. This was then averaged for two pre-event windows: a longer event window (1st January 2013 - 18 June 2013) and a smaller event window (5th June 2013 - 18 June 2013) and averaged for each issuers on the base of the each debt outstanding amount.

Table 3: EBR for two pre-event windows (1st January 2013 - 18th June 2013 and 5th June 2013 - 18 June 2013

| | Expected Bond Return | |
|---|---|---|
| | EBR 10 weeks | EBR 2 weeks |
| Alrosa | 0.0022054 | 0.0010332 |
| America Movil | 0.0002596 | −.0041577 |
| Axtel | −.040241 | −.0135259 |
| BNDES | 0.0044082 | −.0024241 |
| Banco Bradesco | 0.0007998 | −.0104269 |
| Companhia Siderurgica Nacional | 0.0093984 | −.0132356 |
| Gazprom | 0.0025685 | 0.0009591 |
| Gazprom Bank | 0.0127695 | 0.0011083 |
| Pemex | 0.0062661 | −.0021768 |
| Petrobras | 0.0098551 | 0.0035176 |
| Steel Capital | 0.0012303 | −.0083449 |
| TMF | 0.0042582 | −.0043337 |
| Televisa | 0.0029904 | 0.0037148 |
| VEB leasing | 0.0456832 | 0.0017485 |
| Vale | −.0009174 | −.0065733 |
| Vimpel | 0.037913 | −.0055308 |

Table 3 illustrates the EBR results for each issuers. To note that returns for the two periods can be significant different, as the longer pre-event window increase the smoothing of any disturbance registered in the smaller period.

The calculation of abnormal bond returns then is based on the comparison between EBR and actual bond returns in the period. Issuers' abnormal returns have been calculated as per methodology described earlier in this paper.

Table 4: ABR for three pre-event windows (2 days, 1 week, 2 weeks

| | Avearge daily abnormal bond return | | |
|---|---|---|---|
| | ABR1 | ABR2 | ABR3 |
| Alrosa | −.0418361 | −.0140947 | −.0136181 |
| America Movil | −.0384968 | −.0698087 | −.0710341 |
| Axtel | −.0974605 | −.2315796 | −.1744368 |
| BNDES | −.1666482 | −.4590426 | −.3868389 |
| Banco Bradesco | −.1252473 | −.3603377 | −.3017919 |
| Companhia Siderurgica Nacional | −.2197216 | −.5217929 | −.4471191 |
| Gazprom | −.1756769 | −.6615685 | −.5842099 |
| Gazprom Bank | −.2282215 | −.6017211 | −.5362263 |
| Pemex | −.2489018 | −.7883539 | −.6954903 |
| Petrobras | −.2974054 | −.9434155 | −.815848 |
| Steel Capital | −.2767722 | −1.035484 | −.9017791 |
| TMF | −.2908433 | −1.124764 | −.9651713 |
| Televisa | −.2667523 | −1.077564 | −.9329485 |
| VEB leasing | −.1903592 | −.6630168 | −.5858616 |
| Vale | −.3855853 | −1.291798 | −1.084115 |
| Vimpel | −.537326 | −1.434252 | −1.20334 |
| | Cumulative abnormal bond return | | |
| | ABR1 | ABR2 | ABR3 |
| Alrosa | −.0836723 | −.0704733 | −.122563 |
| America Movil | −.0769936 | −.3490434 | −.6393067 |
| Axtel | −.1949209 | −1.157898 | −1.569932 |
| BNDES | −.3332964 | −2.295213 | −3.48155 |
| Banco Bradesco | −.2504946 | −1.801688 | −2.716127 |
| Companhia Siderurgica Nacional | −.4394433 | −2.608964 | −4.024072 |
| Gazprom | −.3513538 | −3.307843 | −5.257889 |
| Gazprom Bank | −.4564431 | −3.008605 | −4.826037 |
| Pemex | −.4978036 | −3.941769 | −6.259412 |
| Petrobras | −.5948108 | −4.717078 | −7.342632 |
| Steel Capital | −.5535445 | −5.177422 | −8.116012 |
| TMF | −.5816866 | −5.623819 | −8.686542 |
| Televisa | −.5335047 | −5.38782 | −8.396537 |
| VEB leasing | −.3807185 | −3.315084 | −5.272754 |
| Vale | −.7711706 | −6.458991 | −9.757031 |
| Vimpel | −1.074652 | −7.171258 | −10.83006 |

Table 4 illustrates the ABR results for each issuers. The analysis includes three abnormal return calculation based on a different length of period :

- the first abnormal bond return (ABR1) has been calculated on a two days return window ($t + 1$: 19th June 2013 - 20th June 2013)
- the second abnormal bond return (ABR2) has been calculated on one week return window ($t + 5$: 19th June 2013 - 25th June 2013)
- the second abnormal bond return (ABR2) has been calculated on two weeks return window ($t + 9$ 19th June 2013 - 1st July 2013)

### 5.2. *Normal and Abnormal liquidity risk analysis*

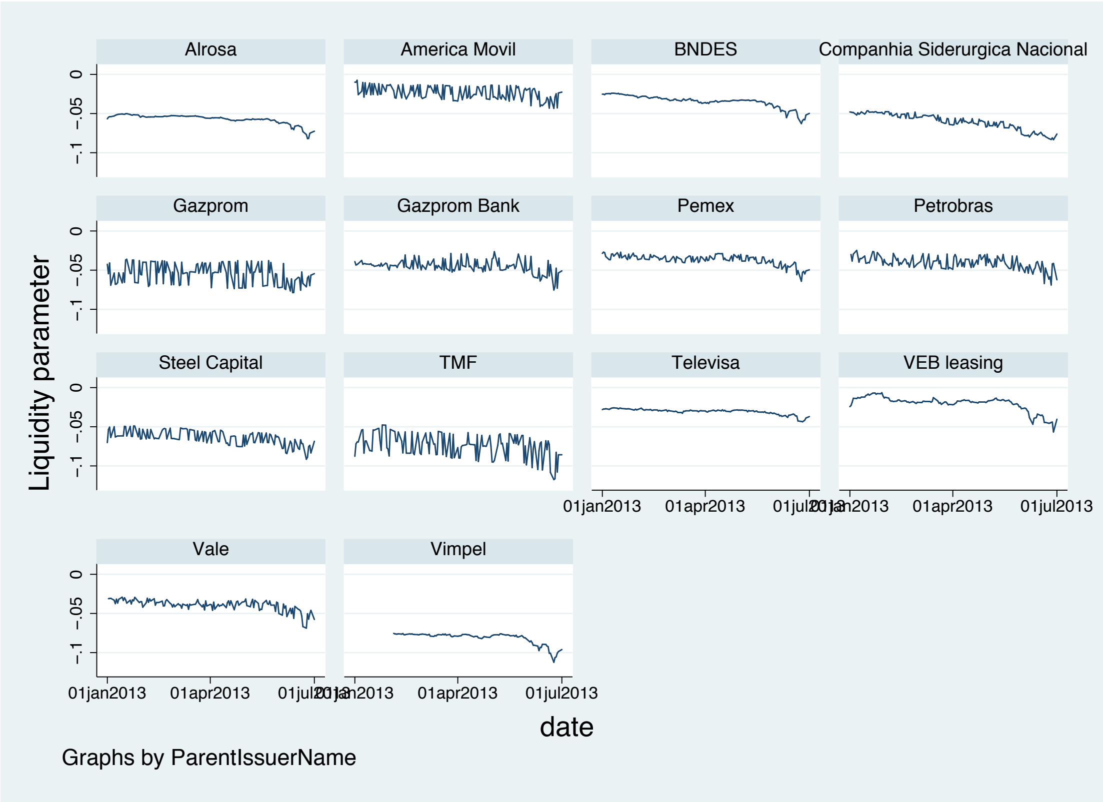
The behaviour of the estimated liquidity risk parameter was analysed through a similar approach used for the return analysis. An expected liquidity premium was calculated for two pre-event windows presented in the previous section.

Table 5: Estimated expected liquidity premium for pre-event windows (1st January 2013 - 18th June 2013 and 5th June 2013 - 18 June 2013

| | Expected Liquidity Premium | |
|---|---|---|
| | 10 weeks window | 2 weeks window |
| Alrosa | 0.0158128 | 0.0142555 |
| America Movil | 0.0115658 | 0.0111665 |
| Axtel | 0.1139509 | 0.0792769 |
| BNDES | 0.012754 | 0.0142195 |
| Banco Bradesco | 0.0069954 | 0.0064325 |
| Companhia Siderurgica Nacional | 0.0320884 | 0.03153 |
| Gazprom | 0.0252567 | 0.0213546 |
| Gazprom Bank | 0.0216423 | 0.018567 |
| Pemex | 0.0134574 | 0.0128098 |
| Petrobras | 0.0209414 | 0.0194249 |
| Steel Capital | 0.0270633 | 0.0245615 |
| TMF | 0.0337162 | 0.0303171 |
| Televisa | 0.0008978 | 0.0008269 |
| VEB leasing | 0.0140339 | 0.0213199 |
| Vale | 0.0198801 | 0.0185051 |
| Vimpel | 0.053923 | 0.0477148 |

The Table 5 illustrates the average daily expected liquidity premium per issuer and illustrates that the average premium was very similar independently from the period window observed. The Figure 7 illustrates the level and evolution of the liquidity premium of the company in the sample analysis.

Figure 7: Average daily portfolio liquidity premium during analysis period




Analysing the post-event window, as illustrated in Table 6, the liquidity premium increased for all the firms in the sample.

Table 6: Liquidity ABR for three pre-event windows (2 days, 1 week, 2 weeks)

| | Avearge daily abnormal liquidity premium | | |
|---|---|---|---|
| | 2 days window | 1 week window | 2 weeks window |
| Alrosa | 0.0222119 | 0.0313405 | 0.0347315 |
| America Movil | 0.0287469 | 0.0331999 | 0.0327249 |
| Axtel | 0.2093457 | 0.224863 | 0.2165493 |
| BNDES | 0.4506084 | 0.5196394 | 0.5009566 |
| Banco Bradesco | 0.1612313 | 0.1820701 | 0.1729519 |
| Companhia Siderurgica Nacional | 0.5070198 | 0.6899772 | 0.6491402 |
| Gazprom | 0.5619801 | 0.5573708 | 0.5727395 |
| Gazprom Bank | 0.1683885 | 0.1831471 | 0.183768 |
| Pemex | 0.3839494 | 0.3832463 | 0.3912327 |
| Petrobras | 0.2784297 | 0.2831926 | 0.2871666 |
| Steel Capital | 1.256906 | 1.288032 | 1.302591 |
| TMF | 0.9216203 | 1.007411 | 1.025323 |
| Televisa | 2.608296 | 2.670121 | 2.702344 |
| VEB leasing | 1.579255 | 1.550325 | 1.588266 |
| Vale | 0.6044487 | 0.617997 | 0.6224852 |
| Vimpel | 3.171522 | 3.264201 | 3.291137 |
| | Cumulative abnormal liquidity premium | | |
| | 2 days window | 1 week window | 2 weeks window |
| Alrosa | 0.0444237 | 0.1567025 | 0.3125835 |
| America Movil | 0.0574938 | 0.1659996 | 0.2945238 |
| Axtel | 0.4186915 | 1.124315 | 1.948944 |
| BNDES | 0.9012169 | 2.598197 | 4.50861 |
| Banco Bradesco | 0.3224626 | 0.9103506 | 1.556567 |
| Companhia Siderurgica Nacional | 1.01404 | 3.449886 | 5.842262 |
| Gazprom | 1.12396 | 2.786854 | 5.154655 |
| Gazprom Bank | 0.3367769 | 0.9157357 | 1.653912 |
| Pemex | 0.7678988 | 1.916231 | 3.521095 |
| Petrobras | 0.5568594 | 1.415963 | 2.5845 |
| Steel Capital | 2.513813 | 6.44016 | 11.72332 |
| TMF | 1.843241 | 5.037057 | 9.227911 |
| Televisa | 5.216593 | 13.35061 | 24.3211 |
| VEB leasing | 3.15851 | 7.751625 | 14.2944 |
| Vale | 1.208897 | 3.089985 | 5.602367 |
| Vimpel | 6.343045 | 16.32101 | 29.62024 |

Liquidity premiums increased across sample, however yields of bigger firms such as Petrobras, America Movil, Gazprom registered a smaller shock compared to other names. This is consistent with the phenomenon of "flight to liquidity", whereby prices of less liquid assets are subject to bigger shocks. To note that country of residence does not seem to have particular importance, similar to the findings of Pan and Singleton (2008) regarding relatively unimportance of country specific variable in explaining Sovereign CDS spreads.

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