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Liquidity and Credit Risk in the Emerging Financial Markets

SUMMARY: In this paper, we examine the relationship between liquidity, liquidity risk and credit risk involved in emerging sovereign bonds after the subprime crisis period. In our study, we concentrate on the effect of liquidity and credit risk on liquidity in the emerging bond markets. Control variables, asymmetric information, amount outstanding, coupon, age and interest rate van provide assistance for a better understanding of this relationship. To explain the role of liquidity and credit risk in liquidity, we use panel data extracted from Datastream. Our result show that liquidity risk has a stronger impact on the liquidity of the bond market than credit risk.

KEYWORDS: liquidity, credit risk, liquidity risk, emerging bond markets
JEL CODES: C33, G15

INTRODUCTION

The variety of liquidity risks and their importance in asset pricing have been a dynamic area of research. The effect of liquidity on the financial market is the subject of an earlier study written by Lesmond et al. (2005). The results of studies on the U.S stock market cannot be applied to emerging markets since these two markets differ in many aspects. Among others, liquidity is one of the apparent factors. Compared to the developed stock markets, most of the emerging stock markets are small and illiquid.

In an earlier study, JP Morgan noted that *"Potential growth rates of 5.8% for emerging economies now overshadow the potential growth of only 1.6% for advanced economies"*. This explains why these markets are associated with very attractive investment opportunities for any investor seeking both better returns and diversification.

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Especially during difficult periods like in the subprime crisis, the liquidity problem was given paramount importance by new research [Gromb and Vayanos (2002), Morris and Shin (2004), Brunnermeier and Pedersen (2009), Menkveld and Wang (2011)].

The problem of liquidity is further enhanced by many economic and financial factors. Credit and liquidity risk are considered as a key factors that influence market liquidity.

In general, liquidity is considered as one of the most important factors for asset pricing. *Amihud* and *Mendelson* (1986); *Brennan* and *Subrahmanyam* (1996); *Datar et al.* (1998); *Chordia et al.* (2001b) show that illiquid assets and assets with high transaction costs are transmitted at low prices relative to their expected cash flows.

The importance of the liquidity risk premium has been shown in the corporate bond market (Chen, Lesmond, and Wei, 2007), in corporate markets affected by credit default swaps (Longstaff, Mithal, and Neis, 2005),

in developed euro-denominated debt markets (De Jong and Driessen, 2005), and in the valuation of sovereign debt (Duffie, Pedersen, and Singleton, 2004).

In recent years, emerging market assets have become increasingly attractive since investors have looked to diversify their portfolios. Despite growing interest in these markets, a recent Moody's Analytics survey found that 75% and 46% of emerging markets participant view the lack of information and scattered information, respectively, as major challenges in assessing credit risk in this area. The problem of liquidity in financial markets has not been investigated in recent years, not even during subprime financial crisis. This lack prompted us to focus our attention on the study of liquidity in emerging bond markets. Therefore, in this study, our main objective is to provide an empirical analysis of the effect of liquidity and credit risk on the worsening of liquidity problems across 10 emerging bond markets in the following countries: Argentina, Australia, Hong Kong, Hungary, Greece, Mexico, Peru, Poland, Spain and Turkey bonds markets.

The paper is organized as follows: Section 2 presents a literature review. Section 3 presents the data and the methodological approach. Section 4 discusses the empirical results. Section 5 concludes the paper.

LITERATURE REVIEW

In recent years, several papers have tried to explain the difference between the two main approaches in credit risk modelling: structural and reduced form models. Based on the versions of standard structural models with incomplete information, it is possible to generate reduced form models in which the intensity of default is not exogenous but endogenous within the model and it is the function of the company's characteristics and the level of information that investors posses. Reduced form models, studied by Duffie (1994, 1998), *Jarrow* and *Turnbull* (1995) and Duffie and *Singleton* (1997, 1999) estimate both the default risk specified separately and the losses. Similarly, there are other models of the reduced form studied by several authors such as, Duffie and Lando (1997), Jarrow, *Lando*, and Turnbull (1997), Jarrow and Yu (2001), Lando (1998), *Madan* and *Unal* (1998), and *Schonbucher* (1998).

In fact, credit ratings are the usual quality attributes of credit types. Most authors (see, for instance, Jarrow et al. (1997) or Lando (1998)) focused on the Markov model of migration applied to credits.

The empirical literature on defaultable state valuation is a rapidly-growing research field. Structural and reduced-form models have been tested for different markets including corporate bonds and credit default swaps. The empirical results of structural models have been quite poor up to now. While earlier studies conclude that models consistently underpredict spreads [Jones, Mason, and Rosenfeld (1984), Ogden (1987), Lyden and Saraniti (2000)], both under- and overprediction with large pricing errors are found in later empirical approaches (Eom, Helwege, and Huang (2004)). Tests of the reduced-form models emerge to be more successful (Duffie (1999), Driessen (2005), and Bakshi, Madan, and Zhang (2006)). Indeed, there are several empirical studies on credit derivatives that are focused on reduced form models such as, *Houweling* and *Vorst* (2005), *Longstaff, Mithal,* and *Neis* (2007), Chen, *Cheng, Fabozzi,* and *Liu* (2008). In addition, these models are considered inadequate to classify market data. Thus, the reduced-form approach appears to be ideally suited for the purpose of credit spread modelling and derivative pricing, and the question

arises whether it would be more expedient to throw out the structural model in favour of the reduced-form approach.

It is encouraging that some recent empirical studies present more favourable findings for structural models. *Leland* (2004) shows that the models of real frequencies are more reasonable. On the other hand, *Schaefer* and *Strebulaev* (2008) found a fairly accurate prediction of the sensitivity of bond yields to equity, even for the simple structural model (Merton (1974)). In recent literature on the pricing of credit risk in corporate bonds, for example *Driessen* (2005), *Amato* and *Remolona* (2005) and *Berndt et al*. (2005) argue that corporate bond spreads should be separated into expected losses from default and the price of risk, namely the default risk premium. We apply this decomposition structure to examine whether anticipated losses depend on the fundamentals of issuers' credit worthiness and the evasion risk premium on factors that influence investors' risk aversion. Therefore, we build upon and extend the notion of implicit ratings of expected loss introduced by Remolona, *Scatigna* and *Wu* (2007b), which is a critical concept that is based on the informational content of credit ratings. The advantage of such information is that this is the information to which market participants react in pricing credit risk.

One of the important shortcomings of risk information derived from credit ratings is that assigned ratings can adjust only slowly to the incoming information which market participants may consider to be relevant for asset valuations.

On the other hand, a number of studies indicate that the LIBOR-OIS contains credit risk and liquidity risk premium; see e.g. *McAndrews et al.* (2008), *Michaud* and *Upper*, 2008, *Sengupta* and *Tam* (2008) and *Hui et al*. (2010).

To understand the role of credit risk and liquidity risk, several authors have found that liquidity risk is important for policy makers, especially during the recent financial crisis. If liquidity risk is the principal factor, then measures to increase liquidity or to improve the functioning of financial markets are desirable policy responses. Nevertheless, if credit risk predominates, then such measures could be ineffective and policies which influence the solvency of banks are called for.

While there is a wide variety of models and determinants, none of the existing literature on emerging market debt directly investigates liquidity effects. In general, the majority of the literature investigated macroeconomic determinants, such as *Ferrucci* (2003) and *Min* (1999), while more recent work examined the importance of volatility, such as *Hilscher* and *Nosbusch* (2004)) and *Baek*, *Bandopadhyaya*, and *Du* (2005).

Martell (2003) investigated the determinants of sovereign bond and US domestic bond yield spreads, and found that after controlling for fundamentals motivated by structural credit models, there are still significant unexplained components of the yield spread. Most of these studies as well as previous work, e.g. *Westphalen* (2001) and *Kamin* and *von Kleist* (1999) show that the yield spread is entirely determined by the compensation for default risk.

Traditionally, the need for data on bond markets has opened a problem for research on liquidity. To avoid these problems, *Lesmond et al* (2005) used three different measures for bond liquidity: the bid-ask spread obtained from Bloomberg, the percentage of zero returns, and the limited dependent variable estimate of Lesmond, *Ogden*, and *Trzcinka* (1999). Although the bid-ask spread is the more direct measure than the two other measures, the advantage of the latter measure is that it needs only the time series of returns on the bonds.

DATA AND METHODOLOGICAL APPROACH

Data

Table 1 summarizes the basic statistical properties of daily data of the 10 emerging bond markets over the period from 7/30/2009 to 1/18/2011.

Our sample consists of bonds issued by the State (sovereign bonds). These data are derived from the basis of „Datastream" data. Our sample contains ten emerging countries: Argentina, Australia, Greece, Hungary, Hong Kong, Mexico, Peru, Poland, Turkey and Spain. In our estimation, we used panel data run on the Statat software.

Table 1 summarizes the main descriptive statistics of the variables used in our analysis.

The methodological approach

Variables

Liquidity Liquidity is a variable that needs to be explained. It is expressed in different ways, which vary from one author to another. This variation depends mainly on the availability of data. According to the literature, there are several ways of expressing liquidity in the market, direct or indirect ways. Lesmond et al. (2005), measured liquidity by means of three categories:

The first category is the direct cost of transaction found in *Jain* (2002), where he used the bid-ask spread. It is considered the best estimate of the underlying liquidity.

The second category has emerged due to the difficulty of the implementation of the first approach which has the problem of lack of information in some markets. This second approach builds on business data and applies both the theoretical and the practical part. The approach includes the revenues and the extent of liquidity premium by Amihud (2002).

The third category includes the indirect costs of the transaction. The advantage of this approach is that it uses only the price of the asset rather than the trading volume as a measure of liquidity, such as *Roll* (1984) and *LOT* (1999).

In our case, we use the first category as a measure of this variable, that is, the bid-ask spread and the cost of commission. These are expressed as follows:

$$liq = [(A_t - B_t)/(A_t + B_t) + (A_{t-1} - B_{t-1})/(A_{t-1} + B_{t-1})]$$

Table 1

STATISTICAL DATA

Variable	Mean	Standard deviation	Min	Max
Liquidity	–0.0165507	0.2181199	–2.24812	1.002979
Liquidity Risk	0.0081914	0.057493	–0.5	0.3043209
Credit Risk	17.30359	3.983037	8	23
Asymmetric Information	–0.3473862	10.72863	–116.2	37
Aos	10.76112	6.219155	–1.9772	26.3722
Age	6.992832	7.055184	–10.9116	37.0422
Coupon	10.18601	5.513868	–1.9871	17.7465
Interest rate	7.323318	10.44097	0.015	74.3

Liquidity Risk Following the crises experienced on the financial markets (both on developed and emerging markets), the level of liquidity has shown large movements, which has made the modeling of liquidity risk a primary objective for all research in the last decades. Since then VaR (Value at Risk) has represented the loss that a financial asset may have in a given time and with a probability level of 95% to 99%. The estimation of the loss can be made by three methods: the historical method, the parametric method and the Monte Carlo method. We can therefore use VaR as a measure of liquidity risk, which is theoretically based on the work of *Jarrow* and *Subramanian* (1997), Bertsimas and Lo (1998), and *Alrngren Chriss* (2000), *Francis* and *Hende Wyrrendeale Van* (2000). Further studies carried out by *Berkowitz* (2000), *Persson Häberle* (2000) and *Shamroukh* (2000), assess liquidity risk using a fork, which is a fixed cost, and the impact of price which expresses the price reaction to the volumes exchanged. In our case, we will use the price range for measuring liquidity risk since there is no data on the volume of transactions.

$$VaR = mean + (standard\ deviation \times probability\ threshold\ of\ 99\%).$$

Credit Risk This is an explanatory variable that expresses the quality of the borrower. There are several measures for this variable which differ from one author to another. This variable is expressed by the rating that reflects the credit quality of the borrower in the form of notations that differ from one agency to another. The three main rating agencies are the following: Fitch, Moody's and Standard and Poor's. The notation used by these three agencies is as follows *(Chart 1)*.

These notations are transformed linearly in digital form, as shown in Cantor and Packer (1996). After transformation the ratings are as follows *(Chart 2)*.

Information Asymmetry Information asymmetry is an explanatory variable that expresses the existing asymmetry between the seller and the buyer of a product or asset. On the credit market, banks give loans and they do not know the risks associated with loans that they give; on the contrary, borrowers know how likely the success of their projects is. This allows banks to raise interest rates to loans granted and essentially for risky borrowers. So, there are two situations: the first is the exante risk which is determined that at the time of signing the contract, and the second one is the ex post risk that emerges after the purchase or signing the contract.

Amount Outstanding This is the known (or estimated) amount of the bond currently in circulation, in the currency of issue.

Age It is the age of bond i at time t. It is considered one of the main characteristics of the bond. It can range from a few months to fifty years before the capital is repaid. During this period, the higher the risk of the bond increases, the more likely it is sold before maturity.

Coupon The interest is offered by the issuer to the investor as compensation for the duration of the loan. It is expressed as a percentage of par value. In theory, the coupon is higher if the issuer is rated lower and the loan is long-term. In contrast, a short-term high quality issuer offers a lower coupon.

The coupon may be fixed or variable. It is mostly paid on an annual basis, but bonds may often pay coupons on half-yearly or quarterly basis, for example. The coupon will depend on the duration of the obligation and the quality of the issuer. There are also obligations that do not pay a coupon during the life of the loan. These are called "zero-coupon" bonds.

Interest rate The rate of interest is considered to be among the essential characteristics of the obligation. This is the rate used to calculate the performance of each obligation.

Chart 1

THE NOTATIONS USED BY THE THREE RATING AGENCIES

Fitch	Moody's	S&P's
AAA	Aaa	AAA
AA+	Aa1	AA+
AA	Aa2	AA
AA-	Aa3	AA-
A+	A1	A+
A	A2	A
A-	A3	A-
BBB+	Baa1	BBB+
BBB	Baa2	BBB
BBB-	Baa3	BBB-
BB+	Ba1	BB+
BB	Ba2	BB
BB-	Ba3	BB-
B+	B1	B+
B	B2	B
B-	B3	B-
CCC+	Caa1	CCC+
CCC	Caa2	CCC
CCC-	Caa3	CCC-
CC	Ca	CC
C	C	C
DDD		SD
DD		D
D		

It is usually fixed and valid for the entire duration of the loan, but some bonds have a "variable rate." There are also inflation-indexed bonds: their value and return follow price trends and provide efficient protection against the loss of purchasing power if prices skyrocket.

A fixed-rate bond can have a constant rate (coupon) throughout the holding period of the product. The interest rate is defined in the wording of the obligation and the date. By multiplying it by the amount of the nominal value (that is to say, the value displayed on the bond), we get the coupon.

In the case of a floating rate bond, the income received by the borrower (that is to say, the bondholder) varies quarterly, every six months or every year depending on the rate yield on the market. If these rates rise, the bondholder receives a higher remuneration. If rates fall, incomes are falling.

The model used to estimate the impact of liquidity risk and credit liquidity in emerging bond markets in the presence of other variables is shown in the following model:

$$Liq_{it}=\alpha_0+\alpha_1 Lr_i+\alpha_2 Cr_i+\alpha_3 Ag_i+\alpha_4 AOS_i+\alpha_5 Coup_i+\alpha_6 AI_i+\alpha_7 IR_i+\alpha_t$$

Chart 2

THE LINEARLY TRANSFORMED DIGITAL FORM OF THE NOTATIONS

Fitch		Moody's		S&P's	
AAA	23	Aaa	20	AAA	22
AA+	22	Aa1	19	AA+	21
AA	21	Aa2	18	AA	20
AA–	20	Aa3	17	AA–	19
A+	19	A1	16	A+	18
A	18	A2	15	A	17
A–	17	A3	14	A–	16
BBB+	16	Baa1	13	BBB	+15
BBB	15	Baa2	12	BBB	14
BBB–	14	Baa3	11	BBB	–13
BB+	13	Ba1	10	BB+	12
BB	12	Ba2	9	BB	11
BB–	11	Ba3	8	BB–	10
B+	10	B	17	B+	9
B	9	B	26	B	8
B–	8	B	35	B–	7
CCC+	7	Caa1	4	CCC+	6
CCC	6	Caa2	3	CCC	5
CCC–	5	Caa3	2	CCC–	4
CC	4	Ca	1	CC	3
C	3	C	0	C	2
DDD	2			SD	1
DD	1			D	0
D	0				

Where *(i)* refers to the obligation studied and *(t)* to the period of analysis. The dependent variable of the model is liquidity *(Liq)*. Indeed, *(Lr) (Cr) (Ag) (AOS) (Coup), (AI)* and *(IR)* represent liquidity risk, credit risk, age of the obligation, issue volume, coupon, information asymmetry and interest rates.

In our estimation we used panel data. These data have two dimensions that take into account the values measured for a set or group of people over a series of time variables.

To study the relationship between liquidity and liquidity risk, credit risk, information asymmetry, age, issue volume, interest rate and coupon, we used data panel on Statat. We conducted a test of the homogeneity of variables and self-test correlation. Then, we tested the relationship between these variables using the fixed effect model and the random effect model. Finally, we carried out the Hausman test that allows us to choose between fixed or random patterns. If χ^2 is less than 1% we will choose the random model effect, if it is not, the model will be fixed effect.

Although the fixed effect models and random effect models seem to be different in nature, the second one is generally recommend-

ed. Tests that we have not detailed here allow testing the two hypotheses.

In fixed as well as random effect models econometricians generally begin by estimating and testing a model with only individual effects; time often has nor or just a very minor effect.

We expect endogeneity problems in the estimation related to causally exogenous variables (particularly the issue volume variable) for the dependent variable (liquidity) in the equation. Thus, traditional econometric methods (such as OLS and fixed GLS generalized effect) do not enable us to obtain efficient estimates of such a model. In order to solve this problem, we introduce the generalized method of moments on panel (GMM) data proposed by *Arellano* and *Bond* (1991) and later developed by Arellano and Bover (1995) and *Blundell* and Bond (1998). According to the proponents of this method, it can provide solutions to the problems of simultaneity bias, reverse causality (especially between issue volume and liquidity) and omitted variables. Moreover, it controls the individual and time specific effects.

EMPIRICAL RESULTS

In this paper, our aim was to study the problem of liquidity in emerging bond markets, focusing on the role of liquidity risk and credit risk in the development of this problem. The result of this estimation is shown in the *table 2.*

The results show that liquidity risk has a significant and positive effect on market liquidity for the entire sample in the table (at the level of 1% for Argentina, Greece, Hong Kong, Hungary, Peru, Poland, Spain and Turkey). However, this effect is not so significant for credit risk in a few exceptions, such as the countries that have experienced a crisis, for example Greece and Spain. The positive and significant relationship between liquidity risk and market liquidity shows that the mismanagement of risk, especially at the time of a crisis, causes a liquidity problem. Indeed, this relationship clearly explains the financial crisis that took place on the majority of financial markets, mainly in the emerging markets, such as the Greece market. On the bond market, the management of liquidity risk is essential. Transactions on this market do not occur in a timely manner and we cannot always find counterparties immediately at acceptable prices. On the other hand, credit risk has no direct effect on market liquidity, which explains the relationship between the risk and liquidity is not significant. Credit risk is measured by the notation which provides information on the quality of the bond issued and not on its liquidity. So, investors look at the difference between the sale price and the purchase price to know the liquidity of the asset. That is to say, if there is a big difference between the sale price and the purchase price, the asset is not very liquid and cannot provide an immediate return and vice versa. Similarly, the information asymmetry is considered as an essential element to explain the variation in the liquidity of the bond market depending on the information asymmetry between investors or between bond issuers and investors. The effect of asymmetric information on liquidity is significant because the existing asymmetry between investors can change the volume of transactions and indirectly market liquidity. This means that the better informed investors may affect the liquidity of the markets either by increasing or decreasing the supply and demand of assets. Therefore, liquidity is a fundamental concept in informational transparency which makes trading on the market less transparent, leading to a reduction in liquidity on the market (Bagehot, 1971, Myers and Majluf, 1984).

Table 2

PANEL ESTIMATION OF LIQUIDITY AND CREDIT RISK IN EMERGING BOND MARKETS

	LR	CR	AI	AGE	COUP	AOS	IR
Argentina	0,009***	0,020**	0,000***	0,000***	0,000***	0,000***	0,000***
	(-0,2016)	(-0,0096)	(-0,0097)	(-0,0204)	(-0,0051)	(-0,099)	(-0,0332)
Australia	0,535	0,92	0,000***	0,358	0,529	0,838	0,309
	(-0,0098	(-0,0004)	(-0,0049)	(-0,0006)	(-0,0032)	(-0,0016)	(-0,0034)
Greece	0,000***	0,000***	0,000***	0,057**	0,000***	0,259	0,594
	(-0,3025)	(-0,0012)	(-0,0145)	(-0,0023)	(-0,0006)	(-0,0003)	(-0,0002)
Hong Kong	0,000***	0,995	0,000***	0,000***	0,424	0,001***	0,319
	(-0,2728)	(-2,15E-07)	(-0,0071)	(-0,0002)	(-0,0002)	(-0,0005)	(-0,0004)
Hungary	0,000***	0,113	0,000***	0,001***	–	0,004***	0,000***
	(-0,6455)	(-0,0002)	(-0,0082)	(-0,0001)		(-0,0001)	(-0,0003)
Mexico	0,166	0,507	0,452	0,121	0,356	0,000***	0,024 **
	(-5,1965)	(-0,0012)	(-0,0048)	(-0,0005)	(-0,0009)	(-0,0087)	(-0,0059)
Peru	0,000***	0,684	0,000***	0,000***	0,000***	0,000***	0,000***
	(-0,1694)	(-0,0003)	(-0,0093)	(-0,0008)	(-0,0002)	(-0,0003)	(-0,0001)
Poland	0,009***	0,177	0,000***	0,000***	0,001***	0,609	0,157
	(-0,2903)	(-0,0006)	(-0,0082)	(-0,0004)	(-0,0003)	(0,0003)	(-0,0007)
Spain	0,017***	0,730	0,000***	0,087*	0,003***	0,064*	0,158
	(-0,0689)	(0,0000649)	(-0,007)	(-0,00013)	(-0,0002)	(-0,0004)	(-0,0002)
Turkey	0,005***	0,007***	0,000***	0,028**	0,093*	0,000***	0,000***
	(-0,0522)	(-0,0278)	(-0,0191)	(-0,0685)	(-0,0033)	(-0,1378)	(-0,07)

On the other hand, the majority of the characteristic of bonds have a significant role in creating liquidity problems. Age is significant at the level of 1% in the majority of the sample and affects the liquidity of the bond market positively. The amount outstanding has a negative and significant effect on the variation of the liquidity of bonds. In other words, the more the amount outstanding increases, the more liquidity decreases and vice versa. Besides, the coupon also has a positive and significant effect. In other words, the more the coupon rate increases the more the liquidity of the bond increases. Furthermore, we should note that the interest rate has no effect on the liquidity of the bond market in the whole sample, especially in countries which have experienced a liquidity crisis, such as Spain and Greece.

The most important result in this estimation is that liquidity risk has a stronger effect on liquidity in the bond markets than credit risk. In fact, this result shows that confidence in the rating agencies as information sources has reduced.

Our results also show that the rating agencies have an important role in the disclosure of inefficient information which led to disturbances in the predictions of investors. The bad reputation of the rating agencies, mainly

after the crisis, led to a lack of confidence in those agencies. This shows well why credit rating has no significant role in the explanation of the problem of liquidity in emerging bonds markets.

CONCLUSIONS

In this paper, we tried to find out what has a stronger effect on the liquidity of emerging bond markets, liquidity risk or the credit risk. The result shows that for most of the countries studied liquidity risk has a stronger impact on liquidity than credit risk. Liquidity is considered among the most important elements in the development of emerging bond markets, both corporate and sovereign. Using a set of unique data for emerging market bonds covering 10 countries, we estimated the effect of liquidity and credit risk on the instability of liquidity in emerging bond markets. Liquidity risk is more significant than credit risk in explaining the development of liquidity problem. Our results also show that the ratings agencies had a crucial role in the onset of the crisis that had spilled over from the U.S. market to other markets of the world. At the same time, they show that the control variables have a significant effect on the majority of the panel data, especially on the asymmetric information between investors. In fact, asymmetric information has a significant effect on the problem of liquidity. This result confirms the findings of several earlier works such as *Verrecchia* (2001), *Petersen* and *Plenborg* (2006).

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