# To Disclose or not to Disclose: Transparency and Liquidity in the Structured Product Market

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**Abstract**

We analyze liquidity effects in the US fixed-income structured product market using new data from the Trade Reporting and Compliance Engine (TRACE) of the Financial Industry Regulatory Authority (FINRA). As of May 16, 2011, virtually all trades in this market have had to be reported, a fact that we use in this study, by including in our dataset transactions up to October 31, 2012. Our main contribution is the analysis of the relation between the measurement of liquidity and the degree of transparency: We compare a wide range of liquidity measures that are based on various information sets using different levels of detail, and provide evidence that transaction cost measures computed at a more aggregate level may still be reasonable proxies for liquidity. This finding is important for all market participants in the context of OTC markets, but particularly for regulators, who need to decide on the level of detail of the transaction data to be disclosed to the market. In addition, we explore the trading activity and transaction costs of the various segments of the structured product market. We find that liquidity is quite diverse, with average costs of a round-trip trade of around 67 bp, and that securities that are mainly institutionally traded, guaranteed by a federal authority, or have low credit risk, tend to be more liquid.

**JEL-Classification:** G12, G14

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# 1 Introduction

The US fixed-income structured product market – also referred to as the securitized product market – is an important financial market that has received much attention in the past few years, especially since the financial crisis. With an average daily trading volume of more than $200 billion in 2011–2012, it is the second largest fixed-income market in the US, after the Treasury bond market. Its products are traded over-the-counter (OTC), with no central market place, or even a clearing house, thus far. Following the financial crisis, in which structured financial products played an important role, the opacity implied by this OTC architecture has been widely critized, since traded prices and volumes are not readily observable. Thus, liquidity in the structured product market, with its complex financial instruments, has only been measurable based on potentially unrepresentative or biased information, such as quotations from individual dealers.

The Financial Industry Regulatory Authority (FINRA) has, therefore, recently launched a project with the aim of improving transparency in the structured product market. Since May 16, 2011, virtually all trades in the fixed-income securitized product market have been required to be reported to the Trade Reporting and Compliance Engine (TRACE) by the broker/dealers.[1] However, FINRA has not yet released this information to the market.[2] This unique dataset allows us to analyze liquidity effects *before* the potential dissemination of the data to the broader market, and thus, before the possible reaction of the market participants to a new regime.

So far, there has been only a modest literature analyzing liquidity effects in the fixed-income structured product market, mostly focusing on liquidity at the market-wide level. However, this type of analysis, dictated by the constraints of data availability, provides only a very limited view of the structured product market's liquidity. Moreover, in contrast to other fixed-income markets, an aggregate analysis of securitized products masks several issues of detail, since this market consists of rather diverse instruments with potentially different liquidity characteristics. Specifically, according to FINRA's definitions, these products can be classified into four main segments: Asset-Backed Securities (ABS), Collateralized Mortgage Obligations (CMO), Mortgage-Backed Securities (MBS) and To-Be-Announced securities (TBA, forward MBS). A comprehensive study of liquidity for *individual* instruments in the securitized product market has been missing so far.

[1] This project follows the earlier FINRA project, which resulted in the establishment of the US corporate bond TRACE database.

[2] FINRA started to release information to the market for the To-Be-Announced (TBA) segment on November 12, 2012 and MBS specified pool transactions on July 22, 2013. FINRA is continuing to study the other segments before deciding on its dissemination policy. However, during our observation period no information had been released to the market.

Our study fills this gap by exploring a broad range of liquidity proxies for the structured product market, employing product characteristics (e.g., amount issued), trading activity variables (e.g., number of trades) and more conceptually sound liquidity measures (e.g., the Amihud measure) that have been proposed in the academic literature in the context of OTC markets. Our main contribution is the analysis of the relation between the measurement of liquidity and the level of detail in the dissemination of trading data. As we have access to all the relevant trading information, we can examine whether the detailed dissemination of transaction data provides valuable information, beyond what simple product characteristics or aggregated information would offer. We should emphasize that the various liquidity measures presented in the academic literature in the context of fixed-income markets require different information sets for their estimation, with varying levels of detail. For example, measuring liquidity based on the *round-trip cost* uses the most detailed information, i.e., each transaction needs to be linked to a particular dealer, on each side of the trade. Other liquidity metrics, such as the *effective bid-ask spread*, do not need such detailed trade information for their computation; yet transactions need to be flagged as *buy* or *sell* trades. Many alternative liquidity measures rely on trading data as well: however, they use only the price and/or volume of each transaction. On the other hand, product characteristics or trading activity variables represent simpler proxies, using either static or aggregated data.

Thus, the question arises as to the level of detail of data that a regulatory authority ought to release to the market, so that market participants can reliably estimate measures of liquidity/transaction costs, without compromising the identities of individual traders or their trading strategies. This issue is important in improving market transparency, in particular in the context of OTC markets, while maintaining trader confidentiality. There is a thin line between additional disclosure, which would risk revealing individual trading positions, and providing transparency. To address this issue, we present a regression analysis discussing the explanatory power of various liquidity measures based on different sets of information.

As an additional contribution, we explore the trading activity and transaction costs of the various segments of the structured product market, in detail. In particular, we analyze liquidity effects in the four main segments of the structured product market (i.e., ABS, CMO, MBS and TBA), covering all the different products, and compare these results with those from other similar OTC markets, such as those for US corporate or Treasury bonds. Furthermore, we provide detailed empirical results, by analyzing liquidity in various sub-segments, e.g., based on trade size and credit rating.

For our empirical analysis, we use all traded prices and volumes in the fixed-income structured product market, along with security characteristics provided by FINRA, and credit ratings from Standard & Poor's

(S&P). Our dataset comprises information for over 267,000 securitized products in the US, for which about 6 million trades were conducted, over the period from May 16, 2011 to October 31, 2012. Hence, our data cover the whole securitized product market during this period, even including those securities with very low trading activity.

We find a high level of trading activity in the structured product market, with an average daily trading volume of around $227 billion, and an average transaction cost of around 67 bp for a round-trip trade. The TBA segment, which is basically a forward market, has the highest trading volume, with $204 billion, whereas the CMO and MBS segments are of the same order of magnitude as the US corporate bond market, which has a daily trade volume of around $15 billion. The ABS market is considerably smaller, with around $5 billion of daily volume. Liquidity is quite diverse in the four segments. The ABS and MBS segments have round-trip costs of around 50 bp, which are comparable to that of the US corporate bond market. In contrast, the TBA segment (4 bp) is far more liquid, whereas the CMO segment (98 bp) is considerably less liquid. Furthermore, we find that securities that are mainly institutionally traded, guaranteed by a federal authority, or that have low credit risk, tend to be more liquid. In all segments, we find more dispersed trading activity than in the US corporate bond market, i.e., fewer trades per security, but with higher volumes.

Exploring the various liquidity metrics and the predictive power of the disseminated information, we show that simple product characteristics and trading activity variables, by themselves, may not be sufficient statistics for measuring market liquidity. In particular, we find, when regressing state-of-the-art liquidity measures on product characteristics and trading activity variables, that the various liquidity measures offer significant idiosyncratic information. Thus, dissemination of detailed transaction data, necessary for the estimation of liquidity measures, is of importance in the fixed-income structured product market. However, there is evidence that liquidity measures based on price and volume information alone (e.g., the Amihud measure) can explain most of the variation observed in measures using significantly more trade information and, therefore, running the risk of compromising the confidentiality of trader identity. In a second set of regressions, we explain the observed yield spreads using various combinations of liquidity variables and find similar results: Liquidity measures provide higher explanatory power than product characteristics and trading activity variables alone. However, this result is mostly driven by price and volume information. Thus, details regarding the identities of specific dealers involved with a particular trade or trade directions are not an absolute necessity in terms of their informational value to market participants: Reasonable estimates of liquidity can be calculated based on prices and volumes of individual trades, without the divulging of dealer-specific information.

The remainder of the paper is organized as follows: In Section 2, we discuss the importance of transparency in fixed-income markets, particularly for structured products, and present our research questions. Section 3 describes the dataset as well as the matching and filtering procedures we apply. Section 4 defines and discusses the liquidity proxies that we employ in our empirical analysis. Section 5 presents the empirical results and Section 6 concludes.

## 2 Transparency in the Structured Product Market

In this section, we discuss the trading architecture of the structured product market and its deficiencies with regard to market transparency. Furthermore, we compare the new disclosure requirements of FINRA with previous transparency projects in the US corporate and municipal bond markets. In this context, we also present the relevant literature and motivate our research questions.

Similar to most other fixed-income markets, the US securitized product market has an OTC architecture. Thus, trading activity is opaque as transactions take place through a one-to-one contact between an investor and a broker/dealer, or between two broker/dealers. However, in contrast to other fixed-income markets (i.e., the Treasury, municipal and corporate bond markets), the market segments and products are quite diverse, as securitized products are based on substantially varying pools of underlying securities and have different cash-flow structures, ranging from simple "pass-through" products to tranches with their complex risk structures (see Section 3). Given the OTC structure of this market, traded (or even quoted) prices and volumes are generally not observable. As a consequence of this lack of transparency, liquidity measures based on the trading costs or market impact of trades can only be estimated using simple measures based on quotation data or market-wide statistics. In such an opaque market environment, the regulation of market activity is difficult, and severe disadvantages can arise for market participants, e.g., high transaction costs for certain types of trades. This effect is exacerbated during periods of crisis, with the liquidity and price disadvantage becoming more pronounced, particularly when selling pressure intensifies. Thus, the deleterious consequences of the skewed effects of liquidity are of concern to regulators. In response to such concerns about the opacity of this market, especially during the financial crisis, FINRA recently started a transparency project for structured fixed-income products, making the reporting of trading activity mandatory for brokers/dealers. In the first phase of this project, which started on May 16, 2011, *all* trades have had to be reported to the TRACE database for structured products, although the information had not been released to the market during our sample period.

FINRA's transparency project for structured products is comparable to its earlier introduction of the TRACE database for the US corporate bond market, where reporting of all trades is mandatory for all brokers/dealers within 15 minutes of execution, with the information promptly disseminated to the market. TRACE was introduced in this market through multiple phases starting in July 2002, and set in place in its current form in October 2004. There was much debate to begin with concerning the dissemination of the transaction data. In the end, information about all trades was disseminated, but without revealing the identity of the dealer or the precise volume (the volume is capped at one or five million, depending on the credit quality of the bond).[3] A similar transparency project was also conducted for the municipal bond market by the Municipal Securities Rulemaking Board (MSRB). Initiatives to improve trade transparency for this market started in 1998, and similar rules to those for the corporate bond market were adopted in 2005, i.e., making trade reporting obligatory within 15 minutes, and disclosing similar information. The TRACE and MSRB initiatives are milestone transparency projects in the context of OTC markets, and have justifiably received a lot of attention in the academic literature. Many studies have used these datasets to quantify and study liquidity effects in the various stages of their implementation.

Using data from the early stages of the MSRB project, Harris and Piwowar (2006) analyze the transaction costs in the municipal bond market for a one-year sample starting in November 1999. They find round-trip costs of around 100 bp for institutional trades, and show that small retail trades turn out to be twice as expensive as this. Furthermore, they document that transaction costs increase with credit risk, maturity and bond age. Green et al. (2007b) focus on the municipal bond market as well, using the round-trip cost measure. They find similar transaction costs and decompose these costs into dealers' costs versus market power, showing that dealers have significant market power in retail trading, and confirming that smaller trades are more expensive. Based on TRACE data for US corporate bonds in various stages of the implementation of that project, Bessembinder et al. (2006), Goldstein et al. (2007) and Edwards et al. (2007) use transaction cost measures of liquidity to show that round-trip costs for intermediate trade volumes are in the range of 30 bp to 60 bp. They also provide evidence that these costs are dependent on trade size, credit risk and maturity in the US corporate bond market.[4]

In contrast to the aforementioned papers, there have been only a few papers analyzing liquidity effects in the fixed-income structured product market, and those have mostly focused on liquidity at the market-wide

[3] More recently, the precise volume has been disclosed, with an 18-month delay.

[4] More recent papers quantifing liquidity in these markets provide, in general, similar evidence. However, they rely on other sets of liquidity measures and study different sample periods. See, e.g., Mahanti et al. (2008), Ronen and Zhou (2009), Jankowitsch et al. (2011), Bao et al. (2011), Nashikkar et al. (2011), Lin et al. (2011), Feldhütter (2012), Friewald et al. (2012) and Dick-Nielsen et al. (2012).

level, given the constraints of data availability. For example, Bessembinder and Maxwell (2008) and Vickery and Wright (2010) use aggregated trading volumes for the whole market to analyze liquidity effects. Given the complexity and diversity of the fixed-income structured product market, an aggregate analysis of this sort may yield only limited insights into issues of liquidity and market microstructure.

The first focus of this paper is to close this gap by employing a wide range of liquidity measures developed in the academic literature (see Section 4) and providing a detailed analysis of liquidity in the structured product market, in general, and its four segments (ABS, CMO, MBS and TBA), in particular.[5] These segments constitute a diverse range of fixed-income securitized products. In addition, we analyze different sub-segments that have turned out to be important in the other fixed-income markets; we compare institutional to retail traded products and sub-segments based on different credit ratings. We expect to find lower liquidity for retail trades and securities with high credit risk, as is documented, e.g., in Harris and Piwowar (2006) for the municipal bond market. In addition, we analyze two aspects that are unique to the securitized product market. First, many products are guaranteed by federal agencies, i.e., government-sponsored enterprises (GSEs), that provide implicit or explicit government guarantees (see Section 3). We compare such products to non-agency issues, expecting to find higher liquidity for agency products. Second, an important fraction of products such as ABS and CMO have complex cash-flow structures offering different tranches based on certain pools of underlying securities, with special risk structures (see Section 3). We analyze these tranches expecting to document that more senior claims tend to be more liquid.

As emphasized earlier, the main focus of our research is the relation between disclosure requirements and the need to measure liquidity appropriately. For instance, during the implementation phases of the MSRB and TRACE projects, there was some controversial discussion over whether an increase in transparency (i.e., the dissemination of transaction data) would have a positive effect on market liquidity. Some market observers argued that such transparency in rather illiquid OTC markets would expose dealers' inventory and trading strategies to other market participants, which could lead dealers to reduce their trading activity in order to avoid the resulting disadvantages in the price negotiation process. However, recent research on price discovery and liquidity, using controlled experiments, finds clear evidence of an increase in liquidity when transparency is improved. For example, Bessembinder et al. (2006) compare transaction costs in the US corporate bond market for a sample of insurance company trades before and after the implementation of the TRACE transparency project in that market. They find that transaction costs decreased dramatically (by

[5]Note that the new TRACE dataset is also used by Atanasov and Merrick (2012), who study trade-size segmentation of MBS issued by Fannie Mae, Hollifield et al. (2012), who compare 144a and registered products for the ABS and CMO markets, and Bessembinder et al. (2013), who provide an overview of trading costs and volumes. These parallel studies cover some aspects of liquidity as well, mostly based on certain sub-segments of the database that we analyze comprehensively in this paper.

50%); even for bonds not subject to the reporting requirements, trading costs reduced (by 20%). Goldstein et al. (2007) find similar results in their study of a BBB bond sample. They report that medium to small trades benefit more from transparency. Furthermore, they show that trade volume does not decrease following greater transparency.[6]

Overall, these papers find that the chosen level of detail of disseminated data has a positive effect, compared to the regime in which no transaction data were disseminated. However, the majority of these papers focus solely on one individual liquidity measure, given the limitations of data availability. Thus, these papers do not ask the broader question of how much data should *optimally* be disclosed to enable market participants to reliably estimate market and liquidity conditions, as they do not comprehensively compare liquidity measures based on different information sets (since this was not possible, given the restricted data samples previously available).

In this paper, we remedy this lacuna by focusing particularly on the relation between the measurement of liquidity and the dissemination of information, in addition to quantifying liquidity. Thus, we ask how much information should be disseminated, optimally, and in particular whether dealer-specific information, such as trader identity and trade direction, should be disclosed. Therefore, we measure the efficacy of liquidity metrics that require different levels of detail in terms of the information used to compute them. We analyze two aspects of this question, using different sets of regressions: First, we explore to what extent product characteristics, trading activity variables and liquidity measures using less information can proxy for liquidity measures using more or even all available information. Second, we study which liquidity measures can best explain the cross-sectional differences in yield spreads for our sample.

## 3 Data Description

We use a new TRACE dataset compiled by FINRA in the course of their recent transparency project for the fixed-income structured product market. This proprietary dataset comprises *all* reported transactions made by dealers and brokers in the US structured product market between May 16, 2011 and October 31, 2012. The complete information will be distributed to market participants in due course, although the level of detail and the time-table for its release are yet to be decided.[7] The dataset contains, as basic attributes,

[6]For the primary municipal and corporate bond markets, Green (2007), Green et al. (2007a) and Goldstein and Hotchkiss (2007) provide similar evidence. They show, both theoretically and empirically, that transparency reduces underpricing, after the dissemination of trading data.

[7]The time period of our data sample is dictated by the fact that, during this period, no data were disseminated to the market. Since then, data on selected market segments has begun to be disseminated in stages, starting with the TBA market on November 12, 2012. Since our research focuses on the optimal level of disclosure, we restrict our attention to the period when no detailed data were disseminated. In subsequent research, we plan to explicitly examine the effects of the (staged) disclosure

the price, volume, trade date and time of each individual transaction. Furthermore, it is possible in our dataset to link individual trades to dealers, as the data are comprised of specific broker/dealer information, although the identity of the individual dealers is coded, and hence concealed. In addition, we can distinguish buy- and sell-side trades in the dataset, identifying the active customer in each transaction.[8]

The raw dataset comprises 9,013,026 transactions in 277,272 products. We employ various cleaning and filtering procedures before analyzing the data. First, we clean our dataset by removing transactions that were reported more than once; this particularly occurs when multiple parties, who are all obliged to report to TRACE, are involved in a given transaction.[9] Disregarding this duplication would otherwise distort the calculation of trading activity variables as well as some of our liquidity proxies. Second, since the transaction data most likely contain erroneously reported trades, we apply two types of filter, a *price median filter* and a *price reversal filter*, similar to the filters suggested for the US corporate bond market data (see e.g., Edwards et al. (2007)). While the median filter identifies potential outliers in the reported prices within a certain time period, the reversal filter identifies unusual price movements.[10] After applying these cleaning and filtering procedures, we end up with 5,821,025 reported transactions for 266,746 securitized products.

Structured products can be classified into four market segments according to FINRA's definitions, i.e., ABS, CMO, MBS and TBA. The instruments traded in these segments are rather diverse, as structured products can be based on substantially different cash-flow structures. Furthermore, the securities are issued/guaranteed by multiple federal agencies as well as non-agencies. In the following, we provide a brief summary description of each of the four market segments to put their distinguishing characteristics in perspective.

*ABS* are created by bundling loans, such as automobile loans or credit card debt, and issuing securities backed by these assets, which are then sold to investors. In most cases, multiple securities are offered. Known as tranches, they are all based on a single pool of underlying loans but have differing levels of risk. In general, payments are first distributed in a "waterfall" to the holders of the lowest-risk securities, and then sequentially to the holders of higher-risk securities, in order of priority, and hence risk. In most cases, ABS are issued by private entities ("non-agencies") rather than federal agencies. *CMO* are instruments similar to

of information.

[8]The dataset also includes some information on buyer and seller commissions. However, we do not use this information as commissions are available only for a tiny portion of 0.52% of all trades.

[9]Our filtering procedures are similar to, but more detailed than, those that are normally applied for the US corporate bond TRACE database (see, e.g., Dick-Nielsen (2009)).

[10]The median filter eliminates any transaction where the price deviates by more than 10% from the daily median or from a nine-trading-day median centered on the trading day. The reversal filter eliminates any transaction with an absolute price change deviating from the lead, lag, and average lead/lag price change by at least 10%. These filters are designed to remove most, if not all, errors arising from data entry.

ABS but backed by pools of mortgage loans. A substantial fraction of these securities offer investors multiple tranches with differing risk characteristics. As is to be expected, the prices of CMO tranches are often highly sensitive to property prices. Other products in this market segment are "pass-through" securities, which entitle the investor to a pro-rata share of all payments made on an underlying pool of mortgages. These securities are often guaranteed by one of the three GSEs, the Government National Mortgage Association (Ginnie Mae), the Federal National Mortgage Association (Fannie Mae) or the Federal Home Loan Mortgage Corporation (Freddie Mac).[11] All three institutions are backed by explicit or implicit guarantees from the US government. *MBS* are similar to CMO securities and represent claims on the cash flows from pools of mortgage loans. However, most MBS are guaranteed by the three GSEs and are "pass-through" participation certificates entitling the investor to a pro-rata share of future cash flows. *TBA* are conceptually different from the three market segments described so far. TBA are essentially forward contracts on MBS where two investors agree on the price and volume for delivering a particular agency's MBS at a future date. The precise composition of the pool is not known at the time of the TBA trade; rather, the broad characteristics (issuer, maturity, coupon, price, amount, and settlement date) are agreed upon at that time. Thus, this market segment is different from the other three, being a forward market with less specificity in terms of the nature of the underlying cashflows.[12]

Based on information provided by FINRA, we can identify the market segment and the issuer/guarantor of each security, i.e., one of the three federal GSEs or a non-agency entity (private labeller). This difference is particularly interesting for the CMO market segment, in which both agencies and private labellers are active. Furthermore, we can determine whether a security is a pass-through certificate or represents one of the tranches based on a specific pool of loans. Securities that represent a tranche exist only in the ABS and CMO market segments. For a particular security representing a tranche, we have data on its priority, defined by the following types: super-super senior (SSSR), super senior (SSR), senior (SR), mezzanine (MEZ), and subordinated (SUB). Note, however, that we have no information available concerning the underlying pool of loans, nor the attachment and detachment points (i.e., the exact definitions of the sizes) of the tranches.

In addition, we have available to us basic data about the characteristics of the securities in our database. In particular, we know the original amount issued, the coupon and the maturity. We also obtain credit ratings from Standard & Poor's. However, only a small fraction of the whole universe of securities is rated, especially in the case of agency instruments, which typically do not have ratings. Finally, to explore the

[11] Fannie Mae and Freddie Mac actually take in mortgages from banks and then issue and guarantee CMO and MBS, while Ginnie Mae just provides guarantees. In a few cases, the guarantee is provided by the Small Business Administration.

[12] See, e.g., Vickery and Wright (2010) for a detailed description of the institutional features of the TBA market.

liquidity of retail trading, we define transactions involving securities with an average daily trading volume of less than $100,000 as retail trades, conforming to the internal definitions used by FINRA. These variables and classifications of the overall sample allow us to analyze, in detail, the liquidity of the structured product market and its segments.

# 4 Liquidity Proxies

In this section, we introduce the liquidity proxies used in our empirical analysis. The proxies that we present cover virtually all liquidity measures proposed in the related literature. We employ both simple product characteristics and trading activity variables, using either static or aggregated data. Furthermore, we present state-of-the-art liquidity measures that estimate transaction costs, market impact or turnover using detailed trading data, allowing us to compare the performance of each measure, in terms of its efficacy in estimating liquidity. In this section, we focus on the concepts underlying the liquidity proxies and their relation to the dissemination of data, and defer the technical details of computing the liquidity measures to the appendix.

**Product characteristics** are rather crude proxies of liquidity that rely on the lowest level of informational detail of all the categories.[13] Thus, product characteristics are typically used as liquidity metrics when there is a limitation on the level of detail in the transaction data. In particular, we use the *amount issued* of a security measured in millions of US dollars. We presume securities with a larger amount issued to be more liquid, in general. Another important product characteristic is the *time-to-maturity*, which corresponds to the time, in years, between the trading date and the maturity date of the security. We expect securities with longer maturities (over ten years) to be generally less liquid, since they are often bought by "buy-and-hold" investors, who trade infrequently. We also consider the instrument's average *coupon* as a relevant proxy. Despite the ambiguity of the relationship between the coupon and both liquidity and credit risk, we believe that instruments with larger coupons are generally less liquid.

[13] Many papers studying bond market liquidity rely on indirect proxies based on product characteristics such as coupon, age, amount issued, industry, and covenants, and are forced to do so by the constraints of data availability prior to the release of the TRACE dataset for US corporate bonds (see, e.g., Elton et al. (2001), Collin-Dufresne et al. (2001), Perraudin and Taylor (2003), Eom et al. (2004), Houweling et al. (2005), and Longstaff et al. (2005)). Recent papers analyzing larger sets of variables include these proxies as well as more conceptually sound liquidity measures (see, e.g., Friewald et al. (2012) and Dick-Nielsen et al. (2012)).

**Trading activity variables** such as the *number of trades* observed for a product on a given day represent the aggregated market activity.[14] Other similar variables that we calculate on a daily basis, for each product, are the *number of dealers* involved in trading a specific product, and the *trading volume* measured in millions of US dollars. We expect these variables to be larger, the more liquid the product. On the contrary, the longer the *trading interval*, which refers to the time elapsed between two consecutive trades in a particular product (measured in days), the less liquid we would expect the product to be.

**Liquidity measures** are conceptually based and more direct proxies for measuring liquidity, and require transaction information for their computation. However, the level of detail concerning the required information set varies considerably across measures. The liquidity measure that uses the most detailed information is the *round-trip cost* measure, which can be computed only if the traded prices and volumes can be linked to the individual dealer; see, e.g., Goldstein et al. (2007). It is defined as the price difference for a given dealer between buying (selling) a certain amount of a security and selling (buying) the same amount of this security, within a particular time period. In our analysis, we assume that a "round-trip" occurs within one day, and that the price is not affected by changes in the fundamentals during this period. The round-trip trade may either consist of a single trade or a sequence of trades, which are of equal size in aggregate, on each side. The *effective bid-ask spread*, proposed by Hong and Warga (2000), can be computed when there is information about whether a transaction was initiated by the buy or the sell side. The effective bid-ask spread is then defined as the difference between the daily average sell and buy prices (relative to the mid-price).

Many other liquidity measures use only the price and/or volume of each transaction, without relying on dealer-specific or buy/sell-side information. A well-known metric proposed by Amihud (2002), and conceptually based on Kyle (1985), is the *Amihud measure*. It was originally designed for exchange-traded equity markets, but has also become popular for measuring liquidity in OTC markets. It measures the price impact of trades on a particular day, i.e., it is the ratio of the absolute price change measured as a return, to the trade volume given in US dollars. A larger Amihud measure implies that trading a financial instrument causes its price to move more in response to a given volume of trading and, in turn, reflects lower liquidity. An alternative method for measuring the bid-ask spread is the *imputed round-trip cost*, introduced by Feldhütter (2011). The idea here is to identify round-trip trades, which are assumed to consist of two or three trades on a given day with exactly the same traded volume. This likely represents the sale and purchase of an asset via one or more dealers to others in smaller trades. Thus, the dealer identity is not employed in this

[14] Papers that use market-related proxies based on aggregated trading activity to study bond market liquidity include, e.g., Perraudin and Taylor (2003), Houweling et al. (2005), De Jong and Driessen (2006), Friewald et al. (2012), and Dick-Nielsen et al. (2012).

matching procedure; rather, differences between the prices paid for small trades, and those paid for large trades, based on overall identical volumes, are used as the measure. The *price dispersion measure* is a new liquidity metric recently introduced for the OTC market by Jankowitsch et al. (2011). This measure is based on the dispersion of traded prices around the market-wide consensus valuation, and is derived from a market microstructure model with inventory and search costs. A low dispersion around the valuation indicates that the financial instrument can be bought for a price close to its fair value, and therefore represents low trading costs and high liquidity, whereas a high dispersion implies high transaction costs and hence low liquidity. The price dispersion measure is defined as the root mean squared difference between the traded prices and the average price, the latter being a proxy for the respective market valuation.

The *Roll measure*, developed by Roll (1984) and applied, e.g., by Bao et al. (2011) and Friewald et al. (2012), in the context of OTC markets, is a transaction cost measure that is simply based on observed prices. Under certain assumptions, adjacent price movements can be interpreted as a "bid-ask bounce", resulting in transitory price movements that are serially negatively correlated. The strength of this covariation is a proxy for the round-trip transaction costs for a particular financial instrument, and hence a measure of its liquidity. This measure requires the lowest level of detail as only traded prices, and not trading volume or dealer-specific information, are used in the computation.

# 5 Results

In this section, we present the results of our analysis. We first discuss in Section 5.1 the descriptive statistics of our liquidity proxies for the whole fixed-income structured product market in the US, and its four market segments (ABS, CMO, MBS and TBA). We then compare our results with those from other markets, primarily the US corporate bond market, allowing us to analyze the general level of liquidity in the various segments, with respect to well-known benchmarks. We mainly choose the US corporate bond market for this purpose, as the general institutional structure is most directly comparable to the fixed-income securitized product market. In Section 5.2, we provide more detailed empirical results, by comparing liquidity for different sub-segments and product categories. First, we compare retail versus institutional trades. Second, we explore liquidity effects of different tranche types. Third, we analyze whether liquidity depends on the issuing/guaranteeing authority, i.e., we compare the three GSEs with non-agency issues. Fourth, we compare different credit rating grades. In Section 5.3, we present our main analysis of the relation between the measurement of liquidity and the level of detail in the dissemination of trading data. Using different sets of regressions, we explore whether liquidity measures using less detailed information can accurately proxy for measures using more detailed data. We elaborate more on this issue in Section 5.4, where we explore the effect of liquidity on the prices of structured products. Specifically, we analyze which liquidity measures can explain differences in yield spreads across securities.

## 5.1 Liquidity Effects in the Structured Product Market

First of all, we discuss the descriptive statistics of the trading activity of the structured products at a market-wide level. Table 1 presents the average daily number of products traded, the number of trades and the traded volume in the market as a whole. On average per day, we observe 3,203 different traded securities, 14,480 trades and an aggregate trade volume of $227 billion. The structured product market has a much higher daily trading volume than the US corporate debt market or the US municipal bond market, each of which has an average daily trading volume of around $15 billion (see, e.g., Vickery and Wright (2010)). However, the average daily trading volume of the securitized market is much lower than that of the US Treasury securities market, the latter being around $500 billion (see, e.g., Bessembinder and Maxwell (2008)).

Trading in the structured market consists of three different spot market segments, i.e., ABS, CMO and MBS, and the TBA market, which is basically a forward market. In this sense, the volume in the TBA market cannot be compared directly with the other three (spot) markets. We find an average daily traded volume in the TBA market of $204.1 billion. The average traded volumes in the spot markets are $4.5 billion (ABS), $12.4 billion (CMO), and $18.2 billion (MBS). Roughly speaking, the MBS segment trades slightly more, and the CMO segment somewhat less than the *entire* US corporate bond market, on average, each day. The TBA segment is much larger than each of these markets, while the ABS segment is much smaller.

The total number of structured issues that are traded during the entire sample period is 266,746 which again is much larger than the total number of corporate bond issues traded during the same period, at around 30,000 traded bonds.[15] However, the daily average number of products traded (3,203) in the structured product market is only about 50% of the number traded in the US corporate bond market per day; see, e.g., Friewald et al. (2012). Approximately the same fraction can be observed for the average daily number of trades. Thus, these comparisons indicate that while, overall, more instruments exist in the securitized product market, they are traded less often than the corporate bonds, albeit with a higher volume per trade. Figure 1 shows the time series of the daily number of trades and trade volume for the four market segments.

[15] We calculated the number of traded bonds based on aggregate information from the US corporate bond TRACE dataset.

Generally, for the spot markets, we encounter a stable pattern of trading activity. However, for the TBA market, we find a cyclical pattern of trading activity, with significantly greater trading activity in the first half of each month, probably driven by the issuance schedule.

Focusing on the liquidity of the individual securities, we present summary statistics (mean, standard deviation, and correlation) for the product characteristics, trading activity variables, and liquidity measures for the whole structured product market as well as for the market segments. Table 2 provides the means of the various variables, which are averaged over time and over the cross-section of the respective sub-samples. In the ABS segment, we observe an average amount issued of around $492 million, compared with $394 million in the MBS, and $89 million in the CMO segments, per issue. In comparison, Friewald et al. (2012) report, for the US corporate bond market, an average amount issued of $320 million per issue. Trading activity and liquidity in the securitized market seem to be rather dispersed across the four segments. Overall, the TBA market shows the highest trading activity per security. On average, around four dealers are active each day per security, with seven trades and a traded volume of $126 million per security. In the other segments, we observe a lower number of active dealers (on average, between one and two dealers). Furthermore, the number of trades (around two trades) and the traded volume (around $10 million) are far lower. In comparison, for the US corporate bond market, Friewald et al. (2012) report an average of 3.5 trades and a trade volume of $4.7 million. Thus, as already indicated, we find fewer trades, but with a higher average trade size, for securitized products in the spot market, compared with the US corporate bond market.

As expected, the TBA market is the most liquid segment of the structured product market. The round-trip trading cost is around 4 bp, compared to 49 bp in the ABS, 50 bp in the MBS, and 98 bp in the CMO segments. This ranking is preserved for basically all the liquidity measures that we consider. For example, for the price dispersion measure, we find 10 bp for the TBA, 34 bp for the ABS, 46 bp for the MBS and 70 bp for the CMO segment. In comparison, Friewald et al. (2012) report for the US corporate bond market a price dispersion of 42 bp, on average. Thus, according to this metric, the TBA and ABS segments are more liquid than the corporate bond market, and the other two markets are less liquid. We find a rather high Amihud measure for the structured product market (3.2% change in price per $100,000 of traded volume). This result turns out to be caused by retail trades, where some small trades lead to high returns, i.e., they are far above or below the average traded price. Retail trading appears to be expensive in this market, especially for products with dispersed trading activity, which leads to high search costs (see Section 5.2).

Tables 3 and 4 present the standard deviations and correlations of the product characteristics, trading activity variables and liquidity measures. The standard deviations are quite comparable to those in the

US corporate bond market, with the exception of the Amihud measure, for which the standard deviation is higher (as emphasized above). Focusing on correlation, we find that the product characteristics show a low level of correlation with each other as well as with the other variables. Interestingly, the trading activity variables exhibit low levels of correlation with the liquidity measures as well (less than 0.20 in absolute terms), indicating that the sets of information provided by the different groups of variables vary considerably from each other. However, within the groups of trading activity variables and liquidity measures, correlation is at a rather high level (on average around 0.50).

## 5.2 Liquidity Effects in Different Sub-Segments of the Market

In this section, we study liquidity effects in four different sub-segments of the structured product market. We first compare liquidity effects between retail and institutional trades. We define trades with an average daily trading volume of less than $100,000 as retail trades, in accordance with the definition used by FINRA. Table 5 presents the liquidity proxies for the ABS, CMO, and MBS market segments. In the TBA market segment, we observe (as expected) an extremely low number of retail trades, as forward markets are primarily used by institutional investors. Therefore, we do not report statistics for that particular market segment.

Around 12% (not reported in the table) of all observations are retail trades in the ABS market segment, while the fractions of retail trades in the CMO and MBS markets are much larger at approximately 60% and 31%, respectively. Retail traders in the CMO market segment apparently focus on instruments with a much lower amount outstanding, approximately $38 million, than in the institutional sub-segment, where the figure is $131 million. Our analysis of the liquidity measures reveals that retail investors in the ABS market segment are confronted with a significantly lower liquidity. Essentially, all our liquidity measures indicate that trading costs are about four times higher for retail investors than their institutional counterparts. For example, the price dispersion measure in the retail sub-segment amounts to 123 bp, whereas it is only about 28 bp in the institutional sub-segment. For the CMO market segment, we find similar results, albeit with a smaller difference in transaction costs: retail trades encounter around 50% higher trading costs than institutional trades. The MBS market segment results fall in between the other two, retail investors having to face approximately twice the transaction costs of institutional investors. Overall, we find that the liquidity of retail trades is far lower than that of institutional trades. As in the case of the introduction of TRACE for the US corporate bond market (see, e.g., Edwards et al. (2007)), we would expect these transaction costs to decrease in the securitized product market following the timely dissemination of transaction data.

In our second piece of analysis, we explore the liquidity effects of different types of tranches in the ABS and CMO market segments (tranches are not relevant for the MBS and TBA markets, where products typically have "pass-through" structures). In these segments, it is common to offer multiple securities, with a hierarchy of credit risk levels, but based on one pool of underlying loans. Payments are first distributed to the holders of low-risk securities, and then to higher-risk securities, in order of priority. The tranche sizes can differ substantially from structure to structure, and the rules for distributing the payments to the different tranches are often complicated. Table 6 shows the values of various liquidity proxies for the different seniorities of tranches.

In the ABS market segment, we find that trading is higher in the SR tranches. We do not observe any trading activity in the SSSR tranches, and nearly no activity in the SSR tranches, indicating that these tranches are not commonly traded. Hence, we do not report the statistics for the liquidity proxies for the SSSR and SSR tranches. The average amount outstanding of $573 million for the SR tranches is much larger than for the MEZ ($35 million) and SUB tranches ($109 million). Accordingly, we find that the trading volume is larger for the SR tranches. Our analysis reveals an interesting pattern when we examine the liquidity measures: the most liquid tranches are also the most senior. However, the least liquid tranches are the mezzanine tranches, presumably because these have much lower amount outstandings and also exhibit less trading activity. For example, the imputed round-trip costs are 28 bp, 68 bp and 43 bp for the SR, MEZ and SUB tranches, respectively. For the CMO segment, we find trading activity in all tranche types (SSSR to SUB) but trading volume is highest for the more senior tranches, and lowest for the subordinated tranches. The largest tranches are the SSR tranches (average size of $230 million), and the smallest the SUB tranches (average size of $30 million). In general, the level of liquidity is somewhat lower than in the ABS market segment which again seems to be related to the tranche sizes.

In the third piece of analysis, we compare securities guaranteed by the three federal GSEs, i.e., Freddie Mac (FH), Fannie Mae (FN) and Ginnie Mae (GN), with non-agency securities (Others). We make this comparison for the CMO market segment only, where sufficient observations are available for all groups. Table 7 provides the liquidity proxies for the securities issued by the different agencies and their non-agency counterparts. We find that the non-agency trades have larger outstanding amounts (around $124 million) than the agency trades (FN: $89, FH: $89 and GN: $42 million), whereas the number of dealers and trades are of comparable size. In terms of their liquidity measures, we find that securities guaranteed by agencies have lower transaction costs than non-agency securities. For example, the imputed round-trip cost is about 81 bp for GN, and around 60 bp for FN and FH, whereas it is 87 bp for the non-agency securities. Comparing the GSEs, we find that securities guaranteed by Ginnie Mae are somewhat less liquid than the securities of the other agencies, potentially because of their smaller issue sizes and trading volumes.

In the fourth piece of analysis, we explore the liquidity effects for different rating grades, i.e., AAA, AA, ..., CCC/C. We present results for the ABS market segment, where around 60% of all securities are rated. In the MBS and TBA segments, ratings play a minor role as securities by GSEs are, in general, not rated. The same is true for the CMO market, where less than 25% of the securities have credit ratings. We document that securities with better credit ratings have larger outstanding amounts: around $600 million for AAA, AA and A, compared to $290 million for BBB, and less than $200 million for BB, B and CCC/C. As expected, we observe lower coupons for better rated securities. Interestingly, we find a somewhat higher trading volume for high-risk securities ($14 million for CCC/C compared to $12 million for AAA), whereas the number of dealers and trades are comparable in all rating classes. Analyzing the liquidity measures, we find the expected result that better-rated securities are more liquid, i.e., have lower transaction costs. For example, the round-trip costs are 24 bp for AAA rated securities and increase to 129 bp for CCC/C rated issues. In particular, the differences between investment and speculative grade securities are pronounced. Similar results are found for all the other liquidity measures.

### 5.3 Liquidity and the Dissemination of Information

In this section, we discuss the relation between liquidity and the dissemination of information. Overall, this analysis allows us to examine whether the dissemination of transaction data provides valuable information to market participants, beyond that provided by liquidity measures based on more aggregate information. This may help the regulators to determine whether the dissemination of transaction data without associations to particular dealers (as is currently planned by FINRA) would be sufficient from the perspective of improving market transparency. Furthermore, it provides insights into the informational value of different liquidity measures.

We can assign the available liquidity proxies to three groups, depending on the level of detail of information required to compute them. The first group comprises product characteristics that rely on the most basic information that is available for almost every fixed-income instrument. The second group consists of trading activity variables for the individual products, e.g., the number of trades or volumes, with the available information aggregated on a daily basis. The third and most important group is composed of liquidity measures at the product level that require detailed trading information. Comparing the product characteristics and trading activity variables to these liquidity measures allows us to determine whether information about individual trades adds to the market's understanding of liquidity.

The descriptive statistics and correlations presented in the previous section provide initial indications of the informational value of the various liquidity measures. When analyzing the liquidity of the different markets and their sub-segments, the liquidity measures offer additional findings compared to the product characteristics and trading activity variables. For example, when comparing the different market segments, higher trading activity is not always associated with lower transaction costs. The correlation analysis hints in the same direction: There is low correlation between the product characteristics and the liquidity measures (the highest correlation is 0.27 in absolute terms) and between trading activity variables and liquidity measures (up to 0.20 in absolute terms). Thus, it seems that liquidity measures that rely on more detailed transaction data can provide important additional information, according to this perspective.

To further emphasize this point, we provide a set of regressions, focusing on securities without implicit (or explicit) guarantees made by the US government.[16] We use a panel regression based on the daily averages of all the variables to explore whether each of our defined liquidity measures ($lm$) can be explained by product characteristics and trading activity variables:

$$\begin{aligned} lm_{it} &= \beta_0 + \beta_1 \cdot trd_{it} + \beta_2 \cdot vol_{it} + \beta_3 \cdot dlr_{it} + \beta_4 \cdot tint_{it} + \beta_5 \cdot amti_{it} + \beta_6 \cdot mty_{it} \\ &\quad + \beta_7 \cdot cpn_{it} + \sum_j \gamma_j \cdot control_{ijt} + \epsilon_{it}, \end{aligned} \tag{1}$$

where $lm \in \{rtc, ebas, ami, irtc, pdisp, roll\}$ is the set of liquidity measures that we would like to explain, in turn (i.e., round-trip cost, effective bid-ask spread, Amihud measure, imputed round-trip cost, price dispersion measure, and Roll measure) using the following explanatory variables: $trd$ is the number of trades, $vol$ the trading volume, $dlr$ the number of dealers, $tint$ the trading interval, $amti$ the amount issued, $mty$ the time-to-maturity and $cpn$ the coupon.[17] We control for the market segment, registered products, and credit ratings in our regressions. This analysis allows us to explore whether measures of transaction costs or price impact, which use more detailed data, can be proxied by more basic variables that use less detailed information.

Table 9 shows the results of this analysis. We present six regressions, each explaining one of the liquidity measures by product characteristics and trading activity variables. In the first regression, explaining the round-trip cost measure, we find an $R^2$ of 32.8%. We obtain similar explanatory power for the effective bid-

[16] The descriptive statistics show that liquidity effects play a more important role for non-agency securities, since agency securities generally only represent pass-through structures with guarantees. Therefore, the data dissemination policy would be more relevant for non-agency securities.

[17] We follow common practice and use logarithmic values of the amount issued in our regression analyses, due to the wide range of values for this variable across securities.

ask spread, the imputed round-trip cost measure and the price dispersion measure. We find an even lower $R^2$ for the Amihud measure (21.4%) and for the Roll measure (17.8%). Analyzing the effect of the explanatory variables, we observe for the trading activity variables that products with a higher trading volume are significantly more liquid, i.e., have lower transaction costs. In addition, a higher number of dealers and more frequent trading activity are associated with lower transaction costs. For the product characteristics, we find that larger issues are more liquid, and higher coupons indicate lower liquidity, as expected. We find no significant relation between the maturity of the products and liquidity. Overall, however, the liquidity measures contain significant idiosyncratic information that is not included in the other variables.

Given these results, it seems evident that the liquidity measures provide additional insights beyond those contained in the basic data on product characteristics and trading activity. Less obvious is the question of whether the liquidity measures using more detailed data provide more insights into the liquidity effects than do the simpler ones. Analyzing the descriptive statistics, we find that the different liquidity measures lead to the same results when comparing different market segments and sub-segments at an aggregate level. Again, the correlation analysis hints in the same direction, as the correlations between these measures are quite high (on average around 0.50, with a maximum of 0.81).

To further analyze these relationships, we present a second set of panel regressions where we regress the measure using the most detailed information, i.e., the round-trip cost, on product characteristics, trading activity variables and all the other remaining liquidity measures, in a nested fashion. Thus, we explore whether the liquidity measures based on *less* information can be a good proxy for the round-trip costs. The regression equation is

$$\begin{aligned} rtc_{it} &= \beta_0 + \beta_1 \cdot ebas_{it} + \beta_2 \cdot ami_{it} + \beta_3 \cdot irtc_{it} + \beta_4 \cdot pdisp_{it} + \beta_5 \cdot roll_{it} + \beta_6 \cdot trd_{it} \\ &\quad + \beta_7 \cdot vol_{it} + \beta_8 \cdot dlr_{it} + \beta_9 \cdot amti_{it} + \beta_{10} \cdot mty_{it} + \beta_{11} \cdot cpn_{it} + \sum_j \gamma_j \cdot control_{ijt} + \epsilon_{it}, \end{aligned} \tag{2}$$

where $rtc$ is the round-trip cost, $ebas$ the effective bid-ask spread, $ami$ the Amihud measure, $irtc$ the imputed round-trip cost, $pdisp$ the price dispersion measure, $roll$ the Roll measure, $trd$ the number of trades, $vol$ the traded volume, $dlr$ the number of dealers, $amti$ the amount issued, $mty$ the time-to-maturity and $cpn$ the coupon. We use different specifications of the above equation, i.e., the full model and other nested specifications, with only one liquidity measure being used as the explanatory variable in each one.

Table 10 shows the results for this piece of analysis, presenting the six specifications. In regressions (1) to (5), we use each of the liquidity measures in turn, plus all trading activity variables and product characteristics, to explain the round-trip costs. When we add just one individual proxy to the regression analysis, we find that the imputed round-trip cost, the effective bid-ask spread and the price dispersion measure are the best proxies, with $R^2$ values of around 50% to 60%, whereas the Amihud and Roll measures only slightly increase the $R^2$ compared to regressions without liquidity measures. When adding all the liquidity measures to the regression equation, in regression (6), we obtain an $R^2$ of 67%, i.e., the explanatory power increases considerably when we include all these proxies. We consider this level of explanatory power quite high given the rather diverse instruments with potentially different liquidity characteristics and the low number of trades per security and day, in general. We get similar results (not reported) when explaining the effective bid-ask spread by liquidity measures using less information. Thus, we find evidence that liquidity measures using more detailed data can be proxied reasonably well by similar measures using less data. We further discuss this issue in the next section and analyze the importance of the dissemination policy in the context of pricing.

## 5.4 Liquidity Effects and Yield Spreads

In this section we explore the cross-sectional relation between liquidity and the yield spreads in the structured product market, focusing again on securities without implicit (or explicit) guarantees made by the US government. We analyze whether the liquidity measures can explain a reasonable proportion of the cross-sectional variation in the yield spreads. We compare these results to those from the US corporate bond market, and further discuss the issue of the level of detail required in the disseminated data.

For this analysis, we compute, for each individual transaction, the related yield of the structured product, based on the trade price and expected coupon payments. Furthermore, we determine the yield of a synthetic risk-free bond based on the swap rate curve at the same time.[18] The dependent variable in our analysis is the yield spread between the individual structured product's yield and the benchmark yield for the same duration. We use a panel regression on the daily averages of all variables to explain the observed yield spreads given the product characteristics, trading activity variables and liquidity measures. In doing so, we

[18] Feldhütter and Lando (2008) show that riskless rates based on swap rates are the best proxies to use as benchmarks.

use the following regression:

$$
\begin{aligned}
yldspr_{it} \quad = \quad & \beta_0 + \beta_1 \cdot rtc_{it} + \beta_2 \cdot ebas_{it} + \beta_3 \cdot ami_{it} + \beta_4 \cdot irtc_{it} + \beta_5 \cdot pdisp_{it} + \beta_6 \cdot roll_{it} \\
& + \beta_7 \cdot trd_{it} + \beta_8 \cdot vol_{it} + \beta_9 \cdot dlr_{it} + \beta_{10} \cdot tint_{it} + \beta_{11} \cdot amti_{it} + \beta_{12} \cdot mty_{it} \\
& + \beta_{13} \cdot cpn_{it} + \sum_j \gamma_j \cdot control_{ijt} + \epsilon_{it}, \qquad (3)
\end{aligned}
$$

where *yldspr* is the yield spread, *rtc* the round-trip cost, *ebas* the effective bid-ask spread, *ami* the Amihud measure, *irtc* the imputed round-trip cost, *pdisp* the price dispersion measure, *roll* the Roll measure, *trd* the number of trades, *vol* the traded volume, *dlr* the number of dealers, *tint* the trading interval, *amti* the amount issued, *mty* the time-to-maturity, and *cpn* the coupon.

Table 11 presents the results based on different specifications. Regression (1) in the table includes only the control variables and has an adjusted $R^2$ of 36.6%, i.e., the control variables provide reasonable explanatory power. Regressions (2) to (7) focus on the liquidity measures, including each of the six liquidity measures individually. Regression (8) includes all these measures taken together. Starting with Regression (2), i.e., including the round-trip cost measure, we find that the adjusted $R^2$ increases to 39.2%, indicating that liquidity is an important risk factor in the pricing of structured products. A one-standard-deviation increase in the liquidity measure increases the yield spread by 43 bp (the standard deviation of the spread is 2.24%). As expected, the round-trip cost measure, which uses the most detailed information, provides the highest $R^2$. It is noteworthy that when we use either the imputed round-trip cost or the price dispersion measure as an explanatory variable, we obtain similar explanatory power (around 38%). When used as independent variables, individually, all of the other measures provide explanatory power of slightly above 37%. In Regression (8), where we include all the liquidity measures, the $R^2$ increases to 39.8%. Since all the liquidity measures quantify similar aspects of liquidity, at least to some extent, not all of them turn out to be statistically significant in this specification, due to the potential multi-collinearity. We find similar explanatory power when we eliminate the round-trip cost measure from the regression equation. Thus, trade-specific reporting of prices and volumes seems to be sufficient for pricing purposes. Analyzing the incremental explanatory power of the liquidity measures alone, we find that these variables cover around 10% of the explained variation in the yield spread. A similar result is reported in Friewald et al. (2012) for the US corporate bond market. This result strengthens the findings of the previous section.

Regressions (9) and (10) provide results using trading activity variables and product characteristics, respectively, as the explanatory variables. Regression (11) is the full model, including all the explanatory variables. In this model, the results for the liquidity measures are confirmed. Analyzing the effect of the trading activity variables in the full model, we find economically significant results only for the trading interval: an increase in the trading interval by one standard deviation is associated with an increase in the yield spread of 12 bp. The information contained in the other trading activity variables, e.g., traded volume, seems to be adequately represented by the liquidity measures. However, more important are the results for the product characteristics. The most relevant variable in the full model turns out to be the coupon. A one-standard-deviation higher coupon results in an increase of 136 bp in the yield spread. Thus, the coupon rate has the highest explanatory power of all the variables, indicating that a higher coupon is also associated with higher credit risk for certain products, in particular when there is no credit rating available. The amount issued shows important effects as well, where a one-standard-deviation increase leads to an 18 bp decrease in the yield spread. Thus, larger issues have lower yield spreads. The maturity of a structured product is related to the yield spread as well, indicating that longer maturities are associated with somewhat lower spreads. However, compared with the other product characteristics, the maturity is of minor importance. Overall, the full model has an $R^2$ of 69.3% with significant incremental explanatory power shown by the liquidity measures. Thus, liquidity is an important driver of yield spreads in the structured product market and, therefore, the dissemination of trading activity information is important, given the size and complexity of this market.

Overall, we find that dealer-specific information and buy or sell-side flags are not absolutely essential, in terms of incremental informativeness, in computing reliable liquidity metrics in the context of OTC markets. Instead, reasonable estimates of the liquidity measures can be calculated based on prices and volumes of individual trades. Thus, a data dissemination policy comparable to that of TRACE for the US corporate bonds, where the focus is on the dissemination of the trading activity without providing dealer-specific information, seems appropriate in this context. It also has the advantage of not compromising the confidentiality of individual trader identities, with little loss of informativeness.

# 6 Conclusion

The US market for structured financial products played an important role during the financial crisis. The opacity of its OTC trading architecture has been widely criticized, especially as this market represents the second largest fixed-income market in the US, after the Treasury bond market. To address this concern, FINRA recently started work on a transparency project to close this gap. Starting on May 16, 2011, virtually all trades in the structured product market are required to be reported to the TRACE database, which we use in this study, including reported transactions up to October 31, 2012.

We analyze the liquidity effects in the structured product market, in general, and in the four main market segments (ABS, CMO, MBS, and TBA), which cover rather different products, in particular, and compare these results to the liquidity in other fixed-income markets. We employ a wide range of liquidity proxies proposed in the academic literature, which was not possible previously, due to the non-availability of trading data. Our main contribution is the analysis of the relation between the measurement of liquidity and the dissemination of trading data. In particular, we explore whether liquidity measures based on less detailed information may still be reasonable proxies of liquidity. This is an important issue in improving market transparency without compromising the identities of individual dealers or their trading strategies.

In our empirical analysis, we find a high trading volume in the fixed-income structured product market, with a daily average of around $227 billion and an average transaction cost of 67 bp for a round-trip trade. The liquidity of the ABS and MBS markets is comparable to that of the US corporate bond market. In contrast, the TBA segment is far more liquid, whereas the CMO market is considerably less liquid. In all four segments, we find more dispersed trading activity than in other fixed-income markets, i.e., fewer trades per security but with higher volumes. Furthermore, we find that securities that are institutionally traded, those that are guaranteed by a federal authority, and those that have low credit risk, tend to be more liquid.

Exploring the relation between the various liquidity proxies and the depth of disseminated information, we find that product characteristics or variables based on aggregated trading activity, by themselves, are not sufficient proxies for market liquidity. The dissemination of the price and volume of each individual trade is important for the quantification of liquidity effects, particularly when explaining yield spreads. However, we also find evidence that liquidity measures that use additional dealer-specific information (i.e., trader identity and sell/buy-side categorization) can be efficiently proxied by measures using less information. Hence, dealer identity need not be compromised in the interests of improving market transparency. In our regression analysis, we find that liquidity effects cover around 10% of the explained variation in yield spreads. Thus, the dissemination of trading activity is essential, given the trade volume and complexity of this market. These results are important for all market participants, and especially for regulators, who have to decide on the level of detail of the transaction data to be disseminated to the market.

# A Appendix: Definitions and Computation of Liquidity Measures

This appendix contains the exact definitions of the liquidity measures that we apply in our empirical analysis. We compute the liquidity measures for each financial instrument individually, using the following notation. We denote the trade price and volume of a transaction observed at time $t_{i,j}$ on trading day $i$ for trade $j$ by $p(t_{i,j})$ and $v(t_{i,j})$. We use $n(t_i)$ to refer to the observed number of trades of a financial instrument on trading day $t_i$.

**Round-Trip Cost** uses the most detailed information. Each transaction needs to be assigned to a particular dealer $d$. The round-trip cost is then defined as the price difference for the same dealer between buying (selling) a certain amount of a security and selling (buying) the same amount of this security. More precisely, for a given trading day $t_i$, we define a round-trip trade $q$ of dealer $d$ as a sequence of consecutive buy transactions with trade prices $p^b_{d,q}(t_{i,j})$, followed by a sequence of sell transactions with prices $p^s_{d,q}(t_{i,j})$ (or vice versa) conducted by the same dealer $d$ such that $\sum_j v^b_{d,q}(t_{i,j}) = \sum_j v^s_{d,q}(t_{i,j})$, where $v^b_{d,q}(t_{i,j})$ and $v^s_{d,q}(t_{i,j})$ denote the trade volumes belonging to the round-trip trade $q$ of dealer $d$. Thus, the round-trip trade may either consist of a single trade on each side or a sequence of trades, on trading day $t_i$. We denote by $pv^s_{d,q}(t_i) = \sum_j p^s_{d,q}(t_{i,j})v^s_{d,q}(t_{i,j})$ and $pv^b_{d,q}(t_i) = \sum_j p^b_{d,q}(t_{i,j})v^b_{d,q}(t_{i,j})$ the dollar amount sold and bought, respectively, in a round-trip $q$ of dealer $d$ on trading day $t_i$. The round-trip cost is then given by

$$rtc(t_i) = \frac{1}{m(t_i)} \sum_{d,q} \frac{pv^s_{d,q}(t_i) - pv^b_{d,q}(t_i)}{1/2 \cdot (pv^s_{d,q}(t_i) + pv^b_{d,q}(t_i))}, \tag{4}$$

where $m(t_i)$ denotes the number of round-trip trades on trading day $t_i$ for a particular financial instrument.

**Effective Bid-Ask Spread** is the difference between the daily average sell- and buy-prices relative to the average mid-price. Thus, transactions need to be flagged as *buy* or *sell* trades. Formally it is defined as

$$ebas(t_i) = \frac{\overline{p}^s(t_i) - \overline{p}^b(t_i)}{1/2 \cdot \left(\overline{p}^s(t_i) + \overline{p}^b(t_i)\right)}, \tag{5}$$

where $\overline{p}^s(t_i) = 1/n^s(t_i) \sum_{j=1}^{n^s(t_i)} p^s(t_{i,j})$ and $\overline{p}^b(t_i) = 1/n^b(t_i) \sum_{j=1}^{n^b(t_i)} p^b(t_{i,j})$ refer to the average sell and buy prices on trading day $t_i$.

**Amihud Measure** quantifies the average price impact of trades on a particular trading day $t_i$. It is defined as the ratio of the absolute price change given as a return $r(t_{i,j}) = \frac{p(t_{i,j})}{p(t_{i,j-1})} - 1$ to the trade volume

$v(t_{i,j})$, measured in US dollars:

$$ami(t_i) = \frac{1}{n(t_i)} \sum_{j=1}^{n(t_i)} \frac{|r(t_{i,j})|}{v(t_{i,j})}. \tag{6}$$

**Imputed Round-Trip Cost** is an alternative way of measuring bid-ask spreads. The idea here is to identify round-trip trades that are assumed to consist of two or three trades on a given day, with exactly the same traded volume. This is likely to represent the sale and purchase of an asset via one or more dealers to smaller traders. Formally, for a given trading day $t_i$, we define an imputed round-trip trade $w$ as a sequence of two or three transactions with trade prices $p_w(t_{i,j})$ and identical volumes $v_w(t_{i,j})$. The imputed round-trip cost is then defined as

$$irc(t_i) = \frac{1}{b(t_i)} \sum_{w} \left(1 - \frac{\min_j p_w(t_{i,j})}{\max_j p_w(t_{i,j})}\right), \tag{7}$$

where $b(t_i)$ refers to the total number of imputed round-trip trades on trading day $t_i$ for a financial instrument.

**Price Dispersion Measure** is defined as the root mean squared difference between the traded prices and the respective market valuation weighted by volume. Thus, for each day $t_i$, it is defined as

$$pdisp(t_i) = \sqrt{\frac{1}{\sum_{j=1}^{n(t_i)} v(t_{i,j})} \sum_{j=1}^{n(t_i)} (p(t_{i,j}) - u(t_i))^2 \cdot v(t_{i,j})}, \tag{8}$$

where $u(t_i)$ refers to the market valuation for trading day $t_i$, which we assume to be the average traded price on that day. We require at least four observations on a given day to calculate the price dispersion measure, i.e. $n(t_i) \geq 4$.

**Roll Measure** is a proxy for the round-trip transaction costs and is defined as

$$roll(t_i) = 2 \cdot \sqrt{-\operatorname{Cov}(\Delta p(t_k), \Delta p(t_{k-1}))}, \tag{9}$$

where $\Delta p(t_k)$ is defined as the change in the consecutive prices $p(t_{k,j})$ and $p(t_{k,j-1})$ on trading day $t_k$ with $t_k \leq t_i$. We compute the Roll measure based on the available price changes within a time frame of 60 days (i.e., $\forall t_k$ with $i - k \leq 60$). Since we interpret the Roll measure as a transaction cost metric, we bound the measure at zero whenever the covariance turns out to be positive.

## References


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

Atanasov, V., Merrick, Jr., J. J., 2012, "Liquidity and Value in the Deep vs. Shallow Ends of Mortgage-Based Securities Pools," *Working Paper, Mason School of Business.*

Bao, J., Pan, J., Wang, J., 2011, "Liquidity and corporate bonds," *Journal of Finance*, 66, 911–946.

Bessembinder, H., Maxwell, W., 2008, "Markets Transparency and the Corporate Bond Market," *The Journal of Economic Perspectives*, 22 (2), 217–234.

Bessembinder, H., Maxwell, W. F., Venkataraman, K., 2006, "Market transparency, liquidity externalities, and institutional trading costs in corporate bonds," *Journal of Financial Economics*, 82, 251–288.

Bessembinder, H., Maxwell, W. F., Venkataraman, K., 2013, "Introducing Daylight to Structured Credit Products," *Financial Analysts Journal (forthcoming).*

Collin-Dufresne, P., Goldstein, R. S., Martin, J. S., 2001, "The determinants of credit spread changes," *Journal of Finance*, 56, 2177–2207.

De Jong, F., Driessen, J., 2006, "Liquidity risk premia in corporate bond markets," *Working Paper, University of Amsterdam.*

Dick-Nielsen, J., 2009, "Liquidity Biases in TRACE," *Journal of Fixed Income*, 19, 43–55.

Dick-Nielsen, J., Feldhütter, P., Lando, D., 2012, "Corporate bond liquidity before and after the onset of the subprime crisis," *Journal of Financial Economics*, 103 (3), 471–492.

Edwards, A., Harris, L., Piwowar, M., 2007, "Corporate bond market transaction costs and transparency," *Journal of Finance*, 62, 1421–1451.

Elton, E. J., Gruber, M., Agrawal, D., Mann, C., 2001, "Explaining the rate spread on corporate bonds," *Journal of Finance*, 56, 247–277.

Eom, Y., Helwege, H. J., Huang, J. Z., 2004, "Structural models of corporate bond pricing: An empirical investigation," *Review of Financial Studies*, 17, 499–544.

Feldhütter, P., 2011, "The Same Bond at Different Prices: Identifying Search Frictions and Selling Pressures," *Review of Financial Studies*, 24 (2).

Feldhütter, P., 2012, "The Same Bond at Different Prices: Identifying Search Frictions and Selling Pressures," *Review of Financial Studies*, 25, 1155–1206.

Feldhütter, P., Lando, D., 2008, "Decomposing Swap Spreads," *Journal of Financial Economics*, 88, 375–405.

Friewald, N., Jankowitsch, R., Subrahmanyam, M., 2012, "Illiquidity or Credit Deterioration: A Study of Liquidity in the US Corporate Bond Market During Financial Crises," *Journal of Financial Economics*, 105, 18–36.

Goldstein, M. A., Hotchkiss, E. S., 2007, "Dealer Behavior and the Trading of Newly Issued Corporate Bonds," *Working Paper, Babson College.*

Goldstein, M. A., Hotchkiss, E. S., Sirri, E. R., 2007, "Transparency and Liquidity: A Controlled Experiment on Corporate Bonds," *Review of Financial Studies*, pp. 235–273.

Green, R., Hollifield, B., Schürhoff, N., 2007a, "Dealer intermediation and price behavior in the aftermarket for new bond issues," *Journal of Financial Economics*, 86, 643–682.

Green, R., Hollifield, B., Schürhoff, N., 2007b, "Financial intermediation and the costs of trading in an opaque market," *Review of Financial Studies*, 20, 274–314.

Green, R. C., 2007, "Presidential Address: Issuers, Underwriter Syndicates, and Aftermarket Transparency," *Journal of Finance*, 62, 1529–1550.

Harris, L., Piwowar, M., 2006, "Secondary Trading Costs in the Municipal Bond Market," *Journal of Finance*, 61, 1361–1397.

Hollifield, B., Neklyudov, A., Spatt, C., 2012, "Bid-Ask Spreads and the Pricing of Securitizations: 144a vs. Registered Securitizations," *Working Paper, Carnegie Mellon University.*

Hong, G., Warga, A., 2000, "An empirical study of bond market transactions," *Financial Analysts Journal*, 56, 32–46.

Houweling, P., Mentink, A., Vorst, T., 2005, "Comparing Possible Proxies of Corporate Bond Liquidity," *Journal of Banking and Finance*, 29(6), 1331–1358.

Jankowitsch, R., Nashikkar, A., Subrahmanyam, M., 2011, "Price dispersion in OTC Markets: A new measure of liquidity," *Journal of Banking and Finance*, 35, 343–357.

Kyle, A. S., 1985, "Continuous auctions and insider trading," *Econometrica*, 53, 1315–1335.

Lin, H., Wang, J., Wu, C., 2011, "Liquidity risk and expected corporate bond returns," *Journal of Financial Economics*, 99, 628–650.

Longstaff, F., Mithal, S., Neis, E., 2005, "Corporate yield spreads: Default risk or liquidity? New evidence from the credit-default swap market," *Journal of Finance*, 60, 2213–2253.

Mahanti, S., Nashikkar, A., Subrahmanyam, M., Chacko, G., Mallik, G., 2008, "Latent liquidity: A new measure of liquidity, with an application to corporate bonds," *Journal of Financial Economics*, 88, 272–298.

Nashikkar, A., Subrahmanyam, M., Mahanti, S., 2011, "Limited arbitrage and liquidity in the market for credit risk," *Journal of Financial and Quantitative Analysis*, 46, 627–656.

Perraudin, W., Taylor, A., 2003, "Liquidity and bond market spreads," *Working Paper, Bank of England.*

Roll, R., 1984, "A simple implicit measure of the effective bid-ask spread in an efficient market," *Journal of Finance*, 39, 1127–1139.

Ronen, T., Zhou, X., 2009, "Where did all the Information go? Trade in the corporate bond market," *Working Paper, Rutgers University.*

Vickery, J., Wright, J., 2010, "TBA Trading and Liquidity in the Agency MBS Market," *Working Paper, Federal Reserve Bank of New York, Staff Report.*

# Tables and Figures

| | Total | ABS | CMO | MBS | TBA |
|---|---|---|---|---|---|
| Traded Products | 3,203 | 328 | 1,126 | 1,787 | 145 |
| Trades | 14,480 | 626 | 3,049 | 3,447 | 8,174 |
| Traded Volume [mln USD] | 226,589 | 4,541 | 12,412 | 18,167 | 204,059 |

**Table 1:** This table presents aggregate data on the average daily number of traded products, number of trades and traded volume for the whole structured product market as well as for the market segments of Asset-Backed Securities (ABS), Collateralized Mortgage Obligations (CMO), Mortgage-Backed Securities (MBS), and To-Be-Announced securities (TBA) during the time period from May 16, 2011 to October 31, 2012, based on data from the Trade Reporting and Compliance Engine (TRACE) provided by the Financial Industry Regulatory Authority (FINRA).

| | Total | ABS | CMO | MBS | TBA |
|---|---|---|---|---|---|
| *Product Characteristics* | | | | | |
| Amount Issued [mln USD] | 297.27 | 491.71 | 88.52 | 393.95 | |
| Time-to-Maturity [years] | 21.16 | 16.69 | 22.90 | 20.84 | 28.31 |
| Coupon [%] | 4.56 | 3.63 | 4.37 | 4.86 | 3.69 |
| *Trading Activity Variables* | | | | | |
| Number of Trades | 2.31 | 1.88 | 2.57 | 1.91 | 7.41 |
| Trading Volume [mln USD] | 14.40 | 13.33 | 10.93 | 9.94 | 125.55 |
| Number of Dealers | 1.53 | 1.30 | 1.49 | 1.47 | 3.67 |
| Trading Interval [days] | 18.52 | 14.77 | 15.38 | 22.85 | 4.65 |
| *Liquidity Measures* | | | | | |
| Round-Trip Costs [%] | 0.67 | 0.49 | 0.98 | 0.50 | 0.04 |
| Effective Bid-Ask Spread [%] | 0.39 | 0.28 | 0.63 | 0.25 | 0.03 |
| Amihud [% / mln] | 32.42 | 11.77 | 52.60 | 23.41 | 0.45 |
| Imputed Round-Trip Costs [%] | 0.51 | 0.34 | 0.75 | 0.42 | 0.07 |
| Price Dispersion [%] | 0.49 | 0.34 | 0.70 | 0.46 | 0.10 |
| Roll [%] | 0.85 | 0.65 | 0.98 | 1.04 | 0.17 |

**Table 2:** This table shows the means of product characteristics, trading activity variables, and liquidity measures for the whole structured product market as well as for the market segments of Asset-Backed Securities (ABS), Collateralized Mortgage Obligations (CMO), Mortgage-Backed Securities (MBS), and To-Be-Announced securities (TBA) for the time period from May 16, 2011 to October 31, 2012, based on data from the Trade Reporting and Compliance Engine (TRACE) provided by the Financial Industry Regulatory Authority (FINRA).

| | Total | ABS | CMO | MBS | TBA |
|---|---|---|---|---|---|
| *Product Characteristics* | | | | | |
| Amount Issued [mln USD] | 812.37 | 529.64 | 231.50 | 1029.04 | |
| Time-to-Maturity [years] | 8.09 | 12.10 | 6.14 | 7.96 | 3.00 |
| Coupon [%] | 1.69 | 2.19 | 1.87 | 1.35 | 1.18 |
| *Trading Activity Variables* | | | | | |
| Number of Trades | 3.07 | 1.87 | 3.02 | 1.81 | 9.94 |
| Trading Volume [mln USD] | 58.55 | 47.00 | 39.32 | 39.46 | 209.71 |
| Number of Dealers | 1.10 | 0.67 | 0.81 | 0.84 | 3.55 |
| Trading Interval [days] | 39.74 | 31.73 | 34.85 | 44.65 | 26.83 |
| *Liquidity Measures* | | | | | |
| Round-Trip Costs [%] | 0.91 | 0.86 | 1.05 | 0.69 | 0.14 |
| Effective Bid-Ask Spread [%] | 0.71 | 0.65 | 0.84 | 0.57 | 0.21 |
| Amihud [% / mln] | 103.95 | 67.44 | 127.47 | 90.27 | 8.41 |
| Imputed Round-Trip Costs [%] | 0.69 | 0.55 | 0.79 | 0.60 | 0.16 |
| Price Dispersion [%] | 0.65 | 0.53 | 0.69 | 0.67 | 0.17 |
| Roll [%] | 1.19 | 1.06 | 1.15 | 1.38 | 0.29 |

**Table 3:** This table shows the standard deviations of product characteristics, trading activity variables, and liquidity measures for the whole structured product market as well as for the market segments of Asset-Backed Securities (ABS), Collateralized Mortgage Obligations (CMO), Mortgage-Backed Securities (MBS), and To-Be-Announced securities (TBA) for the time period from May 16, 2011 to October 31, 2012, based on data from the Trade Reporting and Compliance Engine (TRACE) provided by the Financial Industry Regulatory Authority (FINRA).

| | *amti* | *mty* | *cpn* | *trd* | *vol* | *dlr* | *tint* | *rtc* | *ebas* | *ami* | *irtc* | *pdisp* | *roll* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *amti* | 1.00 | | | | | | | | | | | | |
| *mty* | 0.04 | 1.00 | | | | | | | | | | | |
| *cpn* | 0.00 | −0.04 | 1.00 | | | | | | | | | | |
| *trd* | 0.02 | 0.06 | −0.02 | 1.00 | | | | | | | | | |
| *vol* | 0.10 | 0.06 | −0.13 | 0.38 | 1.00 | | | | | | | | |
| *dlr* | 0.09 | 0.04 | 0.02 | 0.76 | 0.36 | 1.00 | | | | | | | |
| *tint* | −0.09 | −0.02 | −0.02 | −0.16 | −0.04 | −0.18 | 1.00 | | | | | | |
| *rtc* | −0.09 | 0.10 | 0.13 | −0.07 | −0.15 | −0.12 | 0.03 | 1.00 | | | | | |
| *ebas* | −0.06 | 0.05 | 0.13 | 0.02 | −0.12 | −0.14 | −0.01 | 0.78 | 1.00 | | | | |
| *ami* | 0.01 | 0.03 | 0.15 | −0.01 | −0.08 | 0.01 | −0.05 | 0.38 | 0.44 | 1.00 | | | |
| *irtc* | −0.07 | 0.01 | 0.24 | −0.12 | −0.19 | −0.16 | 0.04 | 0.81 | 0.77 | 0.44 | 1.00 | | |
| *pdisp* | 0.03 | 0.05 | 0.27 | −0.03 | −0.20 | −0.02 | −0.04 | 0.65 | 0.63 | 0.52 | 0.68 | 1.00 | |
| *roll* | 0.10 | 0.08 | 0.22 | −0.08 | −0.17 | −0.03 | −0.02 | 0.45 | 0.34 | 0.35 | 0.51 | 0.55 | 1.00 |

**Table 4:** This tables shows the correlations between product characteristics, trading activity variables, and liquidity measures based on a panel dataset for the time period from May 16, 2011 to October 31, 2012, provided by the Financial Industry Regulatory Authority (FINRA), where pairwise-complete observations were required for calculation purposes. The liquidity proxies are the amount issued (*amti*), time-to-maturity (*mty*), coupon (*cpn*), number of trades (*trd*), traded volume (*trd*), number of dealers (*dlr*), trading interval (*tint*), round-trip costs (*rtc*), effective bid-ask spread (*ebas*), Amihud measure (*ami*), imputed round-trip costs (*irtc*), price dispersion measure (*pdisp*) and Roll measure (*roll*).

| | ABS | | CMO | | MBS | |
|---|---|---|---|---|---|---|
| | Retail | Inst. | Retail | Inst. | Retail | Inst. |
| *Product Characteristics* | | | | | | |
| Amount Issued [mln USD] | 463.05 | 495.11 | 37.64 | 131.03 | 482.80 | 362.55 |
| Time-to-Maturity [years] | 15.80 | 16.80 | 22.49 | 23.24 | 19.93 | 21.16 |
| Coupon [%] | 4.21 | 3.57 | 5.24 | 3.65 | 5.47 | 4.65 |
| *Trading Activity Variables* | | | | | | |
| Number of Trades | 1.48 | 1.92 | 1.98 | 3.05 | 1.49 | 2.06 |
| Trading Volume [mln USD] | 0.04 | 14.90 | 0.03 | 19.85 | 0.04 | 13.45 |
| Number of Dealers | 1.16 | 1.31 | 1.40 | 1.56 | 1.27 | 1.54 |
| Trading Interval [days] | 9.71 | 15.39 | 10.49 | 19.78 | 19.21 | 24.33 |
| *Liquidity Measures* | | | | | | |
| Round-Trip Costs [%] | 1.71 | 0.40 | 1.26 | 0.83 | 0.96 | 0.43 |
| Effective Bid-Ask Spread [%] | 1.25 | 0.21 | 0.85 | 0.49 | 0.40 | 0.22 |
| Amihud [% / mln] | 137.24 | 4.01 | 112.06 | 11.91 | 78.14 | 10.09 |
| Imputed Round-Trip Costs [%] | 1.27 | 0.29 | 1.32 | 0.53 | 1.08 | 0.35 |
| Price Dispersion [%] | 1.23 | 0.28 | 0.94 | 0.62 | 1.12 | 0.41 |
| Roll [%] | 2.48 | 0.52 | 1.21 | 0.85 | 1.92 | 0.94 |

**Table 5:** This table shows product characteristics, trading activity variables, and liquidity measures for retail and institutional traded sub-segments in the market segments of Asset-Backed Securities (ABS), Collateralized Mortgage Obligations (CMO), and Mortgage-Backed Securities (MBS) during the time period from May 16, 2011 to October 31, 2012, based on data from the Trade Reporting and Compliance Engine (TRACE) provided by the Financial Industry Regulatory Authority (FINRA). We define trades with an average daily trading volume of less than $100,000 to be retail trades, in accordance with the definition used internally by FINRA.

| | ABS | | | CMO | | | | |
|---|---|---|---|---|---|---|---|---|
| | SUB | MEZ | SR | SUB | MEZ | SR | SSR | SSSR |
| *Product Characteristics* | | | | | | | | |
| Amount Issued [mln USD] | 108.82 | 35.33 | 573.49 | 29.63 | 37.09 | 110.58 | 230.25 | 59.55 |
| Time-to-Maturity [years] | 18.71 | 15.04 | 16.81 | 23.10 | 22.75 | 22.67 | 25.24 | 25.98 |
| Coupon [%] | 4.20 | 4.05 | 3.50 | 2.67 | 1.75 | 4.33 | 3.92 | 3.22 |
| *Trading Activity Variables* | | | | | | | | |
| Number of Trades | 1.80 | 1.93 | 1.83 | 2.53 | 2.28 | 2.59 | 2.29 | 2.41 |
| Trading Volume [mln USD] | 9.66 | 7.01 | 12.87 | 9.11 | 10.22 | 11.75 | 16.01 | 16.30 |
| Number of Dealers | 1.24 | 1.26 | 1.30 | 1.36 | 1.34 | 1.48 | 1.25 | 1.25 |
| Trading Interval [days] | 27.73 | 41.07 | 12.20 | 26.92 | 31.30 | 16.70 | 20.26 | 27.71 |
| *Liquidity Measures* | | | | | | | | |
| Round-Trip Costs [%] | 0.72 | 1.32 | 0.37 | 1.40 | 1.29 | 1.28 | 1.05 | 1.54 |
| Effective Bid-Ask Spread [%] | 0.28 | 0.50 | 0.23 | 0.41 | 0.40 | 0.81 | 0.71 | 0.54 |
| Amihud [% / mln] | 2.12 | 17.45 | 12.07 | 9.76 | 6.29 | 62.67 | 27.38 | 19.58 |
| Imputed Round-Trip Costs [%] | 0.43 | 0.68 | 0.28 | 0.56 | 0.58 | 0.98 | 0.75 | 0.69 |
| Price Dispersion [%] | 0.35 | 0.54 | 0.31 | 0.48 | 0.57 | 0.91 | 0.70 | 0.63 |
| Roll [%] | 0.66 | 0.77 | 0.61 | 0.78 | 0.98 | 1.28 | 1.03 | 0.89 |

**Table 6:** This table shows product characteristics, trading activity variables, and liquidity measures for the tranche type sub-segments (super-super senior (SSSR), super senior (SSR), senior (SR), mezzanine (MEZ), and subordinated (SUB)) in the market segments of Asset-Backed Securities (ABS) and Collateralized Mortgage Obligations (CMO) during the time period from May 16, 2011 to October 31, 2012, based on data from the Trade Reporting and Compliance Engine (TRACE) provided by the Financial Industry Regulatory Authority (FINRA).

| | Others | FN | FH | GN |
|---|---|---|---|---|
| *Product Characteristics* | | | | |
| Amount Issued [mln USD] | 124.32 | 89.28 | 88.59 | 41.59 |
| Time-to-Maturity [years] | 23.13 | 21.35 | 20.94 | 25.61 |
| Coupon [%] | 3.95 | 4.65 | 4.64 | 4.49 |
| *Trading Activity Variables* | | | | |
| Number of Trades | 2.47 | 2.58 | 2.62 | 2.65 |
| Trading Volume [mln USD] | 13.16 | 13.65 | 9.96 | 6.76 |
| Number of Dealers | 1.40 | 1.51 | 1.53 | 1.55 |
| Trading Interval [days] | 19.36 | 14.66 | 13.65 | 12.18 |
| *Liquidity Measures* | | | | |
| Round-Trip Costs [%] | 1.23 | 0.76 | 0.74 | 0.99 |
| Effective Bid-Ask Spread [%] | 0.72 | 0.53 | 0.53 | 0.69 |
| Amihud [% / mln] | 47.68 | 51.29 | 56.84 | 56.48 |
| Imputed Round-Trip Costs [%] | 0.87 | 0.61 | 0.62 | 0.81 |
| Price Dispersion [%] | 0.81 | 0.61 | 0.61 | 0.67 |
| Roll [%] | 1.19 | 0.82 | 0.84 | 0.96 |

**Table 7:** This table shows product characteristics, trading activity variables, and liquidity measures for the issuing authority sub-segments, which are either one of the three federal government-sponsored enterprises (GSEs), i.e. the Federal Home Loan Mortgage Corporation (FH), the Federal National Mortgage Association (FN), or the Government National Mortgage Association (GN), or other institutions (Others), in the market segment of Collateralized Mortgage Obligations (CMO), during the time period from May 16, 2011 to October 31, 2012, based on data from the Trade Reporting and Compliance Engine (TRACE) provided by the Financial Industry Regulatory Authority (FINRA).

| | AAA | AA | A | BBB | BB | B | CCC/C | NR |
|---|---|---|---|---|---|---|---|---|
| *Product Characteristics* | | | | | | | | |
| Amount Issued [mln USD] | 583.56 | 576.23 | 669.90 | 292.48 | 192.93 | 164.09 | 125.26 | 465.35 |
| Time-to-Maturity [years] | 15.40 | 14.64 | 21.17 | 17.55 | 19.69 | 18.47 | 19.97 | 16.62 |
| Coupon [%] | 3.40 | 2.83 | 4.61 | 4.88 | 4.84 | 5.08 | 3.44 | 3.78 |
| *Trading Activity Variables* | | | | | | | | |
| Number of Trades | 1.74 | 1.71 | 1.88 | 1.91 | 2.04 | 2.06 | 1.86 | 1.96 |
| Trading Volume [mln USD] | 11.89 | 13.17 | 10.45 | 9.30 | 10.56 | 12.38 | 13.94 | 15.23 |
| Number of Dealers | 1.27 | 1.27 | 1.37 | 1.36 | 1.33 | 1.35 | 1.25 | 1.29 |
| Trading Interval [days] | 10.32 | 15.32 | 10.20 | 13.10 | 15.34 | 17.66 | 21.88 | 12.19 |
| *Liquidity Measures* | | | | | | | | |
| Round-Trip Costs [%] | 0.24 | 0.29 | 0.48 | 0.68 | 0.89 | 0.94 | 1.29 | 0.38 |
| Effective Bid-Ask Spread [%] | 0.17 | 0.14 | 0.27 | 0.38 | 0.33 | 0.38 | 0.36 | 0.22 |
| Amihud [% / mln] | 10.36 | 3.35 | 4.52 | 17.29 | 5.52 | 6.66 | 3.41 | 4.51 |
| Imputed Round-Trip Costs [%] | 0.21 | 0.29 | 0.36 | 0.46 | 0.53 | 0.58 | 0.61 | 0.33 |
| Price Dispersion [%] | 0.29 | 0.25 | 0.32 | 0.43 | 0.48 | 0.56 | 0.47 | 0.28 |
| Roll [%] | 0.52 | 0.61 | 0.53 | 0.70 | 0.84 | 1.03 | 0.65 | 0.50 |

**Table 8:** This table shows product characteristics, trading activity variables, and liquidity measures for the credit rating grades (AAA, AA, A, BBB, BB, B, CCC/C, NR) in the market segment of Asset-Backed Securities (ABS) during the time period from May 16, 2011 to October 31, 2012, based on data from the Trade Reporting and Compliance Engine (TRACE) provided by the Financial Industry Regulatory Authority (FINRA).

| | *rtc* | *ebas* | *ami* | *irtc* | *pdisp* | *roll* |
|---|---|---|---|---|---|---|
| *(Intercept)* | $0.675^{***}$ | $0.505^{***}$ | $0.729^{***}$ | $0.545^{***}$ | $-0.043$ | $0.479^{*}$ |
| | (6.579) | (5.417) | (3.572) | (5.787) | (−0.468) | (1.936) |
| *trd* | $0.009^{**}$ | $0.046^{***}$ | $-0.001$ | $-0.008^{***}$ | $0.012^{***}$ | $-0.005$ |
| | (2.405) | (11.852) | (−0.140) | (−3.828) | (4.624) | (−1.154) |
| *vol* | $-0.001^{***}$ | $-0.001^{***}$ | $-0.000$ | $-0.001^{***}$ | $-0.001^{***}$ | $-0.001^{**}$ |
| | (−4.074) | (−3.844) | (−1.076) | (−5.402) | (−6.913) | (−2.397) |
| *dlr* | $-0.091^{***}$ | $-0.178^{***}$ | $-0.100^{***}$ | $-0.034^{***}$ | $0.065^{***}$ | $0.004$ |
| | (−6.078) | (−11.640) | (−2.622) | (−2.731) | (5.302) | (0.128) |
| *tint* | $-0.004^{***}$ | $-0.006^{***}$ | $-0.021^{***}$ | $-0.001$ | $-0.002^{*}$ | $-0.006^{***}$ |
| | (−2.761) | (−5.773) | (−10.002) | (−0.751) | (−1.682) | (−2.783) |
| *cpn* | $0.074^{***}$ | $0.090^{***}$ | $0.113^{***}$ | $0.077^{***}$ | $0.092^{***}$ | $0.128^{***}$ |
| | (8.718) | (13.376) | (10.190) | (10.215) | (13.188) | (8.387) |
| *mty* | $0.002$ | $-0.002$ | $0.001$ | $-0.001$ | $-0.001$ | $0.002$ |
| | (1.181) | (−1.613) | (0.250) | (−0.798) | (−0.788) | (0.637) |
| *amti* | $-0.055^{***}$ | $-0.028^{***}$ | $-0.053^{***}$ | $-0.033^{***}$ | $-0.022^{***}$ | $-0.013$ |
| | (−5.503) | (−3.503) | (−3.827) | (−3.837) | (−2.602) | (−0.674) |
| Obs. | 8788.000 | 8788.000 | 8788.000 | 8788.000 | 8788.000 | 8788.000 |
| $R^2$ | 0.328 | 0.362 | 0.214 | 0.241 | 0.328 | 0.178 |

**Table 9:** This table reports the results of regressing the round-trip cost (*rtc*), effective bid-ask spread (*ebas*), Amihud measure (*ami*), imputed round-trip costs (*irtc*), price dispersion measure (*pdisp*) and Roll measure (*roll*) on (i) trading activity variables, i.e., number of trades (*trd*), trading volume (*vol*), number of dealers (*dlr*), and trading interval (*tint*), and (ii) product characteristics, i.e., coupon (*cpn*), time-to-maturity (*mty*), and amount issued (*amti*), using a panel regression of the daily averages of all variables. We control for the market segment, registered products, and credit ratings. Values in parentheses are $t$-statistics based on robust standard errors clustered across time and products. We denote statistical significance at the 1%, 5%, and 10% levels by ***, **, and *, respectively. The sample is based on data from the Trade Reporting and Compliance Engine (TRACE) provided by the Financial Industry Regulatory Authority (FINRA) for the period from May 16, 2011 to October 31, 2012.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| *(Intercept)* | 0.359*** | 0.517*** | 0.277*** | 0.709*** | 0.540*** | 0.288*** |
| | (6.190) | (6.638) | (5.458) | (10.511) | (7.586) | (6.493) |
| *ebas* | 0.625*** | | | | | 0.253*** |
| | (27.659) | | | | | (13.385) |
| *ami* | | 0.217*** | | | | 0.016* |
| | | (15.224) | | | | (1.938) |
| *irtc* | | | 0.729*** | | | 0.438*** |
| | | | (50.155) | | | (23.140) |
| *pdisp* | | | | 0.797*** | | 0.312*** |
| | | | | (33.507) | | (13.746) |
| *roll* | | | | | 0.281*** | 0.045*** |
| | | | | | (20.666) | (4.624) |
| *trd* | −0.019*** | 0.009*** | 0.015*** | 0.000 | 0.011*** | −0.002 |
| | (−6.089) | (2.609) | (4.776) | (0.001) | (3.074) | (−0.809) |
| *vol* | −0.000*** | −0.001*** | −0.000* | 0.000* | −0.001*** | 0.000** |
| | (−3.168) | (−4.525) | (−1.728) | (1.680) | (−3.888) | (2.242) |
| *dlr* | 0.020** | −0.070*** | −0.066*** | −0.143*** | −0.092*** | −0.050*** |
| | (2.464) | (−6.415) | (−7.651) | (−10.758) | (−8.221) | (−6.122) |
| *tint* | −0.000 | 0.000 | −0.004*** | −0.003** | −0.003* | −0.001 |
| | (−0.204) | (0.106) | (−2.661) | (−1.989) | (−1.800) | (−0.756) |
| *cpn* | 0.018** | 0.050*** | 0.018*** | 0.001 | 0.038*** | −0.019*** |
| | (2.585) | (6.131) | (2.830) | (0.170) | (5.179) | (−3.173) |
| *mty* | 0.003*** | 0.002 | 0.003*** | 0.003*** | 0.001 | 0.003*** |
| | (3.029) | (1.193) | (2.906) | (2.756) | (1.020) | (4.271) |
| *amti* | −0.037*** | −0.044*** | −0.031*** | −0.038*** | −0.052*** | −0.025*** |
| | (−5.620) | (−5.205) | (−5.511) | (−6.514) | (−6.787) | (−5.591) |
| Obs. | 8788.000 | 8788.000 | 8788.000 | 8788.000 | 8788.000 | 8788.000 |
| $R^2$ | 0.526 | 0.397 | 0.586 | 0.553 | 0.428 | 0.673 |

**Table 10:** This table reports the results of regressing the round-trip costs (*rtc*) on (i) liquidity measures, i.e., effective bid-ask spread (*ebas*), Amihud measure (*ami*), imputed round-trip costs (*irtc*), price dispersion measure (*pdisp*), and Roll measure (*roll*), (ii) trading activity variables, i.e., number of trades (*trd*), trading volume (*vol*), number of dealers (*dlr*), and trading interval (*tint*), and (iii) product characteristics, i.e., coupon (*cpn*), time-to-maturity (*mty*), and amount issued (*amti*), using a panel regression of the daily averages of all variables. We control for the market segment, registered products, and credit ratings. Values in parentheses are $t$-statistics based on robust standard errors clustered across time and products. We denote statistical significance at the 1%, 5%, and 10% levels by ***, **, and *, respectively. The sample is based on data from the Trade Reporting and Compliance Engine (TRACE) provided by the Financial Industry Regulatory Authority (FINRA) for the period from May 16, 2011 to October 31, 2012.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *(Intercept)* | 1.529*** | 1.327*** | 1.435*** | 1.435*** | 1.366*** | 1.330*** | 1.353*** | 1.273*** | 1.525*** | −0.600*** | −0.785*** |
| | (13.218) | (11.511) | (12.607) | (12.482) | (11.626) | (11.714) | (12.073) | (11.133) | (12.171) | (−4.494) | (−5.717) |
| *rtc* | | 0.446*** | | | | | | 0.407*** | | | 0.475*** |
| | | (10.929) | | | | | | (6.746) | | | (7.977) |
| *ebas* | | | 0.234*** | | | | | −0.180*** | | | −0.294*** |
| | | | (6.809) | | | | | (−5.212) | | | (−10.529) |
| *ami* | | | | 0.165*** | | | | 0.068*** | | | 0.009 |
| | | | | (6.366) | | | | (3.214) | | | (0.623) |
| *irtc* | | | | | 0.337*** | | | −0.084* | | | −0.199*** |
| | | | | | (7.976) | | | (−1.823) | | | (−5.328) |
| *pdisp* | | | | | | 0.503*** | | 0.292*** | | | −0.091** |
| | | | | | | (10.724) | | (5.759) | | | (−2.172) |
| *roll* | | | | | | | 0.190*** | 0.034 | | | −0.042** |
| | | | | | | | (6.578) | (1.147) | | | (−2.122) |
| *trd* | | | | | | | | | −0.004 | | 0.008 |
| | | | | | | | | | (−0.679) | | (1.590) |
| *vol* | | | | | | | | | −0.004*** | | 0.000 |
| | | | | | | | | | (−6.498) | | (0.286) |
| *dlr* | | | | | | | | | 0.040** | | 0.008 |
| | | | | | | | | | (1.969) | | (0.497) |
| *tint* | | | | | | | | | 0.000 | | 0.019*** |
| | | | | | | | | | (0.034) | | (4.805) |
| *cpn* | | | | | | | | | | 0.788*** | 0.817*** |
| | | | | | | | | | | (42.560) | (46.597) |
| *mty* | | | | | | | | | | −0.029*** | −0.031*** |
| | | | | | | | | | | (−8.769) | (−9.368) |
| *amti* | | | | | | | | | | −0.101*** | −0.089*** |
| | | | | | | | | | | (−7.566) | (−6.864) |
| Obs. | 8788.000 | 8788.000 | 8788.000 | 8788.000 | 8788.000 | 8788.000 | 8788.000 | 8788.000 | 8788.000 | 8788.000 | 8788.000 |
| $R^2$ | 0.366 | 0.392 | 0.372 | 0.374 | 0.376 | 0.384 | 0.374 | 0.398 | 0.376 | 0.675 | 0.693 |

**Table 11:** This table reports the results of regressing the yield spread (i.e., the difference between the yield of the structured product and the duration-matched swap rate) on (i) liquidity measures, i.e., round-trip cost (*rtc*), effective bid-ask spread (*ebas*), Amihud measure (*ami*), imputed round-trip costs (*irtc*), price dispersion measure (*pdisp*), and Roll measure (*roll*), (ii) trading activity variables, i.e., number of trades (*trd*), trading volume (*vol*), number of dealers (*dlr*), and trading interval (*tint*), and (iii) product characteristics, i.e., coupon (*cpn*), time-to-maturity (*mty*), and amount issued (*amti*), using a panel regression of the daily averages of all variables. We control for the market segment, registered products, and credit ratings. Values in parentheses are $t$-statistics based on robust standard errors clustered across time and products. We denote statistical significance at the 1%, 5%, and 10% levels by ***, **, and *, respectively. The sample is based on data from the Trade Reporting and Compliance Engine (TRACE) provided by the Financial Industry Regulatory Authority (FINRA) for the period from May 16, 2011 to October 31, 2012.

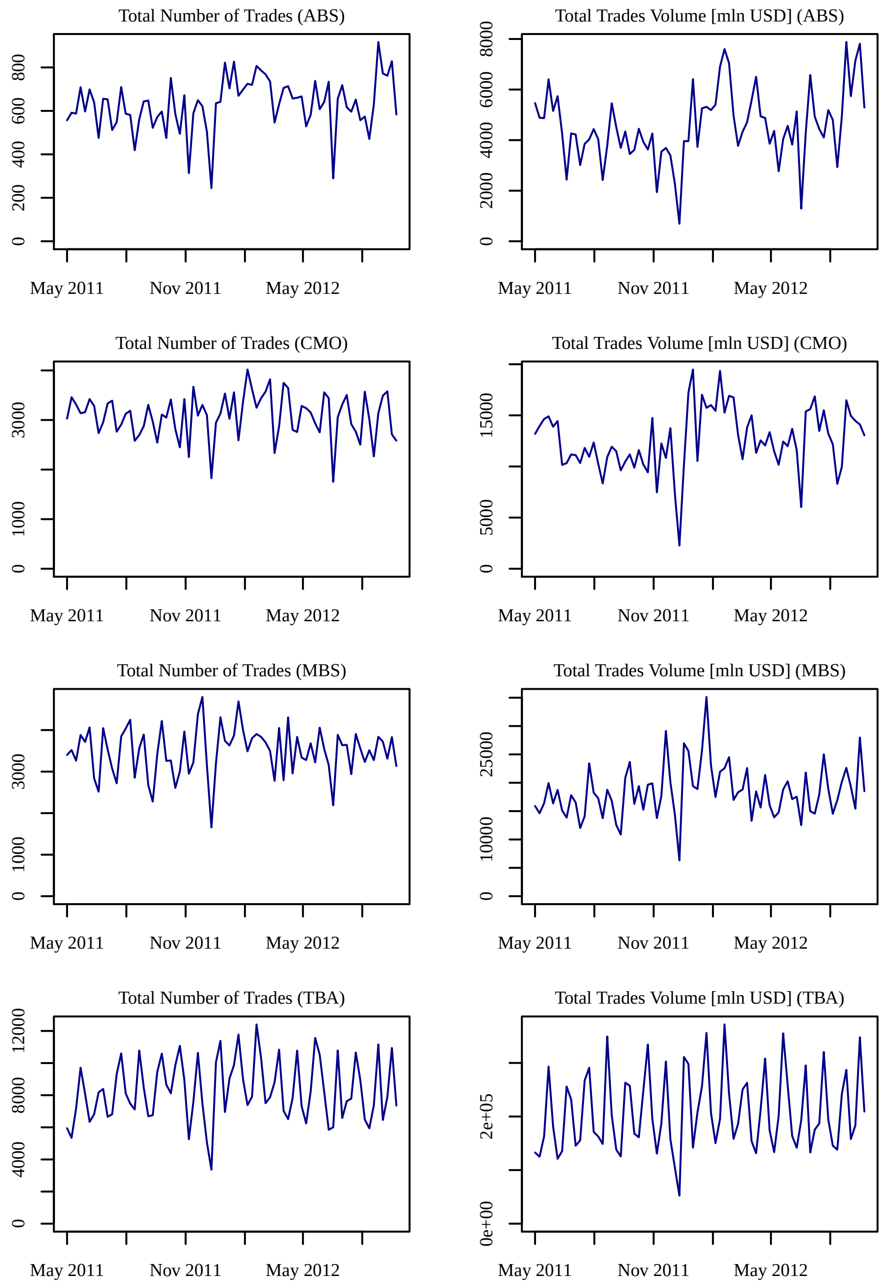


**Figure 1:** This figure shows the weekly averages of the total daily number of trades (in the left-hand side panels) and traded volume (in the right-hand side panels) for the market segments of Asset-Backed Securities (ABS), Collateralized Mortgage Obligations (CMO), Mortgage-Backed Securities (MBS), and To-Be-Announced Securities (TBA) in the time period from May 16, 2011 to October 31, 2012, based on data from the Trade Reporting and Compliance Engine (TRACE) provided by the Financial Industry Regulatory Authority (FINRA).