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**A study of Corporate Bond Liquidity**

**by**

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## Abstract

In this paper we study the liquidity of the U.S. corporate bond market. The recent financial crisis highlighted the importance of market liquidity in corporate bonds and its interaction with the price of credit risk. In our analysis in order to measure liquidity of corporate bonds we used three different existing liquidity measures. We find that many static characteristics of corporate bonds affect liquidity and thus their trading volume.

## 1. Introduction

A company can finance its investment projects through equity issuance, through retain earnings which are earnings that have accumulated over time and through borrowing. A company can borrow money either by resorting to bank institutions or by issuing corporate bonds. Investors who purchase bonds are lending money to the company that issues the bonds and the borrowers aim at raising capital. The owner of a bond does not own a fraction of the company but receives a steady income in the form of interest and the principal amount regardless the profitability of the specific firm. (Haugen, 1992) A company uses the proceeds of the bonds to buy new equipment, to invest in research and development, to pay shareholders dividends, to refinance debt etc. Bonds are usually classified according to their maturity and to the risk profile of the company that proceeds into bond issuance.

Corporate bonds represent one of the largest components in the US bond market. Moreover the specific market is regarded as the largest securities market globally. The market of corporate bonds is very important for issuing companies since bank lending has become more difficult due to the financial crisis which has imposed stricter restrictions on banks. Moreover corporate bonds offer significant advantages to investors who desire a steady and predictable income. The primary and secondary markets link corporate issuers and bond investors efficiently. The domestic markets serve the financial needs of smaller companies while the international market enables bigger companies to raise the capital they need to expand. (ICMA, 2009)

The importance of liquidity in fixed income markets have received increased attention from both investors and researchers over the last fifteen-twenty years. In the

begging it was believed that yield spreads was a compensation for the default risk of a corporate bond compared to a risk-free government bond but then several papers found that a large and significant proportion of these spreads could not be explained only by default risk alone and it could be an effect caused by other variables.

A bond investor is exposed to several type of risks such as inflation risk, interest rate risk, reinvestment risk, default risk and liquidity risk. Inflation risk is associated with the probability that prices will go up and the investor receiving a steady income will experience an erosion of his purchase power. Interest rate risk is associated with the probability that interest rates will go up and therefore the price of the bond will drop resulting in capital losses for the byer of the bond. Reinvestment risk is associated with the possibility that interest rates will drop and therefore the investor will invest the proceeds from the bond coupon at a lower rate. Default risk is linked to the probability that the bond issuer will not respond to his debt obligations. Liquidity risk refers to the probability that the investor will not be able to sell the bond quickly and at a price which reflects the fair value of the bond. (CFA, 2009)

The financial crisis happened in 2008-2009 has shown how vulnerable were financial markets when liquidity deteriorates. Each bond may have multiple issues and when there is no liquidity it is more difficult to match buyers and sellers while most of the corporate bond trading happens over the counter. For this reason and in order to prevent any future financial crisis and make market more transparent there is a global effort to improve the safety and the robustness of financial market through new regulations regarding liquidity issues.

The objective of this assignment is to study the liquidity of corporate bonds and the determinant factors of liquidity. The issue of liquidity is very important since liquidity risk is of great concern for investors who many times proceed into transactions at not convenient prices due to poor market liquidity.

According to Chacko and Stafford (2004) liquidity is the gap between the fundamental / fair value of a security and the price the security is trading at. When liquidity is high then this gap is small and vice versa. Liquidity risk is the uncertainty associated with this gap. In a thin market where the number of buyers and sellers is small the investor will probably encounter a high gap paying a premium for the bond.

Generally speaking the corporate bond market is very illiquid though the liquidity during the last years has been showing signs of slight improvement. Investors, facing liquidity risk are on need of being aware of several liquidity measures. A few of these measures is the liquidity Cost Score which takes into account transaction costs, the Price Impact Measure which measures the ratio of a bond's excess return to its daily transactions volume, the market efficiency coefficient which is the ratio between the variance of long term returns to the variance of short term returns e.t.c. (Konstantinovsky, 2016)

In view of the fact that liquidity represents a major issue in the bond market investors should be fully aware of the factors that affect liquidity and in turn liquidity risk. Such factors can be the rating of the bond, its price, the general market conditions, the bonds internal characteristics such as time to maturity or the bond coupon the firm's size, etc.

The structure of the dissertation will be the following. In Section 2 we are going to review previous literature on bond market liquidity. In Section 3 we are going to refer to the size, function and development of the market of corporate bonds. Section 4 provides a definition of liquidity and describes the liquidity measures used in our empirical analysis. Section 5 refers to liquidity proxies which affect bond liquidity while in Section 6 we outline the liquidity regulations associated with the operation of financial markets and how these can affect liquidity. Section 7 describes our data and section 8 outlines our statistical methodology. In section 8 we present and comment our results and finally in section 9 there is a conclusion of our analysis.



## 2. Literature review

Corporate bonds are among the least understood instruments in the U.S. financial markets. The issue of liquidity in the bond market and its effect on yields, spreads and pricing is very important and has received increased attention in the academic literature resulting in a big amount of empirical papers while investors from their side pay a lot of attention to this figure when making their investment decisions. In this section we are going to present a review of literature focusing on the several existing papers regarding bond liquidity. The begin was made by Amihud and Mendelson (1986) who said that investors demand a liquidity premium in order to buy and then hold an illiquid security. However, liquidity is not only easy to be defined but it is even harder to be measured that's why many financial empirical papers proposed many measures in order to say if one bond is liquid or not.

As we mentioned in the introductory section bond liquidity represents the gap between the fundamental value of a bond and the price the bond is trading at. When liquidity is high then the trading value of a bond will converge to its fair value. The latter is derived from the present value of the steady payments a bond pays. These payments consist of the coupon and the principal amount.

When they first started to examine the issue of liquidity in bonds, they assumed that credit spreads are the compensation for the credit risk taken from investors. Credit spreads are the component of corporate bond yields that are above the yield of comparable government bonds or treasuries which are assumed to be risk free and don't have the risk of default. So credit spreads should reflect this difference in default risk. Amihud and Mendel (1991) demonstrate that short term Treasury notes and Treasury bills with the same time to maturity have different yields owing to differences in the level of their liquidity. In 2003, Amato and Remolana found that this spread in corporate bonds tends to be bigger and said this cannot be explained only default risk. They named this phenomenon as "credit spread puzzle".

Jones, Mason and Rosenfeld (1984) and Longstaff and Schwartz (1995) studied credit spreads and liquidity from an asset pricing view while Grinblatt (1995) and Duffie and Singleton (1997) studied liquidity as part of analyzing the swap market. These studies made clear that there must be more research in bonds liquidity. Some

years later, Duffie (1999) when he tried to estimate the price of default risk in corporate bonds found a non default component and assumed that this component might be a liquidity factor. Kamara (1994) states that the yield spread of treasury notes – bills increases as liquidity risk increases too. Elton and Green (1998) find that differences in trading volume between Treasury securities account for differences regarding bonds in Japan.

Later Elton et al. (2001) calculated that while taxes accounted for 36% of the differential between corporate and treasury spreads, 46% of this difference in spreads remained unexplained by taxes and expected risk of default. Taxes and market risk were also considered to be main attributes to credit spreads by Geske and Delianedis (2001) who used a firm value framework and showed that for AAA (rated bonds) only the 22% of the credit spreads could be explained by default risk. Huang (2003) was also interested to see if bond ratings affect credit spreads and found that in high rate bonds credit spread accounted for only a small fraction of the spreads while the fraction was much bigger in low rating bonds.

Some explanations which received increased attention as possible explanations for the credit spread differential between corporate and treasury bonds was tax, liquidity, rating etc. and Driessen (2005) found that the liquidity premium in corporate bonds accounted for more than 20%. However, Longstaff, Mithal and Neis (2005) calculated that relative to the treasury curve, the default component represented 51% of the spread for AAA/AA-rated bonds, 56% for A-rated bonds, 71% for BBB-rated bonds, and 83% for BB-rated bonds. They also showed that less liquid bonds tend to have a larger liquidity component embedded within their yield spreads.

Bonds, unlike stocks and equities which are more standardized, are mostly traded in the secondary market for fixed income securities with direct trading between two parties but not on a formal exchange because trading is over the counter. Researchers tried to obtain information about these transaction data and tried to measure the effect of liquidity in corporate bond spreads by creating liquidity proxies or indirect measures of liquidity based on bond characteristics. The first one to try it, was Taylor and Perraudin (2013) who divided bonds in two categories based on liquidity proxies which was bond age, issue size and quote frequency and found spread differences of 10 to 28 basis points for AAA bonds to A rating bonds.

Chen, Lesmond and Wei (2007) examined the relation between bond liquidity and yield spreads by drawing a sample of 4000 US corporate bonds, over a 9 year period, which fell into the category of investment grade and speculative bonds. They found that there is a statistically significant relation between corporate bond liquidity and yield spreads and that liquidity explains a large fraction of the variation for speculative bonds.

Giampaolo and Sironi (2005) by taking a sample of 600 major corporations from 15 developed countries during the 1991 – 2001 period for 15 developed economies found that ratings provided by investment house of Moodys or Standard and Poors are the most important factors determining the spreads of the bonds. A spread is defined as the difference between the yield to maturity and the return of the Treasury security. Chang and Hung (2010) found that the liquidity component is a crucial determinant of bond spreads. The bonds with low ratings have a larger liquidity component something which is being reflected in the yield spread. The researchers employed a semi parametric model which took into account the time effect and reduced model bias.

Lin, Wand and Wu (2011) investigate how liquidity risk which depends on the value of liquidity metrics is priced on corporate bonds. Their results which were derived from a sample of 12.000 bonds for the period 1994 – 2009 suggested that liquidity risk is priced in corporate bonds. Liquidity risk refers to the chance that the price of the bond will decline if liquidity conditions aggravate.

The U.S. bond market is the biggest and most important in the world, and as a result has received the most of attention from researchers around the world. However, studies on the European market have pointed to similar results and confirmed that conclusions regarding bond liquidity are just as valid in Europe. Howeling, Mentick and Vorst (2005) examined if liquidity is priced in euro – denominated corporate bonds for the period 1999 – 2001. By using nine liquidity proxies and by constructing one portfolio for each liquidity proxy they found that the null hypothesis that liquidity premiums are jointly equal to zero was rejected for 8 out of nine portfolios. The highest premiums were found in cases where liquidity was proxies through age and yield dispersion. De Jong and Driessen, (2012) used a linear factor model in which corporate bond yields are linearly related to market risk factors and to liquidity risk factors. They found that liquidity and market factors explain at a statistically significant level corporate bond yields.

All the above literature studied bond liquidity before or shortly after the crisis of 2008-2009. In 2006 market liquidity was high but when the financial crisis of 2008 market conditions deteriorated especially at the last quarter of this year. In 2011 liquidity conditions though better than 2008 were still tense due to the sovereign debt crisis spreading to the countries of Southern Europe. In order to prevent new crisis and bankruptcies there is a global effort to promote a better banking sector and a more transparent market. Several market participants like IMF (2015), PwC (2015) and Financial Times (2015) have expressed their doubts regarding liquidity decline due to the new regulatory framework.

Friewald (2012) studied the pricing of US corporate bonds in periods where the bond and equity market are stressed. He employed as a liquidity measure the Roll and Amihud metrics and found that liquidity accounts for 14% of variations in corporate bond yields. Acharaya (2013) examines the exposure of US corporate bonds yields too liquidity shocks within a time frame of 30 years. He found that liquidity shocks affect or not bond prices under 2 circumstances. Under the first circumstance where no crisis exists in the financial markets liquidity shocks do not affect bond prices. However when the economic environment is characterized by financial and macroeconomic distress there is differential impact of liquidity on investment grade bonds compared to bonds of lower credit quality. This practically means that during a liquidity crisis the price of an investment grade bond might go up while the price of a junk bond will drop since there will be a flight to quality from junk bonds to bonds of higher ratings

Dowing, Underwood and Xing (2005) found that long term bonds have a larger beta with respect to the bond illiquidity actor and that liquidity shocks provide a sound explanation for the variation in bond returns on a time series level. Goyenco Subrahmanyam and Ukhov (2011) investigated the liquidity of US treasury bonds of the period 1967 – 2005. They show that liquidity conditions in the corporate bond market are significantly related to the economic environment and that bond spreads significantly increase during periods of recession.

One last empirical paper was by Loon et al. (2014). They created a new liquidity measure in order to extract the liquidity premium of corporate bonds. They found that all rating categories of bond before financial crisis had low liquidity premiums but after the crisis liquidity premiums increased dramatically for bonds with lower rating and

had remained in at a higher level in the following years after the crisis. On the other hand the high rating bonds experienced a small change in premiums and this is supporting the theory “flight to quality”. “Flight to quality” concept means that investors during periods of financial distress shift their portfolios in safer securities because these securities have a small risk of default.

Generally speaking the majority of studies has shown that the more illiquid a bond is the highest the yield of the bond or the lowest its price. The studies have been conducted after controlling for other variables. Therefore when liquidity deteriorates the buyer of a bond will experience capital losses. If liquidity conditions improve and everything else stays equal the price of the bond will normally go up and the investor who sorted the bond will experience capital losses.

The opinions regarding the development of bond market liquidity during the last decade are mixed. Several market participants claim that liquidity has increased while other claim that bond liquidity has decreased. However the majority of buy side and sell side respondents assert that bond market liquidity has deteriorated. (IOSCO, 2017).

### 3. The international market of corporate bonds

A corporate bond is a debt obligation issued by a private company and when an investor buys a bond, is essentially lending money to the entity that issued it. As we mentioned in the introductory section corporate bonds do not convey an ownership interest in the corporation. The bond investor receives a steady income at regular intervals plus the principal amount. A bond can be classified according to its quality. Bonds which are rated higher than BBB (Moody’s rating system) carry a minimal likelihood of default. Bonds which are rated below BB have a high probability of default and in order for investors to be compensated for the high risk they take over, the specific bonds offer high yields. Amongst the most actively traded bonds the 26 % falls into the category of BBB. Considering the less actively bonds 35% fall into the category of A.

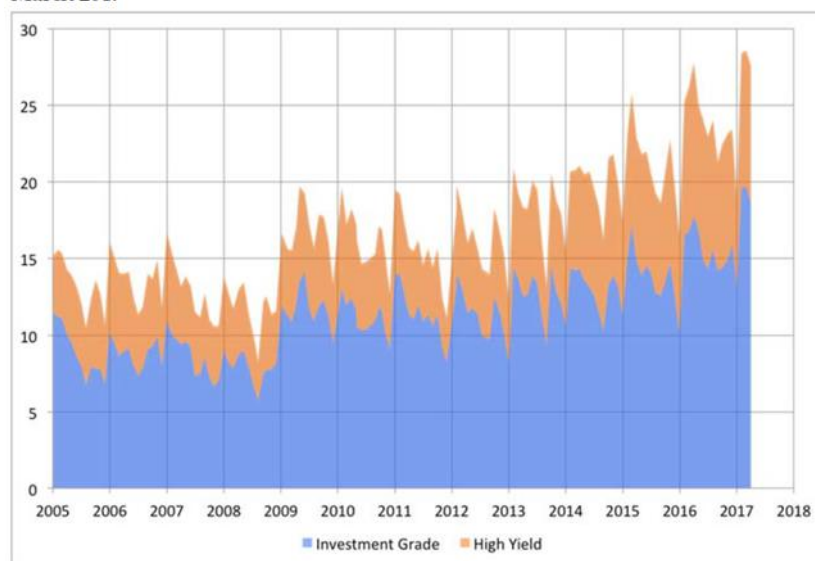
The corporate bond market serves a crucial economic function since it brings together corporations that desire to raise capital to expand their line of business and savers who desire a stable income. Therefore the corporate bond market promotes economic growth productivity and employment especially in a period when the banking sector is stressed.

A basic feature of the bond market is the secondary market which serves as a means to sell existing bond securities which were previously bought in the primary market. A bond investor might hold his security till maturity or he might close his position in the secondary market for several reasons such as to re-adjust his portfolio, to realize capital gains or to match specific liabilities. The role also of the market maker is very important since it matches buyers and sellers of a specific bond at the same time. Market makers are usually bank institutions or dealers and provide a two way pricing to investors depending on if the latter are buyers or sellers. When investors are sellers then the market maker will show a bid which is the lowest price of the spread while if clients are buyers then the dealer will show the ask price. (ICMA, 2016)

The expansion of the corporate bond market can be attributed to the favorable / low interest rate environment. Low interest rates have motivated investors to buy corporate bonds in order to realize higher yields. Low interest rates were the result of quantitative easing policies. More over bank lending was restricted since banks had to comply with the new capital requirements and therefore corporations used bond issuance as an alternative means of finance. During the last decade both demand and supply for corporate bonds has shifted rightwards. Corporate bond financing has increased as a fraction of total corporate financing from 24 % in 2004 to 28 % in 2014 which means that the one fourth of the capital firms raise to finance their operations originate from the bond market. The biggest portion of the funds raised comes from the banking sector.

Over the last decades the corporate bonds market has grown rapidly and has tripled in size since the beginning of the century. In 2013 the value of the specific market reached 49 trillion dollars. In 2013 corporate bond issuance reached the impressive amount of 3.2 trillion as opposed to the amount of just 0,9 trillion in 2000.

Average daily trading volume in U.S. corporate bonds (Billions of dollars), 2005-  
March 2017



Source: SIFMA based on FINRA TRACE data.

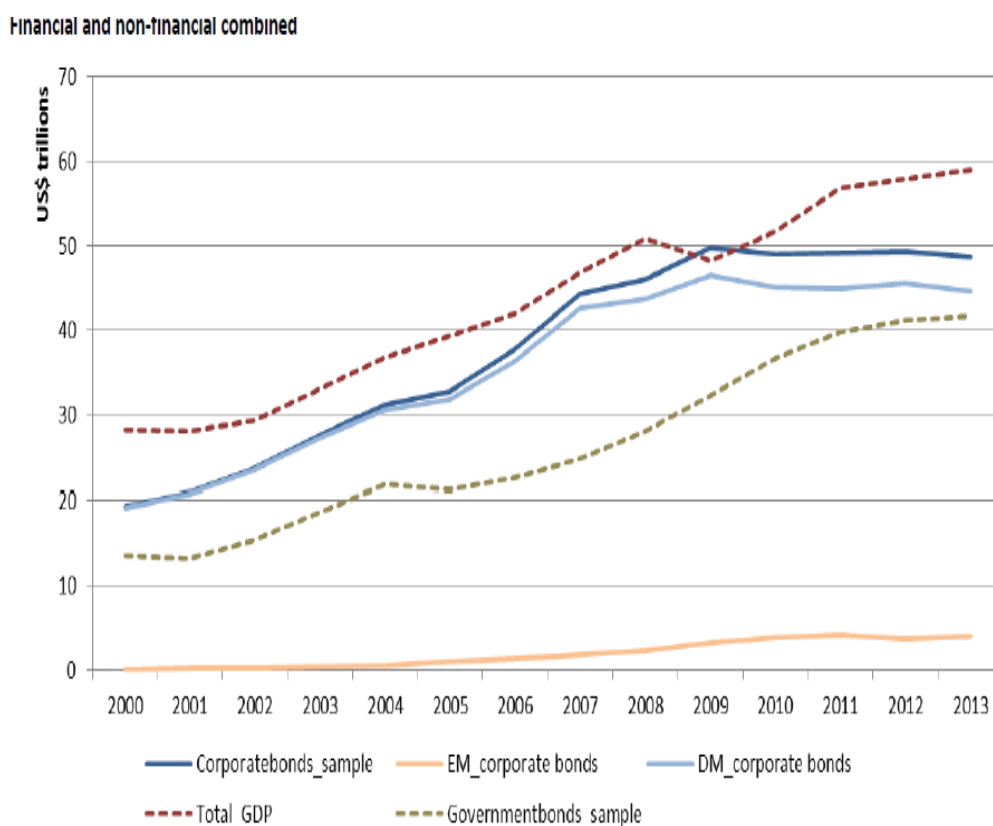
Although the global turmoil of 2008 stalled the growth of the market since banks started deleveraging their balance sheet the decline in the rates of growth were rather moderate since the amount outstanding from firms not belonging to the financial sector continued to expand. (IOSCO, 2014) In the developed markets, the amount of outstanding corporate debt has increased most significantly in the U.S. which the biggest fixed income market in the world. According to Sifma (2017) the value of corporate bond outstanding in US is 8.544,00 billion while corporate bond issuance in US market is 1.441,2 million. The total value of US bond market is 39.907,9 billion. In Europe and other developed markets, the increase has been more gradual, but the overall trend is upward.

Another characteristic regarding the development of the international bond market is that bond issuances have soared reaching the value of 47 billion dollars. Corporate bonds that are being issued in emerging markets however are riskier since the relative business environment in these countries is more volatile. The crisis of 2008 affected significantly the banking sector and companies had to resort to alternative means of financing other than bank borrowing. During the last years corporate bond markets have substituted to an extent banks and have managed to fill the gap between bank lending and long term financing. Corporate bond markets have been exhibiting a particular potential for servicing the needs of small enterprises. (IOSCO, 2014)

In view of the unsteady equity flows and foreign direct investment small medium enterprises are expected to significantly benefit from the constant development of the bond market. The examining market has grown significantly despite the fact that government bond issuance has reached historical heights.

The most important factors for a successful development of a corporate bond market are a well-developed government bond market the relationships between banks and enterprises and the regulatory framework which regulates financial markets. (Levine, 1998) The crowding out effect suggests that an increase of government bond issuance in order to finance its purchases in the frame of fiscal policy will shift funds from the private sector to the public sector resulting in the shrinkage of the corporate bond market. However such a thing did not happen since banks restricted their lending in order to enhance their capital adequacy indices. In the following diagram we demonstrate how the corporate and government bond market evolved from 2000 to 2013.

Diagram 1. Corporate and government bond markets



Source: IOSCO 2014



Since 2004 the ranking of corporate bond markets regarding the top 10 markets has not changed significantly. A particular feature of the international bond market is that concentration has been reduced. Moreover in 2013 many emerging economies have developed to a big extent the examining market and in 2013 the emerging markets of China, South Korea, Russia Malaysia and Thailand ranked amongst the top 20 markets. Finland, Greece, and Portugal ranked amongst the smallest nineteen markets. In the following diagram we demonstrate the top 20 markets for 2013.

A substantial development in the corporate bond market was the emergence of ETFS. Since it has become more difficult for managers to engage in corporate bond trading due to liquidity issues the specific financial instrument provides a means to invest in a basket of corporate bonds or reference index with quite low transaction costs.

As far as the US market is concerned during the last five years there have been a few noticeable trends. Corporate bond issuance has surged reaching historical highs. This increase is obviously attributed to the regulatory changes in the banking sector. Moreover the trade size has decreased, the number of counterparties has dropped and finally the CDS market has shrunk. The primary market in US owing to the growing number of issuance appears to be at a very good state and functions efficiently. The secondary market however is characterized by high illiquidity. (DTCC, 2016)

In 2016 corporate issuers were interviewed to express their opinion regarding the state of the primary and secondary bond market. It was widely accepted that the primary market performed well something which can be documented by the record level of issuances. However the interviewers admitted that the secondary market was rather inefficient. The lack of confidence in the secondary bond market has resulted in the issuer's paying a high premium to compensate investors. According to a survey conducted by IOSCO the 68 % of the byer side participants have claimed that liquidity deteriorated while the 80 % of bond sellers have also perceived a liquidity deterioration. We should point out that these estimates were not based on actual data but on personal experience.

The advantages of developing a corporate bond market are numerous and refer to the ability of the market to supplement bank financing , the creation of a stable financial system, the increased ability of small medium enterprises to raise capital, the freedom from bank monitoring, the higher yields households can enjoy when investing in fixed

income securities, the ability of insurance and pension funds to broaden their financial choices and finally with a developed market the health of firm balance sheets is being improved. Additionally the cost of capital drops since corporate bonds provide a less expensive source of funds compared to loans granted from banks. With the drop of the cost of capital the NPV of projects increases giving rise to the initiation of more investments. (Ramani, 2016)

There are however a few disadvantages associated with the development of a corporate bond market. Transaction costs when trading these bonds can be high, the market is characterized by high illiquidity, the participation of retail investors is low, a lot of regulatory barriers exist, investors avoid purchasing bonds with low credit ratings, risk of default can be high while the legal structure is inadequate.

From 2012 there is an effort towards electrification of corporate bond trading. Technological advances are facilitating the trading in the secondary corporate bond markets by allowing dealers to communicate directly and trade with their clients or facilitating the execution of trades on electronic trading venues. Many corporate bond trading platforms launched, trying to provide better market transparency and lower cost of trading in their try to increase liquidity in corporate bond market. Some regulators and academics argue that transparency can encourage bigger participation from investors in this market and contribute to price discovery. In US all corporate bond trades are reported in FINRA's TRACE system. It was first initiated on July 1 2002, and now all broker-dealers who are FINRA member firms have an obligation to report transactions in corporate bonds to TRACE under an SEC-approved set of rules.

Finally as far as the prospects of the corporate bond market are concerned the operation of the market will not change dramatically in the following 2 – 3 years. Most analysts agree to the fact that liquidity structure within the new regulatory environment should change. The question is which catalyst will trigger such a change. The upcoming increase of interest rates will affect positively the liquidity of the US corporate bond market. Investors will sell a part of their bond portfolio being feared of a selloff in bond prices after an extended period of a bull market. Buyers will take advantage of the falling prices ensuring more decent bond yields compared to yields of previous years which were remarkably low. Therefore liquidity is expected to increase.

Bond holders attach importance on liquidity based on the strategy they adopt. Investors that hold bonds until maturity are not so much concerned with liquidity issues. However investors who are engaged in active portfolio management consider the secondary market liquidity very important. According to the IOSCO survey the 93 % of market participants regard bond liquidity as an essential element in their investment decision.

## 4. Liquidity

Liquidity is plays a key role in the appropriate functioning of markets and these markets are desirable because of the benefits they offer. Amihud and Mendelson (2001) proposed one easy and often even nowadays used definition of liquidity. They said that an asset is liquid if it can be bought or sold at the current market price quickly and at low cost. This means, that if market participants can buy and sell huge amounts of financial assets without affecting the price of these assets negatively, the asset is perceived to be liquid. Gravelle (1998) also stated that liquidity represents the ease with which large size transactions can be effected without at the same time having an impact on prices. A liquid market is that where transactions take place rapidly with a minor effect on trading prices.

Later, in 2002, Sarr and Lybek argued that liquidity characteristics might change over time because liquidity is mainly connected to transaction cost in an environment of a stable market but in periods of crises or stresses these costs are changed.

Brunnermeir and Pedersen (2009) divided the concept of liquidity into two categories: market liquidity and funding liquidity. According to them market liquidity is low when it is difficult to raise money only by selling one asset close to market price and for a sizeable quantity while funding liquidity refers to the tactic used by expert investors or arbitrageurs to obtain money because of the asymmetry of information.

It is difficult to measure market liquidity because except of its many dimensions, these dimensions are not always equally valuable in all situations. Kyle (1985) in his paper on auctions and insider trading, proposed three dimensions of liquidity: i) market tightness which refers to the cost of buying and selling an asset or position of a typical

size, ii) market depth which refers to the size of the trade required to change prices by a given amount and iii) market resiliency which is the speed at which market's depth and tightness recover after some events. In our dissertation when we use the term liquidity we will refer to market liquidity.

## 4.1. Liquidity Measures

This section presents the various liquidity measures that we use in regression analysis as dependent variables to see how bond characteristics (independent variables) affect bond liquidity.

The concept of bond liquidity is very important for bond investors since it determines liquidity risk and in turn the relative investment choices. The higher the liquidity risk and the more risk averse bond investors are, the bigger the premium they are going to require for buying the bond since when liquidating their position they are not going to sell the security at a convenient price.

Bond liquidity represents a rather subjective concept and for this reason a lot of measures have been proposed to assess the liquidity of a bond. As far as corporate bonds are concerned direct liquidity might not be reliable since the majority of bond transactions occurs on the over the counter market. (Dimson, 2001)

Many bond investors are currently in the process of creating more liquidity metrics which will incorporate a wide range of data points such as bid ask spreads, historical trade frequency, price movements, outstanding issue size and the distribution and concentration of holdings. The aim of these measures is to attempt estimating the expected time to execute an order, and the expected impact of such an order on bond price. These measures will be constructed based on the assumption that historical liquidity can predict current liquidity. (ICMA, 2016)

### 4.1.1. Amihud measure

A very popular liquidity measure employed is the Amihud measure. Amihud (2002) constructed an illiquidity measure which was based on the theoretical model of Kyle (1985). Amihud ratio measures the price impact of a trade per unit traded. For each corporate bond the measure is the daily average of absolute return  $r_j$  divided by the trade size  $Q_j$  (in million \$) of consecutive transactions. The Amihud measure suggests that a larger volume indicates that for a given trade price would move more meaning that bond is illiquid. The formula of the specific metric is the following:

$$Amihud_t = \frac{1}{N_t} \sum_{j=1}^{N_t} \frac{|r_j|}{Q_j} = \frac{1}{N_t} \sum_{j=1}^{N_t} \frac{\left| \frac{P_j - P_{j-1}}{P_{j-1}} \right|}{Q_j}$$

### 4.1.2. Zero trading days

An other liquidity measure which is used in our empirical analysis is zero trading days measure. Zero-trading days is calculated as the percentage of days during a period where the bond did not trade at all. In order to compute it in our analysis, for each bond, we found how many days total volume was zero and took it as a percentage from the whole transaction days for each bond.

### 4.1.3. Turnover

Bond liquidity can also be measured by focusing on trading frequency. Assuming that all else is equal bonds which are more illiquid will trade less frequently. The turnover rate can be computed as the ratio of total trading volume to the amount of face value outstanding. (Vayanos, 1998) Higher turnover indicates greater liquidity for corporate bonds and thus smaller yield spreads.

$$Turnover = \frac{Total\ trading\ volume}{Amount\ outstanding}$$

## 5. Proxies affecting liquidity

The empirical part of our dissertation focuses on the factors that affect liquidity. Previous empirical papers that examined liquidity in bond or equity markets used two kind of measures: i) direct measures which is based on transaction data and ii) indirect measures which is based on bond characteristics and/or end of day prices. Some examples for direct liquidity measures are quoted bid-ask spreads, effective bid-ask spreads, traded sizes, trading volume, quote frequencies and trade frequencies. But this direct measures are sometimes not reliable and difficult to obtain because most of corporate bond transactions occur on the over the counter market and might be a shortage of intraday transaction data. For this reason many analysts use indirect measures which are easier to obtain. Such indirect liquidity proxies are coupon, issued amount, maturity, age of bond, rating of the bond (ex AAA,AA,A,BBB), CDS spread (or par equivalent CDS spread) and the contingent convertible. In this section we present a review of literature regarding the factors that affect bond liquidity which we found by searching theoretical and empirical papers.

The need to understand the fundamental factors that affect liquidity is very critical in evaluating the effectiveness of financial markets. When an investor can identify the factors that influence liquidity metrics such as the bid ask spread, the trading volume e.t.c. he can be better informed regarding bond pricing issues to the extent that liquidity risk is incorporated in the prices of bonds. Now we will discuss each of these proxy-factors in more detail and also represent what other empirical paper found for the factors that affect bond liquidity.

### 5.1. Issued amount (*amount outstanding*)

The issued amount of a bond is often assumed to provide an indication of its liquidity. Many investment banks use issued amount as liquidity criterion in their bond indices. The first one to propose it was Fisher (1959), who claimed that large issues should trade more often. Since Fisher, several empirical papers also predict a positive effect of issued amount on liquidity and thus on bond prices. Amihud and Mendelson

(1991) argued that bonds with smaller issued amounts tend to get locked in buy and hold portfolios, reducing the tradable amount and as consequence their liquidity, while Crabbe and Turner (1995) subsequently proved that bonds with larger issued amounts have lower transaction costs because they are owned by more investors. Lee (2016) in his study shows that the issue size has a significantly positive impact on the liquidity of bonds since the bigger the issue size the easier for dealers to manage their inventories. Moreover there is a statistically significant negative relation between liquidity and the age of the bond which practically means that a bond becomes less liquid as it ages. The same researcher also found that liquidity which is measured by trading volume increases as interest rate risk increase and that bonds become very illiquid when the key interest rate rises.

## *5.2. Age of bond (years since issuance)*

The age of the bond is a popular proxy and a factor that affects its liquidity. Wadha, (1989) argues that a bonds liquidity decreases as its age increases meaning that an inverse relationship between age and liquidity exists. Considering the fact that the age of a bond is correlated with time to maturity upon issuance long term maturity bonds will exhibit higher illiquidity. Bao, Pan and Wang (2008) found that illiquidity in corporate bonds is more severe than what the bid – ask spread suggests. Also McGinty (2001) and Schultz (2001) found that new issues trade more than old issues. McGinty argued that this happens because lead managers try to make a market in a newly issued bond while Schultz pointed out that new issues are typically underpriced so that traders buy bonds in the beginning when it is offered and sell it shortly thereafter. Illiquidity appears to be higher for older and smaller bonds and bonds with higher idiosyncratic return volatility. Thus the older o bond gets the less trading takes place and bond become less liquid. Moreover once a bond becomes illiquid, it stays illiquid until it matures.

### *5.3. Coupon*

Bonds which have larger coupons seems to be less liquid than bonds which have smaller coupons. Bonds with different coupons but with identical credit risk exhibit different levels of liquidity. However because we are not always able to adjust for credit risk, coupon cannot be viewed as a pure liquidity proxy.

### *5.4. Contingent Convertible*

Contingent convertible bonds (CoCos) are similar to the traditional convertible bonds in that there is a strike price, which is the cost of stock when the bond converts into stock. The difference is that there is addition to the strike price another threshold which triggers the conversion when certain capital conditions are met. Issuing contingent bonds gives more advantages to companies. This is a new concept and there are not at all any empirical papers dealing with this kind of bonds. For convertible bonds which have many similarities Pinche (1973) states that offer advantages and disadvantages to investors and the balance of the pros and cons will determine the liquidity of these kind of bonds. A convertible feature mitigates the downside risk during economic recession but at the same time convertible bonds carry a lower coupon compared to straight bonds.

### *5.5. Euro traded-exchange rates*

This liquidity proxy is whether a corporate bond is denominated in euros or in one of the legacy currencies. The market generally sees legacy bonds as the less liquid ones, because these bonds are relatively old, not well known to the bond investors and more difficult to trade. The first empirical paper who checked it was by Houweling et al (2004).



Mukherjee and Atsuyuki (1995) found that the exchange rate fluctuation can affect bond liquidity. Liquidity of corporate bonds increases when the foreign currency appreciates. However exchange rate risk will have a moderate impact when few investors are present in the domestic bond market.

### *5.6 Size and specific characteristics of the firm*

The size of the firm which proceeds into bond issuing can be of major importance regarding the bonds liquidity. Wadha (1996) claims that when the issuing firm has a big size then the liquidity of the bond will be high as well. In this case investors perceive that the default risk is low and therefore they prefer these bonds. However it is not clear how large a firm should be so that the bond investor's interest is secured. Guo, Lien, Hao and Zhang (2017) examine the impact of uncertainty on bond liquidity and they find that uncertainty regarding the firm's asset value accounts for 8,5 % of the variation in bond liquidity. Bonds which are issues from firms that have bigger information uncertainty exhibit lower liquidity. This means that the relation between liquidity and uncertainty is negative. The researchers performed also a Granger Test and found that uncertainty causes bond liquidity while the reverse causality is weaker.

A crucial factor which can affect liquidity of bond market is corporate governance. Hyun (2016) has shown that corporate governance has a positive impact on the bond trading volume when variables such as the size and capital structure of the company remain constant. Corporate governance incorporates five basic elements such as the protection of shareholders rights, the functions of the board of directors, the reliability of the audit committee, the sufficiency of disclosure and the distribution of management loss. When these elements receive a high score then corporate governance is more effective and bonds are more popular to investors something which enhances liquidity.

### 5.7. *Quality of bonds-rating*

Cochran (1989) found that investors attach significant weight to the quality of the bonds. Therefore bonds with low credit quality will be very illiquid. Cornell (1992) on the other hand suggests that there might not be a statistically significant relation between the credit quality of a bond and its liquidity.

Wei and Tareque (1998) examined the bond features that affect liquidity by running a regression with 8 independent variables such as bond rating size, term to maturity, coupon and float, convert secured and warrant which are dummy variables. They find that the *bonds rating* has the most statistically significant impact on liquidity. They also run a regression with independent variables such as the daily interbank interest rate, the daily closing stock index, inflation and the exchange rate to detect the statistical significance of the macroeconomic variables affecting liquidity. They found that the interbank rate has a statistically significant impact while the other variables were statistically non-significant.

### 5.8. *Interest rates*

Chakravarty (1999) states that a change in interest rates will significantly affect bond liquidity while Jostova (2007) predicts that if interest rates significantly change the impact on liquidity will be very strong since bond prices exhibit high sensitivity to changes of interest rates.

Nelson (2012) states that the bonds market liquidity is very important for the smooth operation of the bond market and the existence of deeper and more liquid bonds market makes it easier for investors to adjust their portfolios with the lowest possible cost. The particular study supports that bank lending interest rate, domestic debt, foreign exchange rate and savings rate have a statistically significant impact on the liquidity of the bonds.

## 5.9. CDS spreads

An important thing that happened in the last years has been the credit default swaps. The credit default swap contract is a derivative in which the underlying instruments are corporate bonds and financial theory proves us that a strong relationship should exist between CDS contracts and underlying instruments. Thus, the CDS spread is a proxy for the premium attached to credit risk. Nashikkar et al. (2011) found that CDS contract liquidity influences both bond liquidity and bond price itself. Bonds of issuers whose CDS contracts have greater liquidity tend to be more expensive. There are three ways of using a CDS spread to control for credit risk in corporate bonds. However most market participants use the third method called par-equivalent spread.

## 5.10. Other proxies (factors)

Apart from the bonds characteristics macroeconomic factors as well have a significant impact on corporate bond liquidity. During the last decades investors have been highly concerned with the systematic / market risk paying less attention to firm specific factors. Chernoff (1989) claims that when the economic activity shrinks due to a restrictive monetary policy liquidity will deteriorate. A monetary tightening leads to an interest rate increase, to a decrease of investments and probably to a financial crisis something which will have a negative impact on liquidity. Another factor according to Admati and Pfleider (1988) that can affect liquidity is information asymmetry. The latter occurs when one market participant has an information advantage over the other market participant. In the of bond issuance as a means to raise capital the firm is much more aware of its fundamentals and prospects compared to investors. The bigger the information asymmetry the less liquid the bond will be.

Gehr (1992) found that the secondary market regarding investment grade corporate bonds is more illiquid than what most investors believe. He also suggests that apart from the investors' dealer's bid ask spread very important factors that explain the bonds liquidity are the bond characteristics. Galliani, Petrella and Resti (2014) by using a robust liquidity index based on PCA and by estimating a multivariate regression model

found that European bond liquidity is mainly affected by *duration, rating, amount issued and time to maturity*. Liquidity exhibits a higher sensitivity to these factors in periods of crisis. They also found that the illiquidity of individual bonds is a positive function of market illiquidity and the relation is stronger for bonds with longer duration and lower rating particularly in periods of liquidity crisis.

Christensen (2017) states that the quantitative easing programs adopted by the Central Banks in an attempt to boost the economy and to deal with the liquidity crisis resulted in the decline of liquidity premiums. This means that these programs had a positive impact on secondary market bond liquidity.

## 6. Regulations regarding liquidity

An increased level of liquidity is essential for the stability of financial markets. Right now due to the new regulatory framework the risk of a direct liquidity shock is rather low. However owing to the structural changes having taken place the bond market is more vulnerable to a future crisis which could exacerbate the impact of the adverse consequences related to a disruption of the market. (DTCC, 2016).

A few of the structural changes occurred in the bond market refer to the changing ownership of U.S treasuries, the contraction of the repo market, the prevalence of new business models regarding the management of banks, the proliferation of high frequency trading and the creation of electronic trading platforms. Many of these changes have impacted liquidity although as we mentioned in the previous paragraph there is a low risk of an imminent liquidity shock. The structural changes were partly the result of regulatory changes. (DTCC, 2016)

Regulatory changes might have made the bond market more resilient to a financial crisis but many analysts argue that the new regulatory changes can have a relatively negative impact on liquidity. These changes have given rise to a reallocation of capital flowing into the markets. (DTCC, 2016)

The crisis of 2008 has revealed the weaknesses of the financial system. During the global crisis the lack of liquidity threatened the banking system with collapse. Banks

were overleveraged while at the same time were holding risky financial instruments which were offering returns disproportionate compared to their risk. As a result of the disruption of the financial system several regulatory changes took place which aimed at mitigating systematic / market risk. A few of the changes were the following: (DTCC, 2016)

Considering the weak points of Basel II, Basel III was introduced and provided a global framework for banks capital adequacy standards. The regulatory framework included standards for capital requirements, leverage ratios, and liquidity requirements. With Basel III stricter capital requirements were imposed while banks were obliged to attain higher quality assets by complying with the new risk weighted asset requirements. A basic requirement was the 5 % equity ratio for the largest banks.

The new international framework of Basel III obliges banks to take into account two new liquidity ratios. The value of the latter exceed a minimum value so that a bank effectively deals with stressed liquidity conditions. Stressed conditions include run off of a proportion of deposits, downgrade of the bank's credit ratings, increased market volatility, and losses of unsecured wholesale funding. (Galliani, 2014)

Another rule that will take effect was the obligation of important to the financial banks to attain additional capital which ranged from 1 to 5.5 % of total risk weighted assets. This rule will be fully in phase at the beginning of 2019.

To render banks less vulnerable to a future financial crisis banks were now obliged to issue ordinary shares, subordinated debt and other securities. The amount of issuance would be equivalent 16 to 20 % of the value of risk weighted assets.

In order to mitigate the systematic arising from the interconnectedness of banks and other institutions strong standards will be established for financial institutions including central counterparties. Moreover the committee is increasing the risk weights within the financial sector compared to entities which do not operate in the financial sector.

The committee also will introduce a series of measure to effectively cope with pro cyclicity. The objectives of these measures will be to promote more forward looking provisions, to achieve the macro prudential goal, to conserve capital to build buffers at individual banks and to dampen any excess cyclicity. (Basel Committee, 2010)

The liquidity coverage ratio requires banks with a value of assets more than 50 billion to hold high liquid assets in order to respond to short term cash obligations over a thirty day period. This rule will enable banks to effectively cope with periods of financial stress. With the new requirements regarding the liquidity coverage ratio banks will have to hold US treasuries for collateral purposes rather than trading purposes. (Basel Committee, 2010)

The liquidity coverage ratio is defined as the ratio of the stock of high liquid assets to the total net cash outflows over the next 30 calendar days. To reach such a definition a basic scenario was formed which is associated with a strong liquidity crisis. This scenario refers to the run – off of a proportion of retail deposits, to the partial loss of unsecured funding capacity, to the partial loss of secured short term financing, to the additional outflows that would take place as a result of the bank’s public credit, to the increase of market volatility which could impact the quality of collateral exposure of derivative positions and to the bank’s need to buy back debt. (Basel Committee, 2010)

With respect to the liquidity ratio attained by banks the supervisors should take into account not only the current macroeconomic environment but also the forward looking assessments of macroeconomic and financial conditions. To be more specific supervisors should make any assessments at an early stage so that they address liquidity risk, they should allow for differentiated responses to a reported liquidity coverage ratio below the threshold value and they should justify the reason for which the liquidity coverage ratio has fallen below a certain value that is whether the decline was attributed to firm specific or market factors.

An important regulatory change is the stress test procedure banks will have to go through at regular intervals. This test will ensure that banks will be able to cope with the most pessimistic scenarios. Banks that will not pass the test will have to take stricter measures to get immunized against future shocks. Finally other regulations were imposed to enhance transparency and to restore investors’ confidence.

Generally speaking the new regulations have obliged banks to increase their capital buffers. The stricter capital requirements have restricted the trading activity of banks something which had a negative impacts on the liquidity of the bond market. However many experts claim that the impact on liquidity was moderate and that these changes were bound to occur in view of the vulnerability of the financial system during the crisis

and the previous inadequacy of the regulatory framework which was one of the factors that led to the financial turmoil.

## 7. Data

Data was downloaded from J.P. Morgan database. The dataset gives a list of dates traded and volume of 1.746.447 observations. Dataset provides us with bond characteristics such as coupon, issue date, maturity, issue size, rating etc., volumes for the period between 11 March 2010 and 27 June 2013 and firm specific characteristics such as sector and region from companies which may not be in US but issued their corporate bond in US market. In order to conduct our cross sectional analysis we group all transactions happened for each bond resulting us in 5339 different corporate bonds issued by 4935 companies. Our final regression model, used all the available valid variables because in some corporate bonds some observations was missing.

## 8. Statistical Methodology

The scope of the statistical analysis is to detect all possible measures and characteristics of a Corporate Bond that might affect the liquidity of the Bond, as it is expressed by Amihud, Total Turnover and the Percentage of Zero Volume Days within the examined time period (dependent variables). Such measures and characteristics (independent variables) have been described in previous chapters and are the following: Percentage of Coupon, Par Outstand Value, Par-equivalent CDS Spread Value, Remaining Maturity Years of the Bond (in five categories – 0-3 years, 3-5 years, 5-7 years, 7-10 years, more than 10 years), Age of the Bond (up to two years or more than two years), Euro Flag (Yes, if bond is denominated in Euros, No, otherwise), Flag Rating (the rate of the Bond in four categories – AAA, AA, A and BBB), Flag Coc (Yes, for “Change of Control” of the Bond, No, otherwise), Flag Sector (the Sector of the Bond in fourteen categories – Banks, Basic Industries, Capital Goods, Consumer, Energy, Healthcare/Pharmaceuticals, Insurance, Media/Entertainment, Property/Real

Estate, Retail, Technology, Telecoms, Transportation, Utilities), Seniority Flag (with two categories – Senior or Sub Ordinated) and Flag Domicile (the continent in which the Bond is trading grouped in three categories – North/Latin America, Europe and Rest of World (Asia/Middle East/Africa/Oceania)).

In order to examine the possible effects of the independent variables on each one of the three dependent variables (Amihud, Total Turnover and Percentage of Zero Volume Days), we perform an Ordinary Least Squares (OLS) Linear Regression (cross-section analysis) Model for each dependent variable. For all categorical independent variables with k categories, we create k-1 dummy variables, keeping one category for each variable as the Reference Category. The results for all other categories (dummy variables) are compared with the Reference Category. We then fit a linear equation of the form  $Y_i = \alpha + \beta_i X_i + \varepsilon_i$ , where:

$Y_i$ , is the estimated value of the dependent variable

$\alpha$ , is the constant term of the model (average of the covariates and the reference categories)

$\beta_i$ , are the slope coefficients of all the covariates including the dummy variables

$X_i$ , are the independent variables (covariates and dummy variables) and

$\varepsilon_i$ , is the error term of the model.

We choose the Stepwise Method for entering and removing all possible independent variables in the final model, with the probability of entry in the model set to 0,05 (5%) and the probability of removal from the model set to 0,10 (10%).

For all three regressions, we calculate the Coefficient of Determination ( $R^2$ ) for the final model (adjusted by the number of variables in the model) as a measure to estimate the proportion of the variation in the dependent variable that is explained by the regression model.

As Reference category for all categorical variables we set the category with the highest frequency, except for “Yes/No” Flag Variables on which we set the “absence of the characteristic” category (the “No” category).

For matters of simplicity, analysis for Amihud is performed after multiplying Amihud values with 1.000.000, in order to gain more illustrative outcomes.



## 9. Summary Statistics - Results

Table 1 presents all the basic summary statistics for the three dependent variables (Amihud, Total Turnover and the Percentage of Zero Volume Days), as well as for all Corporate Bonds liquidity and static measures and characteristics which take part in the statistical analysis. For continuous measures, we present the Mean, Standard Deviation, Median, Minimum and Maximum value. For categorical proxies, we present the percentage (%) for each category. The number of valid cases (N) varies among each variable and is also presented in Table 1.

As shown on the Table, the variation of the values for all three dependent variables is relatively wide. Amihud values are ranged from 0 to 18,62, with average value equal to only  $0,50 \pm 0,76$  and a much smaller median value of 0,29. For Turnover, values are ranged from 0 to 64.338,67, with average value equal to  $2.552,58 \pm 3169,34$  and median value of 1.675,18. The percentage of Zero Volume days lies from 0% to 100%, the average percentage is 15,21% and the median 8,20%. For all three dependent variables the average value is much higher than the median, implying the presence of extreme high values in the analysis.

The values for the three numerical independent proxies (Percentage of Coupon, Par Outstand and Par-equivalent CDS Spread), seem to be much more symmetric, since the mean and median values for each proxy are relatively close (4,96% Vs 5,25% for Coupon, 801,78 Vs 600,00 for Par Outstand and 114,59 Vs 106,88 for Par-equivalent CDS Spread).

The Age of the Bonds is equally distributed, since 50,04% are up to 2 years and 49,6% are more than two years. For 23,7% of the Bonds the Remaining Maturity Years are up to 3 years, for 19,1% 3-5 years, for 9,8% 5-7 years, for 24,4% 7-10 years and for the rest 23% the Remaining Maturity Years are more than 10. Only 1% of the Bonds are rated as AAA, 12,2% as AA, 37,4% as A, while the majority (49,5%) are rated as BBB. Only 4,8% of the Bonds are denominated in Euros and 25,8% have “Change of Control”. The vast majority of the Bonds are Senior (94,8%) and only 5,2% are Sub Ordinated. The majority of the Bonds are trading in North/Latin America (83,9%), the 12,6% in Europe and only 3,6% in the Rest of the World (Asia/Middle

East/Africa/Oceania. Bonds stem from fourteen economical/business sectors, with the relatively higher sectors to be Banks (18,8%), Consumer (12,9%), Energy (10,9%) and Utilities (10,8%) and the smallest to be Property/Real Estate (3,1%), Transportation (2,5%) and Retail (1,4%).

*Table 1: Summary Statistics for Corporate Bonds Measures & Characteristics*

Variables		N	%	Mean	Std Dev	Median	Min	Max
Amihud (*1.000.000)		4327		,50	,76	,29	,00	18,62
Turnover		4354		2552,58	3169,34	1675,18	,00	64338,67
% Zero Volume Days		5339		15,21	17,87	8,20	,00	100,00
Coupon (%)		5339		4,96	1,84	5,25	,45	15,00
Par Outstand		5339		801,78	609,65	600,00	300,00	6350,00
Par-equivalent CDS Spread		3742		114,59	71,57	106,88	,88	583,50
Remaining Maturity Years	0-3	1266	23,7%					
	3-5	1018	19,1%					
	5-7	524	9,8%					
	7-10	1305	24,4%					
	>10	1226	23,0%					
	Total	5339	100,0%					
Age Years	0-2	2670	50,04%					
	>2	2666	49,96%					
	Total	5336	100,0%					
Flag Euro	No	3924	95,2%					
	Yes	200	4,8%					
	Total	4124	100,0%					
Flag Rating	AAA	52	1,0%					
	AA	650	12,2%					
	A	1996	37,4%					
	BBB	2641	49,5%					
	Total	5339	100,0%					
Flag CoC (Change of Control)	No	3666	74,2%					
	Yes	1277	25,8%					
	Total	4943	100,0%					

Flag Sector	Banks	978	18,8%					
	Basic Industries	342	6,6%					
	Capital Goods	296	5,7%					
	Consumer	669	12,9%					
	Energy	565	10,9%					
	Healthcare/Pharmaceuticals	399	7,7%					
	Insurance	301	5,8%					
	Media/Entertainment	257	5,0%					
	Property/Real Estate	159	3,1%					
	Retail	72	1,4%					
	Technology	239	4,6%					
	Telecoms	223	4,3%					
	Transportation	131	2,5%					
	Utilities	559	10,8%					
	Total	5190	100,0%					
Flag Seniority	Senior	4727	94,8%					
	Sub Ordinated	259	5,2%					
	Total	4986	100,0%					
Flag Domicile	North/Latin America	4145	83,9%					
	Europe	622	12,6%					
	Asia/Middle East/Africa/Oceania	176	3,6%					
	Total	4943	100,0%					

## Statistical Results

### *9.1 Results for Amihud measure*

Table 2 presents the results from the Ordinary Least Squares (OLS) Linear Regression Model for Amihud measure. The dependent variable of the model is Amihud measure (multiplied by 1.000.000) and the possible independent variables are all the static proxies and the characteristics of the Bond (Percentage of Coupon, Par Outstand, Par-equivalent CDS Spread) including all k-1 dummy variables for categorical characteristics (Remaining Maturity Years, Age Years, Flag Euro, Flag Rating, Flag CoC, Flag Sector, Flag Seniority, Flag Domicile). The reference categories (marked as Ref. in Table 2) for each categorical variable are: Remaining Maturity Years="7-10", Age Years="0-2", Flag Euro="No", Flag Rating="BBB", Flag CoC="No", Flag Sector="Banks", Flag Seniority="Senior" and Flag Domicile="North/Latin America". Table 2 presents only the statistically significant results of the final model, after performing the stepwise selection procedure, at level 10% (marked with \*), at level 5% (marked with \*\*) and at level 1% (marked with \*\*\*). More specifically, it presents the regression coefficients ( $\beta$ ) for the independent variables, as well as the standard errors of the coefficients. Results that are not statistically significant after the stepwise procedure are not presented and are marked as N.S. Table 2 also presents the regression coefficient ( $\alpha$ ) and the standard error for the constant term of the model, as well as the Coefficient of Determination ( $R^2$ ) for the final model. Amihud is a measure of illiquidity meaning that higher levels of Amihud values lead to less liquid bonds.

The percentage of Coupon seems to have a significant positive effect on Amihud ratio ( $\beta=0,035$ ,  $p<0,01$ ), this means that an increase of the percentage of coupon seems to lead to an increase of the value of Amihud. This is true according to empirical papers because the bonds with larger coupons are usually less liquid.

On the contrary, Par outstand and Par-equivalent CDS Spread have a significant negative effect on Amihud measure. This effect seems to be very low ( $\beta=-0,00032$ ,  $p<0,01$  and  $\beta=-0,00050$ ,  $p<0,05$ , respectively) but we were expected this because bonds with bigger issues are more liquid (see Lee, 2016) while bonds with higher liquidity in

their CDS contracts tend to be more liquid themselves (see Nashikkar et al. 2011). So because Amihud measures illiquidity, from our regression we found that bonds with higher issued amounts and liquid CDS contracts are liquid, which corresponds with empirical papers. That's why this 2 variables have negative relation with Amihud ratio.

Moreover bonds with remaining maturity of 0-3, 3-5 and 5-7 years appear to have lower levels of Amihud thus more liquidity, when they are compared to bonds with 7-10 remaining maturity years (negative coefficients of -0,391, -0,225 and -0,209, respectively). Bonds which are closer to their maturity have less or not at all, risk of default because they are going to be paid soon resulting in higher levels of liquidity. Bonds whose maturity is above 2 years on average tend to be riskier because of uncertainty of what will happen in the future, leading in an increase of Amihud value.

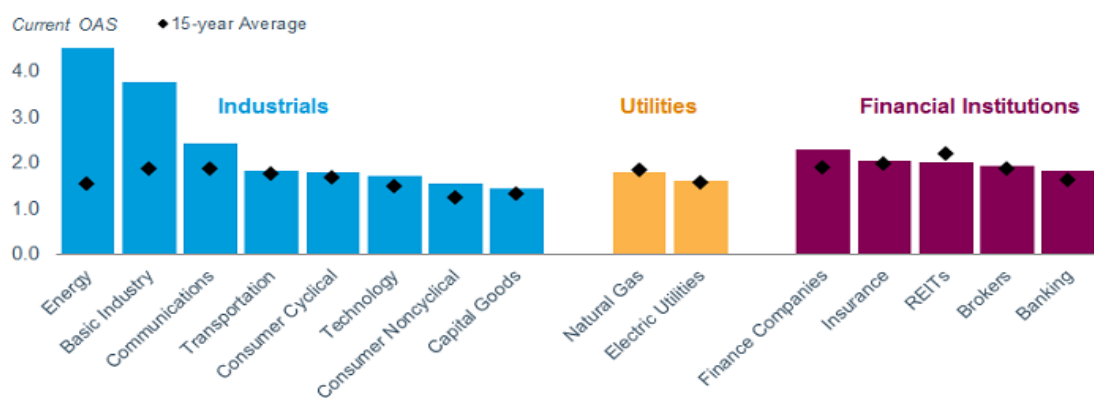
On contrary, bonds of Age of more than 2 years appear to have higher levels of Amihud compared with bonds of age up to 2 years ( $\beta=0,352$ ,  $p<0,01$ ). New issues tend to trade more than old issues according to Schultz (2011) and McGinty (2011) because managers try to make a market or maybe because new issues are typically underpriced. That's why bonds with age up to 2 years on average, tend to be more liquid while bonds with age 2 years and more on average tend to increase Amihud value, thus they are less liquid. Change of control seems to have a negative impact on Amihud value ( $\beta=-0,060$ ,  $p<0,05$ ), leading in an increase of liquidity. A Change of Control provision allows for redeeming bonds if there's a corporate take over or merger. This provision seems to reduce illiquidity because investors have the chance to take their money back from the other company.

Corporate bond performance can vary based on the individual issuer, as well as the sector in which the issuer operates. Bonds which stem from the Capital Goods, the Consumer and the Utilities sectors on average have higher levels of Amihud (increasing illiquidity), when they are compared to bonds from Banks sector (positive coefficients of 0,128, 0,085 and 0,135, respectively), contrary to bonds from Telecoms sector which seem to have lower levels of Amihud ( $\beta=-0,110$ ,  $p<0,05$ ). To get a better sense of what's happening in the corporate bond market, it helps to look at credit spreads. This is the difference in yield between a corporate bond and a U.S. Treasury security with a comparable maturity. The spread is basically a measure of relative risk. A smaller spread means the yield on a corporate bond is closer to that of a comparable Treasury,

suggesting a lower risk of default. A wider spread means the corporate bond offers more yield—and potentially more risk. According to Charles SCHWAB, industrial bond account for more than 61% of the Barclays U.S. Corporate Bond Index while financial bonds account for roughly 31% and utilities make up the smallest part of the investment grade market, with only an 8% weight in the Barclays U.S. Corporate Bond Index. Spreads on industrial bonds and utility bonds are wider than spreads of financial institutions (including banks) meaning that they contain more risk. Banks are usually the underwriters of bonds and they are those who issue and buy more corporate bonds providing better stability and liquidity than other sectors do. They tend to be some of the larger, more diversified issuers, offering the lowest spreads of the bunch but also the highest average credit ratings. In Telecommunication sector competition among telecom operators is tough and there are many challenges from technological changes in the sector. Risks appears to be lower that’s why corporate bonds from telecommunication sector seems to decrease Amihud value on average when they are compared to corporate bonds from Banks sector.

The Rating of the bonds, the Geographical origin, the Seniority, as well as the information that the Bonds are denominated in Euros, do not seem to have any effect on the Amihud values.

Finally as shown on table 2, the coefficient of determination ( $R^2$ ) is 0,217, meaning that 21,7% of the variation of Amihud can be explained by the model, while the rest 78,3% remains unexplained but this happens because our analysis is cross sectional and not time series.



Source: Barclays U.S. Corporate Bond Index. Data as of 2/12/2016. The “15-year average” covers 2/2001 through 1/2016.

*Table 2: OLS Regression Analysis Results for Amihud*

Dependent Variable= Amihud (*1.000.000)		
Independent Variables		$\beta$ (Std Error)
Coupon (%)		0,035*** (0,011)
Par Outstand		-0,00032*** (0,000018)
Par-equivalent CDS Spread		-0,00050** (0,00021)
Remaining Maturity Years	0-3	-0,391*** (0,046)
	3-5	-0,225*** (0,033)
	5-7	-0,209*** (0,038)
	7-10	Ref.
	>10	N.S.
Age Years	0-2	Ref.
	>2	0,352*** (0,036)
Flag Euro	No	Ref.
	Yes	N.S.
Flag Rating	AAA	N.S.
	AA	N.S.
	A	N.S.
	BBB	Ref.
Flag CoC (Change of Control)	No	Ref.
	Yes	-0,060** (0,026)
Flag Sector	Banks	Ref.
	Basic Industries	N.S.
	Capital Goods	0,128*** (0,048)

	Consumer	0,085** (0,034)
	Energy	N.S.
	Healthcare/Pharmaceuticals	N.S.
	Insurance	N.S.
	Media/Entertainment	N.S.
	Property/Real Estate	N.S.
	Retail	N.S.
	Technology	N.S.
	Telecoms	-0,110** (0,053)
	Transportation	N.S.
	Utilities	0,135*** (0,045)
Flag Seniority	Senior	Ref.
	Sub Ordinated	N.S.
Flag Domicile	North/Latin America	Ref.
	Europe	N.S.
	Asia/Middle East/Africa/Oceania	N.S.
Constant		0,617*** (0,052)
No of Observations		3465
R <sup>2</sup> (Adjusted)		0,217

Ref: Reference Category

\*: Significant at 10%

\*\*: Significant at 5%

\*\*\*: Significant at 1%

N.S.: Not Significant

## *9.2. Results for Turnover measure*

Table 3 presents the results from the Ordinary Least Squares (OLS) Linear Regression Model for Turnover measure. The dependent variable of the model is Turnover and the possible independent variables are all the static proxies and the characteristics of the Bond (Percentage of Coupon, Par Outstand, Par-equivalent CDS Spread) and all k-1 dummy variables for categorical characteristics (Remaining



Maturity Years, Age Years, Flag Euro, Flag Rating, Flag CoC, Flag Sector, Flag Seniority, Flag Domicile). The reference categories (marked as Ref. in Table 3) for each categorical variable are: Remaining Maturity Years="7-10", Age Years="0-2", Flag Euro="No", Flag Rating="BBB", Flag CoC="No", Flag Sector="Banks", Flag Seniority="Senior" and Flag Domicile=" North/Latin America".

Table 3 presents only the statistically significant (at level 10%,5% and 1%) regression coefficients ( $\beta$ ) and coefficient ( $\alpha$ ) for the constant term of the model, with their corresponding standard errors, and the Coefficient of Determination ( $R^2$ ) of the final model, after performing the stepwise selection procedure.

The percentage of Coupon seems to have a significant negative effect on Turnover ( $\beta=-544,758$ ,  $p<0,01$ ), meaning that an increase of the Percentage of Coupon seems to lead on average to an important decrease in the value of Turnover. Higher Turnover means that there is a higher transaction volume which implies that liquidity is higher too. Again here bonds with larger coupons according to empirical papers tend to have lower levels of liquidity when they are compared to bonds with smaller coupons. Higher coupon bonds are usually locked in passive portfolios by investors who only need to take this higher coupon payments semi-annually or annually. For this reason the average higher coupon bonds seems to have negative relation with Turnover ratio.

On contrary, Par Outstand and Par-equivalent CDS Spread have a significant positive effect on Turnover, although, especially for Par Outstand, this effect does not seem to be very high ( $\beta=0,896$ ,  $p<0,01$  and  $\beta=16,499$ ,  $p<0,01$ , respectively). According to empirical papers bonds with bigger issues are more liquid (see Lee, 2016) while bonds with higher liquidity in their CDS contracts tend to be more liquid themselves (see Nashikkar et al. 2011). So the average of bonds with big issues and liquid CDS contracts are usually traded more because of their excess liquidity resulting in an increase of the Turnover value (have positive relation with Turnover) as empirical papers argue.

Bonds with Remaining Maturity on average of 5-7 years appear to have higher Turnover, when compared to Bonds on average with 7-10 Remaining Maturity Years ( $\beta=407,945$ ,  $p<0,01$ ), while on contrary, Bonds with more than 10 Remaining Maturity on average years appear to have lower Turnover ( $\beta=-433,169$ ,  $p<0,01$ ). Because the other categories don't appear to be significant in our regression from these 3 which

appeared to be significant we see that on average bonds which are closer to their maturity are trading more than those whose maturity is in more than 10 years, resulting in an increase of Turnover value.

Bonds of Age of more than 2 years seem to have much lower levels of Turnover when compared with Bonds of Age up to 2 years ( $\beta=-1.104,656$ ,  $p<0,01$ ). As we said before bonds which are newly issued is more liquid than bonds which was issued before 2 or more years. For this reason bonds with age more than 2 years because of their lack of liquidity are trading less, thus reducing the value of Turnover.

Change of Control seems to have a negative impact decreasing the Turnover ( $\beta=-304,913$ ,  $p<0,01$ ). A Change of Control provision allows for redeeming bonds if there's a corporate take over or merger. Only 25,8% of corporate bonds in our sample gives this provision, resulting in a decrease of trading volume compared to bonds which not give such a provision.

Bonds rated as AAA and AA have much lower Turnover, compared to Bonds rated as BBB (negative coefficients of -962,988 and -426,926, respectively). Although AAA and AA bonds are supposed to be safer and without risk, most corporate bonds are rated from Moody's or Standard and Poor's as BBB. In our sample from 5339 bonds, bonds characterized AAA and AA are only 702 in number, while BBB bonds are 2641. As we see BBB bonds are about our half sample. So because Turnover measures the trading volume, Bonds rated as BBB on average they are contributing more in the total trading volume while the higher rated bonds reduces Turnover value because of their little number.

Corporate bond performance can vary based on the individual issuer, as well as the sector in which the issuer operates. On average corporate bonds which stem from Basic Industries ( $\beta=368,701$ ,  $p<0,05$ ), Insurance ( $\beta=337,589$ ,  $p<0,10$ ), Media/Entertainment ( $\beta=356,209$ ,  $p<0,10$ ), Retail ( $\beta=1.427,267$ ,  $p<0,01$ ) and Technology Sectors ( $\beta=528,626$ ,  $p<0,01$ ) have higher levels of Turnover, when compared to Bonds from Banks Sector.

To get a better sense of what's happening in the corporate bond market, it helps to look at credit spreads. This is the difference in yield between a corporate bond and a U.S. Treasury security with a comparable maturity. The spread is basically a measure of relative risk. A smaller spread means the yield on a corporate bond is closer to that

of a comparable Treasury, suggesting a lower risk of default. A wider spread means the corporate bond offers more yield and potentially more risk. (See image for spreads in Amihud results)

Firms in Industrial sector (Basic industries, Media/Entertainment, Retail, Technology) because of their needs in cash want more financing. One easy way to raise capital is through bonds issue, so bonds from industrial sector are trading more and more resulting in an increase of Turnover value.

On the other hand, Bonds from Property/Real Estate ( $\beta=-527,390$ ,  $p<0,05$ ) and Utilities Sectors ( $\beta=-378,621$ ,  $p<0,05$ ) seem to have on average lower levels of Turnover compared to Bonds from Banks Sector. After 2008 crisis, investors are more careful about Property/Real estate bonds resulting in less trading volume for them. Also bonds in Utilities sector (smaller part of U.S. corporate bonds) while are tend to be more stable than some other sectors, since they are generally highly regulated, S&P notes that a recent uptick in acquisitions in the sector could pose a risk, especially for deals financed with debt. Bank bonds account for most of the financial institutions category, representing more than 70% of all issues. They tend to be some of the larger, more diversified issuers, offering the lowest spreads of the bunch but also the highest average credit ratings.

Bonds originated from the Rest of the World (Asia/Middle East/Africa/Oceania) seem to have much lower levels of Turnover when compared with Bonds from North/Latin America ( $\beta=-1.104,904$ ,  $p<0,01$ ). Because we examine the corporate bond market of US, it is logical that domicile bonds to be more actively trade, have higher levels of liquidity and increase on average Turnover value.

The Seniority, as well as the information that the Bonds are denominated in Euros, are not proved to have any effect on the Turnover values.

Finally as shown on Table 3, the coefficient of determination ( $R^2$ ) is 0,287, meaning that 28,7% of the variation of Turnover can be explained by the model, while the rest 71,3% remains unexplained but we should keep in mind that analysis is cross-sectional.

*Table 3: OLS Regression Analysis Results for Turnover*

Dependent Variable= Turnover		
Independent Variables		$\beta$ (Std Error)
Coupon (%)		-544,758*** (40,193)
Par Outstand		0,896*** (0,071)
Par-equivalent CDS Spread		16,499*** (0,823)
Remaining Maturity Years	0-3	N.S.
	3-5	N.S.
	5-7	407,945*** (138,773)
	7-10	Ref.
	>10	-433,169*** (117,205)
Age Years	0-2	Ref.
	>2	-1104,656*** (128,939)
Flag Euro	No	Ref.
	Yes	N.S.
Flag Rating	AAA	-962,988** (456,886)
	AA	-466,926*** (152,916)
	A	N.S.
	BBB	Ref.
Flag CoC (Change of Control)	No	Ref.
	Yes	-304,913*** (103,058)
Flag Sector	Banks	Ref.
	Basic Industries	368,701** (167,829)
	Capital Goods	N.S.

	Consumer	N.S.
	Energy	N.S.
	Healthcare/Pharmaceuticals	N.S.
	Insurance	337,589*
		(192,645)
	Media/Entertainment	356,209*
		(188,349)
	Property/Real Estate	-527,390**
		(227,793)
	Retail	1427,267***
		(294,116)
	Technology	528,626***
		(187,519)
	Telecoms	N.S.
	Transportation	N.S.
	Utilities	-378,621**
		(170,526)
Flag Seniority	Senior	Ref.
	Sub Ordinated	N.S.
Flag Domicile	North/Latin America	Ref.
	Europe	N.S.
	Asia/Middle East/Africa/Oceania	-1104,904***
		(299,046)
Constant		3157,707***
		(150,646)
No of Observations		3480
R <sup>2</sup> (Adjusted)		0,287

Ref: Reference Category

\*: Significant at 10%

\*\* : Significant at 5%

\*\*\*: Significant at 1%

N.S.: Not Significant

### 9.3. Results for the Percentage of Zero Trading Days

Table 4 presents the results from the Ordinary Least Squares (OLS) Linear Regression Model for the Percentage of Zero Trading Days (or zero volume days) within the examined time period. The dependent variable of the model is the Percentage of Zero Volume Days and the possible independent variables are all the static proxies and the characteristics of the Bond (Percentage of Coupon, Par Outstand, Par-equivalent CDS Spread) and all k-1 dummy variables for categorical characteristics (Remaining Maturity Years, Age Years, Flag Euro, Flag Rating, Flag CoC, Flag Sector, Flag Seniority, Flag Domicile). The reference categories (marked as Ref. in Table 4) for each categorical variable are: Remaining Maturity Years="7-10", Age Years="0-2", Flag Euro="No", Flag Rating="BBB", Flag CoC="No", Flag Sector="Banks", Flag Seniority="Senior" and Flag Domicile="North/Latin America".

Table 4 presents only the statistically significant (at level 10%,5% and 1%) regression coefficients ( $\beta$ ) and coefficient ( $\alpha$ ) for the constant term of the model, with their corresponding standard errors, and the Coefficient of Determination ( $R^2$ ) of the final model, after performing the stepwise selection procedure. The percentage of Zero Volume Days or zero trading days show us how many days one corporate bond is not traded. If there are few or no trading volumes – transactions for one bond doesn't trade it seems that this bond might be illiquid.

The percentage of Coupon seems to have a significant positive effect on the Percentage of Zero Trading (volume) Days ( $\beta=1,384$ ,  $p<0,01$ ). Like Amihud ratio, we see that an increase in the percentage of coupon seems to lead to an increase in the Percentage of Zero Trading Days in average. Corporate bonds with larger coupons are usually less liquid, thus there is less trading volume for them on average than for bonds which have lower coupons and assumed to be more liquid.

On the contrary, Par Outstand and Par-equivalent CDS Spread have a significant negative effect on the Percentage of Zero Trading Days, so a possible increase on the values of these two proxy variables tend to lead to a slight decrease of the Percentage of Zero Trading Days ( $\beta=-0,012$ ,  $p<0,01$  and  $\beta=-0,024$ ,  $p<0,05$ , respectively). We expected this because on average bonds with bigger issues are more liquid (see Lee, 2016) while bonds with higher liquidity in their CDS contracts tend to be more liquid

themselves resulting in higher levels of liquidity and more activity in trading volume for them (Nashikkar et al. 2011).

Bonds with Remaining Maturity of 3-5 ( $\beta=-3,436$ ,  $p<0,01$ ) or 5-7 years ( $\beta=-2,855$ ,  $p<0,01$ ) appear to have on average lower Percentage of Zero Trading Days, when they are compared to Bonds with 7-10 Remaining Maturity Years, while on contrary, bonds with more than 10 Remaining Maturity years on average appear to have higher Percentage of Zero Trading Days ( $\beta=3,655$ ,  $p<0,01$ ). We see that on average bonds which are closer to their maturity tend to be more liquid and are trading more than those whose maturity is in more than 10 years, resulting in a decrease in the Percentage of Zero Trading Days which corresponds with empirical papers.

Bonds of Age of more than 2 years seem to have higher levels of Percentage of Zero Trading Days when compared with Bonds of Age up to 2 years ( $\beta=3,704$ ,  $p<0,01$ ). New issues tend to trade more than old issues according to Schultz (2011) and McGinty (2011) because managers try to make a market or maybe because new issues are typically underpriced. That's why bonds with age up to 2 years, are more liquid while bonds with age 2 years and more tend to increase the percentage of Zero Trading Days value, thus they are less liquid.

Change of Control seems to have a positive impact and increase the Percentage of Zero Trading Days ( $\beta=2,550$ ,  $p<0,01$ ). A Change of Control provision allows for redeeming bonds if there's a corporate take over or merger.

Bonds rated as AAA, AA and A have lower Percentage of Zero Trading Days, compared to Bonds rated as BBB (negative coefficients of -6,997, -3,369 and -2,877, respectively). Highly rated bonds are assumed to be safer and contain a lower risk of default, thus reducing the percentage of Zero Trading Days. Highly rated bonds are issued by wealthy companies who have a minimal probability to face problems in the future so investors want to invest in those bonds because of the minimum risk of default that these bonds carry. Giampaolo and Sironi (2005) found that ratings provided by investment house of Moody's or Standard and Poor's are the most important factors determining the spreads of the bonds and as a consequence their liquidity (see literature review).

Corporate bond performance can vary based on the individual issuer, as well as the sector in which the issuer operates. Bonds which stem from Capital Goods ( $\beta=2,027$ ,

$p < 0,10$ ), Property/Real Estate ( $\beta = 8,977$ ,  $p < 0,01$ ) and Utilities Sectors ( $\beta = 5,584$ ,  $p < 0,01$ ) have higher levels of Percentage of Zero Volume Days on average, when compared to Bonds from Banks Sector. On the other hand, Bonds from Consumer ( $\beta = -4,013$ ,  $p < 0,01$ ), Insurance ( $\beta = -5,798$ ,  $p < 0,01$ ), Media/Entertainment ( $\beta = -6,316$ ,  $p < 0,01$ ), Retail ( $\beta = -5,172$ ,  $p < 0,01$ ), Technology ( $\beta = -5,970$ ,  $p < 0,01$ ) and Telecoms ( $\beta = -5,014$ ,  $p < 0,01$ ) seem to have lower levels of Percentage of Zero Volume Days on average compared to Bonds from Banks Sector. Like the other two liquidity measures in order to get a better sense of what's happening in the corporate bond market, we should look at credit spreads. This is the difference in yield between a corporate bond and a U.S. Treasury security with a comparable maturity.

Competition in Industrial sectors like Telecoms, Technology, Media/Entertainment and Retail is huge. These sectors need a continuing financing in order to respond technological changes, providing investors higher spreads in their corporate bonds. Although they may be riskier, investors invest actively in these sectors in order to achieve higher returns, reducing the Percentage of Zero Trading days on average. The insurance industry invests colossal amounts across a range of asset classes. In 2012, U.S. insurers held \$5.4 trillion in assets, a 2.3 percent increase from the previous year. The largest asset type is bonds, totaling \$3.7 trillion, or 68.4 percent of total assets. Insurance companies are inherently conservative, with 94 percent of their bond holdings funneled into investment-grade securities. So because this corporations invest in "good" bonds are preferable from investors.

On the other hand corporate bonds from Capital Goods and Property/Real estate and sector seems to be traded less days. After 2008 crisis, investors are more careful about Property/Real estate bonds. Capital Goods (which covers things like food processing, beverages and household product makers) has one of the smallest average spreads in the broad industrials category, reflecting the historically more durable demand for such goods. Bonds from this sector could be a good option for investors looking for stability and not high spreads. Finally, Utilities stands for the 8% of total corporate bonds in U.S. It is also one of the most stable sectors because it is highly regulated but not preferred from investors who need big yields.

Bonds originated from the Rest of the World (Asia/Middle East/Africa/Oceania) seem to have much higher Percentage of Zero Volume Days when compared with



Bonds from North/Latin America ( $\beta=11,127$ ,  $p<0,01$ ). Because we examine the corporate bond market of US, it is logical that domicile bonds to be more actively traded among the others.

As shown also for Amihud and Turnover, the Seniority, as well as the information that the Bonds are denominated in Euros, does not seem to have any effect neither on the Percentage of Zero Trading Days.

Finally as shown on Table 4, the Coefficient of Determination ( $R^2$ ) is 0,325, meaning that 32,5% of the variation of the Percentage of Zero Volume Days can be explained by the model, while the rest 67,5% remains unexplained.

*Table 4: OLS Regression Analysis Results for % Zero Trading Days*

Dependent Variable= % Zero Trading Days		
Independent Variables		$\beta$ (Std Error)
Coupon (%)		1,384*** (0,237)
Par Outstand		-0,012*** (0,00042)
Par-equivalent CDS Spread		-0,024*** (0,005)
Remaining Maturity Years	0-3	N.S.
	3-5	-3,436*** (0,667)
	5-7	-2,855*** (0,841)
	7-10	Ref.
	>10	3,655*** (0,718)
Age Years	0-2	Ref.
	>2	3,704*** (0,760)
Flag Euro	No	Ref.
	Yes	N.S.

Flag Rating	AAA	-6,997*** (2,708)
	AA	-3,369*** (1,012)
	A	-2,877*** (0,627)
	BBB	Ref.
Flag CoC (Change of Control)	No	Ref.
	Yes	2,550*** (0,627)
Flag Sector	Banks	Ref.
	Basic Industries	N.S.
	Capital Goods	2,027* (1,072)
	Consumer	-4,013*** (0,783)
	Energy	N.S.
	Healthcare/Pharmaceuticals	N.S.
	Insurance	-5,798*** (1,130)
	Media/Entertainment	-6,316*** (1,121)
	Property/Real Estate	8,977*** (1,340)
	Retail	-5,172*** (1,718)
	Technology	-5,970*** (1,102)
	Telecoms	-5,014*** (1,197)
	Transportation	N.S.
Utilities	5,584*** (1,017)	
Flag Seniority	Senior	Ref.
	Sub Ordinated	N.S.
Flag Domicile	North/Latin America	Ref.

	Europe	N.S.
	Asia/Middle East/Africa/Oceania	11,127*** (1,736)
Constant		27,599*** (1,159)
No of Observations		3480
R <sup>2</sup> (Adjusted)		0,325

Ref: Reference Category

\*: Significant at 10%

\*\*: Significant at 5%

\*\*\*: Significant at 1%

N.S.: Not Significant

## 10. Conclusion

This analysis has given evidence to prior studies which have been made about corporate bond liquidity and the factors-proxies which affecting it. In the beginning it was believed that yield spreads was the compensation for the default risk of a corporate bond compared to a risk free Treasury (government bond) but several papers have found that a significant proportion of these spreads cannot be explained by default risk and it should be attributed to other variables too.

In this paper we used three different liquidity measures: i) Amihud ratio, ii) Turnover ratio and iii) percentage of Zero Trading Days as dependent variables and examined which static proxies and bond characteristics such as coupon, issued amount, maturity, age of bond, rating of the bond (independent variables) affecting them and as a result affecting corporate bonds liquidity for the period between 11 March 2010 and 27 June 2013 regarding U.S. corporate bond market. In order to examine these effects we perform an Ordinary Least Squares (OLS) Linear Regression Model for each dependent variable, using stepwise method.

Our results confirmed several relationships documented in the previous literature on the effect of factors like coupon, age of bond, amount outstanding, maturity, CDS spreads and bond ratings on liquidity in the corporate bond market on a much more current and extensive dataset. Bonds with lower coupon rates, higher issued amounts, liquid CDS contracts, small age and higher ratings tend to have more trading volume

and be more liquid in general. In addition we found which sector's corporate bonds are affecting more the trading volume and give some reasons about it.

Further, it would be worth examining in future studies, other variables or proxies that may be indicative of bond liquidity that could help in corporate bond yields and liquidity in the bond market. Also it would be good to examine how crisis affected corporate bond performance and their trading volume by taking the available transaction data and use bid-ask spreads.

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## Περίληψη

Η αγορά σταθερού εισοδήματος καθώς και η ρευστότητα που την διέπει αποτελούν ζητήματα υψηλού ενδιαφέροντος τα τελευταία 20 χρόνια, όχι μόνο από ακαδημαϊκούς μελετητές αλλά και από όλους τους συμμετέχοντες σε αυτή την αγορά. Η μελέτη αυτή έρχεται για να συμβάλλει στην ήδη υπάρχουσα βιβλιογραφία μελετώντας τους παράγοντες και τα εσωτερικά χαρακτηριστικά των ομολόγων που επηρεάζουν την τιμή καθώς και την ρευστότητα τους.

Στην αρχή οι διάφοροι ερευνητές πίστευαν ότι η διαφορά των τιμών αποδόσεων των ομολογιών (yield spreads) ήταν μια αποζημίωση για τον κίνδυνο αθέτησής τους σε σχέση με ένα κρατικό ομόλογο το οποίο θεωρείται ότι δεν διατρέχει τέτοιο κίνδυνο, αλλά πολλά επιστημονικά άρθρα βρήκαν ότι ένα σημαντικό ποσοστό της διαφοράς των τιμών των αποδόσεων δεν μπορεί να εξηγηθεί εξ ολοκλήρου από τον κίνδυνο αθέτησης που διατρέχουν τα εταιρικά ομόλογα, αλλά σίγουρα πρέπει να υπάρχουν και κάποιοι άλλοι παράγοντες στους οποίους αποδίδεται η μεγάλη αυτή διαφορά. Μία από τις βασικές εξηγήσεις σχετικά με αυτές τις διαφορές στα spread είναι η ρευστότητα ή η έλλειψη ρευστότητας και πολλοί μελετητές δημιούργησαν διάφορες μεθοδολογίες και τρόπους για να μετρήσουν την ρευστότητα των ομολογιών.

Η χρηματοοικονομική κρίση του 2008-2009 μας έδειξε πόσο ευάλωτες είναι οι χρηματοοικονομικές αγορές όταν η ρευστότητα ελαττώνεται. Κάθε εταιρικό ομόλογο έχει πολλαπλές εκδόσεις και όταν δεν υπάρχει ρευστότητα στην αγορά είναι δύσκολο να γίνει το ταίριασμα μεταξύ πωλητών και αγοραστών, καθώς οι περισσότερες συναλλαγές είναι εξωχρηματιστηριακές (Over the counter).

Το πρώτο μέρος της εργασίας εξηγεί τι είναι τα εταιρικά ομόλογα και πόσο σημαντικά εργαλεία είναι για την χρηματοδότηση των επιχειρήσεων, καθώς η χρηματοοικονομική κρίση των τελευταίων χρόνων και η παγκόσμια προσπάθεια όλων των εμπλεκόμενων φορέων για την αποφυγή μελλοντικών κρίσεων μέσω της θωράκισης του τραπεζικού τομέα, έχει κάνει το τραπεζικό δανεισμό πολύ δύσκολο.

Στο δεύτερο μέρος παραθέτουμε μία εκτενή ανασκόπηση της βιβλιογραφίας σχετικά με την ρευστότητα των ομολόγων και τους παράγοντες που την επηρεάζουν. Η αρχή έγινε από τους Amihud και Mendelson το 1986 που ανέφεραν ότι οι επενδυτές απαιτούν μια πριμοδότηση ρευστότητας για να αγοράσουν και στη συνέχεια να

διατηρήσουν ένα μη ρευστοποιήσιμο χρεόγραφο. Με την πάροδο των ετών έγιναν πολλές έρευνες και εκδόθηκαν πολλά εμπειρικά άρθρα που προσπάθησαν να εξηγήσουν και να μετρήσουν τη ρευστότητα, είτε χρησιμοποιώντας μέτρα ρευστότητας που είναι βασισμένα στα δεδομένα των συναλλαγών, όπως την διαφορά μεταξύ των τιμών πώλησης και αγοράς (bid-ask spreads), είτε χρησιμοποιώντας ως δείκτες ρευστότητας διάφορα εσωτερικά χαρακτηριστικά του ομολόγου όπως το τοκομερίδιο του, το εκδοθέν ποσό του, την ηλικία του κλπ. Σε γενικές γραμμές, η πλειοψηφία των μελετών έχει δείξει ότι αν ένα ομόλογο θεωρείται μη ρευστοποιήσιμο η απόδοση του θα είναι μεγαλύτερη σε αντίθεση με την τιμή του, που θα είναι πολύ μικρότερη.

Το τρίτο μέρος της εργασίας αναφέρεται αρχικά στην παγκόσμια αγορά των ομολόγων και στη συνέχεια επικεντρώνεται στο μέγεθος και στην ανάπτυξη των εταιρικών ομολογιών της Αμερικής. Τις τελευταίες δεκαετίες η αγορά εταιρικών ομολόγων έχει αυξηθεί ραγδαία και έχει τριπλασιαστεί σε μέγεθος σε σύγκριση με τις αρχές του αιώνα. Σημαντική εξέλιξη στην αγορά εταιρικών ομολόγων ήταν η εμφάνιση των διαπραγματεύσιμων αμοιβαίων κεφαλαίων (ETFs). Δεδομένου ότι είναι δυσκολότερο για τα στελέχη να προβαίνουν σε συναλλαγές εταιρικών ομολογιών εξαιτίας των θεμάτων ρευστότητας που προκύπτουν, το συγκεκριμένο χρηματοπιστωτικό μέσο δίνει την ευκαιρία για ευκολότερη επένδυση σε εταιρικά ομόλογα με αρκετά μικρότερο κόστος συναλλαγών. Σύμφωνα με το Sifma (2017), η αξία των εταιρικών ομολογιών που εκκρεμεί στις Η.Π.Α. είναι 8.544,00 δις. , ενώ η έκδοση εταιρικών ομολόγων στην αγορά της Αμερικής για το 2017 είναι 1.441,2 εκατομμύρια ευρώ.

Στο τέταρτο μέρος της εργασίας δίνεται ο ορισμός της ρευστότητας σύμφωνα με τον οποίο ένα ομόλογο είναι ρευστοποιήσιμο αν οι συμμετέχοντες στην αγορά μπορούν να αγοράζουν και να πωλούν τεράστια ποσά ομολογιών, χωρίς να επηρεάζουν αρνητικά την τιμή του. Επίσης παραθέτουμε τρεις δείκτες ρευστότητας (Amihud ratio, Turnover ratio, Zero Trading Days) που χρησιμοποιήσαμε ως εξαρτημένες μεταβλητές για να δούμε πώς τα διάφορα στατικά και μη, χαρακτηριστικά των ομολόγων επιδρούν σε αυτές.

Στο πέμπτο μέρος της εργασίας αναλύονται εκτενώς τα διάφορα εσωτερικά χαρακτηριστικά των ομολόγων όπως το τοκομερίδιο, η ηλικία, η λήξη, το εκδοθέν ποσό της ομολογίας, τα CDS spreads κλπ. που χρησιμοποιούνται ως ανεξάρτητες

μεταβλητές στα υποδείγματα, καθώς και όλη η σχετική προηγούμενη βιβλιογραφία σχετικά με τον τρόπο που επηρεάζουν τη ρευστότητα των ομολογιών

Στο έκτο μέρος αναφέρονται οι κανονισμοί σχετικά με τη ρευστότητα. Η κρίση του 2008 αποκάλυψε τις αδυναμίες του χρηματοπιστωτικού συστήματος. Κατά τη διάρκεια της παγκόσμιας κρίσης, η έλλειψη ρευστότητας απειλούσε με κατάρρευση ολόκληρο το τραπεζικό σύστημα. Λαμβάνοντας υπόψη τα αδύνατα σημεία της Βασιλείας II, εισήχθη η Βασιλεία III και παρείχε ένα παγκόσμιο πλαίσιο για τα πρότυπα κεφαλαιακής επάρκειας των τραπεζών. Το κανονιστικό πλαίσιο περιελάμβανε πρότυπα για τις κεφαλαιακές απαιτήσεις, τους δείκτες μόχλευσης και τις απαιτήσεις ρευστότητας.

Στην έβδομη ενότητα περιγράφεται η βάση δεδομένων που χρησιμοποιήθηκε στην εργασία. Καλύπτει την περίοδο μεταξύ 11 Μαρτίου 2010 και 27 Ιουνίου 2013, αναφέρεται στην αγορά εταιρικών ομολόγων των Η.Π.Α. , και περιέχει 5.339 διαφορετικά ομόλογα. Στην όγδοη ενότητα περιγράφεται η μεθοδολογία που χρησιμοποιήθηκε. Για κάθε μία εξαρτημένη μεταβλητή (Amihud ratio, Turnover ratio, Zero Trading Days) εκτελέσαμε ένα μοντέλο γραμμικής παλινδρόμησης OLS με *stepwise* μέθοδο, για να δούμε ποιες από τις ανεξάρτητες μεταβλητές έχουν επιρροή πάνω στους δείκτες ρευστότητας που χρησιμοποιήσαμε.

Στην ένατη ενότητα παραθέτουμε τα συνοπτικά στατιστικά στοιχεία καθώς και τα αποτελέσματα των τριών παλινδρομήσεων μαζί με τις επεξηγήσεις τους. Τα αποτελέσματα της εργασίας συμφωνούν με τις μέχρι τώρα μελέτες και εμπειρικά άρθρα σχετικά με τη ρευστότητα των εταιρικών ομολόγων. Συνοπτικά, τα ομόλογα με μικρά τοκομερίδια, μεγάλο εκδοθέν ποσό, μεγαλύτερη ρευστότητα στις συμβάσεις ανταλλαγής κινδύνου αθέτησης (CDS contracts), υψηλότερα ratings και κοντά στην λήξη τους, κατά μέσο όρο τείνουν να είναι πιο ρευστά και στα 3 υποδείγματα σε σχέση με αυτά που παρουσιάζουν τα αντίθετα χαρακτηριστικά. Επιπρόσθετα χρησιμοποιήθηκαν κάποιες κατηγορικές μεταβλητές όπως το “flag region” για να δούμε πως επηρεάζουν τη ρευστότητα οι διάφοροι κλάδοι που δραστηριοποιούνται οι εταιρίες που τα εκδίδουν.

Τέλος, η δέκατη ενότητα περιλαμβάνει τα συμπεράσματα της εργασίας και η ενδέκατη τη βιβλιογραφία που χρησιμοποιήθηκε.