20 December 2013

Report on appropriate uniform definitions of extremely high quality liquid assets (extremely HQLA) and high quality liquid assets (HQLA) and on operational requirements for liquid assets under Article 509(3) and (5) CRR

Throughout the global financial crisis which began in mid-2007, many banks struggled to maintain adequate liquidity. Unprecedented levels of liquidity support were required from central banks in order to sustain the financial system and even with such extensive support a number of banks failed, were forced into mergers or required resolution.

The crisis illustrated how quickly and severely liquidity risks can crystallise and certain sources of funding can evaporate, compounding concerns related to the valuation of assets and capital adequacy.

In particular, the main observable features of the crisis were the following:

- The liquidity position of banks has been seriously hit;
- Inappropriate funding structures and scarce liquidity buffers prevailed;
- Liquidity stress situations have led, on occasions, to public interventions;
- Liquidity stress situations have proved lasting over time.

This situation demonstrated a *prima facie* need for intervention through further liquidity regulation.

Some international regulatory steps on liquidity have been taken:

In December 2010, the Basel Committee on Banking Supervision (BCBS) announced the introduction of a Liquidity Coverage Ratio (LCR) and Net Stable Funding Ratio (NSFR), to be put in place in 2015 and 2018 respectively (liquidity requirements being part of the Basel III new regulatory framework). The LCR promotes the short-term resilience of a bank's liquidity risk profile by ensuring that it has sufficient high-quality liquid assets (HQLA) to survive a significant stress scenario lasting for one month. It basically sets the minimum liquidity buffer to bridge liquidity mismatches for one month in a crisis scenario. The NSFR has a time horizon of one year and is being developed to provide a sustainable maturity structure of assets and liabilities.

In January 2013, the LCR was updated particularly with regard to the definition of HQLA and on the implementation timetable (2015 – 2019), while the NSFR is still under development.

Further, regulatory steps on liquidity have been taken at European level:

In June 2013, the European Union published the Capital Requirements Regulation (EU) No 575/2013 (the CRR) and the Capital Requirements Directive 2013/36/EU (CRD IV) which seek to apply the Basel III framework in the EU. They incorporate the cited liquidity coverage requirements, adapting them to European specificities, and empower the European Commission to adopt a delegated act to specify them in detail.

The CRR contains specific mandates for the EBA to develop draft regulatory or implementing technical standards as well as guidelines and reports related to liquidity in order to enhance regulatory harmonisation in Europe through the Single Rule Book.

Article 509(3) CRR tasks the EBA with advising on appropriate uniform definitions of liquid assets for the LCR buffer, and for this purpose defines two categories of transferable assets: assets of 'extremely high' and of 'high' liquidity and credit quality. In addition, Article 509(5) CRR states that the EBA shall report to the Commission on the operational requirements for the holdings of liquid assets. Both mandates are the purpose of this report.

Furthermore the CRR also tasks the EBA with advising on the impact of the liquidity coverage requirement, on the business and risk profile of institutions established in the Union, on the stability of financial markets, on the economy and on the stability of the supply of bank lending *(please refer to a separate EBA report on the impact assessment of the liquidity measures under Article 509(1) CRR)*.

These two reports must be submitted to the European Commission by 31 December 2013.

When drawing up this report, and as required by the CRR, the EBA has consulted the ECB and ESMA. The EBA has also conducted other consultations. In particular, a public hearing, organised on 23 October 2013, a consultation of the EBA's Banking Stakeholder Group (BSG), multiple bilateral meetings with diverse stakeholders, as well as an informal roundtable with the banking industry organised under the aegis of the BSG.

Regarding the consultation with the ECB and ESMA, this consultation has been formally organised during the second week of November.

ESMA's input has been provided to the European Commission as an accompanying document to this report. In substance, ESMA´s feedback, from a different perspective than the supervisory purpose, focused on two areas within its remit which could have cross effects with the EBA recommendations, namely secondary markets and financial reporting. From the perspective of transparency of markets, ESMA indicated that the categorisation of financial instruments as liquid or illiquid, probably substantiated by an empirical analysis, will in all likelihood be one of the major tasks of ESMA when designing the future Level 2 framework applying to pre- and post-trade transparency obligations under the future Markets in Financial Instruments Regulation (MiFIR). The new MiFIR will likely impose transparency obligations on assets on the basis of their consideration as liquid assets. As a consequence liquid assets according to EBA´s recommendations could turn out not to be subject to the most stringent market transparency obligations in so far as they may not fall under the same definition of liquid assets. ESMA is of the view that this may hinder the marketability of liquid assets under EBA´s recommendations. This does not necessarily mean that the instrument is not deemed liquid in a wider sense or that one would not be able to quickly liquidate it in the secondary market or would only be able to liquidate it with a large loss.

From the financial reporting perspective, ESMA has drawn the attention of the EBA to the way the liquidity is assessed with regard to IFRS (International Financial Reporting Standards) mainly regarding those assets measured at fair value. For financial reporting purposes market prices are considered on the basis of the existence of an active market, which is often considered in conjunction with the assessment of liquidity. In this regard the liquidity and credit quality are measured on a case by case basis at the level of a particular financial instrument and not on the basis of a whole asset class as it is the case of sovereign bonds in the EBA recommendations of liquid assets.

The opinion from the ECB was not available at the time when the report was finalised. As soon as available, it will be transmitted to the European Commission, together with an analysis from the EBA, as far as necessary.

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This report is structured in six parts:

- Detailed presentation of the mandate;
- Methodology;
- Executive summary;
- Main findings;
- Operational requirements;
- Technical appendix: Annexes.

List of abbreviations

ABS: Asset-backed securities

AFME: Association for Financial Markets in Europe

BCBS: Basel Committee on Banking Supervision

BGN: Bulgarian Lev

BIS: Bank for International Settlements

BSG: Banking Stakeholder Group

CCPs: Central Counterparty Clearing House

CDO: Collateralised Debt Obligation

CEBS: Committee of European Banking Supervisors

CIU: Collective investment undertaking

CLN: Credit linked note

CRD: Capital Requirements Directive

CRR: Capital Requirements Regulation

DP: Discussion Paper

EBA: European Banking Authority

EC: European Commission

ECAI: External Credit Assessment Institutions

ECB: European Central Bank

ECBC: European Covered Bond Council

EEA: European Economic Area

EFSF: European Financial Stability Facility

EMIR: European Market Infrastructure Regulation

EMU: European Monetary Union

ES: Effective spread

ESM: European Stability Mechanism

ESMA: European Securities and Markets Authority

ETF: Exchange-traded fund

EU: European Union

EUR: euro

FINRA: Financial Industry Regulatory Authority

GBP: Great British Pound

GC: General Collateral

HQLA: High-quality liquid assets

ICMA: International Capital Market Association

ILR: Iliquidity ratio

IMF: International Monetary Fund

ISIN: International Securities Identification Number

ITS: Implementing Technical Standard

LCR: Liquidity Coverage Ratio

LTRO: Long-term Refinancing Operation

LTV: Loan-to-Value

MBS: Mortgage-backed security

MDB: Multilateral development banks

MiFID: Markets in Financial Instruments Directive

MSDC: Marginal Supply Demand Curve

NDF: Non-Deliverable Forward

NSFR: Net Stable Funding Ratio

OTC: over the counter

PSE: Public Sector Entity

QIS: Quantitative Impact Study

QS: quoted spread

Repo: Repurchase Agreement

RMBS: Residential mortgage-backed security

SPV: Special Purpose Vehicle

STD: Standard Deviation

TTM: Time to maturity

UK: United Kingdom

US: United States

USD: US dollar

XLM: Xetra Liquidity Measure

WAL: weighted average life

1. Detailed presentation of the mandate

In accordance with Article 509(3) CRR, the EBA shall report to the Commission on appropriate uniform definitions of high and extremely high liquidity and credit quality of assets for the purpose of Article 416, and on appropriate haircuts for assets of high liquidity and credit quality.

The EBA shall in particular test the adequacy of the criteria below and the appropriate levels for such definitions:

(a) minimum trade volume of the assets;
(b) minimum outstanding volume of the assets;
(c) transparent pricing and post-trade information;
(d) credit quality steps referred to in Part Three, Title II, Chapter 2;
(e) proven record of price stability;
(f) average volume traded and average trade size;
(g) maximum bid/ask spread;
(h) remaining time to maturity;
(i) minimum turnover ratio.

Trilogue negotiations have added other categories of asset classes to be considered, in particular (i) RMBS of high liquidity and credit quality, (ii) other categories of central bank eligible securities or loans, for example local government bonds and commercial paper and (iii) other non-central bank eligible but tradable assets, for example equities listed on a recognised exchange, gold, major index linked equity instruments, guaranteed bonds, covered bonds, corporate bonds and funds based on the above.

Based on different sources the analysis would need to be aligned to:

- assess the appropriateness of the criteria (a)-(i),
- set appropriate haircuts for different assets,
- provide uniform definitions of high and extremely high liquidity and credit quality.

The report is due by 31 December 2013, after having consulted the ECB and ESMA.

In accordance with Article 509(5)(c) CRR the EBA shall report to the Commission on the operational requirements for the holdings of liquid assets, as referred in points (b) to (f) of Article 417, in line with international regulatory developments. The report is due by 31 January 2014.

Both mandates are fulfilled in this single report.

2. Methodology – main features

The report follows the methodology previously published by the EBA in the 'Discussion Paper on Defining Liquid Assets in the LCR under the draft CRR'. As a first step, the EBA assessed a range of asset classes against the fundamental definitions of liquid assets set out in Article 416(3) CRR. Then it performed a detailed quantitative assessment of the liquidity of individual assets. The estimates of various liquidity metrics from the quantitative data have been used to produce an ordinal ranking of the relative liquidity of different asset classes. The relationship between the characteristics of specific assets and these liquidity metrics has also been assessed to identify the characteristics that are of particular importance to market liquidity. This evidence has been used to construct specific definitions of the characteristics of assets that qualify them for consideration as potentially of high or extremely high liquidity.

2.1 Principles underpinning this report

In the broadest terms, a liquid asset is one which can be converted into cash rapidly with little or no loss of value. Although the liquidity of an asset depends on market conditions, the quantity to be monetised and the timeframe considered, there are certain assets that are more likely to generate funds without incurring large discounts in outright sale or repo markets.

The EBA's task is to translate the general definition of liquidity, and the criteria and guidance for classifying liquid assets in the CRR text, into a concrete definition of assets of high and extremely high liquidity and credit quality based on objective criteria, which could serve as a basis for the implementation of the LCR in the EU. The **principles** that underpin the EBA's analysis are listed below.

- although the definitions are explicit, they are **formulated at the level of asset classes, and not individual assets or ISINs**. It will remain the responsibility of individual banks to identify that appropriate liquid assets to hold in order to comply with the LCR, working within the broad asset class-level definitions proposed in this report.

- The definition of liquidity **recognises that some asset classes are more liquid than others**. In compiling a comparative ranking of different asset classes, the EBA provides a tool to distinguish highly - and extremely highly - liquid assets in EU regulation.

When considering the above-mentioned methodology, the following caveats must be taken into consideration:

- **Only assets issued in EU currencies have been assessed.** The empirical analysis is limited to assets denominated in EU currencies;

- For some asset classes, conclusions on their eligibility for the liquidity buffer were determined via a principles-based assessment, generally because of an absence of evidence on market liquidity.

2.2 Data: methodological overview

The analysis in the present report seeks to analyse the liquidity of a wide range of financial assets traded in the EU, in order to classify these assets according to liquidity and credit quality. Our methodology relies on data for the period 1 January 2008 to 30 June 2012. This time period has been chosen in order to provide a thorough coverage of the liquidity characteristics of the chosen assets during the financial crisis and the period thereafter.

The choice of assets to be included in this analysis is based on Article 509(3) CRR, which notes that the liquidity of the following assets should be examined:

- assets defined as liquid under Article 416 CRR, except assets referred to in paragraph 1(a) and (c);
- RMBS;
- other categories of central bank eligible assets;
- other non-central bank eligible but tradable assets, for example equities listed on a recognised exchange and gold.

On this basis the following asset classes have been identified and data collected on them:

- Government bonds;
- Government guaranteed bonds
- Bonds issued by local government;
- Bonds issued by multinationals;
- Bonds issued by Central Banks;
- Corporate bonds;
- Covered bonds;
- Bonds issued by promotional banks;
- Bank guaranteed bonds;
- RMBS;
- ABS;
- Equities listed on a recognised exchange;
- Gold.

Although Government bonds are not explicitly mentioned as an asset class to be analysed, government bonds have been included to provide a benchmark for the analysis of the liquidity of other asset classes.

In addition, data on repo activity for relevant asset classes has also been obtained.

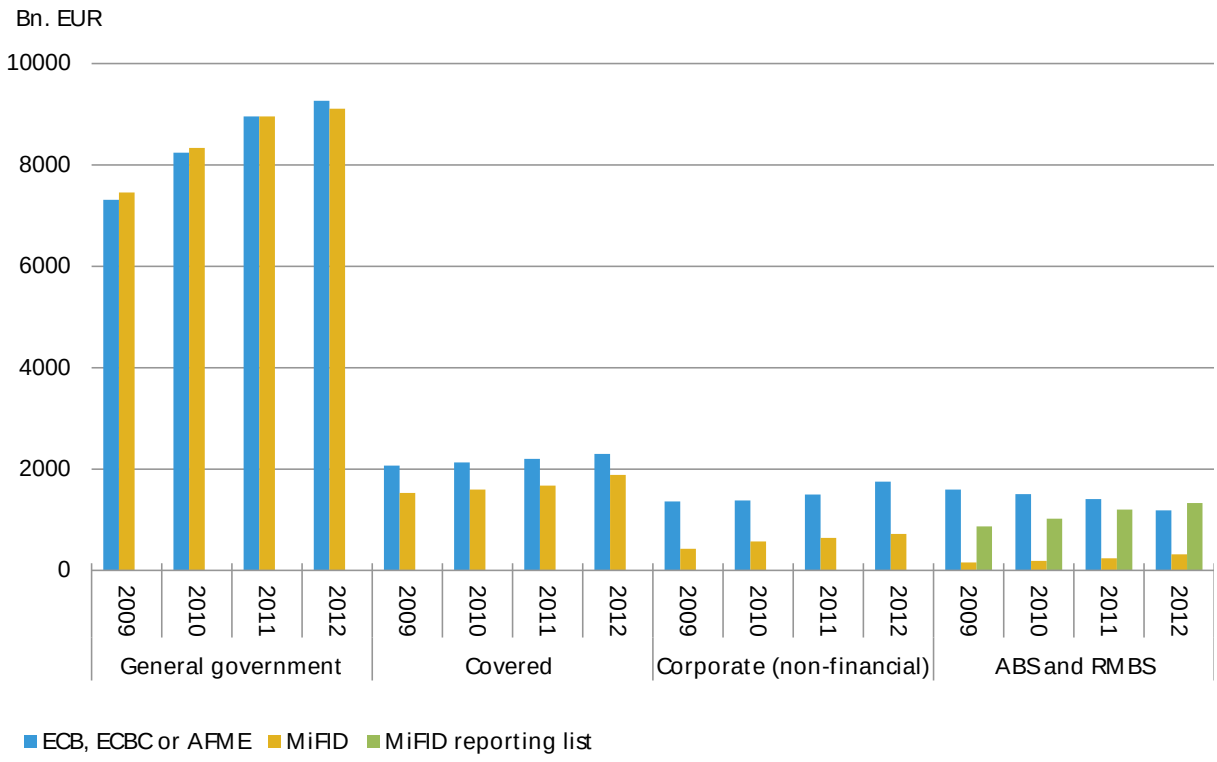
The data used in this analysis is based on a number of sources, given the wide variety of asset classes to be examined. As a result, the type of data and the frequency of observations also varies across asset classes.

Bond data

Data on government bonds, government guaranteed bonds, bonds issued by local government, bonds issued by multinationals, bonds issued by central banks, corporate bonds, covered bonds, bonds issued by promotional banks, bank guaranteed bonds, RMBS and ABS are taken from MiFID transaction reports obtained from national supervisors in 27 European countries. The MiFID,a directive which was implemented in November 2007, introduced a standardised set of requirements across the EU for firms engaged in the provision of investment services to report trading activity for any instrument admitted to trading on a regulated marked. The MiFID transaction reports therefore constitute the most comprehensive data set on bond trades throughout the EU.

To verify how well the MiFID transaction reports cover the total EU bond market, the outstanding amount of the bonds which are traded according to the MiFID data is compared to other sources of the total outstanding amounts within the different categories of bonds. Chart 1 displays this comparison.

OUTSTANDING BONDS Chart 1



Note: MiFID: Refers to the MiFID data set based on the securities present in the transactions reports.
MiFID reporting list: Refers to the full list of securities for which transaction reports are required according to the MiFID directive

Source: ECB: General governments and corporates, excluding financials. The reason for the larger outstanding amounts in the MiFID data than in the ECB database is caused by differences in timing and categorization.
ECBC: Covered bonds
AFME Securitisation Data Reports: ABS and RMBS

Using the other data sources (ECB, ECBC and AFME) as a reference point, the MiFID data seems to cover the EU government and covered bond market very well in the period considered. The data coverage is less extensive for corporate bonds. For RMBS and ABS, it is very low. Whereas the coverage of the MiFID reporting list seems to cover the market for asset backed securities well, the

RMBS and ABS transactions actually reported appear to include a much smaller set of instruments, either due to lack of transactions or missing transaction reports from the financial institutions.

The MiFID reporting rules are primarily intended to be used to detect market abuse; the raw MiFID data has therefore been cleaned to suit the needs of this analysis, as described in Annex 6. This annex also describes the data variables from the MiFID data which are included in this analysis.

As the aim of the analysis is to determine the liquidity characteristics of the respective bonds in the context of a bank's ability to liquidate these assets in times of institution specific or market wide stress, transactions with a nominal value of less than EUR 500,000 have been eliminated. This eliminates transactions of retail size, while not significantly reducing the total turnover coverage of the data sample. This is in line with standard practice in the academic literature and avoids distortions of some of the liquidity metrics, which would occur if these small trades were included in the sample.

The table below shows the frequency of transactions for the different bond categories included in the sample, before and after cleaning. It also shows the percentage of the total turnover in each bond category, which has been dropped from the sample through cleaning. The relatively high percentage of turnover that has been eliminated is to a large extent due to the exclusion of very large trades, which are believed to be due to faulty reporting and not actual trades. As such, individual trades which are stated to be of a size exceeding 10% of the total outstanding amount of an individual bond are excluded. The drop in the number of observations is to a large extent due to the introduction of a minimum transaction size, as noted above. However, this filtering step does not in itself change the total included turnover volume significantly. Missing information regarding key variables and the additional filtering steps noted in Annex 6 also contribute to the exclusion of a number of observations.

Bond type	Observations in raw dataset	Observations in filtered dataset	Percentage of turnover eliminated from sample	Number of distinct assets in filtered dataset
Government bonds incl. central bank issued bonds and bonds issued by promotional banks	53,628,168	8,096,077	41%	3,562
Government guaranteed bonds	361,157	80,206	12%	285
Local government bonds	407,550	87,294	46%	1,190
Multinational bonds	1,704,760	116,120	27%	494
Corporate bonds excl. financials	4,616,613	359,275	37%	1,583
Covered bonds	5,333,081	1,109,277	50%	4,170
Bank guaranteed bonds	171,300	4,262	47%	154
RMBS	92,844	34,847	60%	641
Other ABS incl. MBS	58,341	18,526	93%	665

It should be noted that the number of observations presented in the above table are the number of transactions present in the dataset. For the cross asset class analysis, these transactions are aggregated into observations at daily and monthly frequencies, in order to obtain comparable metrics with the equity and gold data collected.

In addition to the transaction data obtained from the MiFID transaction reports, and the relevant metadata also obtained from this source, a number of additional explanatory variables and characteristics of the chosen assets and their markets were included in the analysis. These include in particular credit ratings, time-to-maturity and information on regulatory regimes for covered bonds.

Equity data

Equity data was obtained from Bloomberg and Datastream. The data sample is at a daily frequency and contains price and turnover data for equities included in the main equity indices of the European countries for which bond data has been obtained. This allows the cross asset class analysis to be based on the same sample jurisdictions and includes only constituents of major equity indices in each chosen jurisdiction in the sample. Annex 7 contains further details of the data sample, cleaning procedures and variables. Observations where the total turnover during one trading day is less than EUR 500,000 have been eliminated. The reasoning behind this is the same as for bonds. The cut-off level is however slightly milder than for bonds, in that observations where the daily volume is below EUR 500,000 are eliminated whereas for bonds observations where the individual transaction size is below EUR 500,000 are eliminated. This is due to the difference in data structure in the two samples.

In analysing the liquidity characteristics of equities, the EBA also looked at a number of explanatory characteristics of the individual assets. These include the industry of the company issuing the stocks and the total market capitalisation of the company. These characteristics may help explain the variation in liquidity values within the equity asset class, and allow a possible split in the liquidity degree of equities.

The equity dataset contains daily end of day prices and turnover for 844 distinct equities, resulting in 965,822 observations in total.

Gold data

Gold data refers to trading in physical gold for delivery. Price and spread data is obtained from Bloomberg, which provides daily data, while volume data is estimated by the World Gold Council from reports on gold clearing turnover on the London Bullion Market gathered from its members. The measure is an annual turnover measure and Europe Economics (2013) states that this volume measure is based on clearing numbers which are typically multiplied by a factor of 5-10 to indicate gross trade volumes. Therefore the unadjusted measure presented in this report is likely to be a conservative lower bound. The price data sample reflects the daily frequency; however there was no daily volume data or outstanding amounts for the gold time series. This results in the inability to compute some of the liquidity metrics in this paper for the gold asset class.

2.3 Methodology for the analysis of liquidity

This section explains the empirical methodology used to perform the analysis of the liquidity of the assets chosen in this report. The methodology follows a criteria approach where a common set of liquidity metrics is computed across asset classes. An ordinal ranking of asset classes and subgroups in terms of liquidity has been constructed on this basis.

The choice of metrics analysed in this report is in part driven by the mandate of Article 509(4) CRR, which requires the EBA in particular to investigate the appropriateness of the following criteria in defining the liquidity of assets, and to set appropriate levels for these measures:

- minimum trade volume of the assets;
- minimum outstanding volume of the assets;
- transparent pricing and post-trade information;
- credit quality steps referred to in Part Three, Title II, Chapter 2;
- proven record of price stability;
- average volume traded and average trade size;
- maximum bid/ask spread;
- (remaining time to maturity;
- minimum turnover ratio.

These measures will enter the analysis at different stages, depending on whether they refer to actual liquidity measures or can be shown to be characteristics that drive differences in liquidity between and within asset classes.

The methodology of the paper is characterised by the following steps:

- The first step of the analysis involves the assessment of a range of asset classes against the fundamental definitions of liquidity included in the CRR. A number of additional liquidity metrics widely used in academic analysis of this topic are also analysed. All these liquidity metrics are computed for all the instruments in each of the asset classes. The enables a comparison of asset classes at the aggregate level.

- Although one asset class may perform better overall than another, this ranking does not necessarily apply to all individual instruments within the asset classes. The second step of the analysis therefore looks further at the characteristics that influence liquidity and credit quality of assets within asset classes, and thus aims to qualify the results of the overall analysis of liquidity at the asset class level. This entails testing whether easily observable explanatory characteristics (e.g. ratings or coupon types) of individual securities within an asset class can be used to predict their liquidity in quantitative terms. In addition to this quantitative assessment, qualitative characteristics of assets and markets of relevance to an evaluation of the inherent liquidity of assets are examined.

- In the third step of the analysis, definitions are constructed that individual assets within an asset class must fulfill in order to be included in the liquid asset buffer as assets of high or extremely high liquidity and credit quality. An ordinal ranking of these asset classes is

produced in order to determine which asset class falls into which liquidity category. The observable characteristics (e.g. rating or issue size) are based on the previous step.

- Lastly, appropriate haircuts are proposed for the assets found to be of high liquidity and credit quality. These are based on evidence on historical price movements, while using the haircut levels suggested by the Basel Committee as a lower bound.

2.4 Measuring liquidity

In the context of this analysis, assets may fundamentally be considered as liquid if they are easily and immediately convertible into cash with little or no loss of value. Such a definition follows the spirit of the LCR, which is intended to oblige institutions to hold liquid assets precisely so that they can turn these into cash if they experience liquidity stress. Whereas such a theoretical definition is relatively easily formulated, there is no one set way to measure such a definition of liquidity for an asset empirically. Hence the present analysis is based on a number of different liquidity related measures, each showing different aspects of the liquidity characteristics of an asset. The set of measures consists of price impact measures, bid/ask spread measures, trading volume measures, zero-trading days and price volatility measures. Each measure, or group of measures, provides an insight into the different aspects of liquidity which when joined give a broad picture of the market liquidity of each asset. For some asset categories, the measures may be supplemented with additional qualitative judgement. Annex 2 describes the measures in more detail in line with what was included in the '*Discussion Paper on Defining Liquid Assets in the LCR under the draft CRR'*.

Price impact

The EBA has computed two different measures of price impact: the Amihud illiquidity ratio and an un-scaled price impact measure. Over short periods, where no new information is available to the market, the price impact of a given trade reflects the liquidity of the market. In a highly liquid market, individual trades would not be expected to move the price of the asset and vice versa in illiquid markets.

The first price impact measure is the Amihud (2002) illiquidity ratio. This is defined as the absolute value of asset return per unit traded. The ratio thereby gives the price impact per unit traded. The higher the Amihud illiquidity ratio is, the less liquid the asset is deemed to be.

When calculating price impacts across trade sizes empirically, it transpires that price impact does not depend appear to depend directly on the trade size. Therefore, a second price impact measure which is not scaled by trade size is calculated. The somewhat surprising result that price impacts are independent of trade size is supported by similar findings for the Danish bond market in Dick-Nielsen et.al. (2012).

The EBA has computed the two price impact measures, both at transaction level and at for daily frequency, using end of day prices. The price impact measures at transaction level give the purest measure of liquidity, as there is less likelihood that the registered price movements are driven by other information arriving on the market. However, the EBA did not have transaction level data for equities and could thus only compute the measures at daily frequencies. In order to ensure using comparable measures in the cross asset class analysis, the EBA thus also computed the price impact measures at daily frequencies on the bond data.

It is a requirement that an asset be traded on two consecutive days when computing daily returns in the price impact measures. This minimises the likelihood that new information has arrived on the market within the period where the price impact measure is computed.

Monthly price impact measures are defined by taking the monthly median of the daily measure for each asset. When making cross asset class analysis, the average value across the relevant assets of the monthly medians has been taken.

The Amihud measure is not computed for gold, as daily trading volume data for this asset class was not available.

Bid/ask spread

Bid/ask spreads are a commonly used measure of liquidity. Tight bid/ask spreads indicate that one is able to sell a portfolio with little loss of value. For bond data, the EBA does not have bid and ask price series as such. Instead the Roll measure has been computed. Roll (1984) shows, that under certain conditions, the relative effective bid/ask spread equals two times the square root of minus the covariance between consecutive returns. The intuition is that the traded price of an asset bounces back and forth between bid and ask prices. This will result in negative covariance between consecutive returns, and higher bid/ask spreads lead to a higher negative covariance. Hence, the more illiquid an asset is, reflected by a high bid/ask spread, the higher the Roll measure will be.

For equity data actual bid and ask end of day quotes are available, hence the bid/ask spread can be computed directly on that basis. However, for some jurisdictions, the quality of the bid/ask spread data is not satisfactory. Hence, the Roll bid/ask proxy for equities has also been computed. This also allows for more direct comparability with the bond data.

As for the price impact measures, the Roll measure has been computed based on daily end of day data. A monthly Roll measure has been computed by looking at the monthly covariance of the computed daily returns.

Trading volume and turnover

High trading volume and turnover indicates high trading activity and the ability to liquidate sizeable portfolios within a short time period. Although high trading volume and turnover indicate assets are liquid, the opposite does not necessarily hold true. Some assets may be in high demand without being traded much, and could easily be liquidated if needed.

Two measures of trading volume have been considered. Firstly, trading volume can be used as an indicator for liquidity, as actively traded assets are considered to be more liquid than assets that are traded to a lesser degree. Secondly, the EBA computed the turnover, which is given by the trading volume divided by the outstanding amount of the relevant asset. The turnover ratio relates the traded volume to the total outstanding amount, and thus the inverse of the turnover ratio can be interpreted as the average holding time of the asset. That is to say, a turnover ratio of 0.5 for monthly data implies an average holding period of 2 months.

Both measures are computed on a monthly basis and when making cross asset class analysis, the average value of the monthly measures across the relevant assets has been taken.

The trading volume and turnover measures are not computed for gold, as the EBA did not have daily trading volume data for this asset class.

Zero-trading days

Assets with lower liquidity will tend to trade less frequently than assets with higher liquidity, hence looking at the number of zero-trading days of an asset over a fixed period will also yield a proxy for the liquidity of an asset. Although a high number of zero-trading days would in general be a sign of illiquidity, this is not necessarily always the case for the same reasons as mentioned above. A monthly zero-trading days measure has been computed by taking the percentage of trading days during a month where an asset is not traded. A high value of this variable will indicate a relatively illiquid asset. When making the cross asset class analysis, averages of the monthly zero-trading days across the relevant assets have been taken.

Volatility

Volatility is relevant to this analysis in two respects. Firstly, the volatility of an asset's return has been shown to be linked to the ease and cost of liquidating that asset. High volatility implies high price uncertainty, which in turn hampers liquidity. Secondly, high price volatility by definition equals large changes in the value of an asset, thereby creating large swings in the liquidated value of that asset, another aspect of liquidity which is relevant for this analysis. On this basis, the analysis includes a measure of return volatility determined as the monthly standard deviation of daily returns. When making the cross asset class analysis, the average value of the monthly measures across the relevant assets has been taken.

In addition, the maximum absolute price change over a 30-day period has been computed. This is suggested as a measure of price stability in the Basel Committee's LCR proposal, and the maximum price decline over a 30-day period is included as an asset characteristic requirement in the definition of the liquidity buffer.

2.5 Cross asset class comparison

The cross asset class comparison is made by computing the previously noted liquidity measures and aggregating to a monthly frequency. Time series for each asset class are computed by taking averages across assets within the respective asset class.

In addition, probability distributions are produced for each asset class, based on the liquidity measures computed for each asset in the relevant asset class. These probability distributions thus reflect variation in liquidity measures both across assets within that asset class and across time.

Based on the time-series and probability distribution evidence a coarse ranking of asset classes by liquidity levels can be produced. For this ranking, a correlation matrix of the different liquidity measures is initially compiled, across asset classes. This is used in order to see whether a grouping of some of the metrics into metrics describing similar liquidity features of the assets in our sample is possible.

This step of the analysis results in a very coarse and initial liquidity ranking. It must be qualified further by the within asset class analysis. In particular, our data sample is not balanced with respect to time period coverage of individual asset classes, credit ratings, time to maturity or any other asset characteristics, that may explain the liquidity of individual assets. If it is shown that credit quality is a determinant of liquidity for individual assets, this would imply that the covered bond sample as a whole may be found to have better liquidity characteristics than corporate bonds and government bonds, simply because of this sample bias. In reality, corporate bonds and covered bonds of the same credit quality might be equally liquid. Further analysis of liquidity measures for assets, taking into account such explanatory variables, will be done in the next step, in order to give a final ordinal ranking. For this reason, while the coarse ranking presented at this stage of the analysis may give an initial insight into the relative liquidity of asset classes, it will not necessarily be fully coherent with the final asset group liquidity ranking.

2.6 Within asset class analysis

The second step of the analysis involves looking further at the characteristics that determine liquidity and credit quality within asset classes. In the second stage one looks at the liquidity measures defined above at the individual asset level, and not aggregated to asset class level.

The EBA has identified the theoretically relevant explanatory characteristics of the liquidity and credit quality of different asset class subgroups, and tested whether these do in fact help predict the liquidity of asset subgroups.

The EBA used regression analysis to identify the explanatory ability of the different asset subgroup characteristics on the different liquidity metrics defined. On the basis of this regression evidence, an asset class has been divided into subgroups, based on the characteristics of the individual observations. These buckets of assets are then used in the final step of the analysis, where an ordinal ranking is produced.

2.7 Uniform definitions

Based on the quantitative analysis, the third step of the analysis is to create actual liquid asset subgroups based on relevant asset characteristics. The asset characteristics are identified during the within asset class analysis. These could e.g. include time to maturity for bonds. For each asset an average value of each liquidity metric over time has then been computed. However, if an asset jumps from one explanatory bucket to another over the life of the sample, then a separate average liquidity measure is calculated for the asset in each of these buckets. If one assumes time to maturity is one of the explanatory buckets, and one divides this into assets with time to maturity below 5 years and above 5 years, then an asset that starts off with 6 years to maturity, will during our sample period jump from the above 5 year bucket to the below 5 year bucket. Hence when computing average values over time, one would include two values for this one asset: one including the average over the monthly observations in the time period where the bond had a time to maturity above 5 years, and one over the monthly observations during the time where the bond had a time to maturity below 5 years.

Once these average values of liquidity metrics and buckets are created and assigned, the EBA looked at how well groups of assets within different buckets perform on the liquidity measures. In setting the distinction between assets of extremely high liquidity and credit quality, and assets of high liquidity and

credit quality, the EBA used government bonds as a benchmark. Hence the EBA picked a homogeneous group of government bonds which, based on their liquidity metric values, can be viewed as assets of extremely high and high liquidity and credit quality. These government bond buckets are then compared to all the different asset buckets previously created, on the basis of asset class and explanatory characteristics, and identify buckets which have liquidity metric distributions equal or close to those of the government bond benchmark. The ordinal ranking is compiled on this basis and aggregated into a basket of assets defining assets of extremely high liquidity and credit quality and a basket of high liquidity and credit quality. Any asset buckets that have liquidity metric values below the lower bound of assets with high liquidity and credit quality are excluded.

This step also involves some use of qualitative judgment. While the quantitative analysis performed tells us something about observed market transactions, it does not necessarily tell us whether a given asset would be easy to liquidate in the market. A high quality government bond may be held on the book of a pension fund for several years, thus not showing any turnover. This bond would by most of the quantitative metrics suggested previously in this paper be considered illiquid, however in reality it would be very easy for the pension fund to liquidate this position if it so wished. While the main element of this step is the empirical analysis, some qualitative judgment should also be taken into account when making the final liquidity grouping and ordinal ranking of assets.

2.8 Haircuts

The final step of the analysis involves assessing appropriate haircuts for the asset classes defined as of high liquidity and credit quality. This is done by calculating the 30-day price change metric for the relevant asset groups. The haircut levels suggested by the Basel Committee (15% for covered, corporate, sovereign and public sector securities in Level 2A, 25% for RMBS in Level 2B and 50% for equities and corporate bonds rated between A+ and BBB-) should be used as a lower bound in the setting of these haircuts.

3. Executive Summary: assessment and policy recommendations

This report comprises the EBA's response to two separate mandates given to it in the CRR text. It meets the requirements of Article 509(3) by proposing uniform definitions of liquid assets eligible for the LCR liquidity buffer in the EU, and recommending appropriate haircuts for the subset of the assets defined as having high liquidity and credit quality. It meets the requirements of Article 509(5) by setting out views on appropriate operational requirements that eligible liquid assets should also adhere to if they are to be included in banks' LCR buffers. The executive summary discusses the main findings of the report in these two areas, starting with the work on uniform definitions of liquid assets.

The report sets out to devise uniform definitions of eligible liquid assets issued in the EU that:

(i) are grounded in observed market liquidity;

(ii) are easy to apply using public information;

(iii) provide a uniform level of liquidity across asset classes;

(iv) ensure that as low a proportion as possible of illiquid assets are inadvertently classified as liquid;

(v) attempt to achieve as broad a definition of liquid assets as possible, subject to satisfying conditions (i) to (iv) above.

These definitions are founded on the analysis of representative data on the trading of relevant assets in the outright sale and repurchase markets. MiFID transaction data is used for the bond asset classes, Bloomberg and Datastream data for equities and Bloomberg and World Gold Council data for gold. The data period extends from 1 January 2008 to 30 June 2012. Data on the repo market is less detailed and for the purpose of this analysis is taken from regular ICMA European repo market surveys and from surveys completed by European market participants, including Eurex. This data is mainly used as supporting evidence, the bulk of our analysis relates to data on outright sale markets.

The data gathered on outright bond trades has been cleaned to ensure errors in reporting are eliminated, including the removal of duplicate trades, inaccurate prices and trade sizes, smaller retail trades, and transactions which do not represent a secondary market trade between distinct counterparties. A sample of close to 10 million transactions covering more than 10,000 individual securities remains after this process of data cleaning. Over 950,000 daily observations on 844 distinct equities are also utilised. The liquidity of the following asset classes is assessed empirically:

- government bonds;
- government guaranteed bonds;
- bonds issued by local government;
- bonds issued by multinationals;
- corporate bonds;
- covered bonds;
- bonds issued by promotional banks;
- bank guaranteed bonds;

- RMBS;
- ABS;
- equities listed on a recognised exchange;
- gold.

A range of liquidity metrics including those specified in the CRR mandate and others in common usage in the academic literature have been calculated to enable the market liquidity of each asset under investigation to be tracked through time.

The relative liquidity of the different asset classes covered in the report has been compared to provide an initial insight into differences in market liquidity, and to help identify which metrics are, in combination, sufficient to capture all facets of liquidity within our sample adequately. At an aggregate level this analysis showed that sovereign bonds were the most liquid assets in the sample, followed closely by covered bonds and some other forms of public sector securities. Corporate bonds were shown to be moderately liquid, while ABS, gold and equity showed low levels of market liquidity on a number of important metrics. However, this preliminary analysis did not attempt to control for heterogeneities within asset classes, and was hence not sufficient in isolation for the purposes of defining liquid assets.

A range of potentially useful explanatory characteristics was assessed using econometric analysis performed within each distinct asset class. This enabled the key attributes suitable for use in a set of definitions to be identified and their relationship with liquidity to be better understood. In general, for sovereign and public sector debt, corporate and covered bonds and all types of ABS, credit rating, time to maturity and issue size were found to be significant determinants of liquidity in each asset class. In addition, in the covered bond asset class, indicators of the strength of the covered bond regulatory regime were also found to be useful determinants of market liquidity.

Uniform definitions of liquid assets were finalised via a detailed analysis of all possible combinations of definitions using the key explanatory variables identified for each asset class. Definitions that reliably identify liquid assets within each asset class with a low error rate, while ensuring maximum possible coverage of the set of liquid assets in that asset class, were identified via examinations of plots of the distribution of type I and type II errors for each possible definition. Once a subset of definitions with the highest informational content was identified for each asset class, uniformity of liquidity across asset classes was assured via selecting appropriate definitions with reference to the typical liquidity of the set of sovereign bonds allocated to the extremely highly and highly liquid categories. Some tolerance was allowed through the requirement to be as liquid as the relevant sovereign bonds at each liquidity level being applied in a flexible manner.

For some asset classes conclusions on their suitability for the liquidity buffer were determined via a principles-based assessment, generally because of an absence of evidence on market liquidity.

Data on observed 30-day price moves for the assets defined as of high liquidity and credit quality were assessed to ascertain whether the minimum proposed haircuts applied to these assets in the Basel text were sufficient to guard against likely fluctuations in market prices.

This report combines the EBA's responses to the mandates in CRR Articles 509 (3) and 509 (5).

In the report an empirical and qualitative analysis of the suitability of a range of asset classes for designation as assets of high or extremely high liquidity and credit quality is performed. A set of uniform definitions is proposed for this purpose. These definitions are designed to ensure that banks in the EU can have a high degree of certainty that the assets they hold in their LCR liquidity buffer will be reliably liquid in a combined idiosyncratic and market-wide stress.

The report concludes that the minimum haircuts set for assets of high liquidity and credit quality in the Basel LCR text would be sufficient for the assets defined in that category in this analysis.

The report also builds on the CRR text to make specific recommendations about how operational requirements for assets in the LCR liquidity buffer should be designed.

The EBA recommends that the analysis performed in this report be repeated on a regular basis to ensure that the uniform definitions provided for EU assets remain appropriate over time.

3.1 Empirical conclusions on the definitions of liquid assets

The empirical approach of the report leads to the following conclusions:

Definitions of assets of extremely high liquidity and credit quality

EEA sovereign bonds issued in domestic currency, rated ECAI 1, with a minimum issue size of EUR 250 million (or the local currency equivalent).

EEA covered bonds rated ECAI 1 with a minimum issue size of EUR 500 million (or the local currency equivalent) and subject to additional conditions relating to the regulations governing the covered bond structure (as set out below).

Note that this analysis has not sought to assess the liquidity of central bank reserves and holdings of notes and coin, which are assumed to be liquid assets by definition.

Definitions of assets of high liquidity and credit quality

Sovereign bonds issued in domestic currency rated ECAI 2 or above, of minimum issue size EUR 100 million (or the local currency equivalent).

Covered bonds rated ECAI 1 of minimum issue size EUR 250 million (or the local currency equivalent).

Corporate bonds rated ECAI 4 or better, of minimum issue size EUR 250 million (or the local currency equivalent) and a maximum time to maturity of 10 years.

RMBS rated ECAI 1 of minimum issue size EUR 100 million (or the local currency equivalent) and a maximum time to maturity of 5 years subject to the additional regulatory requirements listed below.

Bonds issued by supranational institutions in EEA currencies, rated ECAI 1, of minimum issue size EUR 250 million (or the local currency equivalent).

Bonds issued by local government institutions in EEA currencies, rated ECAI 2 or above, of minimum issue size EUR 250 million (or the local currency equivalent) and a maximum time to maturity of 10 years.

Additional regulatory requirements for covered bonds:

The empirical investigation of covered bonds has shown that the liquidity characteristics of covered bonds differ across differing covered bond regulations. On this basis, covered bonds admitted to Level 1, should be issued under stringent covered bond regulation, which is designed to reduce the credit risk faced by bond holders and provide standardized and transparent information to prospective issuers. In practice our tests have shown, that covered bonds issued under regimes for which all of the following applies qualify as Level 1 assets:

- the covered bonds are eligible for the treatment set out in Article 129(4) or (5) CRR or bonds referred to in Article 52 (4) of Directive 2009/65/EC;

- a special licence is required from the local supervisor for the issuing of covered bonds. In order to obtain this license, the issuer must respect stricter risk management requirements compared to those applying to general banking supervision regimes.

- Additional supervisory reporting or transparency/disclosure duties are applied to the covered bond issuer concerning the cover pool, which go beyond the requirements of regular banking supervision regimes.

- Mandatory minimum overcollateralisation is required.

- Exposure to market and liquidity risk is reduced by law or contract.

- In the event that an issuer becomes insolvent, covered bondholders are protected against claims from other creditors via preferential treatment in the creditor ranking and as regards access to the assets in the underlying cover pool.

- Special LTV limits are used for calculating collateralisation rates for the cover pool.

Additional regulatory requirements for RMBS:

- All assets backing an RMBS must be first-lien residential mortgages.

- Only senior tranches can be included.

- The time to maturity of the security shall be calculated using either the first call date of the RMBS or the lowest of either the pricing prepayment assumption as defined in the offering circular or 20% conditional prepayment rate (CPR).

- For securities which have been issued and outstanding for more than one year and which do not include a call option, the prepayment speed (CPR) to be used when calculating the WAL shall be the arithmetic average of:

a. the historical CPR observed since issuance (the lifetime CPR);
b. the lower of the (i) the pricing CPR as defined in the offering circular or (ii) the 20% CPR.

Assets found to be insufficiently liquid

Based on the empirical and principles-based analysis in this report, there is insufficient evidence of market liquidity to propose the following asset classes as assets of high liquidity and credit quality:

- equities;
- gold;
- ABS not backed by residential mortgages;
- credit claims;
- securities issued by financial institutions;
- central bank securities;
- bank-issued government guaranteed bonds;
- bonds issued by promotional banks.

3.2 Conclusion on operational requirements of liquid assets

The analysis of operational requirements to be applied to assets deemed eligible for the LCR liquidity buffer is founded on the requirements set out in the CRR - Article 417(b) to (f) - and in the Basel LCR text according to the mandate. In general it concludes the requirements are well founded and will ensure a high degree of certainty that a bank's liquid assets will serve their purpose in a stress situation. The EBA does however suggest clarification or review of the conditions outlined below.

Legal and practical availability

The concept of availability is fundamental to operational requirements for liquid assets, since it determines the practical usability of the liquidity generating capacity of liquid assets. It is therefore important that any aspect of availability be considered under a liquidity perspective which, in some cases, might differ from a solvency perspective. This is especially true when applying the concept of unencumbrance, where recent reporting requirements take a solvency perspective and focus on the availability for unsecured debitors in the event of default, instead of on short-term liquidity generating capacity.

The EBA recommends that for the purpose of liquidity reporting, the notion of unencumbrance follow that of paragraph 31 of Basel III: Liquidity Coverage Ratio and liquidity monitoring tools, January 2013 which states that

"*Unencumbered" means free of legal, regulatory, contractual or other restrictions on the ability of the bank to liquidate, sell, transfer, or assign the asset*".

The EBA further recommends that ***any*** liquid asset or other integrant of the liquidity buffer ***held*** in a country with transfer restrictions should only be used to cover outflows in that respective country. Any excess holding of liquid assets should not be admissible for use to cover outflows in other countries. To restrict the application of this requirement to assets under Article 416(1)(c) CRR is not compatible with a prudential approach.

Likewise the EBA recommends that any liquid asset denominated in a non-convertible currency should only be used to cover outflows in that currency, regardless of whether the currency risk has effectively been hedged or not.

Control by a liquidity management function

The EBA recommends that the requirement not explicitly demand that liquid assets be held by a specific function (e.g. treasury) or that liquid assets be held in a separate book, but that institutions have policies and procedures in place that establish the proper authority of the liquidity management function and ensure sufficient operational capacity.

As different liquidity management models co-exist in the EU, the interpretation of the criteria should reflect and allow this diversity.

Test sales

The EBA recommends that supervisors apply a principles-based approach to test sales, considering the normal trading activity of an institution and the costs of test sales. In line with the CEBS Guidelines on Liquidity Buffers and Survival Periods (Annex 2), based on the proportionality principle, smaller banks which access markets through another institution, will, in most cases, not have to be active in several advanced money and capital markets.

In order to achieve regulatory transparency and preclude any circumventing of the operational requirements by institutions a harmonised definition of "liquidity risk that an institution incurs in a Member State or a third country" should be prepared and rules governing the treatment of assets that fall under two or more definitions of eligible assets.

Not used in ongoing operations

The EBA recommends allowing the use of liquid assets in hedging or trading strategies as long as they can easily be monetised without conflicting with existing risk limits that control for market, credit and counterparty risk.

To ensure consistency with Article 417(c) CRR, treasury should be interpreted as "liquidity management function".

Currency consistency

A perfect match of currency consistency of liquid assets and net outflows is not required according to the general liquidity requirement under Article 412(1) CRR (or Basel III). Until a specific currency requirement is specified in detail, institutions should monitor risk, test the effectiveness of their hedging strategies and develop contingency plans for stressed conditions.

3.3 EBA recommendations

The EBA is of view that the empirical conclusions on definitions of transferable assets of high and extremely high liquidity and credit quality included in the report item 3.1 should be supplemented by a qualitative/expert judgment substantiated basically on the supervisory advice to stress the great importance attached by the EBA to the alignment of the EU legislative framework with the international standards defined by the Basel Committee on Banking Supervision.

Transferable assets of extremely high liquidity and credit quality:

Particularly the EBA recommends to consider **all sort of bonds issued or guaranteed by EEA Sovereigns and EEA Central Banks in the domestic currency and also those issued or guaranteed by Supranational Institutions** (the Bank for International Settlements, the International Monetary Fund, the Commission, multilateral development banks, the European Financial Stability Facility and the European Stability Mechanism) **as transferable assets of extremely high liquidity and credit quality**:

Although the empirical analysis shows some degree of differentiation in the liquidity features of different sovereign bonds, there are strong supervisory arguments for not discriminating between various Member State sovereigns. In particular, it should be taken into consideration the eventual and likely damage that an exclusion of some sovereign bonds would create in the European market by triggering incentives to invest in domestic sovereign, thus reinforcing the fragmentation of the Single Market and the sovereigns-banks loop.

The analysis shows that some covered bonds display an excellent liquidity based on the available data, which reflects the European covered bond market. Nevertheless, two thirds of the observations come from markets that did not experience a real estate crisis. There are doubts as to whether the findings of the current analysis are sufficient to justify a deviation from the international standards and the inclusion of some covered bonds in the category of extremely high quality liquid assets the characteristic of which is to allow unlimited recourse to such instruments to cover for liquidity requirements.

Transferable assets of high liquidity and credit quality:

The EBA recommends following the empirical definitions of **transferable assets of high liquidity and credit quality** regarding covered bonds, corporate bonds, RMBS and bonds issued by local government institutions. Furthermore the EBA recommends considering as HQLA common equity

shares in accordance with the requirements established in par. 54 (c) of the text of Basel III: The Liquidity Coverage Ratio and liquidity risk monitoring tools, Jan. 2013[1].

Equities show high volume based metrics and are found to be very active as collateral in terms of repoability. The international regulatory framework foresees this asset class under the application of high haircuts.

From the empirical analysis **some whole asset classes do no turn out to meet the empirical requirements neither to be deemed as extremely HQLA nor HQLA**. In EBA's view there are not sufficiently robust qualitative arguments to upgrade the following: Gold, Asset Backed Securities not backed by residential mortgages, Credit Claims, Securities issued by Financial Institutions (unless they are guaranteed by Sovereigns) and bonds issued by promotional banks.

On the other hand since the data used for the analysis is based on EEA assets these recommendations would be applicable for EEA assets. The EBA recommends for non EEA assets to apply the regulation of the corresponding local jurisdictions in this respect.

Finally the EBA recommends following the conclusions reached in the report on operational requirements of liquid assets and on haircuts for the assets of high liquidity and credit quality.

[1]"Common equity shares that satisfy all of the following conditions may be included in Level 2B, subject to a 50% haircut:

- not issued by a financial institution or any of its affiliated entities;
- exchange traded and centrally cleared;
- a constituent of the major stock index in the home jurisdiction or where the liquidity risk is taken, as decided by the supervisor in the jurisdiction where the index is located;
- denominated in the domestic currency of a bank's home jurisdiction or in the currency of the jurisdiction where a bank's liquidity risk is taken;
- traded in large, deep and active repo or cash markets characterised by a low level of concentration; and
- have a proven record as a reliable source of liquidity in the markets (repo or sale) even during stressed market conditions, ie a maximum decline of share price not exceeding 40% or increase in haircut not exceeding 40 percentage points over a 30-day period during a relevant period of significant liquidity.

Contents

4. Main findings

4.1. Quantitative analysis

4.1.1 Quantitative analysis of market liquidity across asset classes

The first stage in our quantitative analysis is a comparison of liquidity measures across asset classes at the aggregate level. This enables us to assess some basic stylised facts about the different liquidity properties of the asset classes under investigation and to observe the properties of the liquidity metrics used in our analysis. This stage will provide the platform for a more detailed examination of the liquidity variation within asset classes on the basis of the relevant liquidity characteristics (section 4.2.2). Finally, our findings can be combined into an analysis of appropriate definitions across asset classes, based on the relevant liquidity characteristics (section 4.2.3).

This section presents cross asset class results for all the liquidity metrics analysed in this report. In the following subsections, the results for each measure are given in tables summarising the average and variation for across assets over the considered sample period. In Annexes 9 and 10, detailed results are shown in charts of time series and probability distributions taking into account variations in the metrics over time and within asset classes.

The original sample of data presented in section 3 is used to compute monthly observations for all the liquidity metrics for each asset in the sample. Not all assets have observations for all metrics at all points in time however. In some cases, this is simply because the asset in question did not exist for some of the time period used in this analysis, i.e. it was either not issued or it had matured. For equities, it may also be the case that these only enter our sample for a sub-period, as they were not a part of the chosen equity indices for the full sample period.

Another important reason for missing values is that some metrics require actual trading to take place in order to be calculated. As many of the individual assets in our sample are not traded every day or even every month, there will not be a full time series of liquidity metrics for these assets. This should be kept in mind when viewing time series and probability distribution evidence of asset class performance. On this basis, tables showing the frequencies of observations and average number of observations of each metric for each asset within an individual asset class are presented at the beginning of each metric section.

Price impact

The two price impact measures computed are the Amihud illiquidity ratio and a pure price impact measure. The price impact measures show how much a given trade moves the market price. The intuition is that for highly liquid assets, individual trades without informational value will not move the price of the asset. For non-liquid assets, the lack of market depth will result in larger price movements. The Amihud illiquidity ratio scales the price impact by the trade volume, resulting in a measure of the price impact per euro traded, whereas the second price impact measure is unscaled.

As is evident from the table below, government bonds generally have the lowest Amihud illiquidity measure, followed closely by covered bonds. The variation in the Amihud ratio within the government and covered bond samples are of approximately the same magnitude, and the time series and

probability distribution evidence shown in Annexes 9 and 10 underline the view of two very similar series, with the level of the government bond series being slightly below the covered bond series. Corporate bonds and ABS show average values of the Amihud ratio that are relatively close. However, volatility within the individual asset categories is somewhat higher for ABS than for corporate bonds in general. Time-series evidence shown in Annex 9 gives a similar picture, with a volatile series for ABS in particular. This is in part due to the relatively low number of observations available for this asset class, as noted in the table below. The low number of observations is in itself the result of relatively sparse trading in this asset class, supporting the evidence of fairly poor liquidity performance of this asset class on this measure. The Amihud ratio of corporate bonds appears to spike by an equivalent magnitude at the height of the financial crisis, with the ABS series spiking even further. The Amihud illiquidity ratio of equities has by far the highest value. This would in principle imply that equities are the least liquid asset class based on the Amihud ratio, as the price impact per unit traded is the highest. However, we must be aware of the limitations of using a metric of this kind, which is based on daily returns, to compute liquidity effects. For equity markets in particular, the high frequency of trading and informational trading, imply that the Amihud metric is more an indicator of price volatility in general than of the liquidity impact of trades.

Asset class	Amihud illiquidity ratio (%-points per million euro)	Price impact (in %-points)	Number of observations	Average number of observations per asset
Government bonds*	0.059 (0.1965	0.328 (0.548)	51,164	12.7
Covered bonds	0.090 (0.205)	0.265 (0.434)	29,831	13.1
Corporate bonds (excl. financials)	0.188 (0.303)	0.370 (0.457)	14,075	12.8
ABS (incl. MBS and RMBS)	0.208 (0.591)	0.773 (1.495)	2,316	3.8
Equities	0.406 (0.886)	1.554 (0,953)	23,852**	43.5**
Gold		0.746 (0.322)	54	54

♦ Note: Average measure over the sample period and standard deviations in brackets.

*Includes bonds issued by central governments, bonds issued by local governments, bonds guaranteed by central or local governments, bonds issued by multinationals, bonds issued by promotional banks and bonds issued by central banks.

**Based on Amihud

For the unscaled price impact measure, the picture is slightly different than for the Amihud ratio. Here, covered bonds generally show the lowest values, both on average and from time-series and probability distribution evidence. The price impact measure, on average, peaks to the same value for

covered bonds and government bonds during the financial crisis in 2008-2009, while government bonds show higher price impact values on average in 2011-2012 than covered bonds.

The performance of corporate bonds is better than ABS. Time series evidence (annex 9) also shows a very large peak for the ABS series during the financial crisis, indicating relatively large sensitivity of this asset class to market unrest. Gold performs at a similar level to ABS.

Equities in general have higher values for the price impact measure than bonds, indicating relatively high day-to-day price volatility. Similar to evidence on the Amihud illiquidity ratio, to what extent this can be seen as an indicator of low liquidity or a higher frequency of informational trading in equities than bonds, is unclear. The relatively large number of observations for the measures per asset for equities indicates that these assets are traded more frequently than bonds.

Bid/ask spread

As we do not have actual bid/ask spread data for the bonds in our sample, we proxy the relative spread by the Roll measure. As we require at least 6 trades in a given asset over a one month period in order to compute a Roll measure, the number of observations for the Roll measure is somewhat lower than for some of the simpler metrics. This also means that the least frequently traded assets in our sample are not included in the Roll measure calculations. However, this does not appear to change the relative performance of the different asset classes significantly compared to other liquidity measures.

Asset class	Roll measure (in %-points)	Number of observations	Average number of observations per asset
Government bonds*	0.630 (1.230)	40,962	13.4
Covered bonds	0.535 (0.839)	21,414	13.6
Corporate bonds (excl. financials)	0.617 (0.864)	10,043	12.9
ABS (incl. MBS and RMBS)	1.081 (2.283)	555	3.0
Equities	1.313 (2.506)	23,084	44.7
Gold	3.938 (24,184)	54	54
Note: Average measure over the sample period and standard deviations in brackets. *Includes bonds issued by central governments, bonds issued by local governments, bonds guaranteed by central or local governments, bonds issued by multinationals, bonds issued by promotional banks and bonds issued by central banks.			

The lowest average Roll measure is observed for covered bonds, indicating that this asset class on average trades at the lowest relative bid/ask spreads. Covered bonds in general perform slightly better than government bonds on the Roll measure, with the time-series for this asset class lying just below

the government bond series. In addition, the two series diverge somewhat in the 2011-2012 time period, with the Roll value of government bonds increasing slightly. This indicates that while bid/ask spreads of government bonds were negatively affected by the market unrest in 2011-2012, covered bond spreads did not react.

The Roll value of corporate bonds is typically in the same range as for government and covered bonds. However time-series evidence shows a spike in this series during the financial crisis, which is not as prevalent in the government and covered bonds asset classes. This indicates higher sensitivity to stress for the liquidity of this asset class. Equities generally have a somewhat higher Roll measure value than the bond asset classes, except for ABS, which again show a rather volatile path. This is particularly the case in the first part of the sample, where very few observations are available for this asset class, as very few assets in this asset class are traded frequently enough for the Roll measure to be computed. Gold has by far the highest bid-ask spread on the Roll measure.

Trading volume and turnover

The trading volume and turnover ratio measures give an indication of the ease with which larger amounts of a given asset can be liquidated in the market and to what extent the outstanding amount in individual assets is traded.

The table below looks at average values of monthly trading volume per ISIN. It is evident that the average trading volume per ISIN is far larger for government bonds than for any other asset class. This indicates a better ability to liquidate large positions in this asset class than in the other bond asset classes. Equities have the second highest value, followed by covered bonds. Corporate bonds and ABS generally show a somewhat lower level. The time series for all asset classes are relatively stable over our time sample.

Asset class	Average trading volume per month per ISIN (mill. euro)	Number of observations	Average number of observations per asset
Government bonds*	3,596 (17,128)	63,202	13.2
Covered bonds	155 (827)	51,227	13.8
Corporate bonds (excl. financials)	30 (58)	24,974	16.4
ABS (incl. MBS and RMBS)	30 (65)	8,674	8.5
Equities	753 (1,711)	21,020	40.9
Note: Average measure over the sample period and standard deviations in brackets. *Includes bonds issued by central governments, bonds issued by local governments, bonds guaranteed by central or local governments, bonds issued by multinationals, bonds issued by promotional banks and bonds issued by central banks.			

The trading volume statistic shows how large amounts of a given asset are traded on average over a given month. This gives a picture of liquidity, in that larger trading amounts indicate the ability to

actually trade such large amounts. Naturally, these values will be different across jurisdictions, with larger jurisdictions typically showing larger average trading volumes. This is particularly the case for government bonds, as is also evident from the relatively high standard deviation noted in the table. However, this does not indicate that those assets traded in smaller jurisdictions are not liquid per definition. Instead it could be said that a lower bound of trading volume indicates liquidity, and above this the actual trading volume is more reflective of market conventions and market structures. This is also the case when looking at the cross asset class figures. In this paper we are looking at liquidity in the context of the ability of financial institutions to liquidate their liquidity buffer assets, so the average trading volume should be seen in this context.

Asset class	Turnover ratio per month	Number of observations	Average number of observations per asset
Government bonds*	0.131 (0.489)	122,697	25.2
Covered bonds	0.059 (0.290)	125,225	33.2
Corporate bonds (excl. financials)	0.026 (0.073)	46,748	30.4
ABS (incl. MBS and RMBS)	0.022 (0.090)	47,718	46.6
Equities	0.071 (0.085)	26,733	51.9
Note: Average measure over the sample period and standard deviations in brackets. *Includes bonds issued by central governments, bonds issued by local governments, bonds guaranteed by central or local governments, bonds issued by multinationals, bonds issued by promotional banks and bonds issued by central banks.			

As a supplement to the trading volume static, the turnover ratio per month indicates how large a proportion of the outstanding amount of a given asset is traded over this period. This allows the trading volume to be scaled relative to the actual size of outstanding assets. For government bonds, on average 15% of the outstanding amount in any individual series is traded each month. This bond asset class has the largest turnover ratio, followed by equities and covered bonds. The ratio remained relatively stable over the time period we sampled for all asset classes, although increasing somewhat for ABS and corporate bonds over the sample period.

Zero-trading days

The zero-trading days measure shows how frequently assets in a given asset class are traded. It shows the proportion of days during a month, where a given asset was not traded. The higher the value of the measure, the less frequently assets in this asset class are traded. As can be seen from the table below, gold and equities are traded virtually every day. In actuality, gold is traded every day and the slight positive value of this measure is due to the construct of the measure, which just assumes an average of 21 trading days per month. Hence, in months with more trading days than this number of trading days, gold will appear to have some non-trading days even though this is not the case. Across asset classes however, this bias should be of the same magnitude, hence a comparison of the values over asset classes is not biased.

Asset class	Zero-trading days	Number of observations	Average number of observations per asset
Government bonds*	0.792 (0.334)	166,026	28.3
Covered bonds	0.884 (0.218)	135,587	32.9
Corporate bonds (excl. financials)	0.863 (0.202)	48,056	30.5
ABS (incl. RMBS)	0.985 (0.048)	70,287	48.1
Equities	0.319 (0.428)	32,346	54
Gold	0.004 (0.013)	54	54

Note: Average measure over the sample period and standard deviations in brackets.
*Includes bonds issued by central governments, bonds issued by local governments, bonds guaranteed by central or local governments, bonds issued by multinationals, bonds issued by promotional banks and bonds issued by central banks.

Amongst the bond asset classes, government bonds are the most frequently traded. This is in line with the evidence from trading volume and turnover statistics discussed previously. On average, covered bonds and corporate bonds show the same level of non-trading frequency. However time-series evidence shows that this average reflects a relatively stable level for covered bonds, while the zero-trading days measure has fallen continuously over the sample period for corporate bonds. Probability distributions show that for all bond asset classes, half of the zero-trading days measures reflect assets that are traded very infrequently, with a zero-trading days measure of one. Hence even for government bonds, a relatively large proportion of the bonds in our sample are not traded frequently. This does not necessarily indicate that these bonds could not be traded, but merely that they are not traded in our sample. Government bonds have the largest probability mass at values of the zero-trading days measure below 0.5, i.e. bonds that are traded on average every other day. The corporate bonds and covered bond asset classes also contain assets that are traded at a relatively high frequency, but the proportion is generally smaller than for government bonds. To what extent this is driven by differences in the composition of assets within the different asset classes, i.e. with a larger proportion of high quality assets in one asset class versus another, will be investigated further in the within asset class analysis of this paper. The proportion of ABS displaying a high frequency of trading is significantly smaller than for the other asset classes examined.

Price volatility

In addition to the many liquidity measures investigated above, we also look at measures of price volatility. Price volatility indicates both the ease with which an asset can be liquidated, and the certainty the holder has of the value at which the asset will be liquidated. In the context of the LCR, it is important for financial institutions both to be able to liquidate their liquid assets portfolios and to have relative certainty of the value at which they may be liquidated. Price volatility can to some extent be compensated for by setting higher haircuts, on the value at which the assets are included in the liquidity buffer. This will be discussed further later in this analysis.

Asset class	Return volatility	Number of observations	Average number of observations per asset
Government bonds	1.001 (1,701)	65,389	14.2
Covered bonds	0.725 (0.972)	42,049	14.5
Corporate bonds (excl. financials)	0.904 (1.184)	19,779	15.8
ABS (incl. RMBS)	2,927 (6.106)	4,991	5.8
Equities	3.294 (6,097)	24,452	44.1
Gold	4.042 (20,582)	54	54

Note: Average measure over the sample period and standard deviations in brackets.
*Includes bonds issued by central governments, bonds issued by local governments, bonds guaranteed by central or local governments, issued by multinationals, bonds issued by promotional banks and bonds issued by central banks.

The table above shows that covered bonds on average are the least volatile asset category. Government bonds show a slightly higher level of price volatility along with corporate bonds. The same picture is observed when looking at time series evidence, as presented in Annex 9. From this it is also evident that both corporate bonds and government bonds show some spikes in volatility around the financial crisis in 2008-2009 and again in 2011-2012, while covered bonds remain relatively stable through these periods. Probability distributions (Annex 10) underscore this picture, with covered bonds having the largest mass of observations with low return volatility. The probability distribution of government bonds is similar to that of financial bonds, while ABS and equities have the smallest probability mass with low return volatility. The price volatility of gold is higher than that observed for both ABS and equities.

The Basel Committee's LCR proposal includes limitations on the maximum price drop of an asset over a 30 day period. For this reason we also look at maximum absolute price changes over a 30-day period. This metric not only contains downward price movement, as the Basel requirement is linked to, but gives a picture of the size of movements both upwards and downwards over a 30-day period, i.e. a more volatility linked measure. If using this as an actual liquidity criterion, one would limit this to downward movements.

Asset class	Maximum price change within 30-day period (%-points)	Number of observations	Average number of observations per asset
Government bonds	3.143 (6,282)	86,969	14.8
Covered bonds*	1.830 (2.030)	61,950	15.0
Corporate bonds (excl. financials)	2.807 (4.746)	26,908	17.1

ABS (incl. MBS and RMBS)	5.830 (10.757)	13,424	9.2
Equities	17.112 (12.785)	25,719	42.9
Gold	9.115 (4.314)	53	53
Note: Average measure over the sample period and standard deviations in brackets. *Includes bonds issued by central governments, bonds issued by local governments, bonds guaranteed by central or local governments, bonds issued by multinationals, bonds issued by promotional banks and bonds issued by central banks.			

The table above shows that, as was the case for the return volatility measure, covered bonds have the lowest 30-day price change on average. This is followed by corporate bonds and government bonds. Gold has the second highest 30-day price change measure while equities show a significantly higher value of 30-day price change than any of the other asset classes.

The time series evidence presented in Annex 9 shows a very stable level of the maximum price change measure for covered bonds, with a very small spike during the 2008-2009 financial crisis. This is supported by probability distribution evidence (Annex 10), which also shows that covered bonds have the largest mass of low price-change observations. Government bonds and corporate bonds show a somewhat more volatile pattern, with spikes both during the 2008-2009 and 2011-2012 periods. ABS generally have a higher level of 30-day price change than the other bond asset classes. Time series evidence shows that this is particularly the case during the period 2008-2010, while in the later years of our sample, this asset class performs in a manner equivalent to government bonds and corporate bonds. The ABS asset class covers a relatively diverse subset of assets however. Further analysis within this asset category will therefore have to be conducted to determine the drivers of this time-series development. Probability distribution evidence similarly shows a large spread in the probability mass for ABS.

Ranking across measures

On the basis of the evidence presented above, an initial coarse liquidity ranking of asset classes is compiled. A ranking of the five asset classes for which all metrics are calculated is produced for each metric. These rankings are then averaged, in order to give an overall ranking. The initial metric rankings are made on the basis of the mean and standard deviation evidence presented in the tables in the previous sections, the time-series evidence presented in Annex 9 and probability distribution evidence presented in Annex 10.

Overall, government bonds and covered bonds obtain a similar ranking. Government bonds generally perform better than covered bonds on volume and trading frequency measures, while covered bonds perform better on measures related to the volatility of prices and bid/ask spreads.

Equities are the most frequently traded asset class. However, they perform relatively poorly on price volatility related measures. Corporate bonds perform moderately on most measures, aside from those relating to volume, where they do poorly. ABS are weak across the board. Gold is not included in this table as not all measures can be calculated, however it shows a similar range of performance as equities, with strong trading volumes, but a significant price volatility across all measures.

	Amihud	Price impact	Roll	Trading volume	Turnover ratio	Zero - trading days	Return volatility	30-day price change	Average ranking
Government bonds	1	2	3	1	1	2	3	3	2.00
Covered bonds	2	1	1	3	3	4	1	1	2.00
Corporate bonds (excl. financials)	3	3	2	5	4	3	2	2	3.00
ABS (incl. RMBS)	4	4	4	4	5	5	5	4	4.38
Equities	5	5	5	2	2	1	4	5	3.63

This ranking presented above allows liquidity levels to only differ by asset class. Hence, asset class is in principle viewed as the only explanatory characteristic for liquidity. Clearly, this is an over-simplification of reality. As the table below demonstrates, there is significant variation in the composition of each asset class along the dimensions of credit rating, time to maturity and issue size. For example, the government bond asset class is issued in much larger sizes than the other asset classes, while ABS have the lowest issue size and longest time to maturity. Corporate bonds have the lowest mean credit rating while covered bonds are almost exclusively rated as ECAI level 1. All these characteristics, which may drive liquidity to a higher degree than just the asset class, will be looked into in the following step of the analysis. A final ranking of different asset groups according to liquidity will be produced on the basis of these additional characteristics.

	Rating (ECAI)		Time to maturity (year)		Issue size (EUR mill.)	
Bond Type	Mean	STD	Mean	STD	Mean	STD
1.GOVERNMENT	1.2	0.7	7.4	8.3	2,980	6,460
2.COVERED	1.0	0.1	6.1	7.6	571	100
3.ABS	1.7	1.1	7.5	5.5	133	267
4.CORPORATE	2.5	1.0	5.4	5.7	485	467

4.1.2 Quantitative analysis of market liquidity within asset classes

This section presents the analysis of market liquidity within the asset classes. The objectives are to identify the characteristics of the assets being examined that are good proxies for market liquidity and hence can be used to design reliable uniform definitions of liquid assets. For each asset class a set of theoretically relevant explanatory characteristics of the liquidity and credit quality has been identified based on the list of asset characteristics suggested in the CRR and in the EBA working paper. In this section we test econometrically which of the characteristics of the individual securities within each asset class are useful predictors of their observed market liquidity.

The analysis is based on pooled regressions in which the dependent variables are the monthly averages of the liquidity metrics identified in the first part of the analysis for each security included in the analysis. Some of the explanatory variables are common across asset classes, whereas others will

vary depending on the relative importance of the specific characteristics for each asset class and the availability of data.

There are a number of characteristics that from a theoretical point of view are thought to affect the liquidity of all asset classes:

- Remaining time to maturity. This captures the possibility that market liquidity is affected by a bond's time to maturity. We expect to observe higher price volatility for bonds having a long remaining time to maturity due to their duration, which makes them more exposed to interest rate risk. We divide the remaining time to maturity into four baskets, where remaining time to maturity of below 1 year is the base scenario compared to remaining times to maturity of between 1 and 5 years, between 5 and 10 years and above 10 years.

- Issue size. Smaller issue sizes could potentially trade with lower volumes or be held by a few investors for longer periods of time. This could imply less transparent pricing and thus reduce liquidity. A narrow investor base and possible exclusion of institutional investors due to limited volume could also add to the risk of the asset turning illiquid. The variable is based on the issue size for each ISIN extracted from Bloomberg. We use the issue size at the extraction point, and if unavailable, the issuance size. The differences between these are not expected to alter the overall conclusions. The issue size is divided into five groups: less than EUR 10 million (the base scenario), between EUR 10 and 100 million, between EUR 100 and 250 million, between EUR 250 and 500 million and above EUR 500 million. For assets denominated in other currencies, the market exchange rates are used for the conversion to euros.

- Credit quality. Bonds with higher credit quality are expected to be more liquid than bonds with lower credit quality, simply because higher-rated bonds provide less risk and more transparency for investors. The quality of the underlying assets decreases the price volatility of bonds with higher credit quality relative to lower rated bonds. Furthermore, these bonds are expected to broadly out-perform in periods with stressed markets, as flight to quality is generally observed. The credit quality variable is created as a homogenous mapping of ratings into a preliminary version of the ECAI credit quality notation. A table of the mapping is shown in Annex 11. The base scenario is ECAI = 2, and we then estimate the effect of bonds which are ECAI = 1, 3, 4, 5 and 6.

In addition, dummy variables for time periods and countries are included in the analyses in order to control for time and country effects.

Public sector Bonds

Within the category of public sector bonds, we test the relative liquidity of the following five subcategories: 1) bonds issued by central or local governments, 2) bonds guaranteed by central and local governments, 3) bonds issued by central banks, 4) bonds issued by multinationals and 5) bonds issued by promotional banks. Bonds issued by governments are on average much larger in terms of amounts outstanding and also have longer maturities than the other subcategories. Multinational bonds are second, whereas bonds issued by central banks have the lowest average size. Government

bonds also have the highest average credit rating, followed by government guaranteed bonds and local government bonds.

In the following two tables the mean and standard deviations of liquidity measures for all public sector bonds and, specifically, for government bonds are given.

Public sector bonds			
	Mean	Standard deviation	Frequency
Amihud	0.039	0.141	24882
Price impact	0.305	0.446	24845
Roll	0.612	1.184	22092
Return volatility	0.757	1.223	29093
Price change	3.003	7.333	35977
Trading volume (mill. EUR)	4,437,000	19,500,000	34171
Turnover ratio	0.157	0.575	62079
Zero-trading	0.686	0.408	62562

Government bonds			
	Mean	Standard deviation	Frequency
Amihud	0.027	0.117	19848
Price impact	0.321	0.454	19808
Roll	0.631	1.224	19003
Return volatility	0,809	1.268	20850
Price change	4.000	9.086	21881
Trading volume (mill. EUR)	6,910,000	24,050,000	21817
Turnover ratio	0,338	0,839	26782
Zero-trading	0,365	0,417	27123

The explanatory characteristics in the analysis of the public sector bond category are given by credit ratings, remaining time to maturity and outstanding amount. In addition, the coupon type and the currency denomination are added as explanatory variables in the analysis. The results are given in the table below:

Liquidity characteristics of public-sector bonds

	Price Volatility Measures					Volume measures		
	Amihud	Price impact	Roll	Return vol.	Price change	Trading Vol.	Turnover ratio	Zero-trading
TTM btw 1 and 5 years	0.018***	0.115***	0.142***	0.250***	0.764***	1.20E+03***	0.038***	-0.011***
	(8.68)	(19.24)	(6.84)	(14.64)	(5.93)	(11.16)	(7.54)	(-3.34)
TTM btw 5 and 10 years	0.032***	0.282***	0.389***	0.658***	2.305***	2.84E+03***	0.072***	-0.007**
	(13.12)	(40.65)	(15.56)	(31.01)	(16.01)	(9.85)	(9.39)	(-1.96)
TTM above 10 years	0.039***	0.529***	0.580***	1.031***	4.335***	1.05E+03***	0.045***	-0.020***
	(13.53)	(58.76)	(20.56)	(41.38)	(23.21)	(2.92)	(5.04)	(-4.72)
ECAI 1	-0.029***	-0.243***	-0.240***	-0.391***	-1.835***	2.95E+03***	0.081***	-0.037***
	(-5.18)	(-16.63)	(-6.32)	(-11.21)	(-15.32)	(9.71)	(11.87)	(-7.87)
ECAI 3	0.112***	0.360***	0.695***	0.557***	2.305**	-1.56E+03***	-0.130***	0.040***
	(4.18)	(6.72)	(5.15)	(5.62)	(2.48)	(-4.41)	(-13.28)	(5.51)
ECAI 4	0.081***	0.405***	0.675***	0.862***	5.382***	-4.52E+03***	-0.381***	0.047***
	(7.51)	(13.96)	(9.28)	(11.85)	(11.59)	(-19.08)	(-24.53)	(4.29)
ECAI 5	0.238***	0.605***	1.041***	1.214***	5.672***	-6.59E+03***	-0.512***	0.201***
	(6.44)	(9.77)	(6.87)	(8.42)	(9.32)	(-12.9)	(-24.34)	(8.63)
ECAI 6	0.437***	1.729***	2.666***	4.708***	35.453***	-6.50E+03***	-0.498***	0.425***
	(11.99)	(19.65)	(10.75)	(19.85)	(10.81)	(-16.92)	(-24.3)	(25.54)
Issue size btw. 10-100 Mio. EUR	0.154***	0.084	0.152	0.300***	0.017	5.37E+02***	0.021***	-0.047***
	(3.77)	(1.47)	(0.91)	(2.7)	(0.1)	(3.86)	(3.58)	(-8.47)
Issue size btw. 100-250 Mio. EUR	0.021	-0.006	-0.145	0.199**	-0.145	4.50E+02***	0.003	-0.036***
	(0.88)	(-0.12)	(-0.91)	(2.56)	(-0.96)	(3.55)	(0.55)	(-6.54)
Issue size btw. 250-500 Mio. EUR	0.005	-0.060	-0.095	0.015	-0.270*	-5.51E+00	0.030***	-0.057***
	(0.23)	(-1.34)	(-0.71)	(0.2)	(-1.79)	(-0.04)	(5.07)	(-9.89)
Issue size of 500 Mio. EUR above	-0.027	-0.103***	-0.186*	-0.296***	-0.288*	1.34E+02	0.125***	-0.365***
	(-1.4)	(-2.72)	(-1.65)	(-4.83)	(-1.78)	(1.12)	(21.36)	(-63.97)
Fixed coupon	0.005	0.042***	0.190***	0.195***	0.682***	1.22E+03***	0.004	-0.088***
	(1.53)	(5.05)	(7.67)	(8.32)	(4.38)	(16.42)	(1.54)	(-30.33)
Denominated in euro	-0.027***	-0.034***	0.002	0.003	0.477***	1.49E+03***	0.052***	-0.207***
	(-4.65)	(-3.09)	(0.08)	(0.13)	(7.77)	(18.85)	(18.82)	(-59.54)
Government guarenteed	0.053***	0.031***	0.104***	0.103***	-0.549***	-2.79E+03***	-0.113***	0.371***
	(12.47)	(2.95)	(3.77)	(4.22)	(-8.93)	(-33.67)	(-35.6)	(101.78)
Promotional banks	0.020*	0.007	0.314***	0.266**	-0.034	-6.46E+03***	-0.229***	0.163***
	(1.95)	(0.22)	(2.87)	(2.1)	(-0.19)	(-12.43)	(-12.72)	(18.41)
Local govenment	0.077***	0.063***	0.273***	0.129***	-0.688***	-2.41E+03***	-0.091***	0.391***
	(9.73)	(4.46)	(6.58)	(5.07)	(-15.47)	(-22.89)	(-23.71)	(105.16)
Multinationals	0.037***	-0.010	-0.105**	-0.009	-0.165*	-1.23E+03***	-0.004	0.134***
	(3.02)	(-0.65)	(-2.38)	(-0.12)	(-1.64)	(-6.81)	(-0.65)	(13.9)
Central bank	0.061**	-0.066	0.000***	0.085	-2.011***	-3.60E+04***	-1.204***	0.849***
	(2.26)	(-1.42)	()	(0.76)	(-7.67)	(-21.88)	(-26.6)	(86.83)
Constant	0.131***	0.337***	1.180***	2.449***	0.446*	-3.60E+03***	-0.113***	1.293***
	(5.34)	(6.87)	(6.87)	(14.12)	(1.92)	(-4.1)	(-3.69)	(89.38)
R-squared	0.193	0.407	0.150	0.298	0.324	0.187	0.240	0.658
Number of observations	24.603	24.563	21.950	28.579	34.753	33.156	57.592	58.052

Note: TTM: time to maturity. Baseline scenario: TTM below 1 year, ECAI 2, issue size below EUR 10 million and bonds issued by the government.

As expected, the results across bonds of different **credit qualities** suggest that for all liquidity measures, lower rated bonds are less liquid than the highest rated bonds (ECAI 1).

With regard to **maturity**, we observe that bonds with a shorter remaining maturity are more liquid than bonds with a longer maturity for all price based liquidity measures. On the other hand, trading volume and frequency seem to be higher for maturities above 1 year, compared to maturities of less than a year. In particular, trading activity is highest for bonds with a time to maturity between 5 and 10 years.

With regard to **outstanding amounts**, the issue size does not seem to matter significantly for price volatility, except for very high issue sizes of above EUR 500 million for which price volatility is relatively lower. The volume based liquidity measures indicate that larger issue sizes imply higher trading volume, turnover ratio and number of trading days, even though the results are mixed.

Finally, results for **coupon types** are mixed. Fixed coupon bonds are less liquid according to the price measures, but more liquid according to the volume based liquidity measures. With regard to the **currency denomination**, bonds denominated in EUR in general appear more liquid.

Turning to the different **public bond subcategories**, the results generally suggest that public bonds issued by other entities than governments are less liquid. Firstly, the trading activity and volume is less for the other bonds. Secondly, price volatility seems to be higher for non-government issued bonds, except for bonds issued by multinationals and central banks. For these entities, price volatility is not significantly different than for government bonds.

We repeat the empirical assessment, for government bonds only, in the table below. The results largely mirror the evidence obtained when including other sub-categories which is not surprising given that government bonds dominate the sample. Only the importance of bond issue size has changed and shows some rather mixed results for government bonds. The results are similar for the price volatility measures but the trading volume is lower for bonds with an issue size between EUR 100 and 500 million than for issue sizes below EUR 10 million, which is rather puzzling.

Liquidity characteristics of government bonds

	Price Volatility Measures					Volume measures		
	Amihud	Price impact	Roll	Return vol.	Price change	Trading Vol.	Turnover ratio	Zero-trading
TTM btw 1 and 5 years	0.016***	0.115***	0.137***	0.263***	0.895***	1.94E+03***	0.092***	-0.007
	(9.23)	(16.88)	(5.86)	(12.03)	(3.7)	(10.81)	(7.77)	(-1.11)
TTM btw 5 and 10 years	0.022***	0.281***	0.380***	0.619***	2.550***	4.46E+03***	0.182***	-0.040***
	(10.59)	(36.88)	(13.68)	(24.32)	(10.3)	(10.54)	(11.14)	(-6.24)
TTM above 10 years	0.028***	0.534***	0.567***	0.980***	4.566***	1.74E+03***	0.110***	-0.029***
	(12.33)	(56.58)	(18.93)	(35.61)	(16.18)	(4.29)	(6.93)	(-4.4)
ECAI 1	-0.016***	-0.232***	-0.235***	-0.390***	-2.082***	4.68E+03***	0.228***	-0.009
	(-3.74)	(-16.6)	(-5.9)	(-11.06)	(-11.09)	(8.18)	(11.68)	(-1.06)
ECAI 3	0.040***	0.313***	0.515***	0.466***	5.160***	-3.99E+03***	-0.262***	0.040***
	(4.23)	(7.72)	(4.2)	(6.22)	(2.63)	(-5.13)	(-12.4)	(2.97)
ECAI 4	0.060***	0.390***	0.659***	0.793***	5.247***	-5.44E+03***	-0.469***	0.079***
	(7.14)	(13.96)	(9.05)	(12.09)	(10.96)	(-17.12)	(-25.03)	(6.29)
ECAI 5	0.225***	0.591***	1.011***	1.167***	5.927***	-7.32E+03***	-0.553***	0.196***
	(6.13)	(9.63)	(6.68)	(8.13)	(9.58)	(-11.51)	(-20.61)	(8.23)
ECAI 6	0.423***	1.705***	2.677***	4.669***	35.294***	-8.25E+03***	-0.599***	0.436***
	(11.66)	(19.39)	(10.77)	(19.79)	(10.76)	(-13.9)	(-22.51)	(25.1)
Issue size btw. 10-100 Mio. EUR	0.389**	0.696*	-0.331	0.482	0.554	-8.11E+02	-0.068**	-0.208***
	(1.97)	(1.71)	(-0.28)	(0.7)	(0.89)	(-1.06)	(-2.51)	(-15.9)
Issue size btw. 100-250 Mio. EUR	0.071	-0.037	-0.077	0.089	-0.256	-4.04E+03***	-0.316***	-0.047***
	(0.79)	(-0.18)	(-0.05)	(0.25)	(-0.47)	(-6.39)	(-12.6)	(-4.39)
Issue size btw. 250-500 Mio. EUR	0.094	-0.120	-0.984	-0.229	-0.251	-4.24E+03***	-0.018	-0.062***
	(0.91)	(-0.63)	(-1.25)	(-0.75)	(-0.63)	(-7.16)	(-0.88)	(-6.69)
Issue size of 500 Mio. EUR above	-0.077	-0.332***	-1.198***	-1.043***	-0.362	1.40E+03***	0.280***	-0.648***
	(-1.04)	(-2.57)	(-2.79)	(-4.71)	(-0.99)	(3.93)	(15.8)	(-83.97)
Coupon	-0.012***	0.020**	0.175***	0.115***	0.824***	2.80E+03***	0.082***	-0.126***
	(-4.12)	(2.24)	(6.33)	(4.22)	(2.61)	(20.86)	(10.49)	(-18.09)
EUR	-0.024***	-0.021	0.033	0.043	0.829***	2.01E+03***	0.054***	-0.336***
	(-2.76)	(-1.26)	(0.7)	(1.42)	(9.01)	(14.07)	(7.54)	(-44.94)
Constant	0.177**	0.553***	2.182***	3.242***	0.372	-9.84E+03***	-0.318***	1.677***
	(2.31)	(4.11)	(4.84)	(11.05)	(0.82)	(-7.57)	(-4.86)	(64.04)
R-squared	0.2415	0.444	0.148	0.323	0.309	0.172	0.228	0.529
Number of observations	19.810	19.768	18.976	20.776	21.727	21.690	26.458	26.799

Note: TTM: time to maturity.

Baseline scenario: TTM below 1 year, ECAI 2, issue size below EUR 10 million.

Corporate bonds

The analysis of the liquidity of corporate bonds follows the same method as for government bonds. The table below gives the mean and standard deviations of liquidity measures for corporate bonds.

Corporate bonds			
	Mean	Standard deviation	Frequency
Amihud	0.163	0.266	8,323
Price impact	0.337	0.410	8,330
Roll	0.581	0.844	6,381
Return volatility	0.814	1.068	11,056
Price change	2.703	3.669	13,679
Trading volume (mill. EUR)	37,302	65,324	13,022
Turnover ratio	0.035	0.072	18,278
Zero-trading	0.782	0.236	18,369

The explanatory characteristics in the analysis of corporate bond liquidity are given by credit ratings, remaining time to maturity and outstanding amount. In addition, the coupon type is added as explanatory variable. The results are given in the table below:

Liquidity characteristics of corporate bonds

	Price Volatility Measures					Volume measures		
	Amihud	Price impact	Roll	Return vol.	Price change	Trading Vol.	Turnover ratio	Zero-trading
TTM btw 1 and 5 years	0.067***	0.127***	0.229***	0.356***	1.355***	6.395***	0.007***	-0.043***
	(6.01)	(6.92)	(5.95)	(11.8)	(22.1)	(4.57)	(6.26)	(-10.6)
TTM btw 5 and 10 years	0.125***	0.285***	0.373***	0.709***	2.622***	10.902***	0.012***	-0.028***
	(10.81)	(14.93)	(9.63)	(22.19)	(37.36)	(6.18)	(8.3)	(-6.06)
TTM above 10 years	0.182***	0.461***	0.619***	1.151***	3.689***	7.255***	0.005***	0.022***
	(12.57)	(19.31)	(12.34)	(27.35)	(31.23)	(3.67)	(3.13)	(4.35)
ECAI 1	-0.025***	-0.026*	-0.076**	-0.045	-0.299***	3.269**	-0.005***	0.021***
	(-2.72)	(-1.91)	(-2.11)	(-1.5)	(-5)	(2.11)	(-3.51)	(4.95)
ECAI 3	-0.002	0.057***	0.037	0.124***	0.845***	13.933***	0.019***	-0.064***
	(-0.23)	(5.9)	(1.45)	(5.72)	(12.76)	(11.86)	(17.03)	(-20)
ECAI 4	0.054***	0.161***	0.128***	0.241***	1.848***	16.339***	0.021***	-0.069***
	(4.81)	(9.3)	(3.16)	(7.03)	(15.58)	(4.08)	(6.15)	(-10.95)
ECAI 5	0.155***	0.481***	0.597***	0.943***	5.625***	15.023***	0.008***	0.004
	(5.49)	(9.65)	(5.34)	(10.05)	(13.9)	(4.07)	(3.05)	(0.46)
ECAI 6	0.379**	0.627***	-0.081	1.385***	5.082***	0.246	-0.007***	0.037***
	(2.55)	(4.38)	(-0.3)	(3.74)	(5.14)	(0.06)	(-2.76)	(3.1)
Issue size btw. 10-100 Mio. EUR	0.085	0.228	1.182	0.489***	-0.265	-19.920***	-0.015***	0.135***
	(1.46)	(1.42)	(1.09)	(2.89)	(-1.21)	(-10.2)	(-4.39)	(25.94)
Issue size btw. 100-250 Mio. EUR	0.071*	0.020	-0.029	0.168**	-0.335	-14.842***	-0.021***	0.138***
	(1.8)	(0.46)	(-0.28)	(1.99)	(-1.6)	(-10.55)	(-11.79)	(34.02)
Issue size btw. 250-500 Mio. EUR	0.037**	0.049**	0.048	0.132**	0.126	-8.784***	-0.018***	0.100***
	(2.07)	(2.14)	(0.73)	(2.56)	(0.94)	(-7.36)	(-10.39)	(24.11)
Issue size of 500 Mio. EUR above	-0.041***	-0.013	-0.012	-0.098***	0.098	21.186***	0.004**	-0.115***
	(-5.18)	(-1.18)	(-0.44)	(-3.93)	(1.35)	(17.01)	(2.35)	(-31.63)
Fixed coupon	0.035**	0.058***	0.007	0.165***	0.154	-2.846**	0.000	-0.011***
	(2.47)	(2.9)	(0.14)	(3.44)	(0.96)	(-2.24)	(-0.16)	(-2.75)
Constant	0.137**	0.046	1.652***	3.088***	1.706***	-20.040***	-0.015***	1.069***
	(2.41)	(0.78)	(5.92)	(9.05)	(4.56)	(-5.57)	(-4.35)	(86.56)
R-squared	0.121	0.224	0.110	0.254	0.220	0.124	0.130	0.433
Number of observations	8.255	8.263	6.326	10.971	13.565	12.918	18.107	18.198

Note: TTM: time to maturity.Baseline scenario: TTM below 1 year, ECAI 2, issue size below EUR 10 million.

Time to maturity broadly seems to have the same effect on corporate bonds as on bonds issued by the public sector. This implies higher price volatility for bonds with a longer time to maturity, but on the other hand also with a higher trading volume and frequency.

Turning to **credit quality,** price volatility in general is lower for bonds with an ECAI 1 rating and higher for lower ratings compared to bonds rated ECAI 2. Credit quality has a less clear effect on trading volume and frequency with both high and low ratings resulting in higher trading volumes.

The outstanding amount does not significantly influence the price impact or the bid/ask spread. Only the return volatility seems to increase when the issue size is above EUR 10 million, but volatility does not seem to increase further as issue sizes grow. The results for the volume measures are somewhat puzzling, as trading volume and frequency seem to decrease with increasing issue sizes.

Results for **coupon types** show that price volatility is higher and trading volume lower for fixed coupon bonds. On the other hand, the trading frequency seems to be higher.

Covered bonds

The characteristics that are important for the liquidity of covered bonds are attempted to be identified. Firstly, an overview of the liquidity measures for covered bonds is given in the table below:

Covered bonds			
	Mean	Standard deviation	Frequency
Amihud	0.081	0.192	19,340
Price impact	0.237	0.387	19,358
Roll	0.487	0.782	14,461
Return volatility	0.663	0.895	26,432
Price change	1.763	1.945	38,196
Trading volume (mill. EUR)	211,000	1,052,000	30,391
Turnover ratio	0.083	0.366	70,510
Zero-trading	0.863	0.245	78,366

The common characteristics are included in the analysis: time to maturity, issue size and credit quality. Two additional characteristics are also taken into account:

- Credit risk regulation. This variable captures whether regulation, which reduces the credit risk of bond investors, is present. Clear regulatory regimes are expected to affect the liquidity of covered bonds positively as risk is decreased and transparency is increased for the investor. The variable has been constructed through an analysis of different covered bond schemes. We create a binary variable for each ISIN with a value of 1 if the scheme satisfies the five requirements listed below, and 0 otherwise.
    - Are there any special LTV limits used solely for calculating collateralisation rates for the cover pool?
    - Is mandatory minimum over-collateralisation required?
    - Is exposure to market risk (e.g. interest rates, currency risks) required to be mitigated by law or contract?
    - Is exposure to liquidity risk required to be mitigated by law or contract?
    - How are covered bondholders protected against claims from other creditors if the issuer becomes insolvent?

- Transparency. This variable covers the availability of information to investors and the level of standardisation of the issue. Information, transparency and standardisation are expected to increase the liquidity of the assets as they reduce uncertainty for investors and broaden the investor base. We create a binary variable based on the criteria listed below. All four criteria have to be fulfilled to obtain the value 1, otherwise the value is 0.
    - Is a special licence required for the issuing of covered bonds?
    - Does a covered bond issuer have special reporting duties to the supervision authority concerning covered bonds and the cover pool, which go beyond the requirements of the regular banking supervision regime?
    - Covered bonds eligible for the treatment set out in Article 129(4) or (5) CRR or bonds referred to in Article 52(4) of Directive 2009/65/EC
    - Does the covered bond fulfill the criteria of Article 52(4) of Directive 2009/65/EC?

- Does the covered bond legislation completely fall within the criteria of Article 129(4) and (5) CRR?

The results of the regression analysis are given in the table below:

Liquidity characteristics of covered bonds

	Price Volatility Measures					Volume measures		
	Amihud	Price impact	Roll	Return vol.	Price change	Trading Vol.	Turnover ratio	Zero-trading
TTM btw 1 and 5 years	0.025***	0.076***	0.130***	0.204***	0.640***	93.416***	0.017***	0.012***
	(8.63)	(12.18)	(10.26)	(19.73)	(24.27)	(3.26)	(9.12)	(5.73)
TTM btw 5 and 10 years	0.061***	0.194***	0.283***	0.551***	1.497***	-72.126***	0.014***	0.032***
	(12.37)	(18.93)	(12.53)	(31.96)	(44.62)	(-2.85)	(7.39)	(13.85)
TTM above 10 years	0.043***	0.199***	0.399***	0.595***	1.938***	21.279	0.241***	-0.101***
	(9.24)	(21.08)	(18.78)	(35.64)	(59.28)	(0.84)	(39.38)	(-33.19)
ECAI 1	-0.110***	-0.325***	-0.363***	-0.531***	-1.682***	186.333***	0.031***	0.002
	(-5.63)	(-8.67)	(-5.17)	(-9.1)	(-11.9)	(7.43)	(5.06)	(0.29)
ECAI 3	0.264**	0.278	1.796***	0.780	2.871*	78.760	0.017	-0.047
	(2.05)	(1.2)	(3.7)	(1.53)	(1.94)	(0.95)	(0.41)	(-1.49)
Issue size btw. 10-100 Mio. EUR	0.063***	0.012	0.176***	0.288***	0.020	-18.555***	0.058***	0.157***
	(8.24)	(0.79)	(4.28)	(10.1)	(0.61)	(-2.78)	(9.34)	(52.25)
Issue size btw. 100-250 Mio. EUR	0.056***	0.023*	0.093***	0.232***	0.179***	-20.383***	0.047***	0.141***
	(7.96)	(1.92)	(2.78)	(9.85)	(6.68)	(-3.75)	(9.11)	(47.69)
Issue size btw. 250-500 Mio. EUR	0.023***	0.011	0.100***	0.051**	-0.071**	47.029***	0.079***	0.077***
	(3.29)	(0.89)	(2.84)	(2.33)	(-2.41)	(7.27)	(13.59)	(20.89)
Issue size of 500 Mio. EUR above	-0.002	0.005	-0.017	-0.045***	0.217***	436.054***	0.155***	-0.185***
	(-0.75)	(0.72)	(-1.33)	(-3.88)	(8.76)	(27.53)	(27.21)	(-49.94)
Credit Risk Reg.	-0.066***	-0.163***	-0.262***	-0.318***	-0.503***	354.410***	0.076***	-0.095***
	(-13.88)	(-16.21)	(-12.42)	(-19.79)	(-19.04)	(23.98)	(37.64)	(-45.96)
Transparency	-0.046***	-0.140***	-0.304***	-0.301***	-0.992***	73.223***	0.009***	0.002
	(-6.69)	(-10.11)	(-9.95)	(-13.45)	(-22.31)	(10.78)	(2.86)	(0.48)
Constant	0.228***	0.661***	1.729***	2.588***	3.159***	-563.212***	-0.112***	0.888***
	(10.58)	(16.27)	(15.93)	(25.96)	(20.04)	(-9.42)	(-5.82)	(78.98)
R-squared	0.080	0.138	0.116	0.197	0.247	0.050	0.082	0.310
Number of observations	19.340	19.358	14.461	26.432	38.196	30.391	70.510	78.366

Note: TTM: time to maturity.
Baseline scenario: TTM below 1 year, ECAI 2, issue size below EUR 10 million.

Overall, the results show that the liquidity of covered bonds depends on all the selected characteristics and the estimated coefficients are in general as expected.

All measures indicate that the price volatility of covered bonds increases with a **bond's time to maturity**. Turning to the measures of trading volumes, the results are mixed. The turnover ratio seems to increase with maturity, while the results for trading volume and trading days is less clear. It should be noted that bonds with a lower trading volume are not necessarily less liquid. Some of the bonds with less trading activity may be bought and held to maturity, implying low actual trading, but they could possibly be liquidated without any problem if a need arose.

High credit quality has a significant effect on liquidity according to the results. Bonds with an ECAI 1 rating have lower price volatility, reflecting the stabilising effect of higher credit quality on prices. High credit quality also implies higher trading volumes and turnover.

The price measures indicate that price volatility in general increases with **issue size**, except for issue sizes of above EUR 500 million. Whilst turnover is higher for higher issue sizes, the effect of issue size on trading volume and trading days is mixed.

Credit risk regulation and transparency have explanatory power for almost all measures. The estimated negative coefficients on all price measures reflect as expected that a regulatory regime, which reduces credit risk and enhances transparency and standardisation of bond issues dampen price volatility. Furthermore, the regulatory measures also enhance trading volume, turnover and the number of trading days.

ABS including RMBS

In the analysis of the liquidity of ABS, we perform an analysis of the total ABS market and of RMBS in particular. An overview of the liquidity measures for ABS and for the subgroup of RMBS is given in the table below:

ABS, total			
	Mean	Standard deviation	Frequency
Amihud	0.207	0.600	1921
Price impact	0.756	1.465	1920
Roll	1.105	2.291	470
Return volatility	2.768	5.835	4162
Price change	5.579	1.015	10810
Trading volume (mill. EUR)	30.2	67.0	6939
Turnover ratio	0.243	0.098	35144
Zero-trading	0.982	0.051	50255

RMBS			
	Mean	Standard deviation	Frequency
Amihud	0.152	0.477	1388
Price impact	0.552	1.054	1387
Roll	0.936	2.086	398
Return volatility	2.230	5.562	2906
Price change	5.139	1.135	6767
Trading volume (mill. EUR)	34.5	7.3	4301
Turnover ratio	0.034	0.123	19572
Zero-trading	0.979	0.058	29360

In line with the other within asset class analyses, we consider the following variables in the attempt to explain the variation in liquidity within the ABS asset class: credit quality, issue size and time to maturity. In addition, given that the ABS class is fairly heterogeneous, we include the subtypes RMBS, MBS and a dummy variable for the senior tranches of ABS.

The **time to maturity** seems to have a negative impact on liquidity, as both price volatility increases and trading activity decreases with time to maturity. For maturity above 10 years, the price impact and bid/ask spread is unaffected, but longer maturity still seems to imply higher price volatility and lower trading activity.

The results indicate that **credit quality** has important effects on the liquidity of ABS. ABS with an ECAI 1 rating seem to have the highest liquidity, whereas liquidity decreases for lower rating categories.

As regards **issue size**, we observe that as expected, trading activity and volume increase with volume size. On the other hand, the price impact and return volatility is higher for larger issue sizes.

With respect to the split by **subtype**, the baseline is other ABS and we test for the impact of assets being RMBS and MBS. In general, the subtype seems to have some significance, in particular in the price change and trading activity measures.

Tranche seniority does not seem to play an important role in price volatility, but trading volume and frequency are significantly lower for senior tranches.

Liquidity characteristics of ABS

	Price Volatility Measures					Volume measures		
	Amihud	Price impact	Roll	Return vol.	Price change	Trading Vol.	Turnover ratio	Zero-trading
TTM btw 1 and 5 years	0.074***	0.242***	0.230	0.610**	2.012***	-0.122	0.004	0.001
	(2.72)	(4.09)	(1.59)	(2.36)	(7.44)	(-0.02)	(1.58)	(0.63)
TTM btw 5 and 10 years	0.150***	0.623***	0.905**	1.086***	3.092***	-12.886***	-0.009***	0.008***
	(3.93)	(5.84)	(2.54)	(3.43)	(9.53)	(-2.62)	(-3.68)	(6.23)
TTM above 10 years	0.151	0.165	0.248	4.434***	3.648***	-12.694***	-0.021***	0.014***
	(1.4)	(0.82)	(0.45)	(5.2)	(7.29)	(-2.66)	(-9.04)	(10.88)
ECAI 1	0.122**	-0.053	0.158	-0.771*	-3.230***	-1.153	-0.002	-0.004***
	(2.14)	(-0.3)	(0.29)	(-1.72)	(-6.27)	(-0.58)	(-1.54)	(-6.84)
ECAI 3	0.372***	0.584***	0.319	2.216***	4.463***	-0.085	0.002	-0.002***
	(4.46)	(3.19)	(0.73)	(3.87)	(6.23)	(-0.05)	(1.11)	(-3.53)
ECAI 4	0.373	0.152	-	2.978**	6.131***	-0.984	-0.011***	0.003***
	(1.33)	(0.54)		(2.22)	(3.86)	(-0.24)	(-6.86)	(4.99)
ECAI 5	1.011	1.526	-1.676**	2.935	5.398***	-0.988	-0.014***	0.005***
	(0.97)	(1.25)	(-2.13)	(1.45)	(4.22)	(-0.28)	(-7.09)	(4.93)
ECAI 6	0.687**	2.396***	0.734	2.768	11.148***	5.038*	-0.006***	0.004***
	(1.98)	(3.33)	(0.4)	(1.19)	(6.34)	(1.65)	(-2.61)	(4.31)
Issue size btw. 10-100 Mio. EUR	0.424***	0.725***	1.052*	2.930***	4.646***	-5.205	0.012***	0.010***
	(6.57)	(5.22)	(1.8)	(6.89)	(14.44)	(-0.82)	(9.55)	(16.83)
Issue size btw. 100-250 Mio. EUR	0.179***	0.542***	0.830*	1.057***	2.724***	11.619*	0.033***	-0.006***
	(5.06)	(5.53)	(1.92)	(3.98)	(12.56)	(1.82)	(16.37)	(-6.1)
Issue size btw. 250-500 Mio. EUR	0.054	0.379***	0.077	0.749***	3.005***	38.580***	0.043***	-0.021***
	(1.55)	(3.77)	(0.21)	(2.85)	(15.44)	(5.8)	(16.49)	(-15.62)
Issue size of 500 Mio. EUR above	0.031	0.169*	-0.230	0.396*	2.965***	54.865***	0.023***	-0.022***
	(1.13)	(1.89)	(-0.65)	(1.75)	(16.36)	(7.65)	(11.68)	(-16.23)
RMBS	-0.070	0.183	1.464**	-0.492	-1.188*	-3.096	-0.031**	0.031***
	(-0.98)	(1.19)	(2.04)	(-0.35)	(-1.79)	(-0.2)	(-2.26)	(8.21)
MBS	-0.058	0.205*	1.254*	0.069	-1.656***	3.775	-0.047***	0.047***
	(-0.85)	(1.82)	(1.95)	(0.05)	(-2.91)	(0.43)	(-3.43)	(13.27)
ABS senior	-0.014	-0.007	-0.179	-0.298	-0.266	-16.270***	-0.017***	0.007***
	(-0.43)	(-0.09)	(-0.93)	(-1.44)	(-1.47)	(-7.3)	(-11.07)	(9.58)
Constant	-0.402***	-0.720	2.700**	11.904***	0.943	1.195	0.013	1.004***
	(-3.62)	(-1.38)	(2.38)	(3.01)	(1.01)	(0.11)	(0.94)	(360.47)
R-squared	0.210	0.297	0.378	0.236	0.204	0.149	0.064	0.122
Number of observations	1.903	1.902	467	4.134	10.752	6.937	35.134	50.043

Note: TTM: time to maturity.
Baseline scenario: TTM below 1 year, ECAI 2, issue size below EUR 10 million.

The results of the separate analysis of RMBS are given in the table below. It indicates that the characteristics in general have the same impact on liquidity of RMBS as on ABS, which is not surprising given the significant share of RMBS in the sample.

Liquidity characteristics of RMBS

	Price Volatility Measures					Volume measures		
	Amihud	Price impact	Roll	Return vol.	Price change	Trading Vol.	Turnover ratio	Zero-trading
TTM btw 1 and 5 years	0.065***	0.204***	0.180	0.221	1.310***	3.369	0.015***	-0.001
	(2.79)	(4.47)	(1.09)	(0.68)	(3.73)	(0.56)	(4.83)	(-0.6)
TTM btw 5 and 10 years	0.112***	0.572***	0.964**	0.983***	2.932***	-6.640	0.002	0.006***
	(4.09)	(6.59)	(2.38)	(2.62)	(6.57)	(-1.07)	(0.5)	(3.48)
TTM above 10 years	0.044	0.086	0.012	2.402***	2.135***	-10.249*	-0.016***	0.016***
	(0.84)	(0.73)	(0.02)	(3.08)	(3.79)	(-1.69)	(-5.89)	(9.19)
ECAI 1	0.135**	-0.032	0.184	-0.031	-3.034***	-2.882	-0.009***	-0.002***
	(2.04)	(-0.17)	(0.29)	(-0.05)	(-3.91)	(-1.21)	(-3.61)	(-2.81)
ECAI 3	0.412***	0.544***	0.296	2.164***	4.606***	-0.852	0.001	-0.001
	(4.46)	(2.9)	(0.59)	(3.43)	(4.73)	(-0.47)	(0.42)	(-1.57)
ECAI 4	0.207**	0.205	-	4.177**	4.681**	-13.571***	-0.025***	0.007***
	(2.04)	(0.56)		(2.08)	(1.99)	(-3.48)	(-8.95)	(7.09)
ECAI 5	-	-	-	6.914**	3.735**	-12.039	-0.033***	0.015***
				(2.45)	(2.21)	(-1.48)	(-10.47)	(11.64)
ECAI 6	1.064	2.193***	-	7.287**	9.549***	-1.865	-0.020***	0.011***
	(1.5)	(3.72)		(2)	(3.74)	(-0.55)	(-5.12)	(8.97)
Issue size btw. 10-100 Mio. EUR	0.411***	0.785***	1.283*	3.793***	6.321***	-12.722	0.010***	0.017***
	(5.61)	(5.16)	(1.91)	(7.66)	(14.1)	(-1.37)	(4.85)	(17.81)
Issue size btw. 100-250 Mio. EUR	0.111***	0.558***	1.166**	1.451***	3.625***	7.308	0.035***	-0.002*
	(3.94)	(5.91)	(2.28)	(4.98)	(12.58)	(0.78)	(12.46)	(-1.79)
Issue size btw. 250-500 Mio. EUR	0.009	0.283***	0.426	0.690**	2.904***	46.365***	0.064***	-0.031***
	(0.36)	(3.65)	(1.05)	(2.5)	(10.11)	(4.75)	(14.29)	(-12.89)
Issue size of 500 Mio. EUR above	0.025	0.174***	0.083	0.482**	2.031***	56.013***	0.016***	-0.026***
	(1.17)	(2.57)	(0.21)	(2.18)	(9.28)	(5.19)	(5.04)	(-10.8)
ABS senior	0.013	0.037	-0.133	-0.192	-0.736***	-12.979***	-0.015***	0.005***
	(0.48)	(0.62)	(-0.7)	(-0.96)	(-3.42)	(-5.73)	(-7.23)	(5.93)
Constant	-0.300	0.652	0.415	16.110***	9.698	-5.239	-0.007	0.996***
	(-0.98)	(0.44)	(0.47)	(2.81)	(1.29)	(-0.46)	(-1.53)	(529.89)
R-squared	0.203	0.297	0.391	0.260	0.213	0.177	0.083	0.163
Number of observations	1.370	1.369	395	2.878	6.711	4.301	19.572	29.158

Note: TTM: time to maturity.
Baseline scenario: TTM below 1 year, ECAI 2, issue size below EUR 10 million.

Equities

In the following, we attempt to identify the characteristics that are important for the liquidity of equities. Firstly, an overview of the liquidity measures for equities is given in the table below:

Equities			
	Mean	Standard deviation	Frequency
Amihud	0.492	0.954	19356
Price impact	1.587	0.969	19367
Roll	1.351	2.519	18619
Return volatility	3.411	6.099	19981
Price change	17.530	13.125	21287
Trading Volume (mill. EUR)	753.7	1711.2	21020
Turnover ratio	0.071	0.085	26733
Zero trading	0.340	0.432	26733

The characteristics included in the equity analysis naturally differ from those used in the analysis of the different bond categories. For equities we still include time dummies and dummies for issue size, although with a slightly different categorisation than for the bond categories, in that the smallest bucket includes issues of up to EUR 100 million. In addition, we include industry sector dummies. The hypothesis is that there may be differences in particular in price volatility measures, as some sectors are typically characterised by higher earnings volatility for the corporations within certain sectors. The base case sector is industrials.

	Price Volatility Measures					Volume measures		
	Amihud	Price impact	Roll	Return vol.	Price change	Trading Vol.	Turnover ratio	Zero-trading
Issue size btw. 100-250 Mio. EUR	-0.534***	-0.333*	-3.283***	-7.177***	-6.912***	14.682	0.014***	-0.110***
	(-2.62)	(-1.94)	(-2.7)	(-6.19)	(-5.53)	(0.87)	(11.57)	(-25.38)
Issue size btw. 250-500 Mio. EUR	-1.285***	-0.616***	-3.714***	-9.153***	-6.896***	3.688	0.035***	-0.360***
	(-6.62)	(-3.76)	(-3.08)	(-8.03)	(-5.71)	(0.22)	(21.69)	(-45.25)
Issue size EUR500M or above	-2.823***	-1.215***	-4.472***	-10.977***	-10.993***	812.353***	0.091***	-0.908***
	(-14.84)	(-7.58)	(-3.72)	(-9.69)	(-9.49)	(42.58)	(97.65)	(-460.71)
Basic materials	-0.036**	0.022	-0.071	0.047	0.844***	184.698***	0.005***	0.037***
	(-1.99)	(1.14)	(-1.38)	(0.51)	(3.08)	(6.64)	(2.96)	(7.84)
Communications	-0.049***	-0.308***	-0.108**	-0.315***	-2.166***	613.861***	-0.023***	0.066***
	(-2.74)	(-15.94)	(-2.04)	(-2.99)	(-7.77)	(8.74)	(-15.58)	(12.43)
Concumer, cyclical	0.080***	-0.043**	-0.045	-0.006	-0.278	160.585***	-0.005***	0.062***
	(4.05)	(-2.31)	(-0.91)	(-0.05)	(-1.06)	(6.62)	(-2.77)	(14.19)
Consumer, non-cyclical	-0.009	-0.421***	-0.097**	-0.418***	-4.301***	18.877	-0.026***	0.047***
	(-0.53)	(-26.12)	(-2.18)	(-4.35)	(-19.43)	(0.98)	(-23.87)	(14.75)
Diversified	0.368***	-0.052	-0.142	0.399	-0.267	-463.400***	-0.048***	0.120***
	(4.47)	(-0.93)	(-1.06)	(1.49)	(-0.27)	(-22.77)	(-18.81)	(8.55)
Energy	0.103***	-0.031	0.134**	0.177*	0.517*	457.728***	-0.014***	0.078***
	(4.89)	(-1.53)	(2.13)	(1.66)	(1.87)	(8.3)	(-6.72)	(12.62)
Technology	-0.247***	-0.041	-0.014	-0.033	0.769	459.653***	0.048***	-0.012***
	(-17.66)	(-1.24)	(-0.17)	(-0.23)	(1.44)	(9.21)	(12.94)	(-3.37)
Utilities	-0.074***	-0.424***	-0.238***	-0.494***	-4.833***	642.557***	-0.040***	0.145***
	(-3.78)	(-21.22)	(-4.12)	(-4.7)	(-19)	(11.55)	(-23.37)	(18.71)
Constant	3.202***	3.446***	17.020***	45.673***	32.789***	602.753***	0.061***	0.911***
	(16.4)	(20.85)	(12.82)	(26.3)	(22.7)	(4.09)	(11.94)	(90.79)
R-squared	0.385	0.415	0.372	0.529	0.305	0.069	0.263	0.744
Number of observations	19.356	19.367	18.619	19.981	21.287	21.020	26.733	26.733

Issue size generally has a significant impact on the liquidity metrics for equities, with larger issuances showing better liquidity values both on price and trading activity related measures. As regards sector, the evidence is more mixed. Consumer non-cyclical, communications and utilities generally perform well, with low price volatility related measures relative to other sectors.

Gold

For gold we naturally do not perform a within asset class analysis, as this only consists of one single asset. The cross asset analysis in section 4.2.1 generally showed this asset class to have relatively high price volatility, but we are not able to compute comparable trading activity measures as we do not have daily turnover data for this asset class, although we have evidence that this asset class shows continuous trading at relatively high volumes.

4.1.3 Assessing appropriate uniform definitions

The approach adopted to finalise uniform definitions of liquid assets builds on the within asset class analysis described in section 4.2.2. This gives a basis for creating a set of possible definitions based

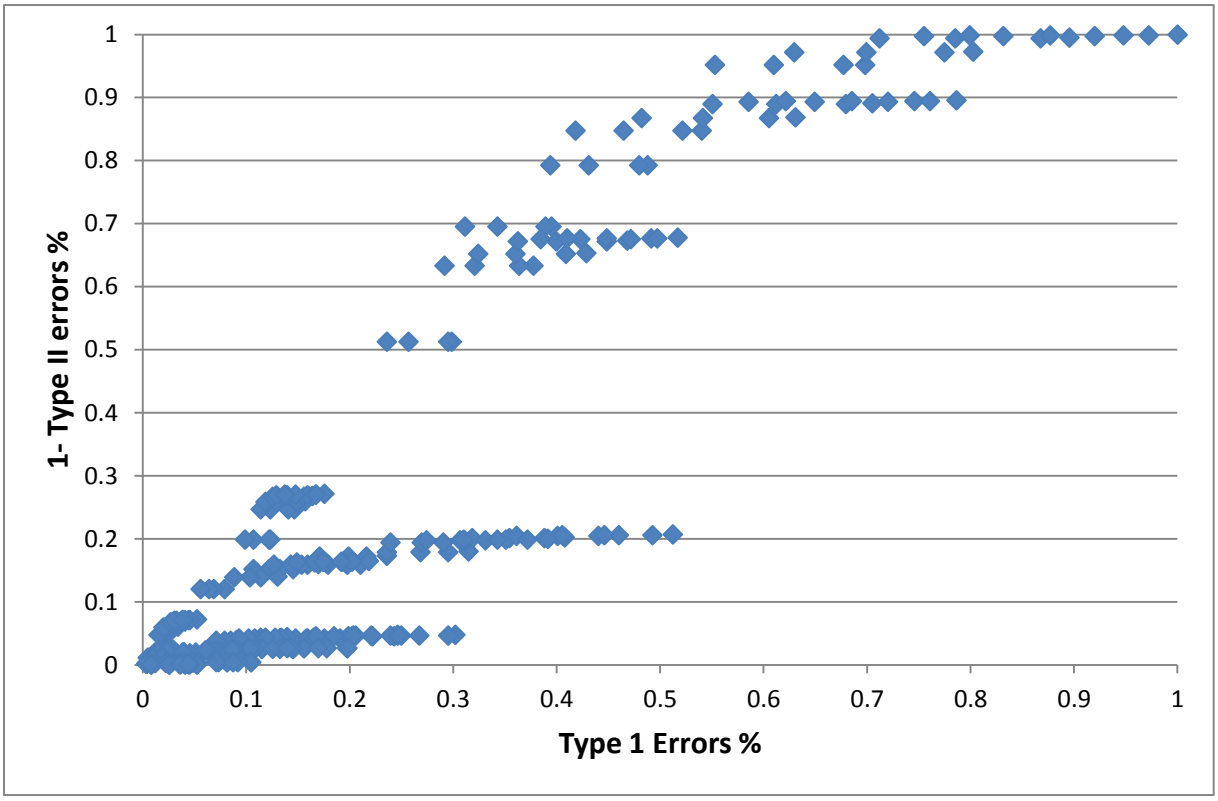
on explanatory variables that have been identified as having useful predictive power for market liquidity in each asset class.

An important objective of this stage of the analysis is to ensure that definitions for each asset class reliably identify securities that are liquid, without either incorrectly defining an illiquid security as liquid or inefficiently defining liquid securities as illiquid. This is achieved within each asset class by setting a common classification of a liquid asset that can be applied across asset classes, and classifying each security on the basis of our empirical analysis. For this stage of the analysis we do not assess liquidity on the full range of metrics analysed previously, but rather select a single volume-based metric (turnover ratio) and a single price-based metric (return volatility) and use these in combination to assess whether an asset is empirically liquid.

Once each asset is classified, we can assess for each possible operational definition how many assets it captures, how many of those assets defined as liquid were actually illiquid (a Type I error), and also how many empirically liquid assets are not captured in the definition (a Type II error). Then we can compare all feasible definitions within an asset class, based on a combination of the factors found to have explanatory power in section 4.2.2, and assess which definitions perform best at minimising the rate of Type I and II errors. The chart below illustrates a typical set of results for sovereign bonds. In this plot, each blue dot represents an operational definition, i.e. a definition which is based on easily observable characteristics (for instance: bonds issued by sovereign governments, above a given issue size, rated no less than ECAI 2, with fixed coupons). There is a very large number of such definitions because each of the criteria can be set at different thresholds, and these choices compound each other. Type I errors are plotted on the x-axis, on the y-axis 1-Type II errors are displayed, effectively capturing the fraction of empirically liquid assets successfully identified by each definition. For each definition, the ‘type I error’ figure is the fraction of bonds in the sample which are objectively illiquid (based on the liquidity metrics from our analysis) and yet would be defined as liquid were we to adopt the definition being tested (represented by the blue dot). The ‘type II error’ figure is the fraction of bonds in the sample which are objectively liquid (based on our analysis) and yet would be defined illiquid were we to adopt that definition.

In this graph, the successful definitions are those closest to the upper left corner of the chart. It is clear immediately that most definitions are strictly dominated by a rival definition, that is to say, there exists another definition that can capture at least as many liquid assets (i.e. the Type II error is no higher) while capturing fewer illiquid assets (i.e. with a lower Type I error). These definitions should clearly be disregarded. However, there is still a whole ‘frontier’ of definitions that are undominated (roughly speaking, the ones standing at the north-eastern edge of the set of blue dots). This frontier goes from (0,0) to (1,1). It shows the trade-off which exists between Type I and Type II errors: a definition which excludes all assets would guarantee 0% Type I but would result in 100% Type II errors, while a definition which accepts all bonds in the sample would achieve 0% Type II but result in 100% Type I error rate. In this diagram we judged that the point furthest to the left on the 0.7 line on the y-axis, represented the best trade-off between Type I and Type II errors. This dot corresponds to the definition we retained for sovereign bonds (sovereign bonds, ECAI 1, a minimum issue size of EUR 250 million).

Plot of Type I and II errors for plausible sovereign bond definitions



We performed a similar process for all asset classes for which we had explanatory variables to test (i.e. not including gold and equities, which are treated as single asset classes with no additional explanatory characteristics). We used the same thresholds (the one we had used for the sovereign bonds) for turnover ratio and for return volatility to classify observations as objectively liquid and objectively illiquid. For each asset class in turn, we then assessed whether there were any definitions which would select a set of observations which would be comparable to the set of sovereign bond observations which meets the definition we had selected. However, we did not require that the sets thus selected should be at precisely the same level, but we allowed for some tolerance. For each possible definition, we checked whether it would select a subsample which matched the median on the selected subsample of sovereigns for one of the metrics (either turnover ratio or price volatility) and for the other metric (turnover ratio or price volatility) we simply required that the security at the 75th percentile for the turnover ratio measure or the 25th percentile for the price volatility measure be able to match the median security in the sovereign bond subsample. For asset classes where it was impossible to find a definition that would achieve this, we considered that these asset classes could not be eligible for the 'extremely highly liquid' level. For the asset class (covered bonds) where there were definitions that would achieve this, we created the same graph as above, and picked the best definition in terms of Type I and Type II errors.

Despite introducing these tolerances, the only other asset class with a comparable level of market liquidity was the covered bond class (as we might have expected from our aggregate comparisons of asset classes in section 4.2.1). Here, we had identified a tightly defined set of covered bonds with large issue sizes and meeting the requirements for enhanced transparency and credit risk management as important determinants of liquidity in section 4.2.2.

The same process was then adopted for the definition of assets of high liquidity and credit quality, omitting all those assets identified as extremely highly liquid, finding the best performing sovereign bond definition based on Type I and II errors for the remaining set of assets, then comparing the relative liquidity of this set to the best sets chosen in the other asset classes. As the liquidity of the remaining sovereigns was significantly lower, on this stage of the analysis we found definitions in a number of asset classes which were of a comparable level of liquidity and hence were deemed to qualify as assets of high liquidity and credit quality. The tables below set out data on the observed market liquidity of the assets defined as liquid in each asset class under this methodology, demonstrating that this method achieved a relatively uniform outcome across asset classes. Neither equities or gold were found to qualify as assets of high liquidity and credit quality as they failed on the price volatility criteria.

Assets defined as assets of extremely high liquidity and credit quality.

	Mean of return volatility	Median return volatility	Mean turnover ratio	Median turnover ratio	75th percentile turnover ratio
EEA sovereign bonds, ECAI 1, min. issue size of EUR 250M	0.6	0.4	0.44	0.17	0.43
EEA covered bonds, ECAI 1, min. issue size EUR500M	0.4	0.3	0.16	0.05	0.17

Assets defined as assets of high liquidity and credit quality.

	Mean of return volatility	Median return volatility	Mean turnover ratio	Median turnover ratio	75th percentile turnover ratio
EEA sovereign bonds, ECAI 1-2, min. issue size of EUR 100M	0.9	0.6	0.22	0.07	0.27
EEA covered bonds, ECAI 1, min. issue size EUR250M	0.8	0.6	0.09	0.03	0.07
Corporate bonds, ECAI 1-4, min. issue size EUR250M, max time to	0.9	0.7	0.08	0.04	0.09

maturity 10 years					
RMBS, ECAI 1, min. issue EUR 100M, max time to maturity 5 years	1.6	0.5	0.06	0.03	0.08
Bonds issued by supranationals, ECAI 1, min. issue size EUR 250M	0.7	0.4	0.06	0.02	0.08
Local government issued bonds, ECAI 1-2, min. issue size EUR 250M, max. time to maturity 10 years	0.3	0.9	0.07	0.05	0.08

4.1.4 Computation of Haircuts

Based on the empirical analysis contained in this report, no additional haircuts are warranted for the assets of high liquidity and credit quality, over and above the minimum levels specified in the Basel LCR text.

4.2. Principles-based analysis of asset classes

Article 416 describes in general terms the composition of the buffer of the LCR. Whereas Article 509(3) CRR mandates the EBA to report to the Commission a uniform definition of transferable assets that are of extremely high liquidity and credit quality (Article 416(1)(b)) and of transferable assets that are of high liquidity and credit quality (Article 416(1)(d)), the CRR itself introduces a set of principles limiting the scope of the eligible assets.

In accordance with to Article 416(1) CRR, assets need to be *transferable*.

Article 416(2) restricts the range of admissible issuers: they should not be issued by a credit institution or by any of the following: (i) an investment firm; (ii) an insurance undertaking; (iii) a financial holding company; (iv) a mixed financial holding company; (v) any other entity that performs one or more of the activities listed in Annex I to Directive 2013/36/EU as its main business. Exceptions are made for covered bonds, asset backed instruments demonstrated to be of the highest credit quality and bonds issued by banks set up by a Member State, guaranteed by a Member State or issued by promotional banks.

Article 416(3) sets out a set of further conditions that assets eligible for the buffer must meet:

a. they should be unencumbered or stand available within collateral pools to be used for the obtaining of additional funding under committed but not yet funded credit lines available to the institution;

b. they should not be issued by the institution itself or its parent or subsidiary institutions or another subsidiary of its parent institutions or parent financial holding company;

c. their price should generally be agreed upon by market participants and able to be easily observed in the market, or their price can be determined by a formula that is easy to calculate based on publicly available inputs and does not depend on strong assumptions as is typically the case for structured or exotic products;

d. they should be eligible as collateral for standard liquidity operations of a central bank in a Member State or if the liquid assets are held to meet liquidity outflows in the currency of a third country, of the central bank of that third country;

e. they are listed on a recognised exchange or they are tradable on active outright sale or via a simple repurchase agreement on approved repurchase markets. These criteria must be assessed separately for each market.

While conditions a and b refer to the eligibility of a single asset within the buffer, conditions c to e are conditions that apply to the asset class itself.

In the following section we will assess each of the asset classes considered by the report in its empirical analysis against the conditions contained in the aforementioned articles:

1. transferability;

2. admissibleness of the issuer;

3. transparency of pricing;

4. central bank eligibility;

5. listing on a recognized stock exchange or tradability on active outright sale or repo markets.

4.2.1 Discussion of the rationale backing the principles

1. Transferability

Article 416(1) requires assets to be transferable. Assets constituting the buffer of the LCR should enable banks to generate means of payment at short notice in order to meet liquidity outflows. To this end banks need to be able to exchange these assets against means of payment. Assets that cannot be transferred cannot in consequence be exchanged against means of payment and are therefore inadequate to insure banks against liquidity risk.

2. Admissibleness of the issuer

Article 416(2) excludes assets issued by credit institutions or other financials. Exceptions are made for covered bonds, asset backed instruments demonstrated to be of the highest credit quality and bonds issued by banks set up by a Member State, guaranteed by a Member State or issued by promotional banks.

Since the LCR is designed to protect banks against systemic stress, it is of the utmost importance that the ratio itself avoid features of pro-cyclicality and wrong way risk. When faced with liquidity stress, a bank is permitted to use the buffer and liquidate the assets it holds either by outright sale or in repo transactions. A fire sale of uncovered bonds issued by financials will inevitably lead to a decline in prices, thus undermining the capacity of banks to refinance themselves on the capital markets and generating pro-cyclical effects.

If eligible, credit institutions could issue these bonds to each other, increasing the interconnectedness in the system and thus systemic risk. This argument underlines the importance of the **concept of outside liquidit**y. This concept emphasises that assets which are intended to serve as a reliable source of liquidity in stress times cannot be solely linked to issuers and investors from the financial system.

3. Transparency of Pricing

The CRR requirement of pricing transparency relates to the Basel HQLA characteristic of "ease and certainty of valuation". The Basel framework argues that "an asset´s liquidity increases if market participants are more likely to agree on its valuation. Assets with more standardised, homogeneous and simple structures tend to be more fungible, promoting liquidity. The pricing formula of a high-quality liquid asset must be easy to calculate and not depend on strong assumptions. Inputs into the pricing formula must also be publicly available. In practice, this should rule out the inclusion of most structured or exotic products." (Basel 2013, paragraph 24) The rationale behind this assumption is that assets that form part of the buffer might need to be liquidated in stress periods and at short notice. Transparent pricing facilitates price discovery under stressed conditions.

4. Central bank eligibility

Liquid assets should be eligible collateral for standard liquidity operations of the central bank of the country in question. This does not imply that an institution actually does need to have direct access to these central bank operations.

The general outset of the LCR underlines the importance of banks´ reliance on private markets to increase their resilience against liquidity stress. Policymakers have identified issues of moral hazard when banks rely too heavily on central bank refinancing in stressed periods. Central banks have generally been perceived as an insurance against liquidity risk, limiting the scope of action of central banks in a crisis.

However, central banks are lenders of last resort. If private markets fail, it should be possible to pledge eligible assets with the central bank to obtain liquid funds. Therefore this criterion can be described as backstop criterion for cases of severe market failure.

Given the varying scope of central bank eligibility within the European Union as shown in the following graph, the compulsory condition of central bank eligibility will lead to different definitions of liquid assets in the different currency zones of the European Union. Policymakers should balance the desired effect of central bank eligibility and the undesired effect of an uneven playing field within Europe when reconsidering the requirement of central bank eligibility. In the Basel framework the condition of central bank eligibility is phrased with “ideally” (Basel 2013, paragraph 23).

List of central bank eligible assets per country:

Table 1: Central bank eligible assets	Bulgaria	Croatia	Czech Republic	Denmark	Euro area	Hungary	Iceland	Latvia	Lithuania	Norway	Poland	[Romania]	Sweden	United Kingdom
Debt instruments issued by central banks	No (1)	yes	yes	yes	yes	yes	yes	no	no	yes	yes	[yes]	yes	yes
Central government debt instruments	No (1)	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	[yes]	yes	yes
Supranational debt instruments	No (1)	yes	yes	no	yes	yes	no	no	no	yes	yes (only EIB) (4)	[yes]	yes	yes
Securities unconditionally guaranteed by the central government	No (1)	yes	no	yes	yes	yes	yes	yes (3)	yes (6)		no	[no]	yes	yes
Local and regional government debt instruments	No (1)	yes	no	yes	yes	yes (2)	no	no	no	yes	yes (4)	[no]	yes	yes
Covered bonds	No (1)	yes (3,4)	no	yes	yes	yes (2)	no	yes (3)	no	yes	yes (4)	[no]	yes	yes
Debt instruments issued by corporate and other issuers	No (1)	yes (3,4)	no	no	yes	yes (2)	no	yes (3)	no	yes	yes (4)	[no]	yes	yes
Credit institutions debt instruments (other than covered bonds)	No (1)	yes (3,4)	no	yes	yes	yes (2)	no	yes (3)	no	no	no	[no]	no	no
Asset backed securities	No (1)	yes (3,4)	no	no	yes	no	no	no	no	yes	no	[no]	yes (5)	yes
Credit claims	No (1)	no	no	yes	yes	no	no	no	yes	no	no	[no]	no	no
Retail mortgage backed debt instruments (rmbs)	No (1)	yes (3,4)	no	no	yes	no	no	no	no	no	no	[no]	no	yes
Other assets	No (1)	no	no	yes	yes	no	no	no	yes (7)	no	no	[By decission of CB]	no	no

(1) See paragraph 4
(2) Allowed in principle, but only few requirements meet the requirements
(3) Allowed in principle, but not used in practice
(4) Subject to conditions
(5) Only until 31. December 2013
(6) State guarantees
(7) Includes credit institution warranties, and guarantees issued by procedure established by the Government and other asset by decission of the Central Bank
[not confirmed]

5. **Listing on a recognised stock exchange or tradability on active outright sale or repo markets**

The existence of private markets for liquid assets is a prerequisite for them being able to be liquidated. These markets need to be “active and sizeable” in Basel terminology.

The CRR requires these criteria to be “assessed separately for each market”. Since the focus of the LCR lies in the liquidation of the buffer on private markets, it is crucial that these markets exist. Listing on a recognised stock exchange can be interpreted as evidence that there is a market place for the asset. Otherwise assets should be tradable on active outright sale markets. As long as there is a possibility to sell the assets in a reasonably short time, the criterion should be met. Therefore for those assets for which we have sufficient data to perform a quantitative analysis, judging whether this criterion has been met is primarily an empirical question.

Taking into consideration repo markets reflects the circumstance that repo markets can substitute outright sale markets as generators of liquidity. For some markets this is especially true under stressed conditions.

It should therefore be ensured that these private markets work under stressed conditions. This implies a high diversity of market participants, a robust infrastructure and ongoing trading.

4.2.2 Mapping between asset classes and principles

1. **Asset classes considered by the empirical analysis:**

- **Government Bonds**

Transferability. Government bonds are transferrable

Admissibleness of the issuer. An exemption from the exclusion of the issuer is made for bonds issued by credit institutions that are set up by a Member State central or regional government and that government has an obligation to protect the economic basis of the institution and maintain its viability throughout its lifetime or the asset is explicitly guaranteed by that government.

Transparency of pricing. Government bonds are standardised and have simple structures. Valuation does not depend on strong assumptions.

Central bank eligibility. State government bonds are central bank eligible for standard liquidity operations in all countries where these exist. Bonds issued by regional governments are not accepted in Bulgaria, the Czech Republic, Iceland, Latvia, Lithuania and Romania. Securities guaranteed by the central government are not admissible in Bulgaria, the Czech Republic, Poland and Romania.

Listing on a recognised stock exchange or tradability on active outright sale or repo markets. In many countries, government bonds are listed on a recognised stock exchange. The results of the quantitative analysis show that government bonds are traded on active markets. Alongside cash, government bonds are the most frequently used collateral in repo transactions.

- **Corporate Bonds**

Transferability. Corporate bonds are transferrable.

Admissibleness of the issuer. Corporate bonds issued by a credit institution, an investment firm, an insurance undertaking, a financial holding company, a mixed financial holding company or any other entity that performs one or more of the activities listed in Annex I of Directive 2013/36/EU as its main business are not admissible as liquid assets under the LCR buffer.

Transparency of pricing. Corporate bonds are standardised and have simple structures.

Central bank eligibility. Corporate bonds are central bank eligible for standard liquidity operations in many countries. They are not eligible in Bulgaria, the Czech Republic, Denmark, Iceland, Lithuania and Romania.

Listing on a recognised stock exchange or tradability on active outright sale or repo markets. Most corporate bonds are listed on a recognised stock exchange. The results of the empirical analysis show that most corporate bonds are traded on active markets. Corporate bonds are less frequently used in repo transactions, although they are eligible collateral for some repo pools comprising central bank eligible assets.

- **Covered Bonds**

Transferability. Covered bonds are transferrable.

Admissibleness of the issuer. Covered bonds eligible for the treatment set out in Article 129(4) or (5) CRR, or bonds referred to in Article 52(4) of Directive 2009/65/EC, are exempt from the exceptions concerning the admissibleness of the issuer. The perceived rationale is that given the collateralisation of covered bonds, these are protected from the effects of wrong way risk. Self-issued covered bonds remain excluded.

Transparency of pricing. The structure and design of covered bonds is standardised in national covered bond regulation. These may involve differing degrees of standardisation with respect to the structure and transparency requirements of the bonds and special regulation for the issuer.

Central bank eligibility. Covered bonds are central bank eligible for standard liquidity operations in many countries. They are not eligible in Bulgaria, the Czech Republic, Iceland, Lithuania and Romania.

Listing on a recognised stock exchange or tradability on active outright sale or repo markets. Most covered bonds are listed on a recognised stock exchange. The results of the empirical analysis show that most covered bonds are traded on active markets. Covered bonds are less frequently used in repo transactions, although they are eligible collateral for some repo pools comprising central bank eligible assets. Covered bonds which are privately placed are not eligible for the liquidity buffer under the LCR.

- **Bonds issued by promotional banks**

Transferability. Bonds issued by promotional banks are transferrable.

Admissibleness of the issuer. Bonds issued by promotional banks are exempt from the conditions limiting the admissibleness of the issuer. The rationale resides in their direct link to state or regional governments and their role in sponsoring the economy. Bonds issued by promotional banks may also have a state or regional government guarantee.

Transparency of pricing. Bonds issued by promotional banks are standardised and have simple structures.

Central bank eligibility. Bonds issued by promotional banks that do not have a state guarantee are not accepted in Bulgaria, the Czech Republic, Denmark, Iceland, Lithuania and Romania. Otherwise, the requirements for state guaranteed bonds apply.

Listing on a recognised stock exchange or tradability on active outright sale or repo markets. Most bonds issued by promotional banks are listed on a recognised stock exchange. The results of the quantitative analysis show that most bonds issued by promotional banks are traded on active markets. Bonds issued by promotional banks are less frequently used in repo transactions, although they are eligible collateral for some repo pools comprising central bank eligible assets.

- **ABS including RMBS**

Transferability. ABS are transferrable.

Admissibleness of the issuer. ABS if demonstrated to be of the highest credit quality as established by the EBA pursuant to the criteria in Article 509(3), (4) and (5) are exempt from the exceptions concerning the admissibleness of the issuer. This criterion should therefore not be binding within the report. ABS which are self-issued are not eligible as liquid assets under the LCR buffer.

Transparency of pricing. The structure and design of ABS are not subject to national regulation. Generally, these products are bespoke. Industry initiatives have been launched to increase the transparency of ABS.

Central bank eligibility. ABS are not eligible for standard central bank operations in Bulgaria, the Czech Republic, Denmark, Hungary, Iceland, Latvia, Lithuania, Poland and Romania. In Sweden they are eligible only until 31 December 2013.

Listing on a recognised stock exchange or tradability on active outright sale or repo markets. Most ABS are listed on a recognised stock exchange. The results of the empirical analysis show that the liquidity of ABS markets is highly heterogeneous. ABS are less frequently used in repo transactions, although they are eligible collateral for some repo pools comprising central bank eligible assets. ABS which are privately placed are not eligible for the liquidity buffer under the LCR.

- **Equities**

Transferability. Equities are transferrable.

Admissibleness of the issuer. Equities issued by a credit institution, an investment firm, an insurance undertaking, a financial holding company, a mixed financial holding company or any other entity that performs one or more of the activities listed in Annex I of Directive 2013/36/EU as its main business are not admissible as liquid assets under the LCR buffer.

Transparency of pricing. Equities are standardised and have simple structures. Equities have high price volatility.

Central bank eligibility. Equities in general are not central bank eligible.

Listing on a recognised stock exchange or tradability on active outright sale or repo markets. Equities are listed on a recognised stock exchange. The results of the quantitative analysis show that equities are traded on active markets and show high trading volumes and turnover rates.

- **Gold**

Transferability. Gold is transferrable.

Admissibleness of the issuer. As a physical asset, the criteria that refer to the admissibleness of the issuer do not apply.

Transparency of pricing. Gold and gold contracts are standardized and have simple structures.

Central bank eligibility. Gold is not eligible as collateral for standard central bank operations in the EU.

Listing on a recognised stock exchange or tradability on active outright sale or repo markets. Gold is not listed on stock exchanges. It is traded in outright sale markets. Gold is not found to be used as collateral in our survey of repo transactions.

2. Asset classes not considered by the empirical analysis due to lack of data (a detailed assessment is required)

- **Credit Claims**

Transferability. The secondary market for credit claims is limited.

Admissibleness of the issuer. Credit claims are claims generated by credit institutions, collateralised however by claims against a private or corporate customers.

Transparency of pricing. Credit claims are claims that banks hold against customers based on an individual loan agreement. Therefore there is no standardised or uniform documentation. Credit claims lack external prices and are generally not rated. The price of credit claims is not generally agreed upon by market participants. At the same time, it may be argued that credit claims can be turned into liquid assets by including them in securitisations, which may subsequently be issued in the primary and traded in the secondary market. A drawback is that the securitisation process may need considerable time and may take too long to obtain liquidity within the 30 day time limit set out for liquidity coverage ratio, without accepting large discounts or haircuts. Another consideration may be that under distressed market conditions the liquidity of credit claims may quickly vanish, being highly dependent on the ease of valuation and market conditions. Overall, the lack of liquidity limits the usefulness of credit claims in the liquidity coverage requirement set out under Article 412 CRR.

Central bank eligibility. The Eurosystem provides credit against a set of non-marketable asset including credit claims subject to eligibility criteria[2]. Under the Eurosystem's general framework, credit claims to debtors or guarantors from the public sector, non-financial corporations and international and supranational institutions which are established in the euro area, subject to high credit standards and denominated in euros are eligible as collateral[3]. The reasons for using credit claims by the Eurosystem are twofold. First, credit claims were already used as eligible collateral by a number of Eurosystem members. Second, the Eurosystem aims at implementing monetary policy with a wide set of collateral. As of Q2 2013, credit claims used as collateral in Eurosystems operations accounted for EUR 452.5 billion or 19% of all used collateral[4]. The inclusion of credit claims as eligible LCR assets would thus significantly widen the definition of extremely high and high liquid assets and undermine the objective of the LCR.

[2] See Article 6.2.2 in the Guideline of the ECB of 20 September 2011 on monetary policy instruments and procedures of the Eurosystem (recast) (ECB/2011/14).

[3] In addition, retail mortgage backed debt instruments and fixed term deposits from eligible counterparties are also eligible as non-marketable assets.

[4] N.B.: the volume and share of non-marketable assets pledged as collateral in the Eurosystem's operations has gone up significantly since the onset of the financial crisis. In 2006, the corresponding share was 4 percent.

Listing on a recognised stock exchange or tradability on active outright sale or repo markets. The lack of available evidence for the quantitative analysis reflects the lack of secondary market trading activity in these assets. Credit claims cannot be liquidated directly in secondary markets.

- **Major index linked equity instruments: Exchange traded funds (ETFs)**

Exchange traded funds are funds traded on the stock exchange investing in all kinds of assets. What started as a simple plain vanilla replication of a main stock market index, which was passively managed, may now also be an actively managed synthetic ETF where the assets are not held outright but where the ETF attempts to replicate index performance via swap contracts. In addition, ETFs holding equity shares outright obtain a significant part of their income from securities lending giving rise to counterparty credit risk concerns. From a macroprudential perspective, a sudden withdrawal by ETF investors may negatively impact the market liquidity of assets held by ETFs[5]. As a result, equity ETFs besides being volatile may not exhibit the desired characteristics for the liquidity coverage requirement.

Transferability. ETFs can be transferred on private markets. While low transaction and management costs permit the efficient liquidation of ETF shares to ETF investors, the underlying assets of ETFs typically give rise to high volatility

Admissibleness of the issuer. ETFs are issued either by financial institutions or SPVs. Especially synthetic ETFs which only replicate the index are highly dependent on the ability of the credit institution to honour its swap contracts with the emitting SPV.

Transparency of pricing:.The price of the ETF should mirror the price of the index it represents.

Central bank eligibility: ETFs are not central bank eligible

Listing on a recognised stock exchange or active outright sale or repo markets. The assets of equity ETFs are by definition listed on a stock exchange. They are not usually used as collateral in repo transactions.

- **Mutual funds (CIUs)**

For the purposes of this assessment we restrict the assessment of mutual funds to CIUs mentioned in the CRR reporting requirement.

As per Article 416(6) CRR, shares in CIUs may be treated as liquid assets provided that a CIU (apart from derivatives to mitigate interest rate or credit or currency risk), only invests in liquid assets eligible for the LCR. The CIU is therefore considered to be a liquid asset depending on the assets it invests in. The above-mentioned principle-based criteria refer only to specific assets. It seems however useful to assess whether CIUs have the liquidity generating capacity that is needed when allowing CIUs to form

[5] See Financial Stability Board (2011), Potential financial stability issues arising from recent trends in exchange traded funds.

part of the buffer. This refers mainly to the smoothness and timeliness of them being liquidated. An institution should therefore be able to liquidate shares of CIUs at short notice in private markets or return their shares to the asset management company. In the former case, liquidation should be possible in active outright or repo markets. In the latter case, the decision should lay exclusively with the bank returning the CIU. Moreover, consideration should also be given to the specific inclusion of shares in CIUs in the LCR. Shares of a CIU investing entirely in assets of extremely high liquidity may be considered as eligible in Level 1, while CIUs investing in assets corresponding to the definition of high liquidity could be included in Level 2. In order to facilitate the classification of CIU shares, CIUs will need to be transparent with regard to their investment portfolios. Further consideration will be needed for cash held by CIUs as deposits with banks with regard to their inclusion in the LCR.

Summary Table: Mapping of assets to principles for acceptable liquid assets:

	Transferability	Issuer	Pricing	Central Bank eligibility	Listing or active outright sale or repo markets
Government bonds	✓	✓	✓	✓	✓
Covered bonds	✓	not applicable	✓	✓ or X*	✓
Corporate bonds	✓	✓	✓	✓ or X*	✓
Bonds issued by promotional banks	✓	not applicable	✓	✓ or X*	✓
ABS incl. RMBS	✓	not applicable	X	✓ or X*	X
Non-financial Equities	✓	✓	✓	X	✓
Gold	✓	not applicable	✓	X	X
Credit Claims eligible with CBs	X	X	X	✓ or X*	X
ETF	✓	X	✓	X	✓
CIU	not applicable				

*Depends on the regime of the national central bank

4.2.3 Conclusions of the principles-based analysis

The conclusions that can be drawn from the principles-based analysis are as follows:

Central bank eligibility as collateral for standard operations differs substantially between the currency zones in the European Union. Policymakers should balance the desired effect of central bank eligibility and the undesired effect of an uneven playing field within Europe when reconsidering the requirement for central bank eligibility. In the Basel framework the condition of central bank eligibility is prefaced with “ideally” (Basel 2013, paragraph 23).

The principles-based analysis of the different asset classes shows the following result:

- Government, corporate and covered bonds all pass the principles-based assessment at an asset class level. However, the latter two are not eligible as collateral in standard central bank operations in some countries within the European Union.

- ABS show possible deficiencies in the transparency of pricing and trading.

- Equities and gold both fail the central bank eligibility criteria.

- A principles-based assessment indicates that credit claims and ETFs should not be considered as eligible as they fail on multiple criteria.

This analysis at an asset class level should not exempt institutions from applying the principles to individual assets, as for some markets and/or assets this general validation may not hold true. It remains the responsibility of individual single bank to judge whether a single asset would qualify to be eligible for the LCR-buffer.

4.3. Quantitative analysis of repo market data

Article 417(b) CRR specifies that institutions may only report as liquid assets those that, inter alia, are legally and practically readily available at any time during the next 30 days to be liquidated via outright sale or via a simple repurchase agreement on approved repurchase markets in order to meet obligations coming due. In line with this, feedback during the public consultation clearly pointed towards the importance of the repo market in any analysis to provide uniform definitions of assets of high and extremely high liquidity and credit quality.

While sections 4.3.1 to 4.3.3 present qualitative summaries of the European repo market as well as its development during recent years, sections 4.3.4 and 4.3.5 present a survey-based analysis.

4.3.1 Summary of the European repo market

The European repo market grew steadily before the crisis and remained within stable relatively bounds after December 2009, it is currently experiencing expansion which may be partly due to LTRO repayments.

As the latest ICMA European Market Survey (June 2013) shows, cross-border repo transactions continue to dominate, although their share fell from 50.5% in December 2012 to 48.2%, while

domestic and anonymous transactions rose to 30.7% and 21.1% respectively. CCPs retain an important role in the European repo market, with a share of approximately 30% of all deals, although market sentiment is good and risk aversion should not be high. At the same time, the tri-party segment stayed below 10%. European repo transactions are mainly conducted in euros (about 65%), with U.S. dollars and British pounds following (about 15% and 11%). German, British and French collateral dominates (22%, 12% and 12%), although British government securities exhibited a significant decline and *Pfandbriefe* halved their share. In tri-party transactions, government securities play the most important role (38%), followed by equity (21%) and corporate bonds (14%). Haircuts narrowed slightly for a number of collateral types in 2013 and vary between 2.2% for public agencies/sub-national to 9.5% for commercial mortgage-backed. The haircuts of lower quality collateral had increased in 2012. Generally the maturities of the contracts are short, 57% of them maturing in less than a month, up from 50.5% in December 2012, probably a sign of migration from the LTRO towards market funding. The degree of concentration is on a downward sloping trend.

4.3.2 The EU repo market during the financial crisis

During the recent financial turmoil the terms for repo transactions tightened and the absolute volume of repos generally declined, a noteworthy exception being the German Eurex repo market and its EURO GC (General Collateral) pooling segment. However, because market participants experienced a loss of confidence in their counterparties' creditworthiness, the importance of secured lending increased, which translated into superior relative volumes of repos, compared to the rest of the money markets.

To begin with, the average repo maturity shortened significantly throughout the world, overnight repos gaining an increasingly important share of the market, while Germany remained the exception and experienced longer maturities due to the reduced credit risk on the CCP-cleared market.

With regard to collateral, cross-border use of it increased, reflecting the shortage of high quality collateral. Interbank repos were mainly based on government securities, while ABS and non-marketable securities were used with the central banks. Markets that allowed re-use of collateral seem to have performed better (e.g. Luxembourg). In addition, the liquidation of collateral posed, at times, problems of a legal and operational nature.

Margins and haircuts increased in many markets, such as the US and the UK, but not in Germany, Japan or Switzerland. Nevertheless, settlement fails generally did not increase, excepting the US, UK and Japan, which saw an increase in settlement fails especially during the period around the default of Lehman Brothers. The cost of failing was however low.

Central banks played an important role during the crisis by actively providing funding in the repo market and broadening the list of central bank eligible collateral. At the same time, the liquidity facilities they offered, in combination with a low interest rate environment, further contributed to a reduction in repo transactions in some markets.

Consistent with the rise in risk aversion, credit risk mitigants proved to be especially valuable and CCP-cleared repos actually increased in volume in some markets or decreased considerably less than non-CCP cleared ones. Furthermore, although tri-party repo seems to have remained a reliable source of funding for some institutions, the tri-party repo volume generally decreased, but to a lesser extent than for bilateral transactions.

Overall, high credit risk aversion, combined with legal and operational issues related to the liquidation of collateral and the lack of transparency in some repo markets led to a broad deleveraging of market participants. Credit lines have been significantly reduced and counterparty limits tightened. High quality collateral became scarce, while interest rates plummeted. Repo maturities decreased as margins and haircuts increased. Under such conditions, repo activity could only shrink in nominal terms.

4.3.3 Developments in the EU repo market

The GC pooling segment is based on standardized baskets of collateral and saw an increase in popularity over the past years. It is also attractive because it makes use of a third party, which is often a central clearing counterparty. A good example of such a market is the Eurex GC pooling segment, which increased in volume by more than 10% per year even during the financial turmoil. An important benefit of trading over it is the reusability of collateral for other money market transactions; in particular, the participants have also the opportunity of refinancing within the framework of European Central Bank open market operations. Nevertheless, it provides anonymity and eliminates credit or security allocation issues through its CCP.

With regards to the tri-party segment of the repo market, it is much larger in the United States compared to Europe, amounting to as much as two thirds of total transactions. In Europe, not only does the tri-party segment represent approximately 10% of the market, but it is on a downward trend and it currently experiencing a low. Possible reasons for such behavior are the fact that tri-party agents do not absorb any of the risks associated with the transactions and, at the same time, 3-year LTROs are competing with tri-party repo financing.

4.3.4 Data description

For the quantitative analysis of the European repo market, we use information from a survey-based data collection. Our data contains information per asset class and collateral type from June 2008 to June 2013. More specifically, the dataset includes information on the total amounts and percentages outstanding as well as the average haircuts of all asset classes, and is further broken down by currency (EUR, GBP, other) in addition to credit quality steps.[6]

[6] The following asset classes are included: 1) EEA sovereign debt; 2) Non-EEA sovereign debt; 3) EEA public agency/Non-central government PSEs; 4) Non-EEA public agency / Non-central government PSEs; 5) BIS, IMF, EC and MDB debt; 6) ESM and EFSF debt; 7) Financial corporate debt; 8) Non-financial corporate debt; 9) Covered bonds; 10) ABS; 11) RMBS; 12) Other MBS; 13) CDOs; 14) CLNs and 15) Equities.

As is usually the case with surveys, our data are subject to potential measurement biases. While we cannot do this with absolute certainty, we verified the data as far as possible via cross-comparisons with other data sources. On top of this general problem, we could only collect detailed information from 2008 to 2013, implying that our time series might not be fully representative. Importantly, however, our dataset includes a few months before the failure of Lehman Brothers and is therefore sufficient for our purposes. A third shortcoming of our data is that for some elements of the analysis it only includes tri-party repos cleared by a limited number of large counterparts. Each EMU country however is represented in every period of our data. Data included in the analysis does not measure the value of repos transacted with central banks as part of refinancing operations.

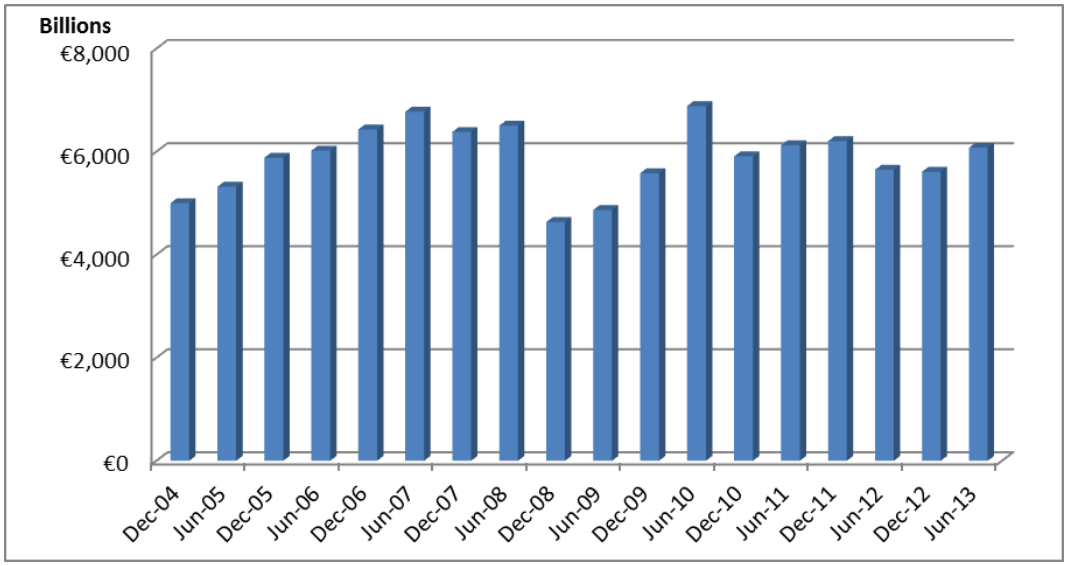
Despite these shortcomings, our data can be considered to be sufficiently representative of the European market and will facilitate a comparison across asset classes at a given point in time and a comparison across time periods of the individual asset classes. Still, the analysis of the repo markets can only be seen as supplementary to the main data analysis and is not a stand-alone exercise.

4.3.5 Data analysis for the EU repo market

Total value outstanding

Figure 1 shows the total value at a given point in time for repos and reverse repos outstanding at European institutions covered by the survey. It highlights a decline in repo business in 2008, in the middle of the financial crisis, and a steady increase in repos outstanding from that point, back to pre-crisis levels. The amount outstanding reached a recent low of EUR 4.6 trillion in Dec 2008 and a high of EUR 6.9 trillion in June 2010.

Figure 1 – Total value outstanding 2004 - 2013



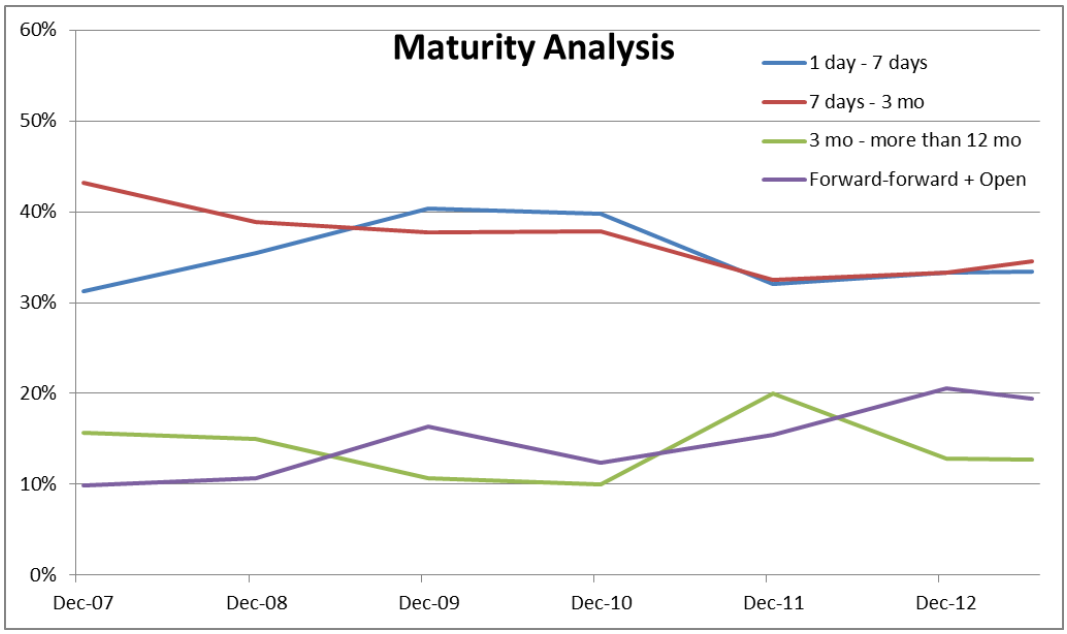
Maturity analysis

The maturity profiles of repo transactions have changed over time. Historically, repo maturities have been relatively short with over 60% of outstandings having a maturity of 3 months or less throughout the period 2001 – 2013. Between 2007 and 2009 there was a marked shortening of maturities. By December 2009, over 40% of repos outstanding had a maturity of 7 days or less. Over the same period there was a corresponding a drop in outstandings with maturities of over 1 month. In recent years there has been an increase in open maturity repos and forward-forward repos. The changes to maturity profiles can be seen in Table 1.

Table 1 – Maturity analysis 2007 - 2012

	Dec-07	Dec-08	Dec-09	Dec-10	Dec-11	Dec-12	Jun-13
1 day	14%	18%	22%	21%	16%	17%	17%
2-7days	17%	17%	18%	19%	16%	16%	16%
> 7 days <= 1mo	23%	20%	23%	23%	16%	17%	17%
<= 1 mo <= 3 mo	20%	19%	15%	15%	17%	16%	16%
<= 3 mo <= 6 mo	7%	8%	5%	5%	4%	4%	4%
<= 6mo <= 12 **mo**	6%	6%	5%	4%	3%	3%	3%
more than **12mo**	3%	2%	1%	1%	13%	6%	6%
forward-forward repos	6%	5%	11%	7%	10%	8%	8%
open	4%	6%	5%	6%	6%	13%	13%

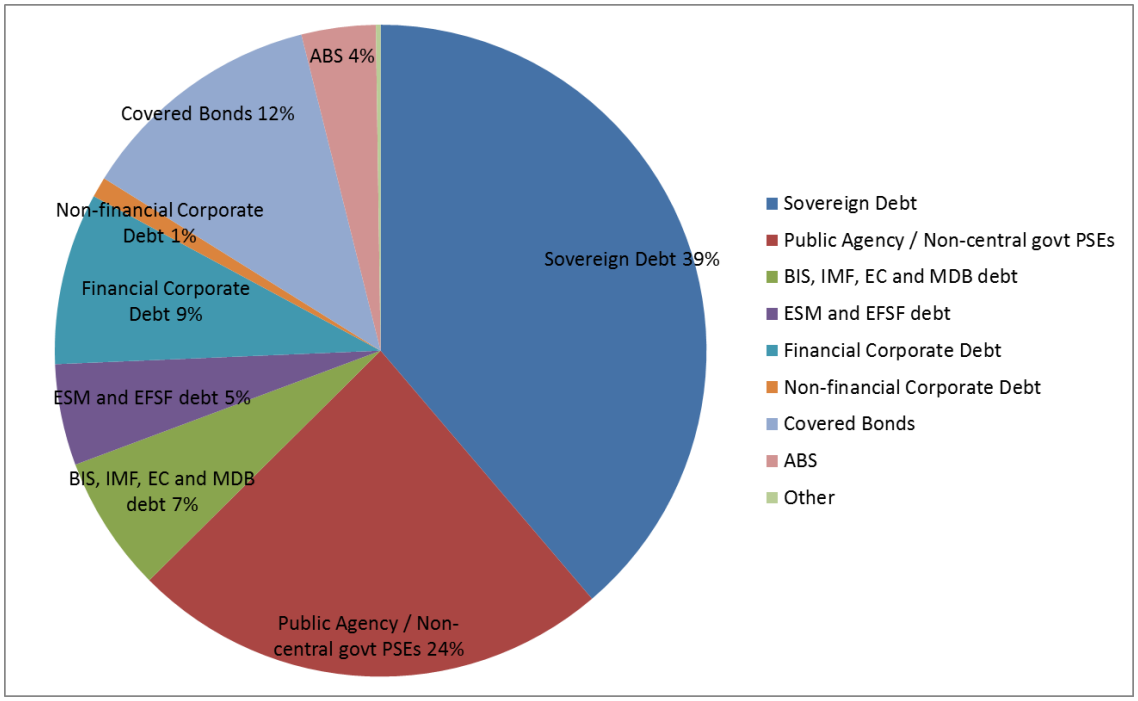
Figure 2 – Maturity analysis 2007 - 2013



Breakdown by collateral type

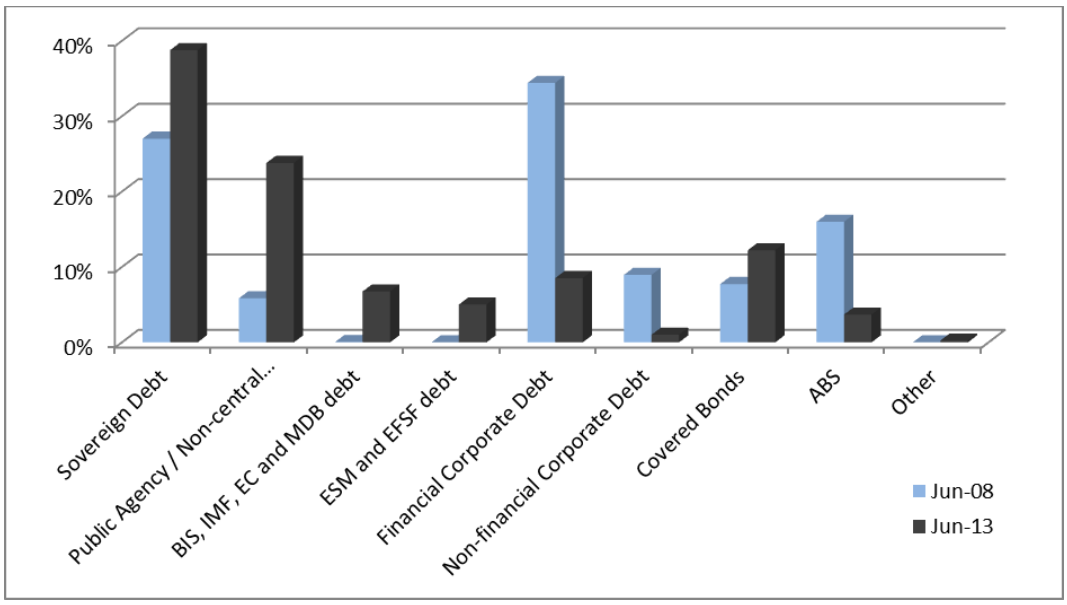
Figure 3 gives the breakdown by collateral type of the main fixed income asset classes. Sovereign debt is the most commonly used collateral in repo transactions, accounting for approximately 39% of all outstanding repos followed by public agency/PSE and supranational debt. Covered bonds account for 12% and corporate bonds 10%, however the majority of this debt is financial corporate debt. While ABS make up 4% of the total outstanding, this is comprised of all types of ABS, including RMBS, CMBS, CDO and CLNs.

Figure 3 – % Outstanding by fixed income collateral type as at June 2013



The type of collateral used in fixed income repo transactions has changed significantly since the onset of the financial crisis. In 2008, corporate debt and ABS would have accounted for over 59% of all fixed income repos. This combined total has dropped to 13% in 2013. Sovereign, public agency/PSE, supranational debt and covered bonds have gone from making up 33% of the total outstanding in 2008 to 74% in 2013. Figure 4 emphasises this change over a relatively short time period.

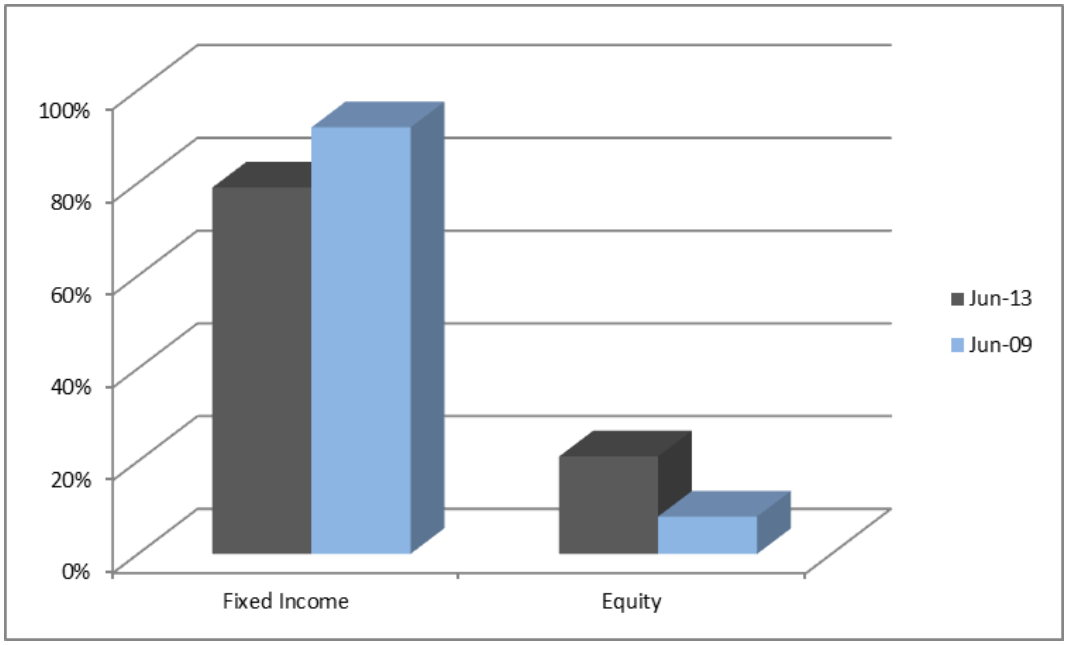
Figure 4 – % Outstanding by fixed income collateral type 2008 - 2013



When Equity is included in the analysis as a type of collateral used in tri-party repo transactions and compared against fixed income collateral types, it is shown to make up an increasing amount of the total collateral outstanding. Figure 5 highlights the increase in the use of equity compared to fixed income collateral from 2009 to 2013.

It should be noted that while the volume outstanding of equity collateral is relatively high, it does not necessarily signify a corresponding increase in the use of the asset in money market transactions, rather, it highlights that there has been an increase in the amount of collateral used in equity market transactions relative to fixed income repo transactions.

Figure 5 – % Outstanding - fixed income & equity - 2009 - 2013



Analysis by collateral type

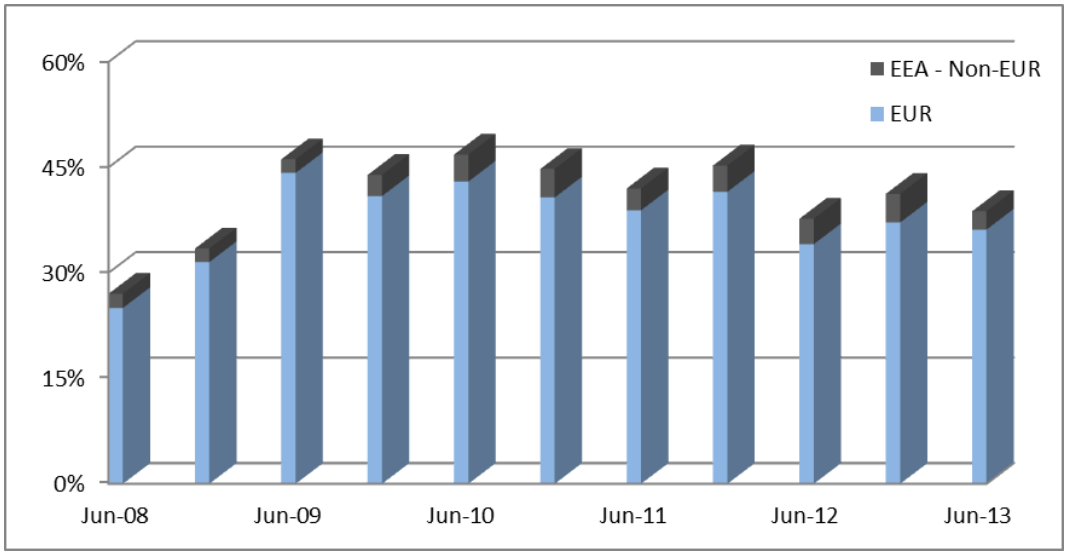
The following section examines the change over time of the use of the main asset classes as collateral and gives a further breakdown of the percentage outstanding in asset subclasses and includes detail on the relative use of collateral with credit quality as a determining factor.

Sovereign debt

By June 2008, there was a large decrease in the total repos outstanding which reflects a reduction of business transacted through repos. Between December 2008 and June 2009 there was another significant shift. The repo market itself remained relatively stagnant, yet dealers moved away from using financial corporate debt and ABS as collateral and relied more on sovereign bonds. As the market picked up in 2010 this trend continued with the percentage of sovereign debt to total collateral outstanding remaining relatively constant. This can be seen in Figure 6. There has been a slight reduction in the use of sovereign debt since 2011, which coincides with a relative increase in the use of public agency and supranational debt.

The amount of non-Euro EEA sovereign debt used for collateral relative to total repos outstanding has remained relatively constant throughout the period, fluctuating between 2% - 4% of total collateral outstanding.

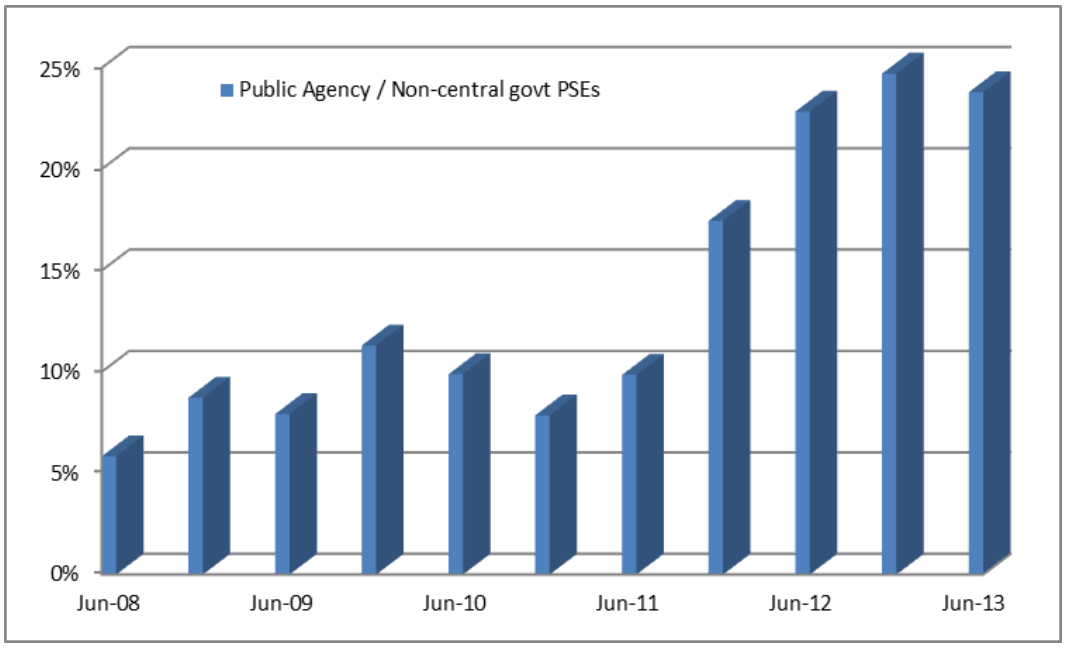
Figure 6 – Sovereign debt as a % of fixed income repos outstanding 2008 - 2013



Public agency & non-central government public sector entities

The amount of public agency and non-central government PSE debt used as collateral was relatively constant between June 2008 and June 2011. Starting in December 2011 there was a large increase in the use of these bonds as collateral. In a six month period, the amount used as collateral doubled. The amount relative to total fixed income collateral outstanding went from 10% in June 2011 to 24% in June 2013.

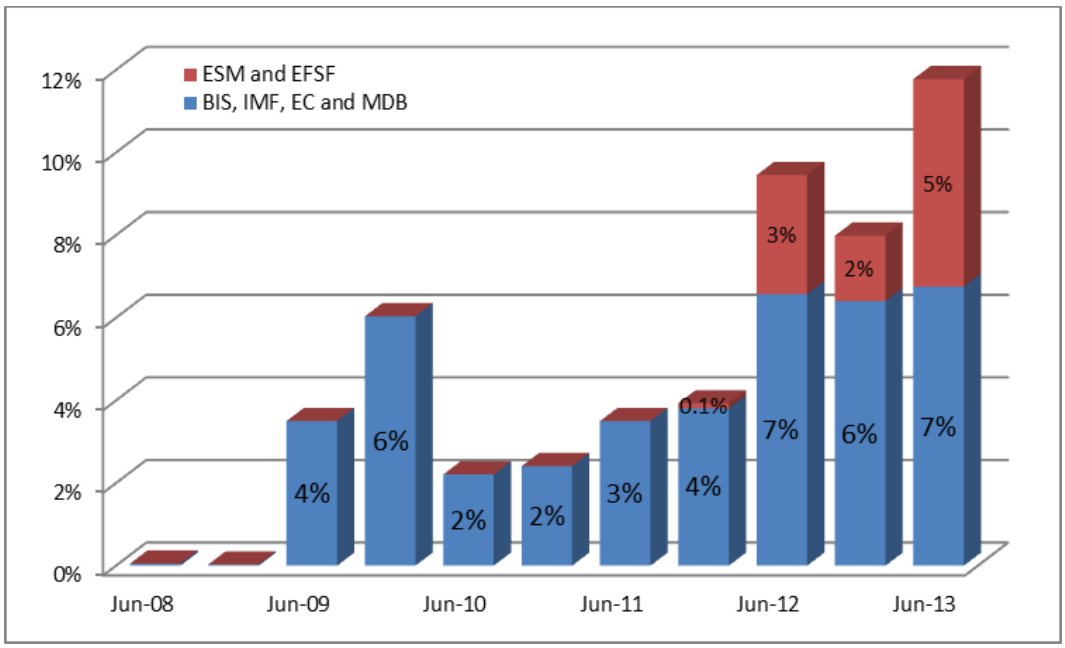
Figure 7 – Public agency & non-central govt. PSE debt as a % of fixed income repos outstanding 2008 - 2013



Supranational debt

Supranational debt used as collateral, i.e. debt issued by the BIS, the IMF, the Commission, multilateral development banks, the ESM and the EFSF has increased from close to 0% of all outstanding collateral in 2008 to 12% of all fixed income collateral traded in 2013. These bond types became more popular from 2009 as dealers reduced their holdings in other types of collateral. EFSF debt was first issued in 2011; ESM and EFSF debt now account for circa 5% of all outstanding fixed income collateral or 42% of the supranational debt used as collateral.

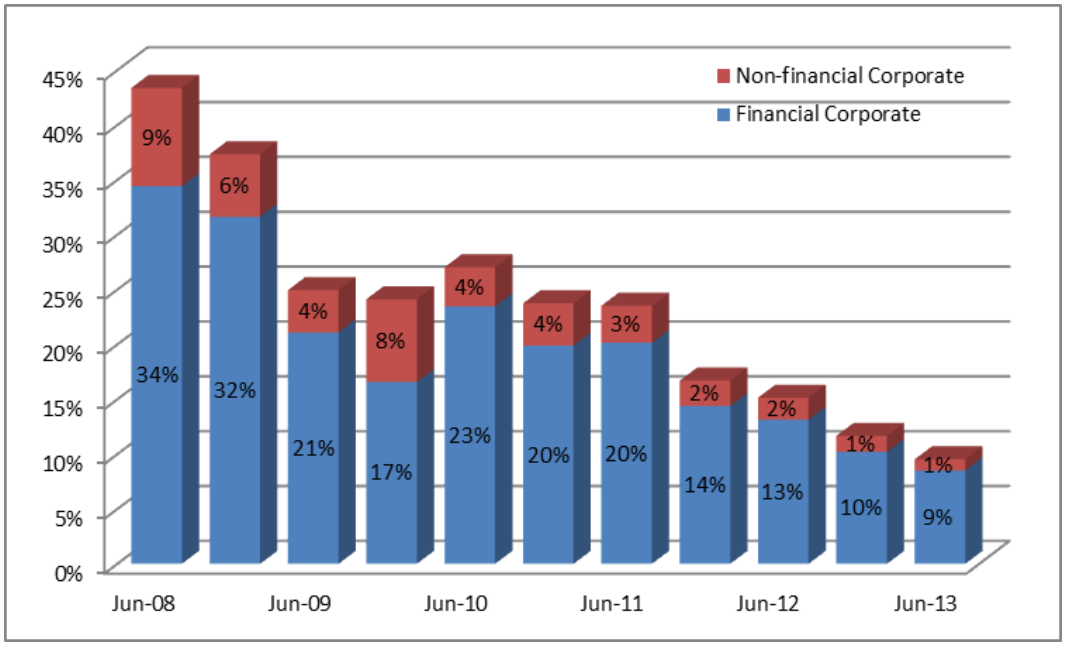
Figure 8 – Supranational debt as a % of fixed income repos outstanding 2008 - 2013



Corporate debt

The amount of corporate debt used as collateral in repo transactions has decreased considerably since 2008. Taken together, financial and non-financial corporate debt accounted for over 43% of outstanding repo collateral in 2008. This has since dropped to 10%.

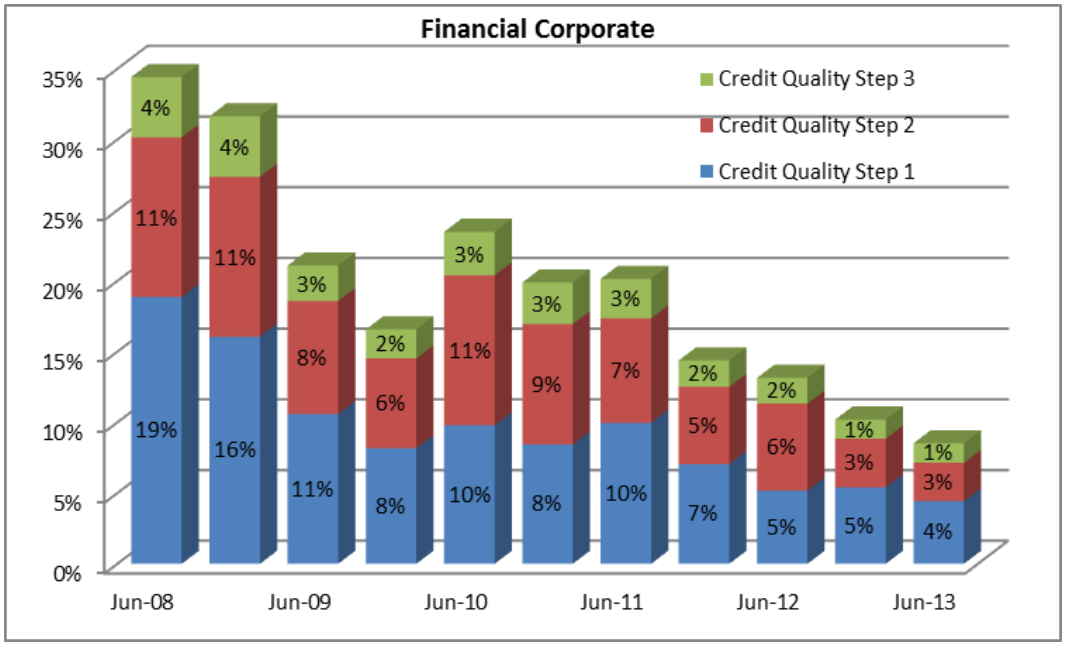
Figure 9 – Corporate debt as a % of fixed income repos outstanding 2008 - 2013



When financial corporate debt is analysed by credit quality steps 1 to 3, as in Figure 10, the decrease in outstandings across all credit quality steps can be seen. In 2008, financial corporate debt at credit

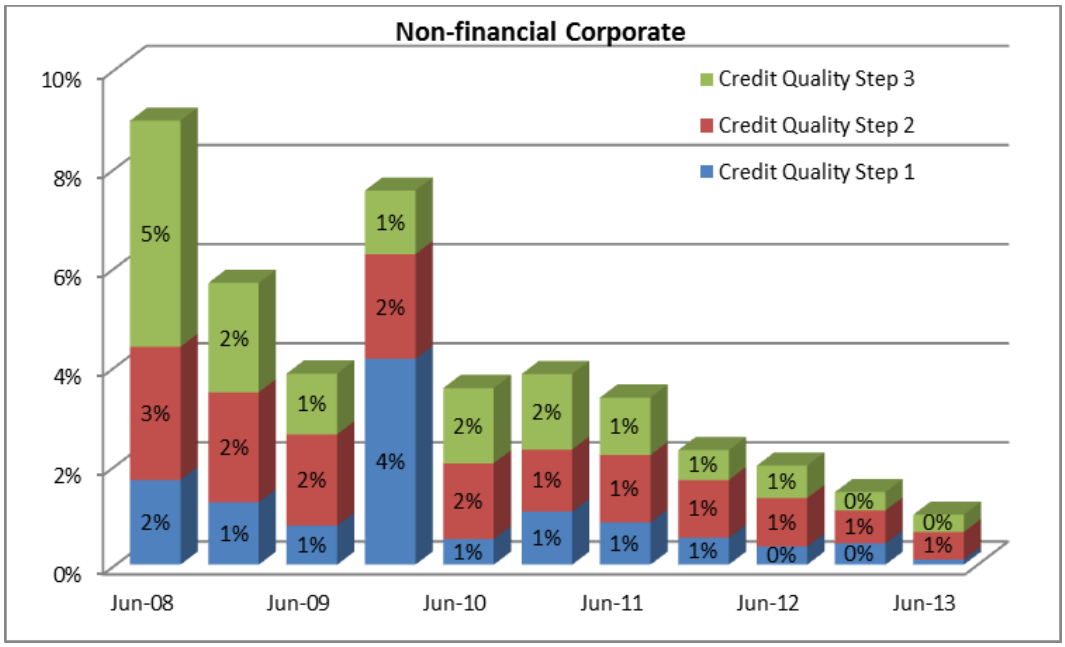
quality step 1 made up the larger proportion of all outstanding financial corporate debt collateral. In 2013 however, this split is less pronounced, repo outstandings across all credit quality steps are relatively low. The decrease in all credit quality steps is indicative of a reduction in the use of financial corporate debt as collateral, rather than simply debt, moving to a lower credit quality step following a downgrade.

Figure 10 – Financial corporate debt by credit quality step as a % of fixed income repos outstanding 2008 - 2013



When non-financial corporate debt is analysed by credit quality step, this downward trend is again prevalent. Apart from a possible outlier in Dec 2009, Figure 11 shows that there has been a steady decrease in the use of non-financial corporate debt as collateral. It accounted for 9% of all fixed income outstandings in 2008, but is now at 1% across all credit quality steps.

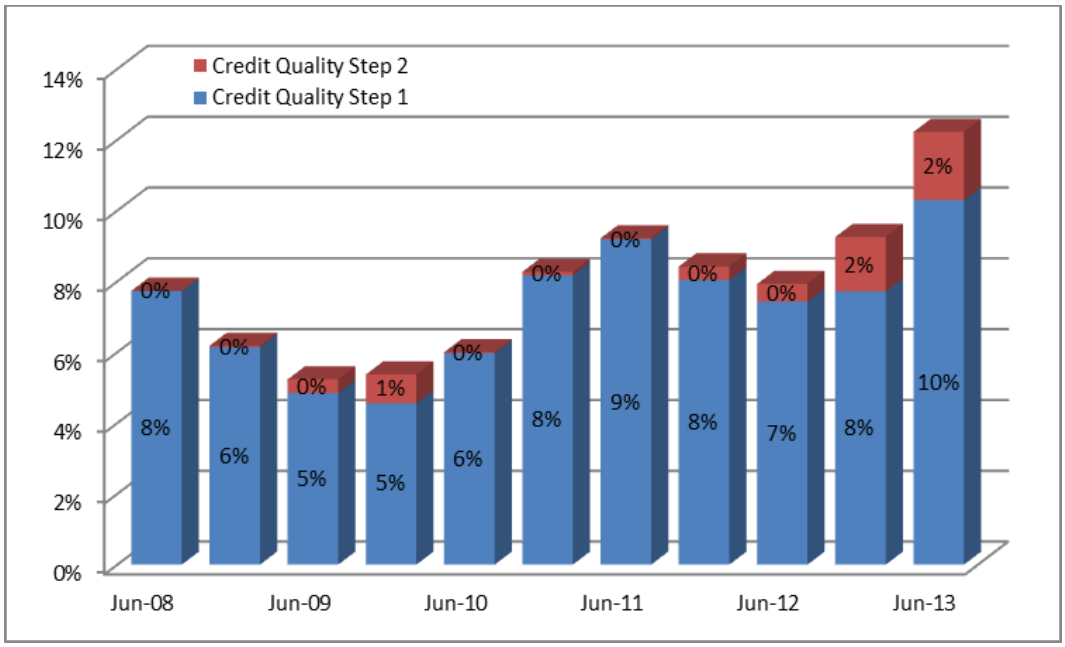
Figure 11 – Non-financial corporate debt by credit quality step as a % of fixed income repos outstanding 2008 - 2013



Covered bonds

The use of covered bonds as repo collateral has generally increased over the time period of the analysis. There was a decrease in the use of covered bonds between 2008 and 2010. While total collateral outstanding also decreased in this period, the proportion of covered bonds used relative to sovereign/public agency/supranational debt fell slightly. Until 2012 it was mostly covered bonds at credit quality step 1 that were used in this category. In 2012 and 2013 there was an increase in the use of covered bonds at credit quality step 2. Covered bonds used as repo collateral have predominately been denominated in EUR.

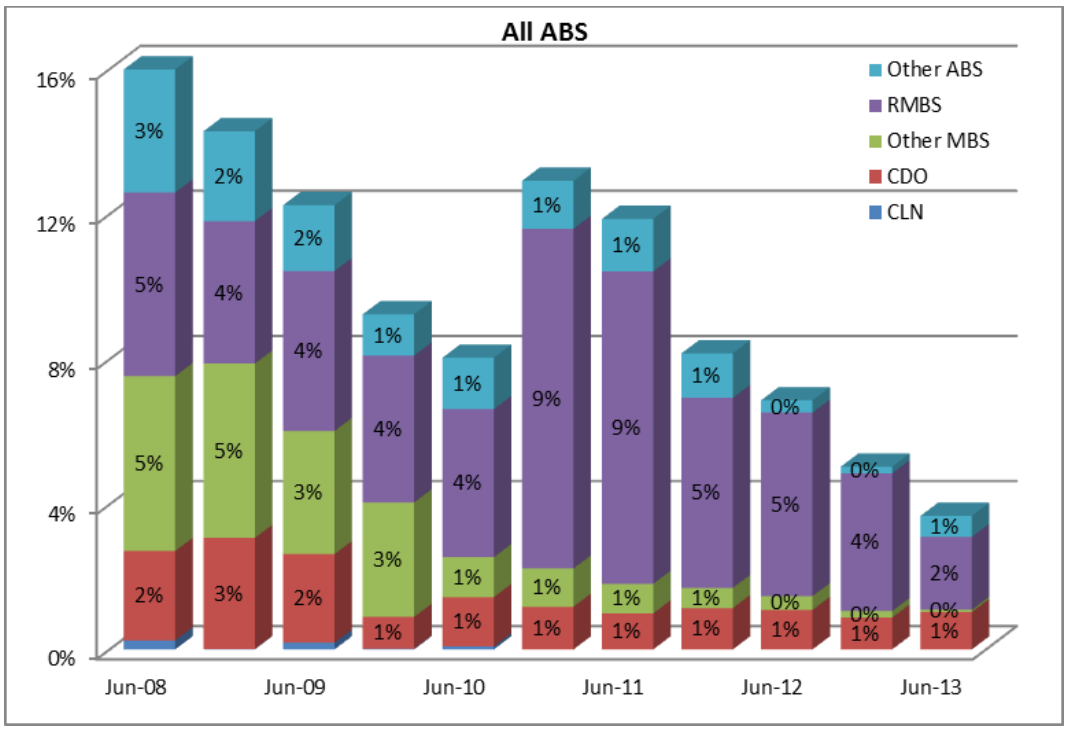
Figure 12 – Covered bonds by credit quality step as a % of fixed income repos outstanding 2008 - 2013



Asset backed securities

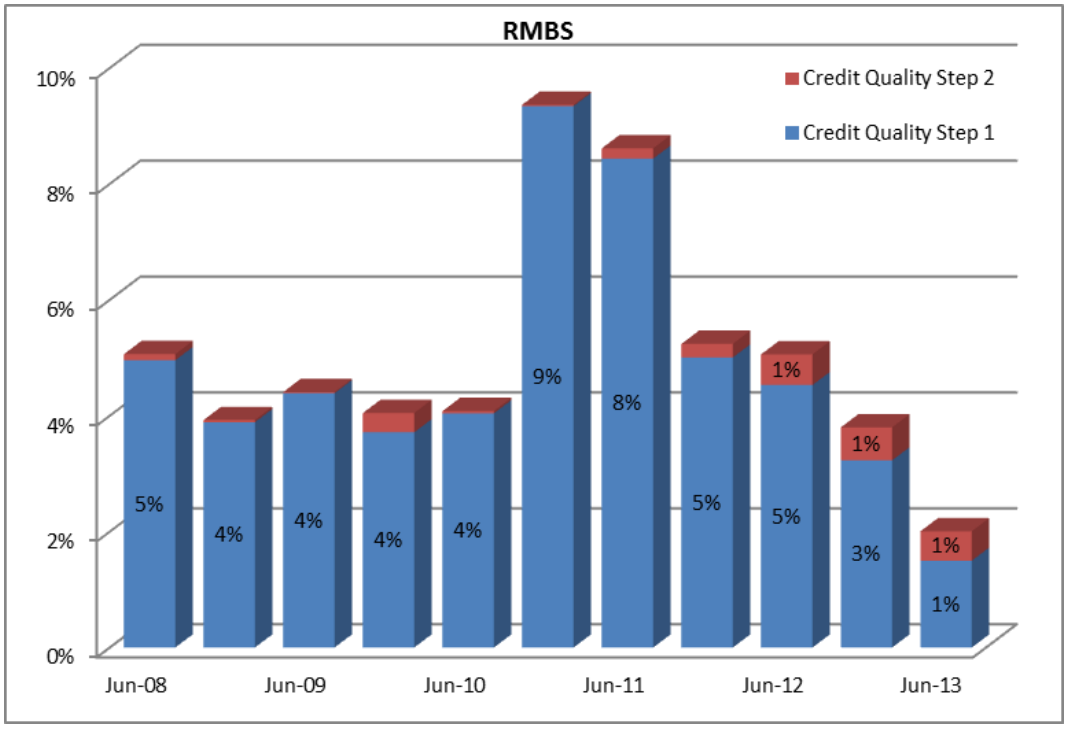
When all classes of ABS are analysed collectively or separately, the result is the same. There has been a marked decrease in the use of these asset types as collateral in repo transactions. The amount outstanding of this asset category has gone from 16% in 2008 to 3.7% in 2013. In 2008 RMBS and other MBS made up the bulk of total ABS outstanding. While the outstandings of all types of ABS fell, the decrease in the use of RMBS has been less pronounced. Figure 13 shows the split between types of ABS from 2008 to 2013.

Figure 13 – ABS by credit quality step as a % of fixed income repos outstanding 2008 - 2013



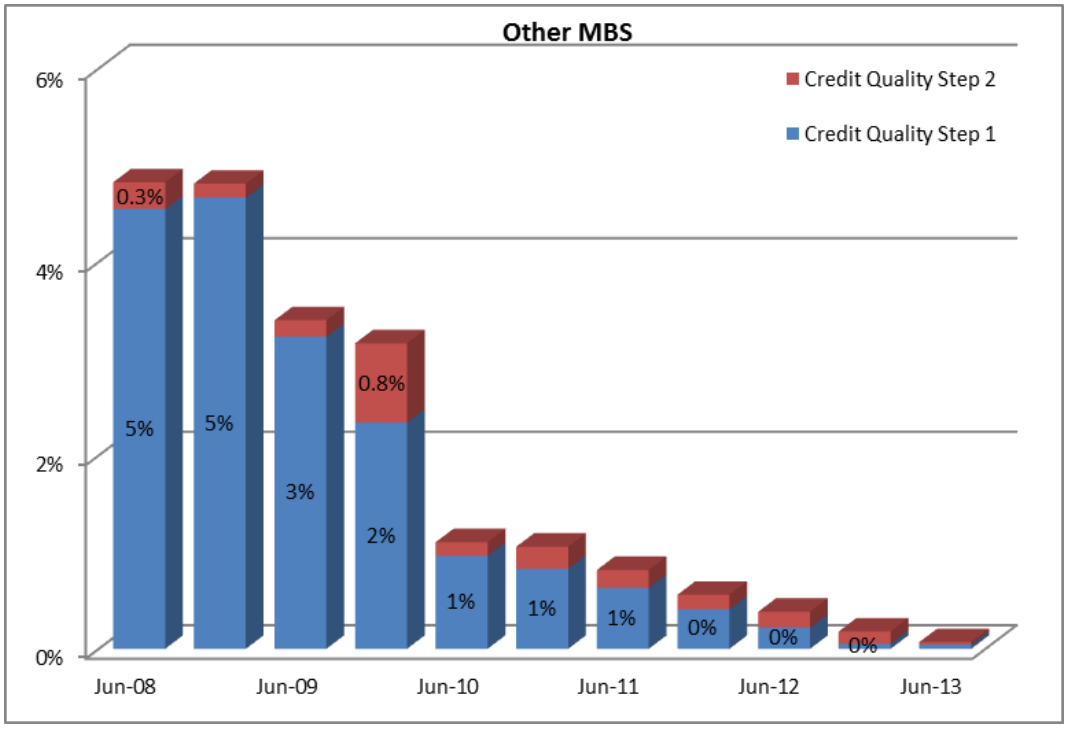
When RMBS as a sub category of asset is analysed, as indicated in Figure 14, apart from possible outliers in 2010, between 2008 and 2012 there was not a significant fall in the use of these assets. 2013 to-date has seen the largest drop in outstandings of RMBS as collateral; there was however an increase in the use of RMBS at credit quality step 2 in 2012 and 2013.

Figure 14 – RMBS by credit quality step as a % of fixed income repos outstanding 2008 - 2013



The decrease in the use of ABS as collateral for repo transactions is emphasised when the use of other MBS is analysed as in Figure 15. Commercial MBS are included in this category. Securities with credit quality step 1 made up the bulk of other MBS that were used as collateral in 2008. Virtually no other MBS of either credit quality step 1 or 2 were used as collateral in repo transactions in 2013.

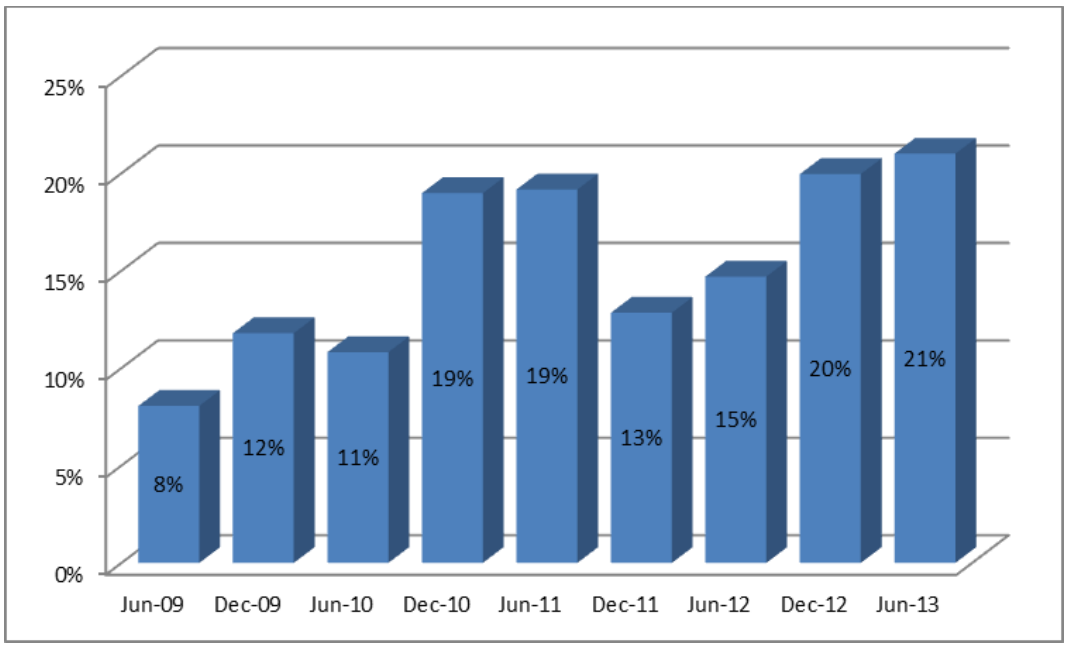
Figure 15 – Other MBS by credit quality step as a % of fixed income repos outstanding 2008 - 2013



Equity

Figure 16 highlights that the use of equities in repo transactions increased between 2009 and 2012. It should be noted that this analysis does not differentiate between the markets that the repo transactions are used for, i.e. the majority of these transactions may relate to equity market positions rather than use as a liquidity generating instrument.

Figure 16 – Equity as a % of total repos outstanding 2009 - 2013

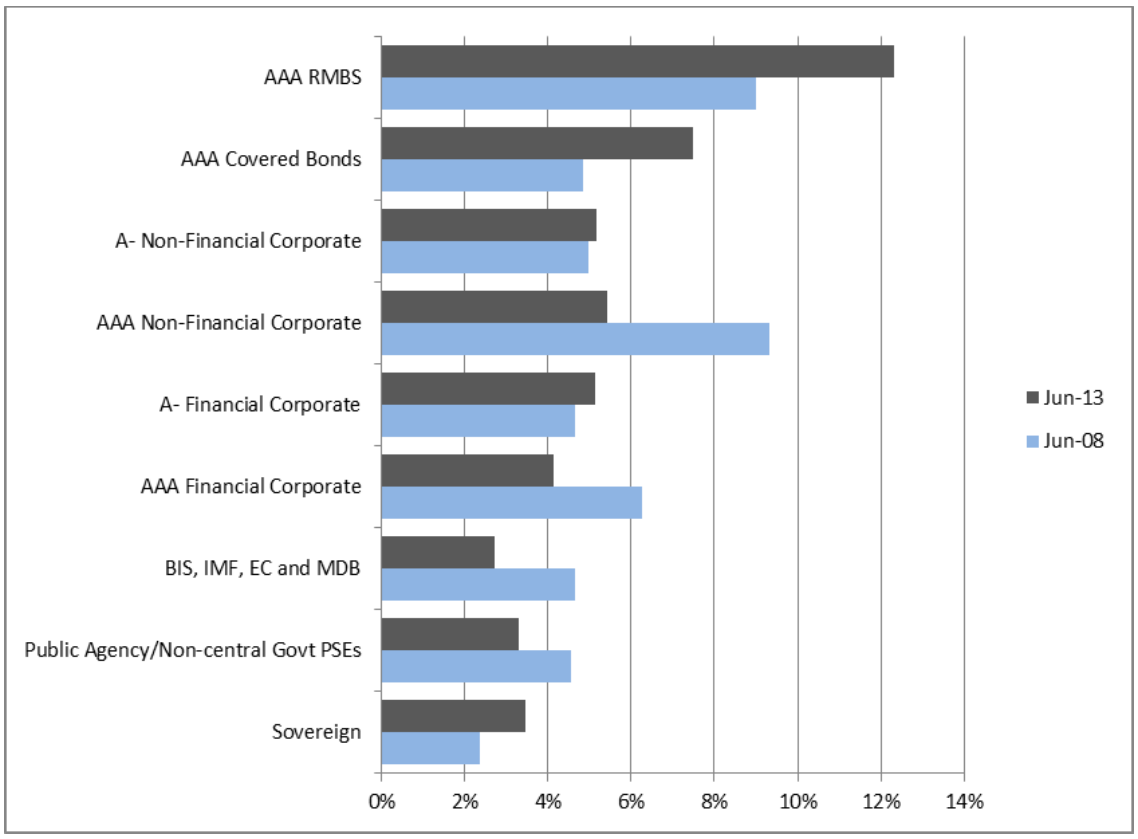


Analysis by average haircut

Average haircuts applied to the different collateral types used in repo/reverse repo transactions were analysed. The same type of survey data was used for this analysis as that discussed in section 4.4.4. It should be noted that this survey is relatively new for institutions and may be less reliable than the survey on repo volumes outstanding.

In general, average haircuts for RMBS, corporate and covered bonds are greater than those for sovereign, public agency and supranational debt. Average haircuts for RMBS, covered and sovereign bonds increased since 2008 while those for AAA corporate debt decreased. Average haircuts for sovereign debt in 2013 are greater than those for public agency and supranational. The opposite was the case in 2008.

Figure 17 – Repo haircut by collateral type 2008 - 2013



4.3.6 Summary of the EU repo market

The presence of an active repo market increases the market liquidity of a particular asset class. The volume of repo/reverse repo transactions fell during the recent financial crisis however it has recovered somewhat in recent years, indicating that during a stressed situation, as in outright sales, liquidity related to repo markets may lessen.

The relative composition of the type of collateral used in repo transactions has changed significantly since 2008, with sovereign, public agency, supranational and covered debt replacing corporate debt and ABS as the main types of collateral used. This relative composition is still changing. In the period immediately following the financial crisis, sovereign debt became the main type of collateral used. While this remains the case, the proportion of public agency and supranational debt as collateral is increasing markedly.

In relation to the individual asset classes, it can be said that in general, there is an active repo market for sovereign, public agency, supranational and covered bonds however the same cannot be said for corporate bonds and ABS, as the percentage of these asset types used has fallen significantly since the onset of the financial crisis.

5. Operational requirements of liquid assets

This section of the report is written in response to the mandate presented to the EBA in Article 509(5)(c)CRR that “the EBA shall report to the Commission on the operational requirements for the holdings of liquid assets, as referred in points (b) to (f) of Article 417, in line with international regulatory developments”.

Independent of the eligibility in principle of the assets covered by Article 416(1), an institution’s holdings of liquid assets have to meet certain operational requirements so that these assets can effectively be considered as part of the buffer under the Liquidity Coverage Requirement as specified in Article 412 CRR.

These operational requirements are set out in Articles 416 and 417 CRR. The EBA is mandated to produce a report deliberating on the conditions set out in Article 417(b) to (f). The diversification requirement of Article 417(a) is not part of the mandate for this report and will therefore not be considered further.

This report intends to reflect the rationale of each requirement and deliberates on their practical implications. The report furthermore highlights cases in which the rationale of the requirements seems weak, and contains recommendations for future review.

The range of liquid assets as set out in Article 416(1) CRR includes cash (notes and coins) and exposures to central banks (a), transferrable assets ((b) to (d)), standby credit facilities granted by central banks (e) and legal or statutory minimum deposits with the central credit institution and other statutory or contractually available liquid funding from the credit institution (f). Shares or units in CIUs may be treated as liquid assets up to an absolute amount of EUR 500 million in the portfolio of liquid assets in each institution as long as it only invests in liquid assets (Article 416 (6) CRR).

Since these different forms of liquid assets have different characteristics, the interpretation of the operational requirements will have to be made taking these special characteristics into account. Special consideration will be given to the application to CIUs, where the operational requirements do not only apply to the liquid assets contained in a CIU, but should also address the liquidity generating capacity of a CIU itself, i.e. apply to the shares or units in the CIU.

According to the mandate of the report in Article 509(5) CRR, the report is to be made “in line with international regulatory developments”. Reference is therefore made to “Basel III: The Liquidity Coverage Ratio and the liquidity risk monitoring tools”, Jan 2013 BIS and the CEBS “Guideline on Liquidity Buffers & Survival Periods”, 9 December 2009.

The Basel QIS exercises have highlighted that liquid assets “trapped” in legal entities and liquid assets outside the control of the treasury or in trading positions accounted for most of the liquid assets excluded from the buffer due to operational requirements.

As shown by the Basel QIS exercises, it is important to ensure a harmonised understanding of operational requirements in order to avoid differences in the strictness of application between banks. To this end, this report is intended to contribute to a common understanding of the required operational requirements and minimise the scope for deviations in interpretation.

For banks to determine whether any assets should be excluded from the liquidity buffer due to operational requirements, they accordingly need to have the ability to assess these assets on an ongoing basis.

The next sections of this report consider the relevant CRR operational requirements in sequence.

5.1. Availability

As per Article 417(b) CRR, the holdings of liquid assets need to be legally and practically available at any time during the next 30 days to be liquidated via outright sale or via simple repurchase agreement on approved repurchase markets in order to meet obligations coming due.

Rationale

“Legally and practically available”

The liquid assets that form part of the liquidity buffer under the LCR are intended to be effectively monetised to meet liquidity outflows in the 30 days of the scope of the LCR. Therefore it is necessary that an institution have unlimited access and power of disposal to meet this end.

An asset is *legally* available if it is:

- unencumbered in the sense that there are no legal, regulatory or contractual impediments to sell or lend the asset;
- there are no transfer restrictions in the country where the asset is held;
- the asset is denominated in a convertible currency.

An asset is *practically* available if:

- there are no regulatory, tax or accounting impediments to effectively monetise the position in liquid assets;
- the legal entity in which the assets are being held has direct market access or the assets can be freely and timely transferred to another legal entity that has market access;

- any excess liquid assets that are taken into account at consolidated level must be freely transferable between legal entities. Excess liquid assets are those that are not needed at the single entity level to cover LCR-minimum requirements;

- the liquidity management function has a timely overview over the amount, composition and location of liquid assets;

- the liquidity management function has full control over the holdings of liquid assets. Procedures and systems are installed allowing immediate monetization assets when required. (Further laid out in Article 417(c)).

- Monetisation must be executable in the standard settlement period for the asset class in the relevant jurisdiction.

- Liquid assets are not used in ongoing operations (further laid out in Article 417(e)).

As regards CIUs, the liquidity generating capacity of CIUs is highly dependent on the legal structure of a CIU, the allowed form of liquidation and the time needed to actually generate liquid means. Institutions and supervisors should ensure that, under normal and stressed conditions, the generation of liquidity from CIUs:

- falls under the sole decision of the institution;

- is unrestricted; and

- can be executed without delay.

The thorough assessment of these characteristics should be linked to the proportion of the liquidity buffer held in the form of CIUs. If CIUs account for the major part of the liquidity buffer of an institution, requirements on availability should be particularly strict, to ensure the usability of the buffer.

Liquid assets must be available at any time during the next 30 days. Concerning secured lending, the CRR assumes prolongation of secured lending coming due within 30 days and collateralised by HQLA (Article 422 CRR). Therefore assets received from reverse repos and other securities financing transactions maturing within the next 30 days that are held within an institution and where the institution has full rights of rehypothecation may be considered available during the next 30 days (however an outflow has to be taken into account under Article 422).

Encumbrance

The availability of assets is linked to the concept of encumbrance.

Article 416(3)(a) addresses the need of HQLA to be unencumbered explicitly: “They are unencumbered or stand available within collateral pools to be used for the obtaining of additional funding under committed but not yet funded credit lines available to the institution”.

The CRR does not provide a definition of encumbrance, but the EBA in its draft ITS on asset encumbrance reporting under Article 100 CRR offers the following draft definition of encumbrance:

“*For the purpose of this Regulation an asset is considered encumbered if it has been pledged or if it is subject to any form of arrangement to secure, collateralise or credit enhance any transaction from which it cannot be freely withdrawn*.”

However, for the purpose of liquidity provision it is important that the definition of encumbrance not be based on solvency considerations, but on liquidity considerations (within a time horizon of 30 days). The practical interpretation of the concept of encumbrance in the context of liquidity reporting should therefore differ from the interpretation of encumbrance applied for the reporting on asset encumbrance, which focuses solely on solvency.

The Basel definition of encumbrance/unencumbrance (Basel III: Liquidity coverage ratio and liquidity monitoring tools, January 2013 – paragraph 31) captures the essential features of liquidity, by focusing on the possible impediments to the provision of liquidity.

“*Unencumbered” means free of legal, regulatory, contractual or other restrictions on the ability of the bank to liquidate, sell, transfer, or assign the asset*”

Paragraph 31 of the Basel III text further states:

“*An asset in the stock should not be pledged (either explicitly or implicitly) to secure, collateralise or credit-enhance any transaction, nor be designated to cover operational costs (such as rents and salaries). Assets received in reverse repo and securities financing transactions that are held at the bank, have not been rehypothecated, and are legally and contractually available for the bank's use can be considered as part of the stock of HQLA. In addition, assets which qualify for the stock of HQLA that have been pre-positioned or deposited with, or pledged to, the central bank or a public sector entity (PSE) but have not been used to generate liquidity may be included in the stock. (Footnote: If a bank has deposited, pre-positioned or pledged Level 1, Level 2 and other assets in a collateral pool and no specific securities are assigned as collateral for any transactions, it may assume that assets are encumbered in order of increasing liquidity value in the LCR, ie assets ineligible for the stock of HQLA are assigned first, followed by Level 2B assets, then Level 2A and finally Level 1. This determination must be made in compliance with any requirements, such as concentration or diversification, of the central bank or PSE.)”*

The Basel definition recognises that an asset may be bound for some specific purpose but still be a source of liquidity. For instance, liquid assets received in a reverse repo would be considered encumbered under a solvency perspective, but not in general under the Basel definition. If an institution has full disposal of the assets within the remaining time of the reverse contract, these assets

may be counted as part of the liquidity buffer. A further requirement would of course be that the institution has the ability to sell or rehypothecate the asset and can do so in compliance with existing regulatory requirements.

As another example, cash received from customers and earmarked to cover future claims are likely to be considered as encumbered under a solvency perspective. However, if these means are invested in liquid assets precisely with the aim of meeting such future claims, they would count as part of the liquidity buffer under the Basel definition - again provided that an institution has the ability to sell or rehypothecate the asset and can do so in compliance with existing regulatory requirements.

Transfer restrictions and non-convertible currencies

Article 417(b) furthermore states that "liquid assets referred to in point (c) of Article 416(1) which are held in third countries where there are transfer restrictions or which are denominated in non-convertible currencies shall be considered available only to the extent that they correspond to outflows in the third country or currency in question, unless the institution can demonstrate to the competent authorities that it has hedged the ensuing currency risk appropriately.

Transfer restrictions

This requirement refers to liquid assets under Article 416(1)(c) **held** in third countries (i.e. non-EU countries) where there are transfer restrictions. In this case the asset should only be intended to cover outflows in that third country.

Transfer restrictions are existing restrictions imposed under applicable laws, regulations and supervisory requirements. Accordingly, it would be appropriate for institutions to have processes in place to capture all liquidity transfer restrictions to the extent practicable, and to monitor the rules and regulations in the jurisdictions in which a group operates and assess their liquidity implications for the group as a whole.

In the case of Article 416(1)(c) the restrictions set up by the CRR are twofold: government bonds and other liquid assets mentioned under letter (i)

- should only be held to cover liquidity outflows in the country of their issuance and
- should not held outside this country if there are transfer restrictions.

However, it is plausible that ***any*** integrant of the liquidity buffer, not just assets referred to in Article 416(1)(c), **held** in countries with transfer restrictions is not legally and practically available to be used to cover outflows outside the respective country. Excess holdings of any liquid asset that is held in a country with transfer restrictions cannot by definition be used to cover liquidity outflows in another location. The requirement should therefore apply to any liquid asset coming under the scope of the definition in Article 416.

Non-convertible currencies

Liquid assets under Article 416(1)(c) which are denominated in non-convertible currencies will be considered available only to the extent that they correspond to outflows in the currency in question, unless an institution can demonstrate to the competent authorities that it has appropriately hedged the ensuing currency risk.

If liquidated, the value of an asset denominated in a non-convertible currency cannot be converted freely into a means of payment in another currency, since non-convertible currencies are not traded on foreign exchange markets or only traded in limited amounts. Hedging the currency risk by means of a non-deliverable forward (NDF) foreign exchange transaction eliminates market risk. However, the nominal corresponding to the value of the asset is not converted into another currency. The asset is therefore not suitable to cover liquidity outflows in other currencies.

As with the previous condition, it is plausible that this condition should apply to ***any*** liquid asset denominated in a non-convertible currency and not be restricted to assets under Article 416(1)(c). The use of the proceeds from HQLA in a non-convertible currency is restricted to covering outflows in that respective currency.

Conclusion

The concept of availability is fundamental to operational requirements for liquid assets, since it determines the practical usability of the liquidity generating capacity of liquid assets. It is therefore important that any aspect of availability be considered under the point of view of liquidity, which, in some cases might differ from availability considered from the point of view of solvency. This is especially true when applying the concept of unencumbrance, where recent reporting requirements take a solvency perspective and focus on the availability for unsecured debitors in the event of default, instead of on short-term liquidity generating capacity.

We recommend that for the purpose of liquidity reporting, the notion of unencumbrance follow that of paragraph 31 of Basel III: Liquidity Coverage Ratio and liquidity monitoring tools, January 2013 which states that

"*Unencumbered" means free of legal, regulatory, contractual or other restrictions on the ability of the bank to liquidate, sell, transfer, or assign the asset*".

We further recommend that ***any*** liquid asset or other integrant of the liquidity buffer ***held*** in a country with transfer restrictions should only be used to cover outflows in that respective country. Any excess holding of liquid assets should not be admissible for use to cover outflows in other countries. To restrict the application of this requirement to assets under Article 416(1)(c) is not compatible with a prudential approach.

Likewise we recommend that any liquid asset denominated in a non-convertible currency should only be used to cover outflows in that currency, regardless of whether the currency risk has effectively been hedged or not.

5.2. Control by a liquidity management function

Article 417(c) CRR requires that holdings of HQLA be controlled by a liquidity management function.

Rationale

In order to ensure effective monetisation in case liquidity outflows have to be met through the liquidation of liquid assets, these need to be under the control of the liquidity management function. The function should have the continuous authority, and legal and operational capability, to monetise any asset in the stock in case it is needed and the proceeds should be available to the function (Basel 2013, paragraph 33). The operational requirements should not impose a requirement for a segregated, ring-fenced liquidity pool.

Control over the buffer of liquid assets can be demonstrated in 2 ways:

- "either by maintaining liquid assets in a separate pool under the sole control of the liquidity management function";

- or "by demonstrating that the function can monetize the assets at any point in the 30-day stress period and that the proceeds of doing so are available throughout the 30-day stress period without directly conflicting with a stated business or risk management strategy". In this case, paragraphs (c) and (e) have to be read in conjunction.

Furthermore, the liquidity management function could also be defined as the one identified by internal methodologies described in Article 86(4) CRD, as in charge of the identification, measurement, management and monitoring of funding positions. This would ensure that this is in line with the liquidity management's internal structures of each firm or liquidity subgroup.

Conclusion

We recommend that the requirement not explicitly demand liquid assets to be held by a specific function (e.g. treasury) or that liquid assets be held in a separate book, but rather that institutions should have policies and procedures in place that establish the proper authority of the liquidity management function and ensure sufficient operational capacity.

As different liquidity management models co-exist in the EU, the interpretation of the criteria should reflect and allow this diversity.

5.3.Test sales option

Article 417(d) requires that a portion of the liquid assets except those referred to in points (a), (c) and (e) of Article 416(1) be periodically and at least annually liquidated via outright sale or via simple repurchase agreements on an approved repurchase market for the following purposes:

(i) to test the access to the market for these assets;

(ii) to test the effectiveness of its processes for the liquidation of assets;

(iii) to test the usability of the assets;

(iv) to minimise the risk of negative signalling during a period of stress.

Rationale

It is important that banks regularly test the effectiveness of their internal processes and functions to ensure timely liquidation of assets. It is equally important to accustom markets to the fact that an institution trades on the market so that there will be no immediate feedback relating any asset sales to a perceived liquidity stress of the institution.

The CEBS guideline points out: “Firms should seek to be active on a regular basis in each market in which they hold assets for liquidity purposes. Accessing the market regularly will help to reduce the potential stigma of firms suddenly accessing markets, alerting other firms to the fact that they may be under liquidity pressure (in turn, causing more investors to withdraw funds, thereby accentuating the liquidity pressure).”

Assets under Article 416(1) (a), (c) and (e) are not subject to the test sales (or repos) under the CRR provision. In the case of letters (a) and (e) the rationale is clearly intuitive, since both letters address directly available central bank liquidity.

Literal application of the requirement to assets under Article 416 (1) (f) is not possible, since deposits or available liquid funding from the central credit institution cannot be sold. However, following the rationale of the requirement, the availability of this kind of liquidity should also be tested.

The rationale of excluding (c) from test sales could lie in the restricted scope of application of the liquidity under letter (i). Assets qualifying under Article 416(1)(c) are eligible to the buffer independently of their empirical liquidity because they may only be used under the LCR reporting requirement “if the institution incurs a liquidity risk in that Member State or third country that it covers by holding those liquid assets”. However there is no definition of “liquidity risk that an institution incurs in a Member State or a third country” so it will be difficult to check that these assets are used only to cover such risk exposure. There are also no rules on how assets that do conform both to points (b) and (c) (or (e) and (c)) should be reported, meaning that imposing more precise requirements might be extremely difficult to monitor, as the institutions can game the requirements simply by regularly

changing the classifications of assets[7]. It should in any case be part of a prudent approach of institutions to closely monitor changes in the liquidity generating capacity of these assets.

Concerns have been raised concerning the costs of test sales. Since bonds reported under Article 416(1)(c) are exempted from test sales, banks might preferably want to classify them as such, even in cases where they would also be eligible under Article 416 (1)(b). Furthermore, in the absence of a definition and a reporting duty of "liquidity risk in that Member state or third country" adequate supervision is not possible.

A further concern has been raised that banks might manipulate test sales (or test repos) to each other to report liquid markets in cases where this liquidity might be in doubt.

Both concerns address the ability of banks to arbitrage test sales either by circumvention of the requirement or by manipulation of the results. These concerns should be brought to the attention of supervisors.

Conclusion

We recommend that supervisors apply a principles-based approach to test sales, considering the normal trading activity of an institution and the costs of test sales. In line with the CEBS Guidelines on Liquidity Buffers and Survival Periods (Annex 2), based on the proportionality principle, smaller banks which access markets through another institution, will, in most cases, not have to be active in several advanced money and capital markets.

In order to achieve regulatory transparency and preclude circumventing the operational requirements by institutions a harmonised definition of "liquidity risk that an institution incurs in a Member State or a third country" should be also prepared as well as rules governing the treatment of assets that fall under two or more definitions of eligible assets.

5.4 Not used in ongoing operations

Article 417 (e) states that price risks associated with the assets may be hedged, but that the liquid assets are subject to appropriate internal arrangements that ensure that they are readily available to the **treasury** when needed and especially that they are not used in other ongoing operations, including:

(i) hedging or other trading strategies;

(ii) providing credit enhancements in structured transactions;

(iii) covering operational costs.

[7] The example of such rules might be treatment of bonds in held to maturity portfolio, where mark-to-market valuation is not required, for accounting purposes.

Rationale

Article 417(e) addresses the use of liquid assets in the context of hedging operations. Price risks associated with the assets may be hedged, however institutions should take into account the cash outflow that would arise if the hedge were to be closed out early or apply adequate haircuts.

As for the inclusion of liquid assets in hedging strategies, these may, at the sale of the asset, create an open risk position for an institution. Hedging strategies may therefore lead to practical impediments to the monetisation of the assets through outright sale. However, this is not the case for assets that are monetised using a repo transaction, if the availability of liquid repo markets for the asset is guaranteed. The same consideration is valid for the use of liquid assets in trading strategies.

The Basel framework explicitly allows for assets to be used in hedging strategies (paragraph 34 of Basel III: Liquidity Coverage Ratio and liquidity monitoring tools, January 2013:

A bank is permitted to hedge the market risk associated with ownership of the stock of HQLA and still include the assets in the stock. If it chooses to hedge the market risk, the bank should take into account (in the market value applied to each asset) the cash outflow that would arise if the hedge were to be closed out early (in the event of the asset being sold).

The same rationale would apply to liquid assets involved in trading strategies.

Liquid assets should not be used to provide credit enhancements in structured transactions and should not be considered part of the liquidity buffer, if this means the assets cannot be freely liquidated. There are two ways in which liquid assets can be used in credit enhancement techniques:

- liquid assets can be directly used as overcollateralization in which case they are pledged and no longer freely available to the institution for use outside the structure;

- an institution incurs a payment obligation (e.g. a standby letter of credit) which takes the form of a guarantee.

In the first case, liquid assets are not eligible because they are not available for liquidation. In the second case, the institution incurs a contingent liquidity outflow (which might well materialise under the LCR stress scenario) that it covers with the holding of liquid assets. In both cases, the liquid assets in question are no longer freely available to the institution to cover other outflows.

Liquid assets should not be used to cover operational costs. Operational costs are not considered to be an outflow relevant for the LCR stress scenario in Article 420 CRR. This is because operational cost are not typically stress sensitive, may not in all cases lead to an liquidity outflow (e.g. in the case of salaries paid on accounts held with the institution) or their amount is negligible with a view to the overall liquidity risk of an institution.

However, if an institution decides to make provisions for the liquidity outflows that may arise from its operational costs in the form of holdings of liquid assets, these are no longer available to cover other outflows considered under the LCR stress scenario.

Conclusion

We recommend allowing the use of liquid assets in hedging or trading strategies as long as they can easily be monetised without conflicting with existing risk limits that control for market, credit and counterparty risk.

To ensure consistency with Article 417(c), treasury should be interpreted as “liquidity management function”.

5.5 Currency Consistency

Article 417 (f) requires the denomination of the liquid assets to be consistent with the distribution by currency of liquidity outflows after the deduction of inflows.

Rationale

Since liquid assets need to be monetised to meet liquidity outflows in a specific currency, it is mandatory that these liquid assets be able generate liquidity in the respective currency. This is particularly true for non-convertible currencies. However, even with currencies that are regularly traded, it should not be taken for granted that foreign exchange markets will remain accessible at any time during the stressed conditions reflected in the LCR. The reliance on foreign exchange markets during stressed conditions may, furthermore, expose an institution to significant market risk, which could sharply widen existing mismatched positions.

Institutions should therefore monitor the currency mismatch they incur in different currencies. Instruments to this end are the LCR and NSFR reporting by significant currency, as well as the reporting of the additional monitoring metrics by significant currency. Institutions should test the effectiveness of existing currency risk hedging strategies under stress.

Conclusion

A perfect match of currency consistency of liquid assets and net outflows is not required according to the general liquidity requirement under article 412.1 (or Basel III). Until a specific currency requirement is specified in detail, institutions should monitor risk, test the effectiveness of their hedging strategies and develop contingency plans for stressed conditions.

Annex 1: Relevant CRR Articles on uniform definitions of liquid assets

Recital 100

Institutions should hold a diversified buffer of liquid assets that they can use to cover liquidity needs in a short term liquidity stress. As it is not possible to know ex ante with certainty which specific assets within each asset class might be subject to shocks ex post, it is appropriate to promote a diversified and high quality liquidity buffer consisting of different asset categories. A concentration of assets and overreliance on market liquidity creates systemic risk to the financial sector and should be avoided. A broad set of quality assets should therefore be taken into consideration during an initial observation period which will be used for the development of a definition of a liquidity coverage requirement. When making a uniform definition of liquid assets at least government bonds, and covered bonds traded on transparent markets with an ongoing turnover would be expected to be considered assets of extremely high liquidity and credit quality. It would also be appropriate that assets corresponding to Article 416(1) (a) to (c) should be included in the buffer without limitations. When institutions use the liquidity stock, they should put in place a plan to restore their holdings of liquid assets and competent authorities should ensure the adequacy of the plan and its implementation.

Article 416: Reporting on liquid assets

1. Institutions shall report the following as liquid assets unless excluded by paragraph 2 and only if the liquid assets fulfil the conditions in paragraph 3:

(a) cash and exposures to central banks to the extent that these exposures can be withdrawn at any time in times of stress. As regards deposits held with central banks, the competent authority and the central bank shall aim at reaching a common understanding regarding the extent to which minimum reserves can be withdrawn in times of stress;

(b) other transferable assets that are of extremely high liquidity and credit quality;

(c) transferable assets representing claims on or guaranteed by:

(i) the central government of a Member State, a region with fiscal autonomy to raise and collect taxes, or of a third country in the domestic currency of the central or regional government, if the institution incurs a liquidity risk in that Member State or third country that it covers by holding those liquid assets;

(ii) central banks and non-central government public sector entities in the domestic currency of the central bank and the public sector entity;

(iii) the Bank for International Settlements, the International Monetary Fund, the Commission and multilateral development banks;

(iv) the European Financial Stability Facility and the European Stability Mechanism;

(d) transferable assets that are of high liquidity and credit quality;

(e) standby credit facilities granted by central banks within the scope of monetary policy to the extent that these facilities are not collateralised by liquid assets and excluding emergency liquidity assistance;

(f) if the credit institution belongs to a network in accordance with legal or statutory provisions, the legal or statutory minimum deposits with the central credit institution and other statutory or contractually available liquid funding from the central credit institution or institutions that are members of the network referred to in Article 113(7), or eligible for the waiver provided in Article 10, to the extent that this funding is not collateralised by liquid assets.

Pending specification of a uniform definition in accordance with Article 460 of high and extremely high liquidity and credit quality, institutions shall identify themselves in a given currency transferable assets that are respectively of high or extremely high liquidity and credit quality. Pending specification of a uniform definition, competent authorities may, taking into account the criteria listed in Article 509(3), (4) and (5) provide general guidance that institutions shall follow in identifying assets of high and extremely high liquidity and credit quality. In the absence of such guidance, institutions shall use transparent and objective criteria to this end, including some or all of the criteria listed in Article 509(3), (4) and (5).

2. The following shall not be considered liquid assets:

(a) assets that are issued by a credit institution unless they fulfil one of the following conditions:

(i) they are bonds eligible for the treatment set out in Article 129(4) or (5) or asset backed instruments if demonstrated to be of the highest credit quality as established by the EBA pursuant to the criteria in Article 509(3), (4) and (5);

(ii) they are bonds as referred to in Article 52(4) of Directive 2009/65/EC other than those referred to in point (i) of this point;

(iii) the credit institution has been set up by a Member State central or regional government and that government has an obligation to protect the economic basis of the institution and maintain its viability throughout its lifetime; or the asset is explicitly guaranteed by that government; or at least 90 % of the loans granted by the institution are directly or indirectly guaranteed by that government and the asset is predominantly used to fund promotional loans granted on a non-competitive, not for profit basis in order to promote that government's public policy objectives;

(b) assets that are provided as collateral to the institution under reverse repo and securities financing transactions and that are held by the institution only as a credit risk mitigant and that are not legally and contractually available for use by the institution;

(c) assets issued by any of the following:

(i) an investment firm;

(ii) an insurance undertaking;

(iii) a financial holding company;

(iv) a mixed financial holding company;

(v) any other entity that performs one or more of the activities listed in Annex I to Directive 2013/…/EU* as its main business.

3. In accordance with paragraph 1, institutions shall report assets that fulfil the following conditions as liquid assets:

(a) they are unencumbered or stand available within collateral pools to be used for the obtaining of additional funding under committed but not yet funded credit lines available to the institution;

(b) they are not issued by the institution itself or its parent or subsidiary institutions or another subsidiary of its parent institutions or parent financial holding company;

(c) their price is generally agreed upon by markets participants and can easily be observed in the market, or their price can be determined by a formula that is easy to calculate based on publicly available inputs and does not depend on strong assumptions as is typically the case for structured or exotic products;

(d) they are eligible collateral for standard liquidity operations of a central bank in a Member State or if the liquid assets are held to meet liquidity outflows in the currency of a third country, of the central bank of that third country;

(e) they are listed on a recognised exchange or they are tradable on active outright sale or via a simple repurchase agreement on approved repurchase markets. These criteria shall be assessed separately for each market.

The conditions referred to in points (c), (d) and (e) of the first subparagraph shall not apply to the assets referred to in point (e) of paragraph 1.

The condition referred to in point (d) of the first subparagraph shall not apply in the case of liquid assets held to meet liquidity outflows in a currency in which there is an extremely narrow definition of central bank eligibility. In the case of liquid assets denominated in currencies of third countries, this

* OJ: Please insert serial number of the Directive contained in document PE-CONS 15/13 (2011/0203 (COD)).

exception shall apply and only apply if the competent authorities of the third country apply the same or an equivalent exception.

4. Notwithstanding the provisions of paragraphs 1, 2 and 3, pending the specification of a binding liquidity requirement in accordance with Article 460 and in accordance with the second subparagraph of paragraph 1 of this Article, institutions shall report on:

(a) other non-central bank eligible but tradable assets such as equities and gold based on transparent and objective criteria, including some or all of the criteria listed in Article 509(3), (4) and (5);

(b) other central bank eligible and tradable assets such as asset backed instruments of the highest credit quality as established by EBA pursuant to the criteria in Article 509(3), (4) and (5);

(c) other central bank eligible but non-tradable assets such as credit claims as established by the EBA pursuant to the criteria in Article 509(3), (4) and (5).

5. The EBA shall develop draft implementing technical standards listing the currencies which meet the conditions referred to in the third subparagraph of paragraph 3.

EBA shall submit those draft implementing technical standards to the Commission by 31 March 2014.

Power is conferred on the Commission to adopt the implementing technical standards referred to in the first subparagraph in accordance with Article 15 of Regulation (EU) No 1093/2010.

Before the entry into force of the technical standards referred to in the third subparagraph, institutions may continue to apply the treatment set out in the second subparagraph of paragraph 3, where the competent authorities have applied that treatment before …*.

6. Shares or units in CIUs may be treated as liquid assets up to an absolute amount of EUR 500 million in the portfolio of liquid assets of each institution provided that the requirements in Article 132(3) are met and that the CIU, apart from derivatives to mitigate interest rate or credit or currency risk, only invests in liquid assets as referred to in paragraph 1 of this Article.

The use or potential use by a CIU of derivative instruments to hedge risks of permitted investments shall not prevent that CIU from being eligible. Where the value of the shares or units of the CIU is not regularly marked to market by the third parties referred to in points (a) and (b) of Article 418(4) and the competent authority is not satisfied that an institution has developed robust methodologies and processes for such valuation as referred to in the first sentence of Article 418(4), shares or units in that CIU shall not be treated as liquid assets.

* OJ: Please insert the date of application of this Regulation.

7. Where a liquid asset ceases to be eligible in the stock of liquid assets, an institution may nevertheless continue to consider it a liquid asset for an additional period of 30 calendar days. Where a liquid asset in a CIU ceases to be eligible for the treatment set out in paragraph 6, the shares or units in the CIU may nevertheless be considered a liquid asset for an additional period of 30 days provided that those assets do not exceed 10% of the CIU's overall assets.

Article 509: Liquidity requirements

(...)

3. The EBA shall, after consulting ESMA and the ECB, by 31 December 2013, report to the Commission on appropriate uniform definitions of high and of extremely high liquidity and credit quality of transferable assets for the purposes of Article 416 and appropriate haircuts for assets that would qualify as liquid assets for the purposes of Article 416, with the exception of assets referred to in points (a), (b) and (c) of Article 416(1).

The European Parliament and the Council shall be given the opportunity to state their views on that report.

The report referred to in the first subparagraph shall also consider:

(a) other categories of assets, in particular residential mortgage-backed securities of high liquidity and credit quality;

(b) other categories of central bank eligible securities or loans, for example local government bonds and commercial paper; and

(c) other non-central bank eligible but tradable assets, for example equities listed on a recognised exchange, gold, major index linked equity instruments, guaranteed bonds, covered bonds, corporate bonds and funds based on those assets.

4. The report referred to in paragraph 3 shall consider whether, and if, to what extent standby credit facilities referred to in point (e) of Article 416(1) should be included as liquid assets in light of international development and taking into account European specificities, including the way monetary policy is performed in the Union.

The EBA shall in particular test the adequacy of the following criteria and the appropriate levels for such definitions:

(a) minimum trade volume of the assets;

(b) minimum outstanding volume of the assets;

(c) transparent pricing and post-trade information;

(d) credit quality steps referred to in Part Three, Title II, Chapter 2;

(e) proven record of price stability;

(f) average volume traded and average trade size;

(g) maximum bid/ask spread;

(h) remaining time to maturity;

(i) minimum turnover ratio.

(...)

Annex 2: Literature on market liquidity

This section provides a definition of liquidity and summarises the literature on liquidity measures and methods to guide and provide grounds for the liquidity measures intended to be adopted in the EBA methodology. Due to the breadth of this literature, the overview needs to be limited and focuses mainly on empirical methods and metrics that are of direct relevance to the project.

The first section below provides a definition of market liquidity, the second section surveys the most relevant literature on liquidity and liquidity measurement. The last section provides a summary of empirical results regarding actual liquidity estimates, and measures applied, for different asset classes.

Defining liquidity

When attempting to measure and analyse liquidity, one must confront a basic question: how should liquidity be defined? At the general level, it is a simple concept. However, the exact meaning of liquidity is far from apparent, and how one defines it has implications for how one goes about measuring it. Liquidity also means different things to different traders, depending on their characteristics and typical trading needs. An early general definition of liquidity can be found in Keynes (1930), who considers an asset as more liquid *'if it is more certainly realisable at short notice without loss'*. As defined by O'Hara (1995), '*a liquid market is one in which buyers and sellers can trade into and out of positions quickly without having large price effects'.* Implicit in these definitions is the notion that a liquid market has the ability to absorb large liquidity demands without generating excess volatility. The absorption capacity of markets is of particular importance in the case of LCR, as a funding shock to banks would potentially trigger a joint liquidation of LCR assets by the banking sector. Thus, the EBA will focus on the absorption capacity of markets and measure liquidity accordingly.

To provide this absorption capacity, markets rely on some form of liquidity suppliers that are willing to take the opposite side in transactions initiated by traders that demand liquidity. Who these liquidity suppliers are differs across market structures. For example, quote-driven markets (dealer markets) rely on intermediaries such as designated market makers, specialists or dealers that continuously post bid and ask quotes at which they are committed to buy and sell a specified quantity of an asset. In pure limit order markets, on the other hand, there are no formal intermediaries, and liquidity is provided through limit orders submitted by the traders themselves (the limit order book). Hybrid markets (e.g. the New York Stock Exchange) rely on liquidity provision by both designated market makers (former specialists) and limit order traders, while non-continuous markets (e.g. call markets) concentrate all trading interest at discrete points in time. The EBA will be attentive to the details of the market structure.

Traders that demand liquidity are typically impatient and willing to pay a cost to liquidate or build a position quickly, while patient traders are willing to supply liquidity to the more impatient traders. Most liquidity measures attempt to measure the cost associated with demanding liquidity, or analogously the compensation required to supply liquidity. As such, variables that measure for example the

frequency of trading activity may not in isolation be appropriate liquidity measures as e.g. a high frequency of trading activity does not necessarily map into low implicit costs associated with executing these trades. To obtain a direct measure of liquidity one would need trading activity to be translated into a measure of costs or examined in conjunction with other liquidity measures. This point has been made by e.g. Aitkin and Commerton-Forde (2003), and more recently by Vayanos and Wang (2012).

The above description does not provide much guidance with respect to how exactly liquidity should be measured. For this purpose, Harris (1990) attempts to provide a more operational definition of market liquidity and proposes that liquidity can be defined through four interrelated dimensions: *width, depth, immediacy and resiliency*.

- *width* reflects the cost of demanding liquidity (as opposed to supplying it) and is typically captured by the size of the bid/ask spread. While the spread measures the cost incurred by consuming liquidity immediately ('crossing the spread'), it does not capture the quantity that can be transacted at the best quotes.

- *Depth* refers to the quantity of liquidity supplied, and is typically measured by the volume offered at the bid and ask quotes.

- *Immediacy* refers to how quickly a large trading need can be accomplished. In most continuous markets small orders are typically executed immediately. However, large orders (e.g. by institutional traders) may take time to execute without incurring large costs. In an illiquid market, a large trader may incur significant delay costs if prices move during the time it takes to build the position. This cost is commonly referred to as implementation shortfall (see e.g. Perold, 1988). Immediacy may also reflect search costs, which can be significant in e.g. OTC markets (see e.g. Duffie et al, 2007).

- *Resiliency* refers to the time it takes for a price to return to its pre-trade equilibrium level after a large (uninformed) order consumes liquidity. While resiliency was initially defined with respect to prices, resiliency can also be defined as the speed at which liquidity (quotes and depth) replenishes to equilibrium levels after a large liquidity shock.

An important insight from the above discussion is that several measures are typically needed to obtain an accurate picture of an asset's market liquidity. For example, a tight bid/ask spread is not enough to define an asset as extremely liquid unless a large quantity can be transacted at the best quotes relatively quickly. For example, large traders that split up their orders into smaller chunks to minimise transaction costs, resiliency and immediacy are also very important. In other words, while the dimensions proposed by Harris (1990) are closely related, individual liquidity metrics are typically only able to capture some facets of liquidity. Hence a combination of liquidity measures that capture different aspects is required to get a complete picture. The EBA plans to use a variety of measures in its analysis.

Measures of market liquidity

When structuring the vast literature on market liquidity, the liquidity dimensions proposed by Harris (1990) are useful as a general framework to think about different liquidity measures. However, since many measures and methods aim at capturing several aspects of liquidity simultaneously, the EBA will mainly use his definitions to interpret the measures proposed in the literature.

There are several recent papers that provide a comprehensive literature overview. For example a recent paper by Vayanos and Wang (2012) gives a detailed overview of both the theoretical and empirical literature on market liquidity. In this overview, however, the focus is mainly on the empirical literature with particular focus on liquidity measures that are applicable to this project. It is also important that the measures be relatively simple and transparent as they will be applied to a broad range of assets and markets. However, the accuracy and (proven) quality of a measure should not be sacrificed for simplicity.

Another important aspect is the distinction between liquidity measures that rely on high frequency transaction and/or order level data versus measures that rely on low frequency data (e.g. daily data). While the EBA intends to use detailed transaction data (MiFID data) in the final report, it will also cover measures that are tailored to be estimated using daily data, since such measures will be useful for evaluating the liquidity of asset classes for which the EBA does not intend to gather transaction level data. Finally, it should be noted that the major part of research on liquidity measurement historically has focused on equity markets due to the superior data availability. However, more recent studies on the liquidity of other asset classes (e.g. corporate bonds) typically apply the same measures initially developed for equity markets. In instances where there are concerns regarding the applicability of a measure to a specific asset class or market structure, those will be explicitly noted.

Spread measures

The most widely applied proxy for liquidity is the bid/ask spread. As noted above, spread measures relate to Harris' (1990) width dimension of liquidity. A large part of the theoretical market microstructure literature focuses on understanding why a positive bid/ask spread appears in equilibrium and which factors give rise to cross-sectional differences in spreads. Overall, these studies have established that a spread consists of three main cost components; inventory costs, order processing costs and adverse selection costs (see e.g. O'Hara, 1995). In dealer markets, these costs are incurred by the market makers who typically set a zero-profit (competitive) spread that exactly covers these costs. An important part of both the theoretical and empirical literature focuses on the adverse selection cost component of the spread, which is defined by the market-makers' expected loss to privately informed traders (see Glosten and Milgrom, 1985).

In the empirical literature several spread measures are commonly applied that capture different aspects of transaction costs. The most basic spread measure is the quoted spread (QS), which is simply measured as the difference between the highest bid quote (B_k) and the lowest ask quote (A_k) associated with transaction (or quote update) k, $QS_k = A_k - B_k$. While this is a direct measure of the roundtrip cost associated with trading a *small* quantity of an asset, it is commonly expressed

relative to the bid/ask midpoint price such that the proportional spread (PS) can be expressed as$PS_k = QS_k/M_k$, where $M_k = (A_k + B_k)/2$.

Since trades in dealer- or OTC markets can occur inside the prevailing best quotes, the effective spread might provide a more accurate measure of the spread. The effective spread (ES) for transaction k is typically measured as, $ES_k = q_k(P_k - M_k)/M_k$ where q_k is a signing variable that takes the value 1 if the trade is initiated by a buyer and -1 if the trade is initiated by a seller. In many transaction datasets, however, there is no indicator variable (q_k) explicitly stating whether a trade was initiated by a seller or a buyer. In those cases, the standard method used in the literature is the Lee and Ready (1991) algorithm. This algorithm simply checks whether transaction k occurs above (buyer initiated) or below (seller initiated) the bid/ask midpoint prevailing just before the trade occurs. In the cases where the trade happens exactly at the prevailing midpoint, the standard procedure is to check the transaction price against the midpoint for longer lags. Ellis et al. (2000) examine the accuracy of the Lee and Ready (1991) algorithm and show that it is able to sign about 76% of transactions correctly.

An issue not discussed above is that intraday measures of the spread are also commonly volume weighted or time weighted. By weighting the individual spread observations by the total volume traded, one would obtain a spread measure that reflects more accurately the actual costs realised by traders. The time weighted spread is typically calculated by weighting each spread observation by its intraday duration, which gives a more representative spread measure if there are long periods with the same spread. Calculating a time weighted spread, however, typically requires order-level data.

In cases when one do not directly observe the bid and ask quotes the literature suggests several implicit spread estimators. The best known estimator is proposed by Roll (1984) that exploits the fact that trades typically occur at, or within, the bid and ask quotes. As such it is closely related to the effective spread measure discussed earlier. The main idea is that transaction prices tend to 'bounce' between the (unobserved) bid quote and ask quote as buyer and seller initiated trades execute against these quotes. This generates a negative autocorrelation between consecutive transaction prices (and returns), which can be used to map out the size of the spread. The Roll (1984) implicit spread estimator for a time window t is simply estimated as, $Roll_t = \sqrt{-cov(r_{k-1}, r_k)}$, where $r_k = p_k - p_{k-1}$.

There is also a growing part of the literature that examines low frequency estimators of the spread that only require daily data. These studies are very useful as they offer methods that make it possible to construct long liquidity time series for large samples of individual assets. There are several recent measures that are shown to be very good when evaluated against actual high frequency spread measures. One early estimator is the LOT measure proposed by Lesmond, Ogden, and Trzcinka (1999) that exploits the information inherent in zero-return days to estimate the effective transaction costs for any asset. The basic idea is that assets with large spreads require larger information value for new information to be traded into the price. Hence, if the value of new information is less than the costs of trading, prices will not move. They show that their measure is highly correlated with spread measures calculated using actual quote observations. While the LOT measure requires relatively little data, it needs to be estimated by maximum likelihood, and more importantly requires the return on a

market index. While the requirement of having the return on a market index is unproblematic for equities, for other asset classes and markets the availability of high quality benchmarks are not readily available.

To solve this issue, Fong, Holden and Trzcinka (2011) propose a simplified and less data intensive version of the LOT measure, which they coin FHT. They evaluate the power of this measure against other low frequency and high frequency proxies estimated for more than 18 000 stocks listed on 43 different exchanges around the world, covering a period of more than ten years. The measure is shown to strongly dominate prior percentage cost proxies, and is also highly correlated with various price impact measures. The measure is an analytic measure that requires only daily return observations (i.e. not a market index) and the fraction of zero return days relative to total trading days for the asset. The measure can be calculated for period t as, $FHT_t = 2\sigma_t \mathrm{N}^{-1}[(1 + Z_t)/2]$ where σ_t is the standard deviation of the asset's daily returns over the period; Z_t is the number of zero return days as a fraction of total trading days during the period; and N^{-1} is the inverse function of the cumulative normal distribution.

Depth and price impact measures

As the spread measures typically measure the implicit cost of trading a small quantity at the best prevailing quotes, Harris (1990) proposes a second important aspect of liquidity; *depth*. In recent years the availability of order-level data from limit order markets has made it possible to measure depth more accurately. However, direct depth measures typically involve massive amounts of data, especially due to the tremendous growth in high frequency trading activity recent years. The EBA will focus on metrics applied in the literature that are tailored to provide implicit measures of depth.

A key element in asymmetric information models is that trades convey information, and the quicker prices reflect new information (private and public) the more efficient are prices. Typically, the speed of price discovery, and hence price efficiency, is closely linked to liquidity. As discussed above, Lesmond, Ogden, and Trzcinka (1999) suggest that assets that have higher transaction costs also have less informationally efficient prices. An important distinction is between informed and uninformed trades, and is a key to measuring the price impact of trades. Informed trades should adjust prices *permanently* to new equilibrium levels while uninformed trades caused by e.g. traders receiving idiosyncratic shocks that trigger trades should generate temporary price impacts where prices quickly revert to the pre-trade equilibrium price. This distinction forms the basis for several empirical models of price discovery that aim at quantifying price impacts. One important contribution in this regard is Hasbrouck (1991) who proposes that the interactions of trades and quote revisions be modelled as a vector autoregressive system. Without going into the details of his model, the main results can be summarized as follows; (i) a trade's full price impact is not instantaneous; (ii) the impact is a positive and concave function of the trade size; (iii) large trades widens the spread and produce larger price impacts; and finally (iv) information asymmetries are more significant for smaller firms. In a more recent paper Hasbrouck (2009) examines low frequency proxies of effective cost estimators for the US equity markets, where he proposes an intraday price impact measure. He proposes that the representative price impact (λ_i) of trading in a stock i can be estimated as, $\Delta p_{it} = \lambda_i S_{it} + u_{it}$ where S_{it} is the aggregate signed square-root dollar volume during window t, measured as $S_{it} = \sum(q_t\sqrt{|v_t|})$

where v_k is trading volume (in currency) executed during window t. The length of the aggregation window, t, used in Hasbrouck (2009) is 5 minutes.

There are also several low frequency price impact measures that are typically applied when researchers use daily data. One widely applied measure is the Amihud (2002) illiquidity ratio (ILR). While ILR can be applied to intraday data, it is typically considered a low frequency measure of illiquidity. The ILR is simply calculated as $ILR_n = 1/D_n \sum_{k=1}^{n}[|r_k|/v_k]$ where $|r_k|$ is the absolute return of the asset over time window k, v_k is the currency volume traded over window k, and D_n just reflect the number of windows n (which could be number of hours or days). The ILR is typically scaled up by a factor of 10^6 for practical purposes. Intuitively, the ILR capture how much the price of an asset moves (in either direction) per currency unit of trade. On average, the ILR measure reflect how sensitive the price is to trade volume, and assets with a high ILR are less liquid (have greater price impact) than assets with a low ILR. One issue with the ILR is that as the denominator gets close to zero, the ILR measure goes to infinity. Hence, especially when applying this measure to less traded stocks, or at the intraday frequency, one may experience large outliers.

Price and liquidity reversal

Another dimension that Harris (1990) proposes as an important characteristic of liquid assets is how quickly the price reverts back to the equilibrium price after large liquidity trades. As discussed earlier, this may also be defined as how quickly liquidity supply replenishes after a large liquidity demand has been filled. To measure the resiliency of an asset is relatively challenging, and the literature is relatively scarce. The papers that attempt to estimate the resiliency are typically focusing on electronic limit order markets. Degryse et al. (2005) studies the resiliency of stocks traded on the Paris Bourse by examining the price impact of aggressive order flow (marketable limit orders that demand liquidity) and how prices recover after aggressive trades. They find that the Paris Bourse stocks recover quickly, within just a few quote updates. In another paper Large (2007) measures resiliency as how long it takes for liquidity to replenish after aggressive trades. Moreover, he studies the time it takes for the limit order book to return to its normal shape after large trades. As this estimator requires detailed order level data, the EBA does not go into the details as it will not be applicable for this paper. However, other measures are available. One example is Pastor and Stambaugh (2003), who propose that stock market liquidity can be measured by regressing next period returns for an asset on the signed current period return multiplied by the currency volume of trades in the asset. The authors obtain a monthly measure ($\gamma_{i,t}$) from the regression, $r^e_{i,d+1,t} = \theta_{i,t} + \phi_{i,t} r_{i,d,t} + \gamma_{i,t} sign\left(r^e_{i,d,t}\right) \cdot v_{i,d,t} + \epsilon_{i,d+1,t}$, where $r^e_{i,d+1,t}$ is the excess return on asset i on day d in month t; $v_{i,d,t}$ is the currency volume traded in asset i on day d in month t. While their measure is essentially a measure of price impact, it has a flavour of resiliency as it instead of measuring the direct price impact of trades it captures how much the price reverts to get back to its equilibrium level. It should be noted however that the authors themselves warn that their measure seems too noisy to be useful at the individual asset level due to large sampling errors, and is most applicable to measure market-wide liquidity for an asset class.

Other methods

There is also a part of the literature on market liquidity measurement that proposes that one looks at common (latent) factors across different measures of liquidity. As such, these methods attempt to reduce the universe of liquidity metrics across several liquidity dimensions to a few metrics.

Several papers study whether liquidity risk is systematic and whether that systematic risk is priced in equity markets. Among these are studies by Chordia, Roll, and Subrahmanyam (2000), and Hasbrouck and Seppi (2001), which demonstrate that liquidity has a common systematic factor. One important contribution to this literature is by Korajczyk and Sadka (2007), who propose using principal component analysis to extract common liquidity factors from a large set of different liquidity measures. In their paper they extract three common factors from a set of liquidity measures containing ILR, turnover, quoted spread (QS) effective spread (ES), four price impact measures and a measure of order imbalance measured as the ratio of the net sum of signed trading volume over the month scaled by the number of shares outstanding. They show that shocks to assets' liquidity have a common component across measures which account for most of the explained variation in individual liquidity measures. The main purpose of their analysis is to examine whether liquidity is a priced risk factor in stock market returns, and find that the across-measure systematic liquidity factor is priced. A recent application of principal component methods to the US corporate bond market is in Dick-Nielsen, Feldhutter and Lando (2012), which is discussed below.

Annex 3: Literature on the liquidity of different asset classes

The discussion in Annex 2 mapped out some common liquidity measures applied in the literature. While several of these measures were initially tailored to and assessed for equity markets, they have also been applied to other asset classes. It is very useful to obtain an overview of which measures have been applied successfully to various asset classes. It will also be useful to secure an overview of the typical liquidity estimates obtained for different asset classes, both as a benchmark against which the results obtained can be compared, and to examine how different asset classes have been ranked relative to each other for other markets and other periods. Note that there are several limitations in the literature, largely due to data availability. While studies for equity markets exist for a wide range of markets, a large part of the literature on corporate and government bonds, as well as for other asset classes, concentrates on US data.

Corporate bonds

Historically, corporate bonds have largely been traded over the counter, and data availability has been relatively scarce. There are, however, several studies on the liquidity of the corporate bond market in the US that use different low frequency data sources. In a recent paper, Chen et al. (2007), examine various liquidity measures for a sample of more than 4000 US corporate bonds spanning a wide range of bonds from investment grade to speculative categories. Their main data sources are Bloomberg and Datastream, which they use to calculate several liquidity measures for individual bonds, and groups of bonds. The first measure they calculate is the proportional bid/ask spread (using Bloomberg data). Due to the low frequency (quarterly) nature of their data, they also apply the spread proxies discussed earlier in this section. The two additional measures they calculate are the percentage zero-return days measure (*Zeros*), and the Lesmond et al. (1999) LOT. Overall, they show that their estimates of liquidity costs increase as credit rating worsens. With respect to proportional spreads, they report average spreads of 0.25% for AAA, to 0.31% for BBB and 0.77% for CCC to D for bonds with maturities between 1 and 7 years. For the LOT and Zeros measure, they estimate a significantly larger difference in liquidity costs between investment grade and speculative grade bonds.

In the US, the Financial Industry Regulatory Authority's (FINRA) TRACE is responsible for operating the reporting and dissemination facility for over-the-counter corporate bond trades. The data starts in 2002, and the reporting requirements were gradually increased until 2005 when about 99% of all public transactions are captured. This dataset has been applied in several more recent studies examining the liquidity of the US corporate bond market.

One important paper that exploits the TRACE transactions data is Bao et al. (2011) who stud the US corporate bond market for the period 2003 through 2007. They show that the illiquidity of US corporate bonds is substantial and significantly greater than can be explained by bid/ask spreads. Furthermore, they establish a strong link between bond illiquidity and bond prices and show that changes in market wide illiquidity can very often explain variation in the yield spreads of high-rated bonds.

The paper also shows that the liquidity risk component overshadows the credit risk component. The illiquidity measure they apply is calculated as; $\gamma = -cov(\Delta p_t, \Delta p_{t+1})$ where $\Delta p_t = p_t - p_{t-1}$, and prices

are in natural logarithms. While their measure looks very similar to the Roll (1984) measure, the economic intuition is different. While the Roll (1984) estimator exploits the negative autocorrelation in trade prices caused by the bid ask bounce, the measure by Bao et al (2011) is motivated by the fact that the transitory impact of liquidity should be uncorrelated with the fundamental value of the asset. Hence, their measure is closely related to the Pastor and Stambaugh (2003) measure discussed earlier, as it measures the illiquidity as the size of price reversals. More illiquid stocks are expected to have a stronger *negative* covariance of consecutive price changes (greater reversals), which would imply a larger positive γ given their specification of γ above. In terms of magnitude, their estimate of γ has a cross-sectional average of 0.58 using the full time-series sample.

To compare their price reversal measure against other metrics, Bao et al. (2011) also calculate the Roll (1984) measure for their sample bonds. Furthermore, they also compare their results with another paper by Edwards, Harris, and Piwowar (2007) who uses a more detailed version of the TRACE dataset which also includes information on the side on which a dealer participated. This makes them able to determine whether a trade was initiated by a buyer or seller, such that they can directly measure the effective spread. Bao et al. (2011) compare their Roll measure with the effective spreads in Edwards, Harris, and Piwowar (2007) for various trade sizes. Interestingly, in both studies the implicit and effective spreads decline with trade size. E.g. for trade sizes in the range of $7.5k to $15k, the average implicit spread is 1.98% and the effective spread is 1.42%, while for trade sizes above $750k, the implicit spread is 0.52% and the effective spread is 0.18%.

The most extensive study of the liquidity of the European corporate bond market is a commissioned report produced by Biais et al. (2006) for the City of London on the transparency, liquidity and efficiency of the European corporate bond market. This report surveys the empirical literature on the liquidity of corporate bonds and also provides empirical evidence for the European market using International Index Company (IIC) data containing daily end-of-day bid and ask quotes in the iBoxx index. They examine euro- and sterling-denominated corporate bonds for the period 2003-2005, and the report contains a wide range of statistics across various characteristics. While it is not clear how representative their results are for today's market, they find that, after controlling for sample period and credit risk, the effective spreads in euro-denominated bonds are lower than their US counterparts. Moreover, they find that the effective half spread for trades above one million Euros is 0.049%. This is significantly lower than the results in Goldstein et al. (2005) for the US market, who find that the half spread is 0.22% for transactions above one million USD. Interestingly, the spread estimates for the US corporate bond market are similar to the results in Chen et al. (2007) discussed earlier. Biais et al. (2006) suggest some explanations for the difference between the US and European bond markets. Since the advent of the euro, the European bond market has become integrated with investors from all European countries trading in the same market. This large pool of buyers attracts sell-side intermediation. As such, they argue that their results suggest that the supply of liquidity in the euro-denominated bond market is rather competitive, which drives spreads down.

Since this study is about identifying which assets have the ability to retain their liquidity during stressful periods, a recent paper by Dick-Nielsen, Feldhutter and Lando (2012) is particularly enlightening. They perform an extensive study of the corporate bond market liquidity in the US for the period 2005 to 2009. For this purpose, they calculate several liquidity measures including an Amihud (2002) ILR,

zero-trading days, and the Roll (1984) implicit spread measure among other things. They also extract principal components from a set of eight different liquidity and activity measures. Their overall results suggest that bond market liquidity worsened dramatically during the subprime crisis. They also find that their common liquidity factor derived from a principal component analysis is superior to earlier measures when it comes to explaining variations in yield spreads.

Houweling, Mentink and Vorst (2005) take a different approach by studying bond- and issuer-specific characteristics that are related to liquidity. Motivated by the fact that for corporate bonds, most transactions occur on the over-the-counter market, direct liquidity measures (based on transaction data) are often not reliable and difficult to obtain, and researchers need to rely on other proxies of liquidity. They examine a set of bond and issuer specific characteristics that have been used to proxy for corporate bond liquidity and liquidity risk in other papers. The measures they examine are (i) issued amount, (ii) whether a bond is listed on a stock exchange, (iii) whether a bond is denominated in euros or in one of the legacy currencies, (iv) if a bond is on-the-run, (v) age, (vi) missing prices (as a proxy for no-trades), (vii) yield volatility, (viii) the number of contributors (proxy for competition) and (ix) yield dispersion. Their null hypothesis that liquidity risk is not priced in their sample of euro corporate bonds is rejected for eight out of nine liquidity proxies. The only proxy that they do not find support for relating to liquidity risk is the number of contributors. Overall, they find a significant liquidity premium, ranging from 13 to 23 basis points. Another important contribution of their paper is that the vast majority of empirical papers on sovereign and corporate bond liquidity studied data from the United States, and relatively little is known about the extent to which these results apply to the euro market. Although their paper does not give any direct measures on corporate bond liquidity, this is one of the first papers that study the effects of corporate bond liquidity on bond yields in the European markets.

Government bonds

Also for government securities, most empirical studies focus on the US market. A much cited study on the liquidity of the US treasury market is Fleming (2003). His paper estimates and evaluates a wide range of liquidity measures using high frequency data from the interdealer market (GovPX data). The measures examined are trading volume, trading frequency, bid/ask spreads, quote sizes, trade sizes and price impact coefficients. He compares various measures against each other to provide insights as to how liquidity can be best measured and tracked. One main result in this regard is that the bid/ask spread is found to be a good measure of treasury market liquidity and is highly correlated with a more sophisticated price impact measure (the coefficient from a regression of price changes on signed volume and trades). Interestingly, he finds that trading volume and trading activity in particular are found to be weak proxies for market liquidity, as both high and low levels of trading activity are associated with periods of poor liquidity. This is consistent with the results and arguments in Aitken and Comerton-Forde (2003) for the equity market.

For US government bonds, a recent paper by Goyenko, Subrahmanyam and Ukhov (2011) examines how liquidity varies across different maturities and also between on-the-run and off-the-run bonds. Their sample period spans more than 35 years covering the period from November 1967 – December 2005. They use data from the Center for Research in Security Prices (CRSP) daily Treasury Quotes file containing bid and ask prices for Treasury fixed income securities for maturities ranging from 3

months up to 30 years. The main liquidity measure they apply is the proportional quoted bid/ask spread. Their main results are that spreads increases in recessions across all maturities, both for on- and off-the-run bonds. However, they find that the increase in spreads is especially large for long term bonds. They argue that these results suggest that investors shift into short term bonds during recessions. The average proportional spread for medium term US government off-the-run bonds is 0.11%, which is much lower than what is found for US corporate bonds in e.g. Bao et al. (2011) reported earlier. When looking separately at US recession periods and non-recession periods (as classified by NBER), their spread estimates are 0.149% during recessions and 0.101% during non-recessions. For short term bonds (Treasury bills) the whole sample average proportional spread is 0.025%, with an average spread of 0.049% during recessions and 0.002% during non-recession periods.

For the European market a similar commissioned report to the one produced by Biais et al. (2006) on the corporate bond market was produced for the European government bond market. This report was produced by Dunne et al. (2006). The empirical analysis in the report uses several data sources. For the euro-denominated European government bond market they use detailed data for the limit order book and transactions from the MTS trading platform covering selected months over the period 2003 through 2005. They also apply various datasets for the US treasury market (e.g. Cantor Market Data, BrokerTec and GovPX) to compare the liquidity of the European versus the US government bond market. While they also examine a wide range of other characteristics, the liquidity variables they calculate are the effective spread, the steepness of the order book, trade size, liquidity (depth) at the best bid and ask quotes and depth at the best three quotes. Overall they find that the median effective spreads for the European MTS sample is significantly higher than for the US sample. They suggest that this can be explained by the relatively small size of issuance, the fragmented nature of the euro-denominated markets, and the fact that there are fewer primary dealers providing liquidity across a larger number of issues. For short maturity bonds, the median effective spread for European issues is more than double that of US counterparts. These results are also largely mirrored for medium and long maturities.

Covered bonds

The literature studying the liquidity of covered bonds is much scarcer than for the above asset classes. However, a recent study by Dick-Nielsen, Gyntelberg and Sangill (2012) examines the secondary market liquidity of government and covered bonds in Denmark before, during and after the 2008 financial crisis. They apply a liquidity measure that is closely related to the Amihud (2002) ILR measure, but modified in a manner demonstrated by Dick-Nielsen, Feldhutter and Lando (2012) to be a good proxy for US corporate bond liquidity. The modified ILR measure is calculated as, $\mathrm{PI}_{t,i,k} = \left|\mathrm{p}_{t,i,k} - \mathrm{p}_{t,i-1,k}\right| / \mathrm{p}_{t,i-1,k}$, where i refers to the ith transaction on day t in bond k. Hence, the measure captures how much the price moves in either direction in response to a trade. The study finds that the liquidity of both government and covered bonds worsened during the crisis period. Whilst government bonds outperformed covered bonds before the crisis, the liquidity of the two instruments was broadly similar during the crisis. Therefore the liquidity of covered bonds worsened less than government bonds during the crisis, although overall liquidity conditions were similar across the two markets.

Equities

The literature on liquidity is most developed for equities markets due to the superior data availability both with respect to readily available very detailed intraday order level data for many markets, the time series length of the data, and also the large theoretical equity market microstructure literature. O'Hara (1995) provides a study of the theoretical microstructure literature while Madhavan (2000), Biais, Glosten and Spatt (2005) and Vayanos and Wang (2012) survey both the theoretical and empirical literature. Most, if not all, market liquidity measures that are applied to other asset classes were initially developed for equities. The literature on equity market liquidity is large and we limit the review to some key articles. The literature can generally be divided in two main parts: (a) studies that examine how liquidity can be measured, and (b) studies on the asset pricing implications of liquidity and liquidity risk (applying various liquidity measures). As the first part of the literature is the one most relevant for this paper, we will disregard the second part (asset pricing) of the literature, and focus on the more recent studies.

A much cited paper that that examines the development in US equity market liquidity using a century of data is Jones (2002). He compiles a time series of bid/ask spreads on Dow Jones Stocks covering the years 1900 through 2000. He finds that the average quoted and proportional bid/ask spreads have decreased over the sample period, a result also documented in Hasbrouck (2009) among others. The proportional spread estimates in Jones (2002) suggest that the average proportional spread has fallen from around 0.7% in the early 1900s to about 0.2% in 2000. Interestingly, he toofinds that the annual share turnover was much higher early in the sample (about 200% in 1900) than in the more recent part of the sample (50% in 1990), although there is an increasing trend from the 1970s. Another result in Jones (2002) is that equity market liquidity has a cyclical component and worsens in periods of market stress. The results in Næs, Skjeltorp and Ødegaard (2011) strongly suggest that equity market liquidity in the US (1947-2008) and Norway (1980-2008) has a cyclical component related to the business cycle. Moreover a worsening of equity market liquidity is found to be a strong and stable predictor of NBER recession periods and the business cycle. The business cycle component of market liquidity is most pronounced for stocks with low market capitalisations. Using detailed equity ownership data, Næs et al. (2011) also find that investors shift their portfolios both within equities and out of equities during economic downturns, and that this is consistent with a flight to quality. The liquidity measures applied in the above studies are quoted and proportional spreads, the Hasbrouck (2009) effective cost measure, the Amihud (2002) illiquidity ratio (ILR) and the Lesmond et. al (1999) measure (LOT).

More recent studies on equity market liquidity use detailed high frequency order book data to provide more accurate measures of liquidity. Also, a large part of this recent empirical literature tries to identify the low-frequency measures that best proxy for their high-frequency counterparts, and also to analyse the liquidity of markets outside the US. A recent paper by Fong, Holden and Trzcinka (2011) examines the liquidity of more than 18 000 stocks listed on 43 exchanges around the world. They examine 19 low frequency measures over a sample period from 1997 through 2007. They find that overall, both price impacts and effective spreads have fallen across most markets over their sample period. An important contribution in Fong et al. (2011) is that they propose a new low frequency proxy for

effective spread (FHT) which is both simple to calculate and is shown to be superior to most other percent cost proxies.

Commodities

Since gold is defined as a potential LCR eligible asset class in Art. 481 paragraph 2 of the most recent CRR, it is useful to review the literature assessing the market liquidity of commodities markets. While this literature is very scarce, a recent paper by Marshall, Nguyen and Visaltanachoti (2011) provides a broad analysis applying various liquidity measures to a wide range of commodities, including gold. They also evaluate which liquidity measure best captures the liquidity of commodities markets by comparing high frequency benchmarks with low frequency proxies similar to Goyenko et al. (2009) and Fong et.al (2010) for equities. Their study examines commodity futures covering six energy commodities, eight agricultural commodities, three livestock commodities, five industrial metals and two precious metals. These are the twenty-four commodities that comprise the S&P Goldman Sachs Commodity Index (S&P GSCI). Their main data source is the Thomson Reuters Tick History database covering both open-outcry and electronic trading. They also examine daily commodity data obtained from Thomson Reuters Datastream. The paper examines a total of 17 low frequency (daily data) liquidity proxies and three high frequency benchmarks (tick data). The main result in their study is that the Amihud (2002) ILR measure has the highest correlation with the high frequency benchmarks across all low-frequency liquidity measures. Interestingly, their results find support for earlier findings by Ferguson and Mann (2001) that the Roll (1984) effective spread estimator is a poor proxy for commodity liquidity. With respect to the liquidity of different commodities, their results strongly suggest that precious metals (gold and silver) are a highly liquid commodity class. Bid/ask spread measures, price impact measures and resiliency measures show that gold is consistently the most liquid commodity.

Annex 4: Survey of liquidity metrics

#	Metrics	Formula	Concept	Input
1	Trading volume	$V(\Delta t) = \sum_{i=1}^{N_{\Delta t}} q_i$	Sum of the number of securities traded during a time interval Δt.	Trades sizes
2	Turnover	$T(\Delta t) = \sum_{i=1}^{N_{\Delta t}} p_i * q_i$	Sum of the number of trade prices (trade size * trade price) during a time interval Δt.	Trades sizes and prices
3	Depth or Quantity depth	$D(t) = q_{ask}(t) + q_{bid}(t)$	Sum of best ask and bid volumes in the order book at time *t*.	Best ask and bid volumes
4	Log depth	$D_{log}(t) = \ln(q_{ask}(t) * q_{bid}(t))$	Sum of the natural logarithm of the best ask and of the best bid volumes in the order book at time *t*.	Best ask and bid volumes
5	Dollar depth	$DD(t) = \frac{q_{ask}(t) * p_{ask}(t) + q_{bid}(t) * p_{bid}(t)}{2}$	Arithmetic average of the product of the best ask price and its respective volume and the best bid price and its respective volume in the order book at time *t*.	Best ask and bid prices and volumes
6	Number of transactions per time unit	$N(\Delta t)$	It counts the number of trades during time interval Δt.	Order book
7	Number of orders per time unit	$O(\Delta t)$	It counts the number of orders inserted into the order book during time interval Δt.	Order book

8	Absolute spread (or dollar spread)	$S(t) = p_{ask}(t) - p_{bid}(t)$	Difference between the lowest ask and the highest bid prices in the order book at time *t*.	Lowest ask and the highest bid prices at time *t*
9	Log absolute spread	$S_{log}(t) = \ln\left(p_{ask}(t) - p_{bid}(t)\right)$	Natural logarithm of absolute spread at time *t*.	Lowest ask and the highest bid prices at time *t*
10	Relative or proportional spread calculated with mid price	$S_m(t) = \frac{\left(p_{ask}(t) - p_{bid}(t)\right)}{p_{mid}(t)} = \frac{2 * \left(p_{ask}(t) - p_{bid}(t)\right)}{\left(p_{ask}(t) + p_{bid}(t)\right)}$	Absolute spread at time *t* divided by the mid-price at time *t*.	Lowest ask and the highest bid prices at time *t*
11	Relative spread calculated with last price	$S_{p(t)}(t) = \frac{\left(p_{ask}(t) - p_{bid}(t)\right)}{p(t)}$	Absolute spread at time *t* divided by the last paid price before time *t*.	Lowest ask and the highest bid prices and the last paid price before time *t* / Order book
12	Relative spread of log prices	$SRelLog(t) = \ln\left(\frac{p_{ask}(t)}{p_{bid}(t)}\right)$	Difference of natural logarithms of the lowest ask and of the highest bid prices in the order book at time *t*.	Lowest ask and the highest bid prices at time *t*
13	Effective spread	$Seff(t) = \left\lvert p(t) - p_{mid}(t)\right\rvert = \left\lvert p(t) - \left(\frac{p_{ask}(t) + p_{bid}(t)}{2}\right)\right\rvert$	Difference between the last paid price before time *t* and the mid-price at time *t.*	Lowest ask and the highest bid prices and the last paid price before time *t* / Order book
14	Relative effective spread calculated with mid price	$SeffRelMid(t) = \frac{\left\lvert p(t) - p_{mid}(t)\right\rvert}{p_{mid}(t)} = \frac{\left\lvert p(t) - \left(\frac{p_{ask}(t) + p_{bid}(t)}{2}\right)\right\rvert}{\left(\frac{p_{ask}(t) + p_{bid}(t)}{2}\right)}$	Effective spread at time *t* divided by the mid-price at time *t*.	Lowest ask and the highest bid prices and the last paid price before time *t* / Order book

15	Relative effective spread calculated with last price	$SeffRelLast(t) = \frac{\lvert p(t) - p_{mid}(t) \rvert}{p(t)} = \frac{\left\lvert p(t) - \left(\frac{p_{ask}(t) + p_{bid}(t)}{2} \right) \right\rvert}{p(t)}$	Effective spread at time *t* divided by the last price at time *t*.	Lowest ask and the highest bid prices and the last paid price before time *t* / Order book
16	Quote slope	$QS(t) = \frac{S(t)}{D_{log}(t)} = \frac{\left(p_{ask}(t) - p_{bid}(t) \right)}{\left(\ln(q_{ask}(t)) + \ln(q_{bid}(t)) \right)}$	Absolute spread divided by the Log depth.	Lowest ask and highest bid prices and their respective volumes at time *t*
17	Liquidity ratio 1 (Baker (1996)) (or Amivest liquidity ratio)	$LR_1(t) = \frac{T(\Delta t)}{\lvert r(\Delta t) \rvert}$	Turnover divided by the return during time interval Δt.	Trades sizes and prices and asset return during time interval Δt.
18	Liquidity ratio 2 (Ranaldo (2000))	$LR_2(t) = \frac{LR_1(t)}{(N_e - N_o)}$	LR1 divided by the difference between the total number of securities and the number owned by the firm during time interval Δt.	Trades sizes and prices and asset return during time interval Δt and total number securities available and owned by the firm
19	Order ratio	$OR(t) = \frac{q_{bid}(t) - q_{ask}(t)}{T(\Delta t)}$	Difference between the best bid and the best ask volumes at time *t* scaled by the turnover during time interval *t*.	Best bid and the best ask volumes and trades sizes and prices.
20	Market impact	$MI(t,T) = p_{ask}(t,T) - p_{bid}(t,T)$	Difference between the ask and the bid price in the order book at time *t* for a certain turnover *T* to be generated.	Order book
21	Depth for price impact	$DI_{ask}(t, p_{ask}(t) - p_{mid}(t)) = V_{ask}(t, p_{ask}(t) - p_{mid}(t))$ $DI_{bid}(t, p_{bid}(t) - p_{mid}(t)) = V_{bid}(t, p_{bid}(t) - p_{mid}(t))$	This represents the number of securities *DI* that must be traded to move the price a certain amount from the quote	Order book

midpoint.

22 Price impact

$$PI_{ask}(t,q) = \ln\left(\frac{\sum_{k=1}^{K} p_{ask,k}(t) * q_{ask,k}(t)}{q(t) * p_{mid}(t)}\right)$$

$$PI_{bid}(t,q) = -\ln\left(\frac{\sum_{k=1}^{K} p_{bid,k}(t) * q_{bid,k}(t)}{q(t) * p_{mid}(t)}\right)$$

with $q(t) = \sum_{k=1}^{K} q_k(t)$.

PI is calculated on the demand and supply curve. A market order of size *q* is executed at *K* different prices with q_k *securities trading at price* p_k and $q(t) = \sum_{k=1}^{K} q_k(t)$.

Order book

23 Xetra Liquidity Measure (XLM) (weighted spread liquidity measure)

$$XLM(n * p_{mid}) = \left(\frac{\sum_{i}\left(p_{ask}(t,i) * q(t,i)\right) - \sum_{i}\left(p_{bid}(t,i) * q(t,i)\right)}{n * p_{mid}}\right.$$

The XLM is a weighted spread liquidity measure. It was developed by Deutsche Boerse Group for its electronic platform Xetra. The Xetra platform calculates automatically XLM based on the Xetra electronic book which includes the iceberg orders, trades submitted invisible.

The XLM is the average limit-order-volume weighted price of all limit orders, which are required for transacting a

Measure provided by Xetra for the Xetra trading platform but can be calculated from the order book (including iceberg orders)

specific size, relative to the mid price.

The XLM can be seen as the cost of immediate execution of a specific size $(n*p_{mid})$ compared to the mid price.

The XLM is very similar to the Price Impact.

24 Marginal Supply Demand Curve (MSDC)

The Marginal Supply-Demand Curve (MSDC) is defined formally as follows:

An asset A is a good traded in the market with prices given by a function

$$x \to m(x) : \Re \setminus \{0\} \to \Re$$

called the Marginal Supply-Demand Curve (MSDC) which satisfies:

1. $m(x_i) \geq m(x_{i+1})$ *if* $x_i < x_{i+1}$

2. $m(x)$ is cadlag (i.e. $lim_{y \downarrow x}\, m(y)=m(x)$) for $x<0$ and ladcag (i.e. $lim_{y \uparrow x}\, m(y)=m(x)$) for $x>0$

Let $m^+=m(0^+)$ be the *best bid* and $m^-=m(0^-)$ the *best ask*. The quantity $\delta m = m^+ - m^- \geq 0$ is called the *bid/ask spread*.

A necessary assumption is the no arbitrage requirement that any bid be lower than any ask prices. Given this assumption, the MSDC is decreasing by construction.

Let m_i represent the prices and Δx_i represent the corresponding maximum sizes (expressed in number of contracts x). For instance, suppose that we have to sell a given number of contracts z of a certain asset. We list all the bid prices in a decreasing order vector, which lists the prices from the most convenient to the least convenient from our sell point of view. So we will index the quotes accordingly ($m_i \geq m_j$ *if* $i \leq j$). We will firstly exploit the highest bids by selling amounts $\Delta z_i \leq \Delta x_i$ until $\sum_i \Delta z_i = z$. The net proceed from our sales will be $P=\sum_i m_i \Delta z_i$. For ask prices, the reasoning is symmetrical and the best quotes will be the lowest.

We can build the MSDC $x \to m(x)$ by collecting all the prices $m(x)$ available for trades of dx contracts and sorting them by decreasing order in x. We obtain a

Order book

single decreasing curve with the best ask quotes for buying z contracts in the interval $x \in [-z,0[$ and the best bid quotes for selling z contracts in the interval $x \in]0,z]$.

The MSDC does not only include the bid/ask spread (tightness) information but also the bid/ask depth (depth) information and the demand and supply information (resiliency).

Annex 5: Responses to the EBA Discussion Paper on the methodology to be used in this report

Between 21 February 2013 and 21 April 2013 the EBA conducted a public consultation on the methodology it proposes to use to identify a uniform definition of liquid assets in the LCR under the CRR.

Thirty-four responses have been received by the EBA (23 responses attributable to the banking sector, 5 from other financial institutions and 6 responses from other sectors).

Answers to the questions

Q1. Given the difficulties with obtaining transactional data outlined here, do you think a data sample cover 2008-2012 is sufficient for this analysis? Would you see merit in extending the sample in those countries where more data is available?

- There is broad agreement about the data sample proposed. Some responses recognise that a wider data sample may have some practical benefits, but data would be difficult to obtain (MiFIDMiFiD data is not possible to obtain). Some respondents disagree with the proposed sample and ask for a longer period (at least 10 years, or more than an economic cycle).

- There is ample support for the inclusion of data for repo markets.

- Some respondents have raised the issue of including assets denominated in non-European currencies in the analysis.

Q2. Do you have additional data sources to suggest? Specifically, can you suggest a source of repo data and gold that would fit our needs?

The most commonly suggested additional data sources are:

- data providers (Bloomberg, Reuters, etc.);

- custodians;

- clearing houses;

- The REPO council annual survey.

Some respondents stress the advantages of the use of publicly available date, so that banks can duplicate the EBA´s assessment.

Q3. Do you agree with the list of liquidity metrics under consideration to be used in the EBA assessment, as mentioned in this section and Annex 5? Can you suggest further metrics the EBA should make use of, where information would be available?

- The list of metrics is considered sufficiently broad. The main concern pointed out in some responses is calibration of the individual metrics, since the consultation paper is not explicit about the weighting and combination of the individual metrics. Several responses are concerned that some assets, considered as liquid, may fail some of the individual metrics (failing a litmus test, thresholds). In this context, the concern is raised that the use of several metrics additively may lead to an overly restrictive definition of liquid assets.

- Several respondents point to the fact that overreliance on quantitative liquidity metrics might lead to a liquidity definition biased towards big markets and will not take the rather qualitative liquidity features of small markets sufficiently into account.

- There was moreover a concern that since the EBA proposes to establish a relative ranking of assets the final cut off between “extremely liquid”, “highly liquid” and “ineligible” would be arbitrary, since no general definition of liquidity is provided.

Q4. Do you agree with the list of explanatory characteristics whose linkage to liquidity it is proposed to be tested in the EBA assessment? Can you suggest further characteristics the EBA should assess?

There is broad support for the explanatory characteristics proposed. However, some concerns, listed below, are indicated in the responses.

- Practicality for market participants and the ability to measure such a characteristic objectively is not evident.

- There were concerns about the use of these metrics in the analysis.

- Many of the explanatory characteristics (e.g. the large number of market makers, being traded via additional platforms and markets, the wide range of potential buyers) cannot be handled in quantitative terms, since they are qualitative in nature.

- The criterion of “remaining time to maturity” considered inappropriate for short term securities and liquid assets monetised via repo.

- Eligibility in the main clearing houses (i.e. GC pooling) should be considered as an additional qualitative characteristic.

- The EBA should give consideration to the inclusion of an asset as a constituent of major market indices or the presence of active derivatives and index markets for the asset (e.g. Futures, CDX, ITRAXX etc)

Q5. Do you agree with the methodology proposed? Do you have alternative approaches that might be used?

There is general acknowledgement of the difficulties faced by the EBA with producing a uniform definition of liquid assets. Most respondents agree with the proposed methodology and advocate a simple, harmonised definition of liquid assets. The definition should be easy to use by banks. As for differentiation within asset classes and across countries, views are split, with some respondents asking for a harmonised approach and others arguing in favour of differentiation between currencies and markets.

The fact that the EBA will define eligible asset classes is expressively welcomed by respondents, as banks lack the (data) resources to conduct a comprehensive liquidity analysis on their own. Doubts remain however, as to what extent banks will have to assess the liquidity of the single selected asset. In this context the wish for an ISIN list of liquid assets is repeatedly mentioned.

A major flaw is seen in EBA focusing only on transactional data as opposed to repos.

One alternative repeatedly proposed is ECB-eligibility as only and sufficient criterion for liquidity (collateral eligibility in repo markets for equities). This approach is justified by the current role of the central bank and the definition of the LCR stress scenario of being not only idiosyncratic but also systemic.

As a variation, ECB-eligibility is proposed as the "standard approach" whereas sophisticated banks should be allowed to use their own definitions of liquid assets.

As another alternative, respondents propose a more qualitative approach, where entities analyse the liquidity of assets on their own on the basis of criteria and thresholds proposed by EBA.

Other main findings

Periodic review/update of the definition of liquid assets is suggested, as the liquidity of asset classes and/or the appropriateness of liquidity metrics may change over time.

Respondents ask for increased transparency on the scorecard model used by the EBA, i.e. the envisaged combination of the outcome of the application of different liquidity metrics. This transparency should allow banks to duplicate the identification process of liquid assets, to anticipate changes in the eligibility and avoid cliff effects.

The proposed approach focuses primarily on transactional data as a basis for the liquidity definition of an asset. That would not appropriately reflect the possibility of liquidating a high credit quality asset which is not traded actively in the market simply because of the fact that it is kept by their current holders as a high credit quality asset stock. "Structural bid" should therefore be considered as a correction factor in the analysis.

- The impact of the definition of the liquidity of assets itself on the liquidity of the respective assets should be taken into account (liquidity is not determined entirely endogenously). The EBA should also take into account the expected effect of other regulatory initiatives (financial transaction tax, Solvency II, EMIR).

- The EBA´s analysis focuses on assets denominated in European currencies. Internationally active banks will require guidance on the definition of HQLA denominated in other currencies, most importantly the US Dollar.

- Some respondents refer to the possible outcome of the EBA´s analysis and argue in favour of the inclusion of specific assets (notably RMBS and ABS). One respondent suggested a further consultation on the uniform definition of liquid assets itself. For the sake of ensuring a global level playing field, other respondents express their expectation that the EBA´s definition should be in line with the one established by the BCBS.

Proposed Feedback

The EBA proposes to address the issues listed below.

- The EBA currently stepping up efforts to include liquidity information from repo markets.

- Whilst producing a relative ranking of the liquidity of different asset classes, the quantitative analysis needs to be flanked by qualitative information. Defining the cut-off between eligible and ineligible asset classes needs to be based to a certain extent on expert judgement and may be somewhat subjective. The EBA agrees on the need to depict the rationale of the analysis in a transparent way and will point out the stage at which expert judgements need to be made or political decisions taken.

- The need for qualitative judgement does also apply to the incorporation of a forward looking approach into the analysis, taking into account other regulatory initiatives implemented in parallel, such as financial transaction tax.

- In the spirit of the single rule book, the EBA will present a uniform definition of HQLA applicable throughout Europe. The qualitative metrics used should allow application in all markets, independently of their size.

- As for the liquidity assessment of specific asset classes, this subject was not within the scope of the discussion paper, which focused strictly on the methodology and not on any analytical outcome. At this juncture the outcome of the analysis cannot be prejudged.

- The scope of the asset classes subject to the assessment is defined by the CRR. Government bonds fall within this scope as they might be either admissible as HQLA in their own right if covering a liquidity risk in the country issuing a bond, as well as thanks to their liquidity features.

Furthermore, when producing a relative ranking of asset classes, government bonds might serve as a benchmark.

- Concerning the interdependency between the definition of HQLA and monetary policy, the EBA will conduct its analysis of the liquidity of assets independently of these considerations, which will be a subject of the overall impact assessment of the LCR. However, central bank eligibility is acknowledged to be a factor influencing the market liquidity of an asset as an explanatory characteristic and is currently a necessary condition in the CRR for HQLA eligibility.

- The definition of HQLA is based on market liquidity. The systemic component of LCR stress and the role of central bank liquidity are taken into account in the design of the LCR, which allows recognition of exposures to central banks and standby credit facilities of central banks as part of the enumerator of the LCR.

- Due to reasons of practicability and data restrictions, the quantitative assessment conducted by the EBA will focus on European currencies only.

- Within the framework of asset classes proposed which will be proposed by the EBA, the selection of the individual ISIN remains the responsibility of the bank.

- Under the CRR, the EBA has been charged with providing a one-off report on a uniform definition of liquid assets. If there is a need to adapt this definition to a changing market or regulatory environment (that might be unveiled by the annual overall impact assessment of the LCR) we believe the European legislator will duly react.

Annex 6: Bond data description

The major source of bond data for this analysis is transaction data for EU bond markets. The data gathered encompass outright sales trades on government bonds, corporate bonds, covered bonds, bonds issued by promotional banks, RMBS and ABS. The data source is data collected by national supervisors on the basis of the reporting requirements on security trades due to the MiFID directive. Data has been submitted from 27 countries covering trades in the period from 1 January 2008 to 30 June 30 2012.

Cleaning and filtering the data

The purpose of this step is to filter out erroneous observations, and also to obtain the most uniform data set across the contributing countries. This ensures that the level of quality both within and between countries is similar and thus permits a comparative analysis of the metrics. The filtering therefore deals with both erroneous reporting and the inherent nature of the data. Some filters are therefore absolute thresholds, while others try to consider specific market characteristics. The specific filtering methods and thresholds are presented below.

Price filters

Bonds should trade close to 100. Hence, reported prices that deviate from 100 are considered erroneous, even though some variation should be allowed as credit rating or changing interest rate levels can create substantial deviations from the issue price. Therefore all transactions not priced between 5 and 500 are eliminated.

For many countries there are several bonds that trade at prices around 1. These observations are assumed to be percentage notations. Hence, to include these trades, all prices between 0.7 and 1.3 are multiplied by 100.

The next step is to eliminate outliers within an individual ISIN code. These outliers are for the most part caused by a defaulted trade price (100) or simply a mistake made by the reporter. This problem is alleviated by removing observations that range outside two standard deviations from the mean price, measured over the entire sample for a specific bond. This method allows for larger single price jumps in volatile bonds than less volatile instruments, and the filter is unlikely to remove any single price jumps that are not erroneous. Finally, bonds that do not have any variation in the price are also deleted using this filter. This is done because some bonds are reported only with default prices (100). In addition, this filter also removes bonds in which only one trade is registered. A limit of a 100 bps price change between trades has been implemented within each instrument. These trades are either errors or the price change reflects new information, as opposed to liquidity characteristics. As a last price filter, any prices within an instrument that are in multiples of 10 compared to the lowest price are adjusted. That is to say, if a bond is traded at both 30 and 300, the large price is divided by 10.

Trade size filters

Initially all trades with the same time and price are merged, as other investors will not be able to differentiate between them, and therefore the price information should only be used once.

There are a substantial amount of retail trades in the data (small trade value). As these trades do not carry any liquidity information, and because there seems to be a correlation between retail trades and bad reporting in general, all trade sizes less than EUR 500 000 are deleted. This eliminates the majority of bad reporting, meanwhile preserving a maximum of information. With respect to large trade sizes, all trades that are greater than ten percent of the outstanding amounts are removed. This removes all upward errors in the reporting.

Time and instrument code filters

As the time stamp is essential in removing repos and redundant trades, all trades without useful time information are removed. Furthermore all transactions in invalid ISIN-codes are removed.

Repo filters

Market participants should in principle exclude repo transactions in MiFID trade reporting. Repos are nonetheless present in the data, and should thus be removed. Repos are identified as trades between the same entities, within a day with the same quantity, and as a buy and a sell respectively. Most repos are reported within one or two minutes of each other, however. Using the day reference point does not change results, and allows for some lag in reporting.

Redundancy filter

If both parties in a trade are MiFID reporters, a trade will figure twice in the data. The redundant trades are removed by identifying trades with exactly the same price and quantity, reported as a buy and a sell between the parties. If two such trades are identified, only the buy side is kept in the data.

Annex 7: Equity data description

The source of equity data for this analysis is Bloomberg. For each of the countries represented in our bond sample from the EU and the EEA, we pick out equities included in a representative major stock index of that country. The indices included are presented below.

We use the daily closing price, daily trading volume, outstanding amount and industry sector variables from Bloomberg for our analysis. The data cover the full sample period from 1 January 2008 to 30 June 2012. We eliminate observations where the daily trading volume is below EUR 500 000. This is in order to eliminate retail size trades and ensure comparability of the liquidity metrics with the analysed bond data. No further cleaning or filtering of the data is performed.

	Country	Country ISO	Full Name	Description	# Members
Eurozone	Austria	AT	AUSTRIAN TRADED ATX INDX	The Austrian Traded Index is a capitalisation-weighted index of the most heavily traded stocks on the Vienna Stock Exchange. The equities use free-float adjusted shares in the index calculation. The index has a base level of 1000 as of 2 January 1991.	20
	Belgium	BE	BEL 20 INDEX	The BEL 20 Index is a modified capitalisation-weighted index of the 20 most capitalised and liquid Belgian stocks that are traded on the Brussels Stock Exchange. The equities use free-float shares in the index calculation. The index was developed with a base value of 1,000 as of 1 January 1991.	20
	Cyprus	CY	GENERAL MARKET INDEX CSE	Cyprus General Market Index (CSE)	18
	Estonia	EE	OMX TALLINN OMXT	OMX Tallinn (OMXT)is a capitalization weighted chain-linked total return index which includes all the shares listed on the Main & Secondary lists on the Tallinn Stock Exchange. The aim of the index is to reflect the current status & changes on the Tallinn market. The base date is 3 June 1996, with a value of 100.	16
	Finland	FI	OMX HELSINKI 25 INDEX	The OMX Helsinki 25 Index is a modified-capitalisation weighted index that consists of the 25 most traded series on Helsinki Stock Exchange's Main List. The index is used as a benchmark for the Finnish Market. The index calculation includes free float factors and each company in the index is limited to a weight of	25

			10%.	
France	FR	CAC 40 INDEX	The CAC 40, the most widely-used indicator of the Paris market, reflects the performance of the 40 largest equities listed in France, measured by free-float market capitalisation and liquidity. The index was developed with a base level of 1,000 as of 31 December 1987.	40
Germany	DE	DAX INDEX	The German Stock Index is a total return index of 30 selected German blue chip stocks traded on the Frankfurt Stock Exchange. The equities use free-float shares in the index calculation. The DAX has a base value of 1,000 as of 31 December 1987. As of June 18, 1999 only XETRA equity prices are used to calculate all DAX indices.	30
Germany	DE	MDax Index	The German DAX Mid-Cap Index is a total rate of return index of 50 mid-cap issues that rank below the DAX. The MDAX exclusively tracks issues from the various traditional sectors. The index was developed with a base value of 1,000 as of December 31, 1987.	50
Greece	GR	Athex Composite Share Pr	The Athens Stock Exchange General Index is a capitalisation-weighted index of Greek stocks listed on the Athens Stock Exchange. The index was developed with a base value of 100 as of December 31, 1980.	60
Ireland	IE	IRISH OVERALL INDEX	The ISEQ Overall Index is a capitalisation-weighted index of all Official list equities in the Irish Stock Exchange but excludes UK registered companies. The index has a base value of 1000 as of January 4, 1988.	44
Italy	IT	FTSE MIB INDEX	The Index will consist of the 40 most liquid and capitalised stocks listed on the Borsa Italiana. In the Foreign shares will be eligible for inclusion in theFTSE MIB Index. Secondary lines will not be eligible for inclusion. The calculation and methodology will be unchanged from the S&P MIB Index.	40
Luxembourg	LU	LUXEMBOURG LuxX INDEX	The Luxembourg LuxX Index is a weighted index of the most capitalised (by free float) and liquid Luxembourg stocks. The index was developed with a base value of 1,000 as of	11

			January 4, 1999.	
	Malta	MT	MALTA STOCK EXCHANGE IND	The Malta Stock Exchange (MSE) index is a capitalisation weighted index encompassing all shares traded on the Stock Exchange of Malta. Index = Current Market Value of all shares listed. The index was created on December 27, 1995 with a base value of 1000. From May 19, 1998 the index has been calculated on a daily basis.	20
	Netherlands	NL	AEX-Index	The AEX-Index is a free-float adjusted market capitalisation weighted index of the leading Dutch stocks traded on the Amsterdam Exchange. The index was adjusted to the Dutch Guilder fixing rate. The old value as of 31 December 1998 was 1186.38 and the new value at start of trading on 1/4/99 was 538.36, after conversion. HP and GP can be adjusted back to Dutch Guilders by typing NLG.	25
	Portugal	PT	PSI 20 INDEX	The Portugal PSI 20 Index is a capitalisation weighted index of the top 20 stocks listed on the Lisbon Stock Exchange. The equities use free-float shares in the index calculation. The index was developed with a base value of 3,000 as of December 31, 1992.	20
	Slovakia	SK	SLOVAK SHARE INDEX	The Slovak share index (SAX) is a capital-weighted total return index that compares the market capitalisation of a selected set of shares with the market capitalisation of the same set of shares as of a given reference day. The index was developed with a base level of 100 of September 14, 1993.	7
	Slovenia	SI	Slovenian Blue Chip Idx	SBI TOP is the Slovenian blue chip index. It is a free-float capitalisation weighted index comprising the most liquid shares traded on the Ljubljana Stock Exchange. Each stock's weighting is capped at 30%. The index was developed with a base level of 1 000 as of 31st March 2006.	7
	Spain	ES	IBEX 35 INDEX	The IBEX 35 is the official index of the Spanish continuous Market. The index is comprised of the 35 most liquid stocks traded on the Continuous market. It is calculated, supervised and published by the Sociedad de	35

				Bolsas. The equities use free-float shares in the index calculation. The index was created with a base level of 3000 as of December 29, 1989.	
	Bulgaria	BG	SOFIX INDEX	The Bulgaria Stock Exchange Sofix Index is a free-float market capitalisation weighted index representing the most liquid companies listed on the exchange. The market capitalisation of each company should not be less than BGN 50 million.	15
	Czech Republic	CZ	PRAGUE STOCK EXCH INDEX	The PX index is the official index of the Prague Stock Exchange. The index was calculated for the first time on March 20, 2006 when it replaced the PX50 and PX-D indices. The index took over the historical values of the PX50 index. The starting date was April 5, 1994 with a base of 1 000 points. As of 24 Sep 2012, its composition fully reflects the free float of members due to methodology changes.	14
	Denmark	DK	OMX COPENHAGEN 20 INDEX	The OMX Copenhagen 20 index consists of the 20 most actively traded shares on the Copenhagen Stock Exchange. OMXC20 is a tradable index on which futures and options are issued. The composition of the OMXC20 index is revised twice a year.The OMXC20 is a market weighted price index. The base date for this index is July 3, 1989, with a base value of 100.	20
	Hungary	HU	BUDAPEST STOCK EXCH INDX	The Budapest Stock Exchange Index is a capitalisation-weighted index adjusted for free float. The index tracks the daily price only performance of large, actively traded shares on the Budapest Stock Exchange. The shares account for 58% of domestic equity market capitalisation. The index has a base value of 1 000 points as of January 2, 1991 and is a total return index.	13
	Latvia	LV	OMX RIGA OMXR	OMX Riga (OMXR) is an all-share index consisting of all the shares listed on the main and secondary lists on the Riga Stock Exchange in Latvia with the exception of companies where a single shareholder controls at least 90% of the outstanding shares. The aim of the index is to reflect the current status & changes on the Riga market. The base date is 1999/12/31, with a value of	31

			100.	
	Lithuania	LT	OMX VILNIUS OMXV	OMX Vilnius (OMXV) is a total return index which includes all the shares listed on the main and secondary lists on the Vilnius Stock Exchange. The aim of the index is to reflect the current status &changes on the Vilnius market. The base date is December 31, 1999, with a value of 100.	24
	Poland	PL	POLISH TRADED INDEX EUR	The Polish Traded Index (PTX) is a capitalisation-weighted price index which contains the most attractive Polish blue chip stocks. The index is calculated by Wiener Börse and is part of the CECE Index Family. The index had a base value of 612.12 index points on January 04, 1999.	12
	Romania	RO	BUCHAREST BET INDEX	Bucharest Exchange Trading Index (BET) is a capitalisation-weighted index, comprised of the most liquid 10 stocks listed on the BSE tier 1. The index is a price index and was developed with a base value of 1000 as of Sepember 22, 1997.	10
	Sweden	SE	OMX STOCKHOLM 30 INDEX	The OMX Stockholm 30 Index is a capitalization-weighted index of the 30 stocks that have the largest volume of the trading on the Stockholm Stock Exchange. The equities use free-float shares in the index calculation. The index was developed with a base level of 125 as of September 30, 1986. ** Effective on April 27, 1998 there was a 4-1 split of the index value.	30
	United Kingdom	GB	FTSE 100 INDEX	The FTSE 100 Index is a capitalisation-weighted index of the 100 most highly capitalised companies traded on the London Stock Exchange. The equities use an investibility weighting in the index calculation. The index was developed with a base level of 1 000 as of January 3, 1984. * Please see the UKEDA 100 Index and the FTPTP 100 Index for the official FTSE 100 index dividend yield and P/E ratio. *	101
	Iceland	IS	OMX Iceland 6 PI	The OMX Iceland 6 index consists of the six most actively traded shares on the Nasdaq OMX Iceland exchange. The limited number of	6

			constituents guarantees that all the underlying shares of the index have excellent liquidity, which results in an index that is highly suitable as underlying for derivatives products.	
Norway	NO	OBX STOCK INDEX	The OBX Index is a capitalization-weighted index of the largest companies traded on the Oslo Stock Exchange. The equities use free-float shares in the index calculation. * Note that effective April 21 2006, the OBX Stock Index became a total return index and had a price history split by a factor of 4.	25
Croatia	HR	CROATIA ZAGREB CROBEX	The CROBEX is a capitalisation-weighted index, capped at a maximum 20% weighting of the index capitalisation. The index was designed to measure the price movements of shares listed on the Zagreb Stock Exchange. The CROBEX was developed with a base level of 1 000 for the base period beginning September 1, 1997.	25

Annex 8: Definition and implementation of liquidity metrics

In this annex we describe in detail how the liquidity measures presented in section 4.2.1 are defined and how the measures are calculated empirically.

The Amihud illiquidity ratio

The daily Amihud illiquidity measure for asset *i* for day *t* is given as the ratio of the daily absolute log return on asset *i* to the trading volume for asset *i* of that day.

$$ILLIQ_{it} = \frac{|r_{it}|}{Vol_{it}} * 1{,}000{,}000 = \frac{\left|ln\left(\frac{P_{it}}{P_{i,t-1}}\right)\right|}{Vol_{it}} * 1{,}000{,}000$$

In order to compute the Amihud measure we require a positive trading volume on the two adjacent trading days over which the log return is calculated. This is to ensure that the Amihud measure relates to liquidity effects and not general price impacting market information.

Monthly illiquidity ratios are created by taking the median of the daily Amihud measure of each ISIN over a calendar month. For cross asset class comparisons, averages of the monthly Amihud measure are taken across assets within the respective asset class after removing the upper 0.05 percentile within each asset class, which means 99.5% of data is used. This ensures that we capture the general characteristics of the data, and that the conclusions are not based on outliers. The results presented in this paper are scaled to percentage points.

Price impact

The daily price impact measure for asset *i* for day *t* is given as the absolute log return between two adjacent days:

$$PI_{it} = |r_{it}|$$

In order to compute the price impact measure we require a positive trading volume on the two adjacent trading days over which the log return is calculated.

Monthly price impact measures are created by taking the median of the daily price impact measure of each ISIN over a calendar month. For cross asset class comparisons, averages of the monthly price impact measure are taken across assets within the respective asset class after removing the upper 0.05 percentile within each asset class, which means 99.5% of data is used. This ensures we capture the general characteristics of data, and that the conclusions are not based on outliers. The results presented in this paper are scaled to percentage points.

The Roll measure

Roll (1984) shows that under certain conditions, the percentage bid/ask spread equals two times the square root of minus the covariance between consecutive returns:

$$Roll_{i,t} = 2 * \sqrt{-cov(r_{i,n}, r_{i,n-1})}$$

Where *t* is the time period over which the measure is calculated. We compute a daily Roll measure, using a 21 trading day rolling window in the computation of the covariance. We require at least 6 transactions within the 21 day window in order to compute the Roll measure. This is to ensure a reasonably stable covariance computation. In cases where a positive covariance is found, the Roll measure is set to zero. We define a monthly Roll measure by taking the median of the daily Roll measures for each ISIN over a calendar month. For cross asset class comparisons, averages of the monthly Roll measures are taken across assets within the respective asset class after removing the upper 0.05 percentile within each asset class, which means 99.5% of data is used. This ensures we capture the general characteristics of data, and that the conclusions are not based on outliers. The results presented in this paper are scaled to percentage points.

Trading volume

The trading volume metric is calculated as the sum of the EUR value Q of each trade x per ISIN i in month t. X denotes the total number of trades for ISIN i in month t.

$$Volume_{i,t} = \sum_{x}^{X} Q_{i,t,x}$$

For cross asset class comparisons, averages of the trading volume measures are taken across assets within the respective asset class

Turnover ratio

The turnover ratio shows the trading volume compared to outstanding amount for a given month. It is calculated as volume per month t, divided by the outstanding amount for each ISIN i:

$$TR_{i,t} = \frac{Volume_{i,t}}{Outstanding\ amount}$$

Then the average is taken for each asset class. This ensures that highly traded instruments do not weigh more than other instruments in the final ratio. The outstanding amount is taken at the time of extraction from Bloomberg. If unavailable, the issued amount is used instead. For a small subset of the instruments neither variable is available, and these instruments have been left out of the turnover ratio calculation.

Zero-trading days

The zero-trading days metric is given as the percentage of days during a month where an asset is not traded. Zero trading is calculated as the inverse of the number of days with a recorded trade, divided by the number of trading days in a month t for each ISIN i. We set the number of trading days to 21 for all periods, which is assumed to be representative across the different markets and countries:

$$Zero_{i,t} = 1 - \frac{Traded\ days_{i,t}}{21}$$

The zero-trading day metrics for each asset class is calculated as the average of all instruments in that class.

Volatility

The volatility metric is calculated as the standard deviation of the log returns r of each ISIN i within a month t. The number of trades per ISIN in each month is denoted T.

$$Volatility = STD(r_{i,t}) = \sqrt{\frac{1}{X}\sum_{x}^{X}\left(r_{i,t,x} - \overline{r_{i,t}}\right)^2}$$

Where x denotes each specific trade for an ISIN i in each month t. The number of trades for an ISIN in a month is denoted X. For cross asset class comparison we take the average for each metrics within the asset class. The results printed in the paper are scaled to percentage points.

30-day price change

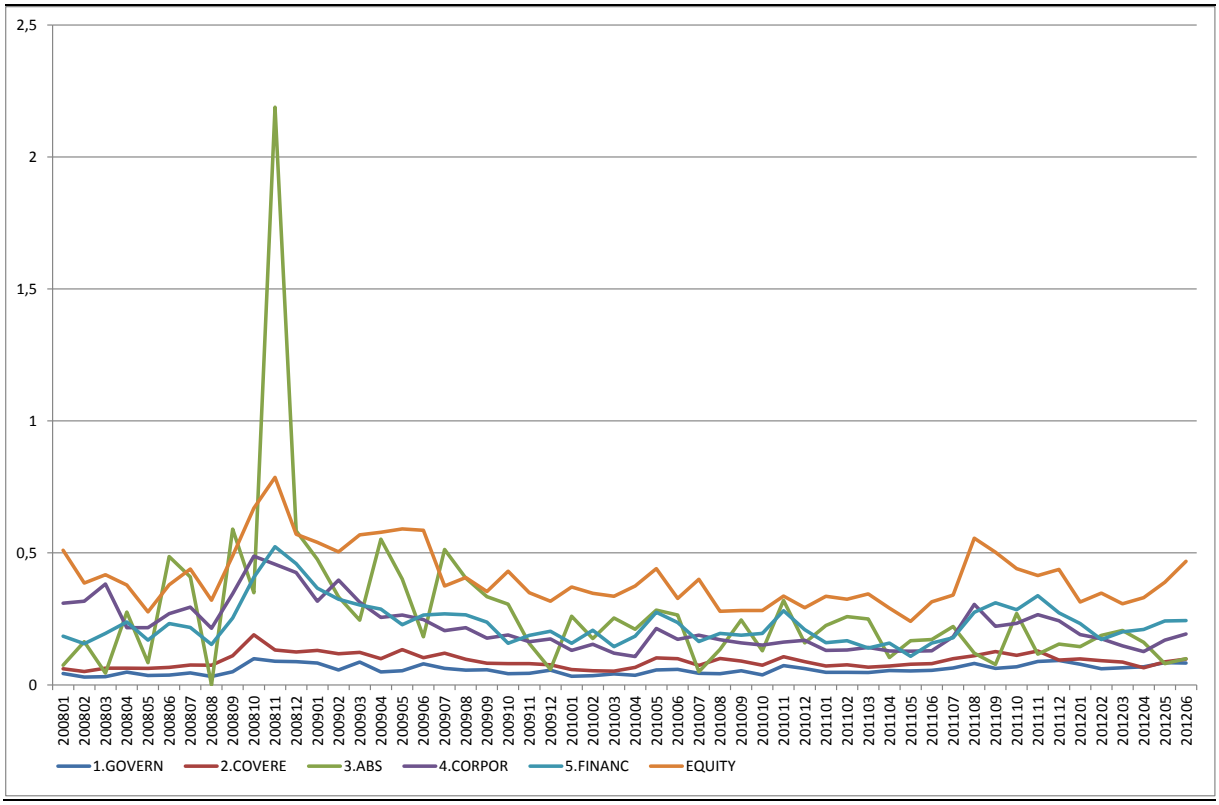
The 30-day price change measure is defined as the maximum observed absolute daily log return over a 30-day period

$$\text{30-day price change} = \text{Max}\left[ln\left(\frac{p_{i,t}}{p_{i,t-1}}\right)\right]$$

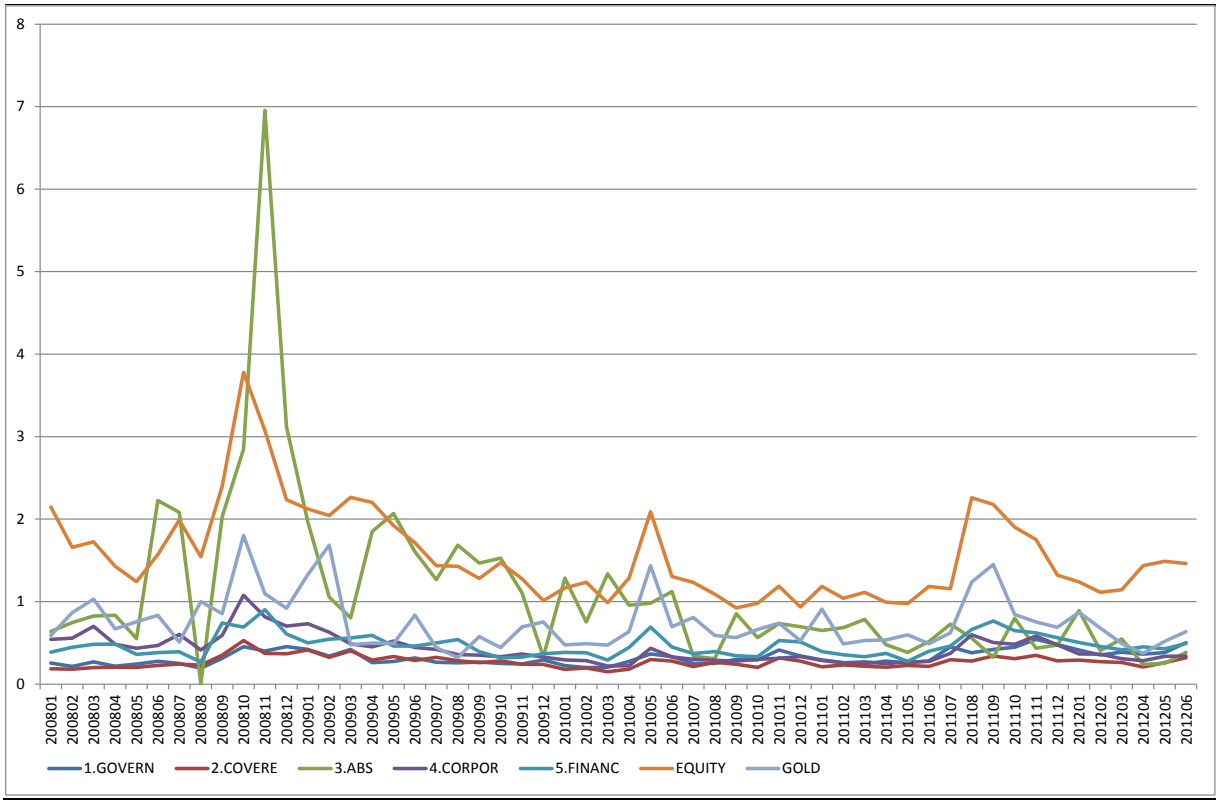
for t=1 through 21, where t is trading days. The measure is computed over rolling 30 calendar day periods, so that a daily measure is established. A monthly measure is computed by taking the maximum of the daily measures within a calendar month for each ISIN. For cross asset class comparisons, averages of the monthly measures are taken across assets within the respective asset class. The results presented in this paper are scaled to percentage points.

Annex 9: Time series for cross asset class analysis

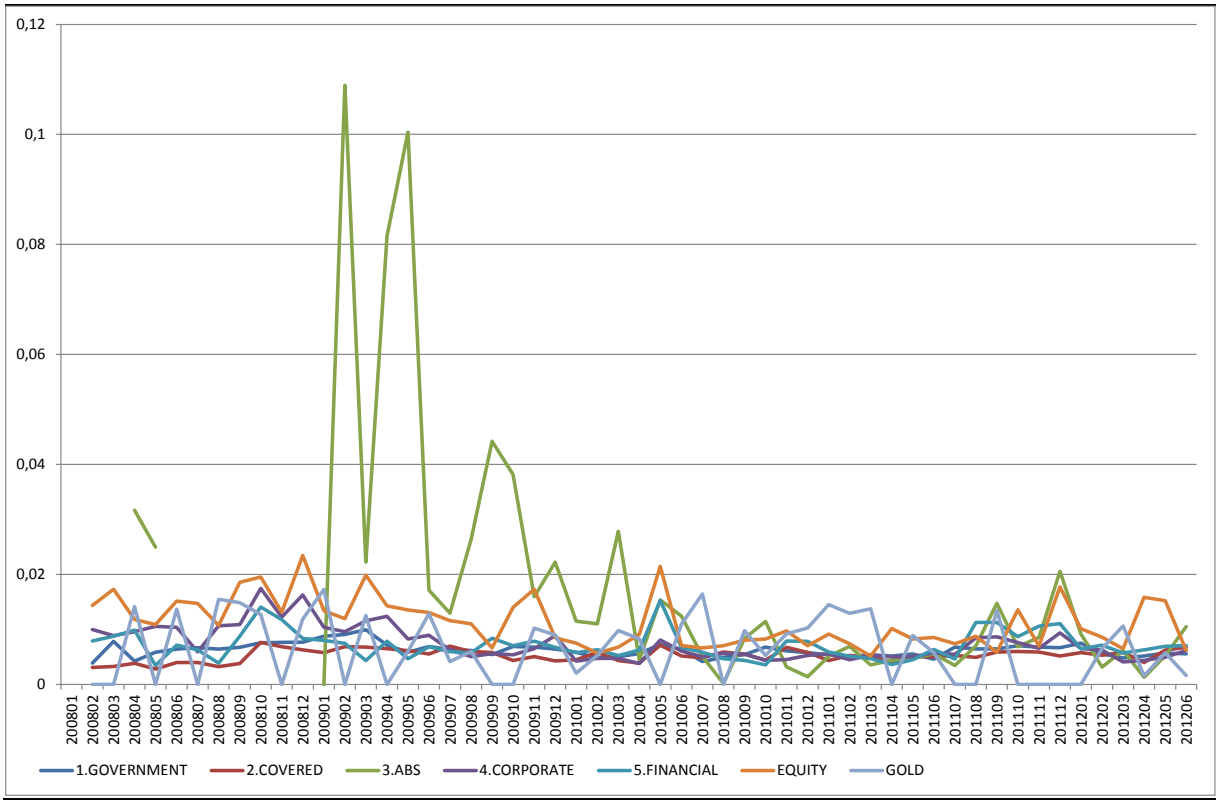
AMIHUD ILLIQUIDITY RATIO



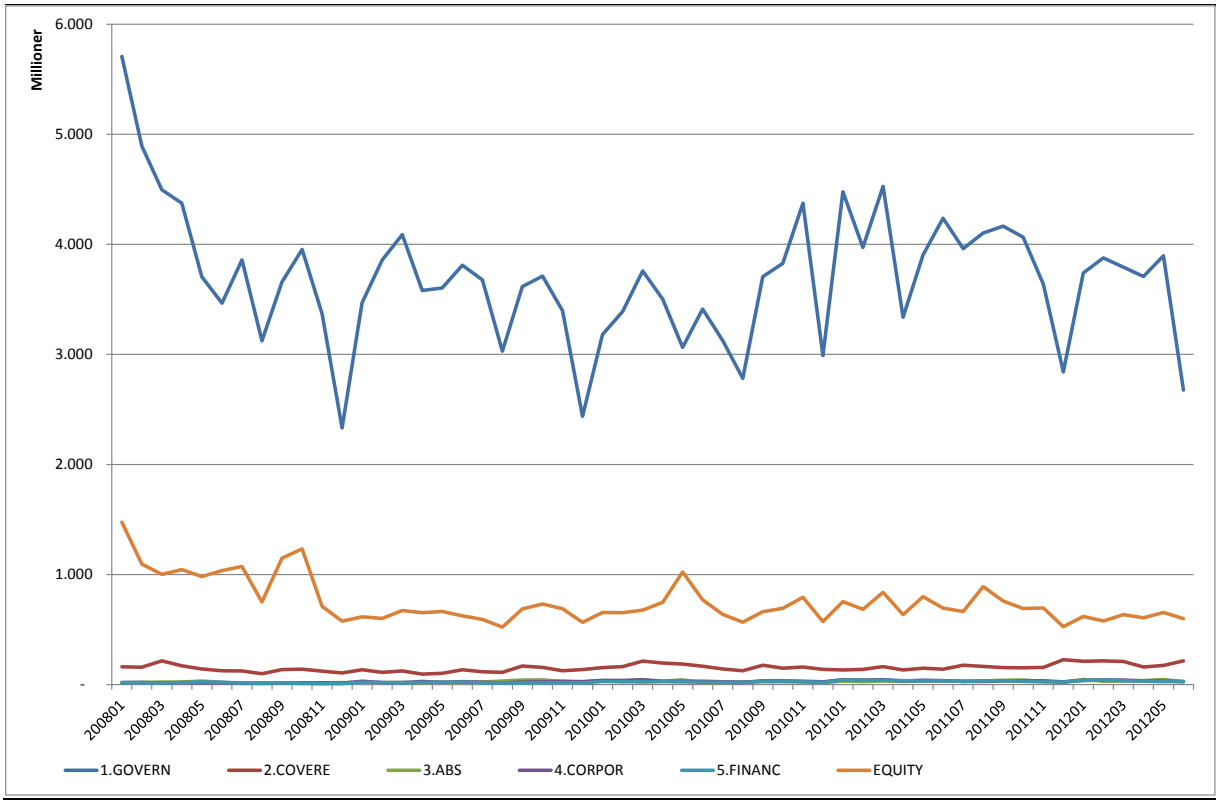
PRICE IMPACT



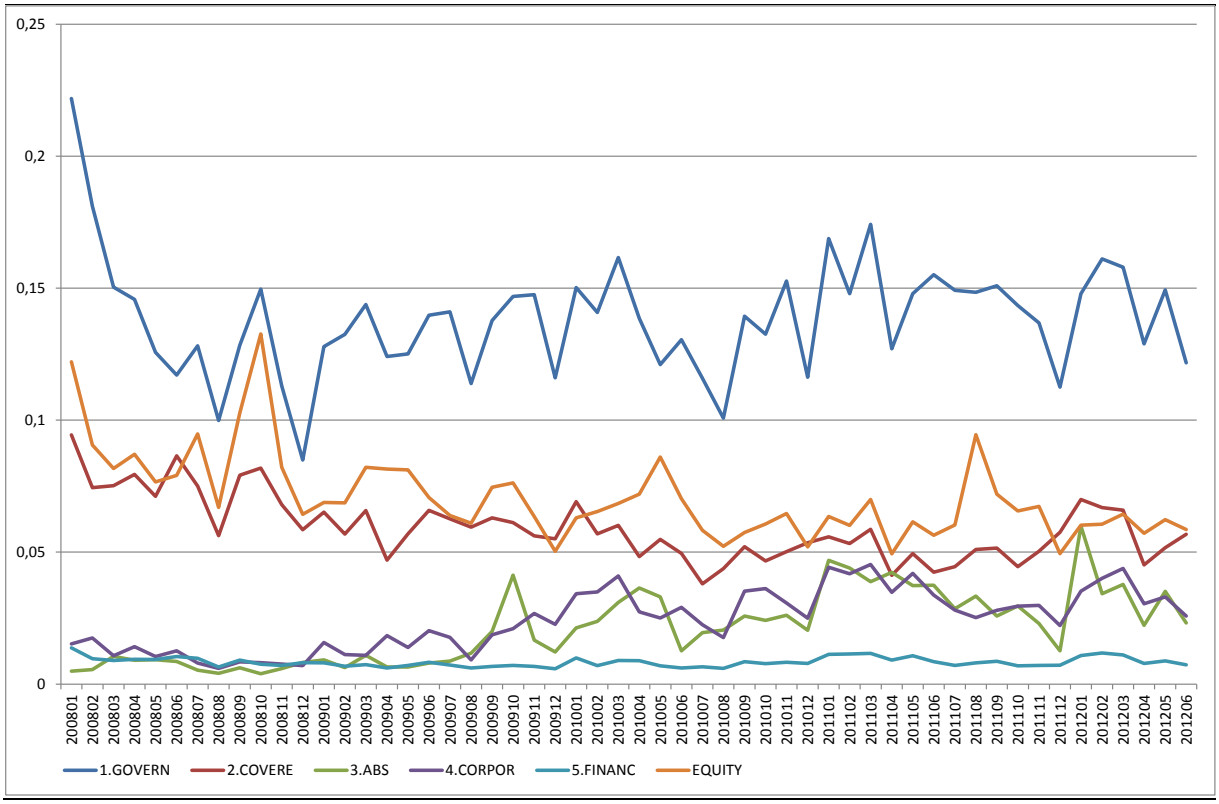
ROLL



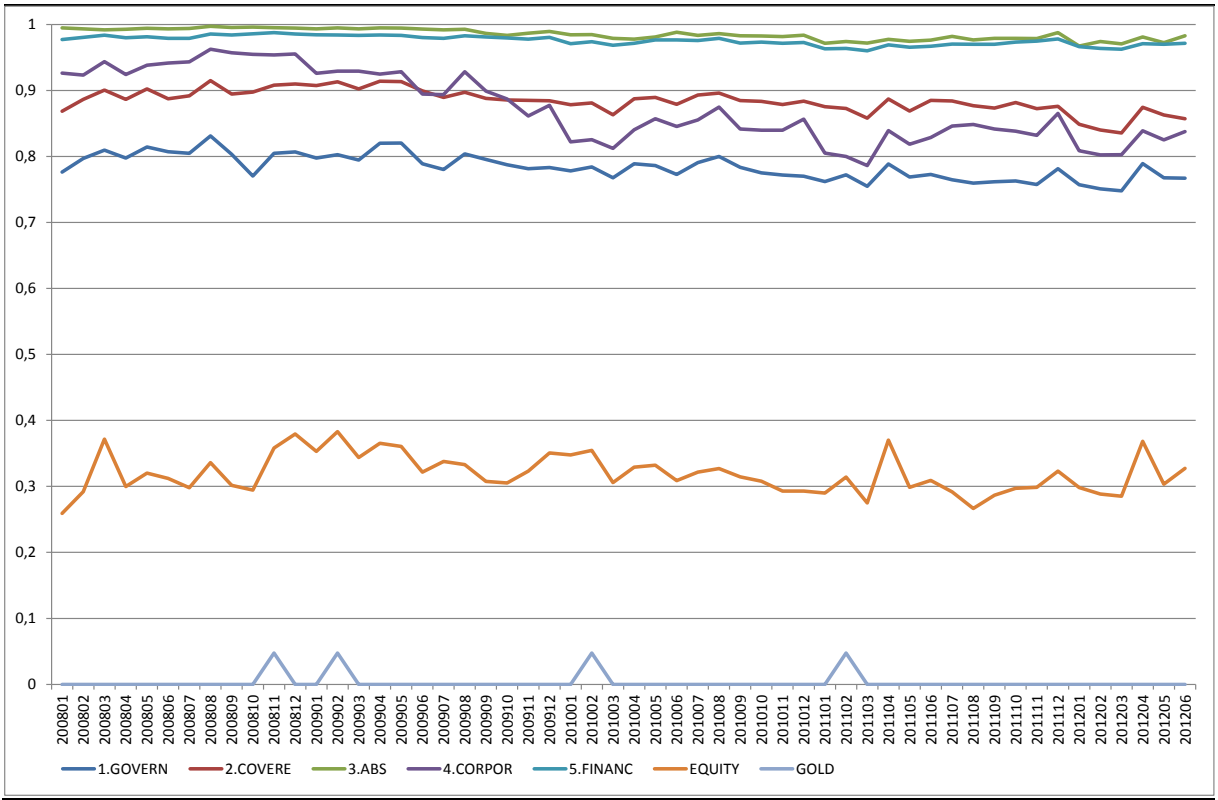
Average volume per ISIN



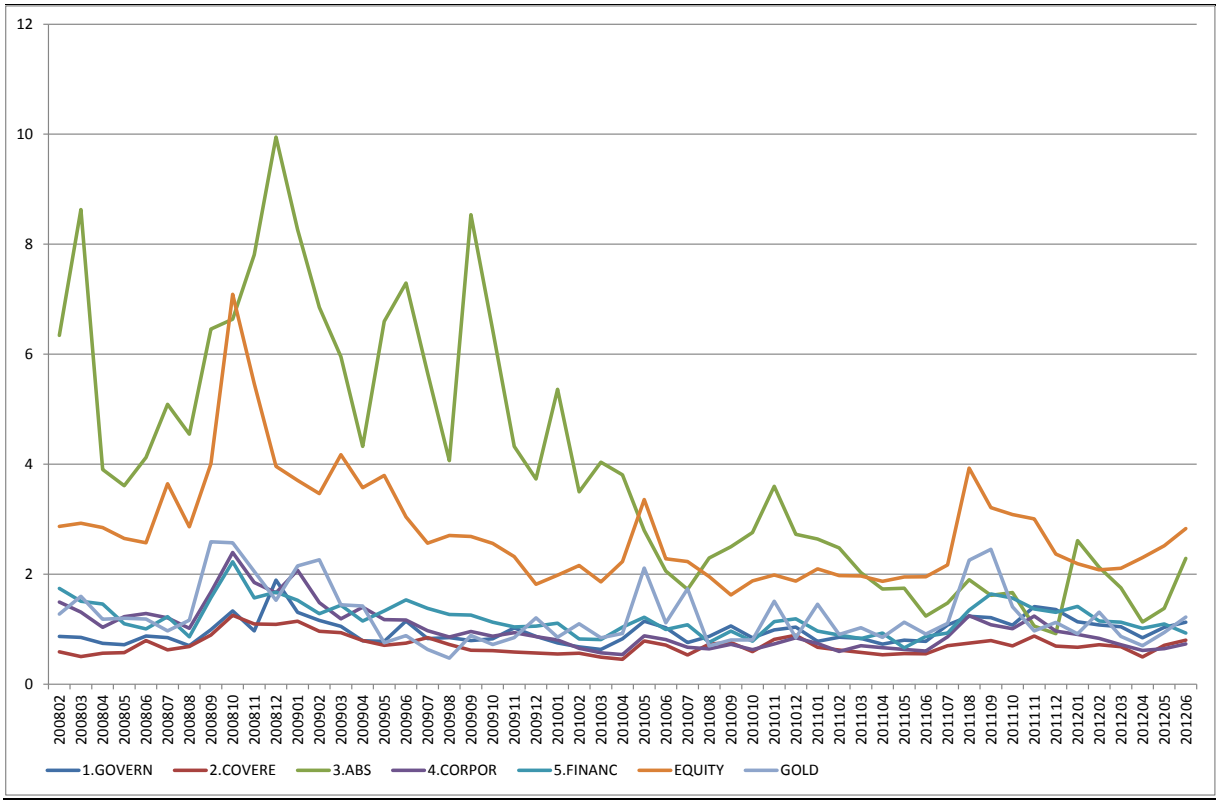
TURNOVER RATIO



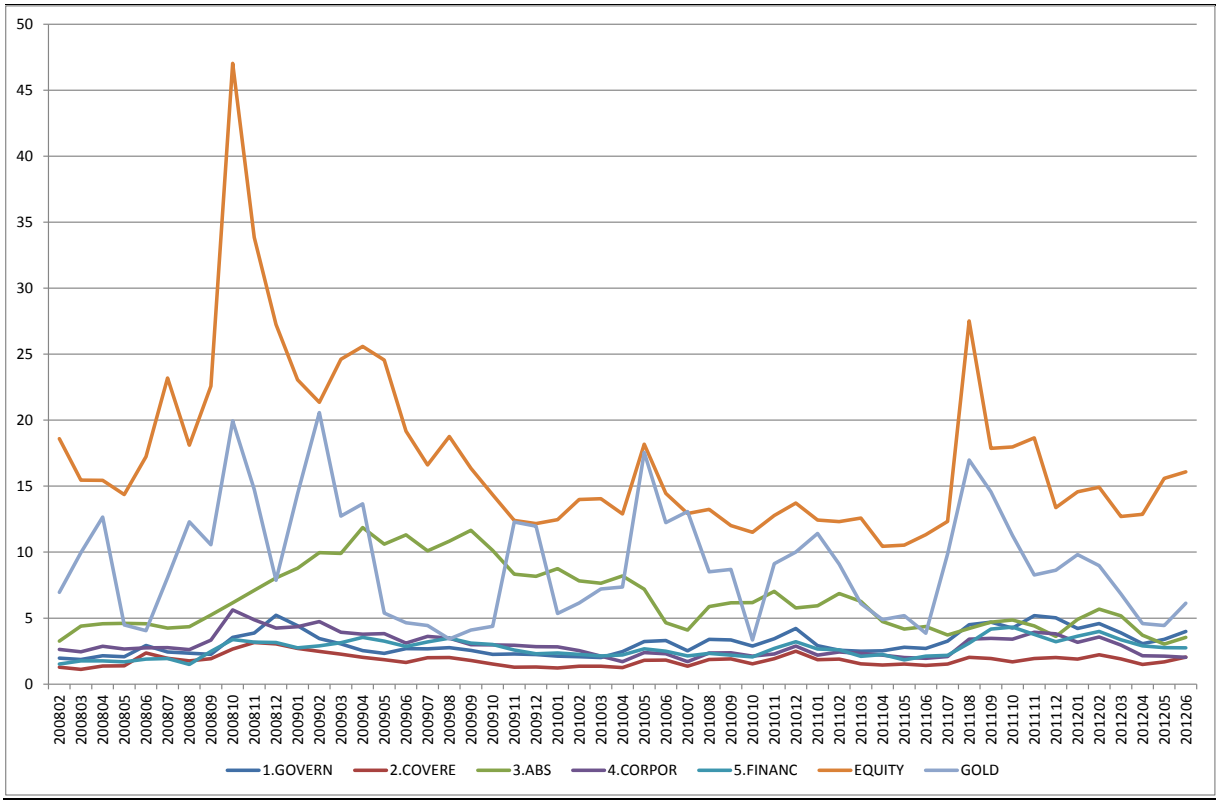
ZERO TRADING



PRICE VOLATILITY

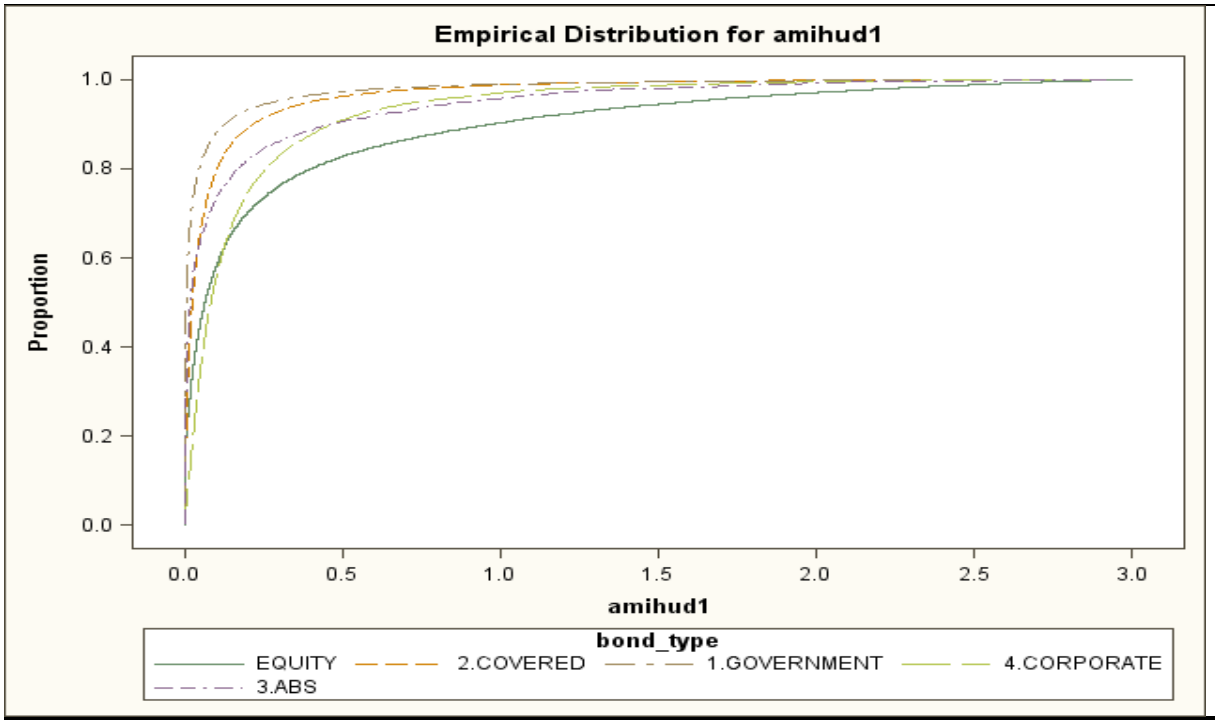


PRICE CHANGE

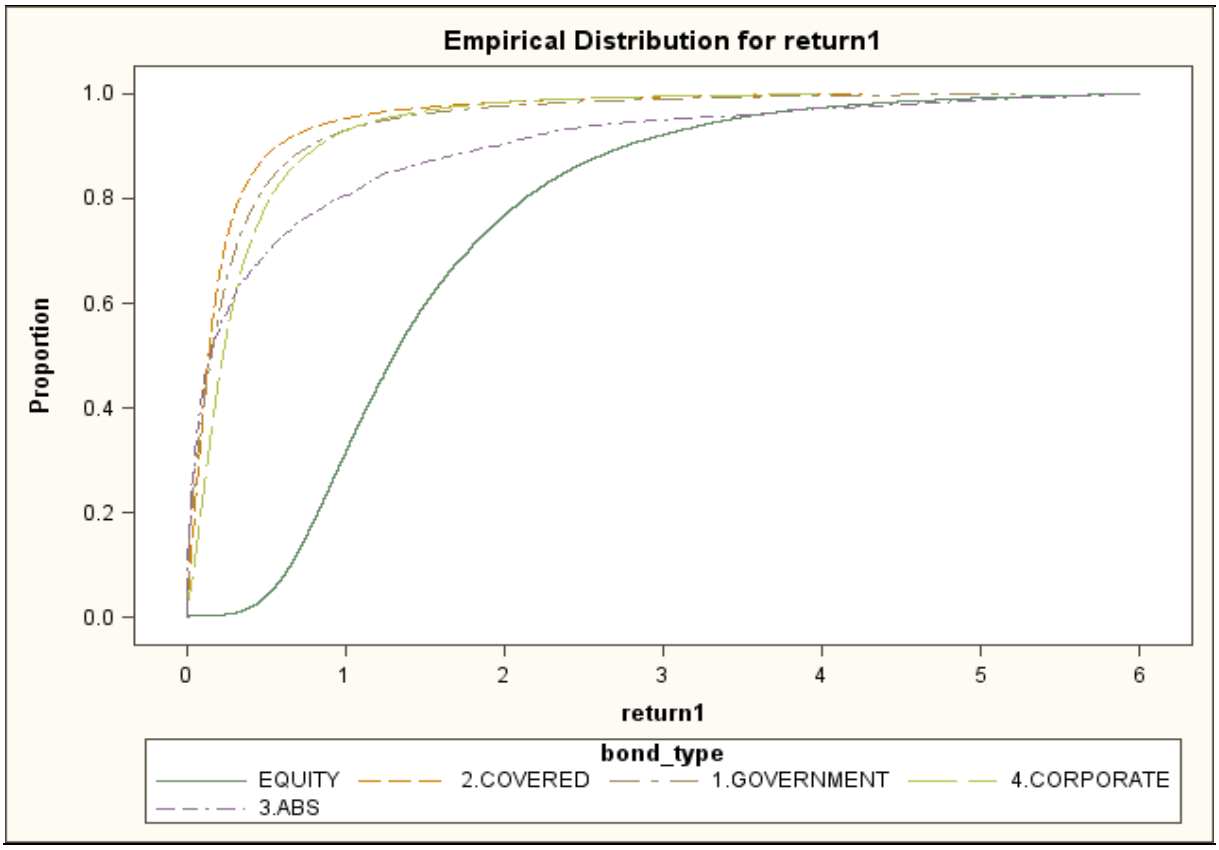


Annex 10: Probability distributions for cross asset class analysis

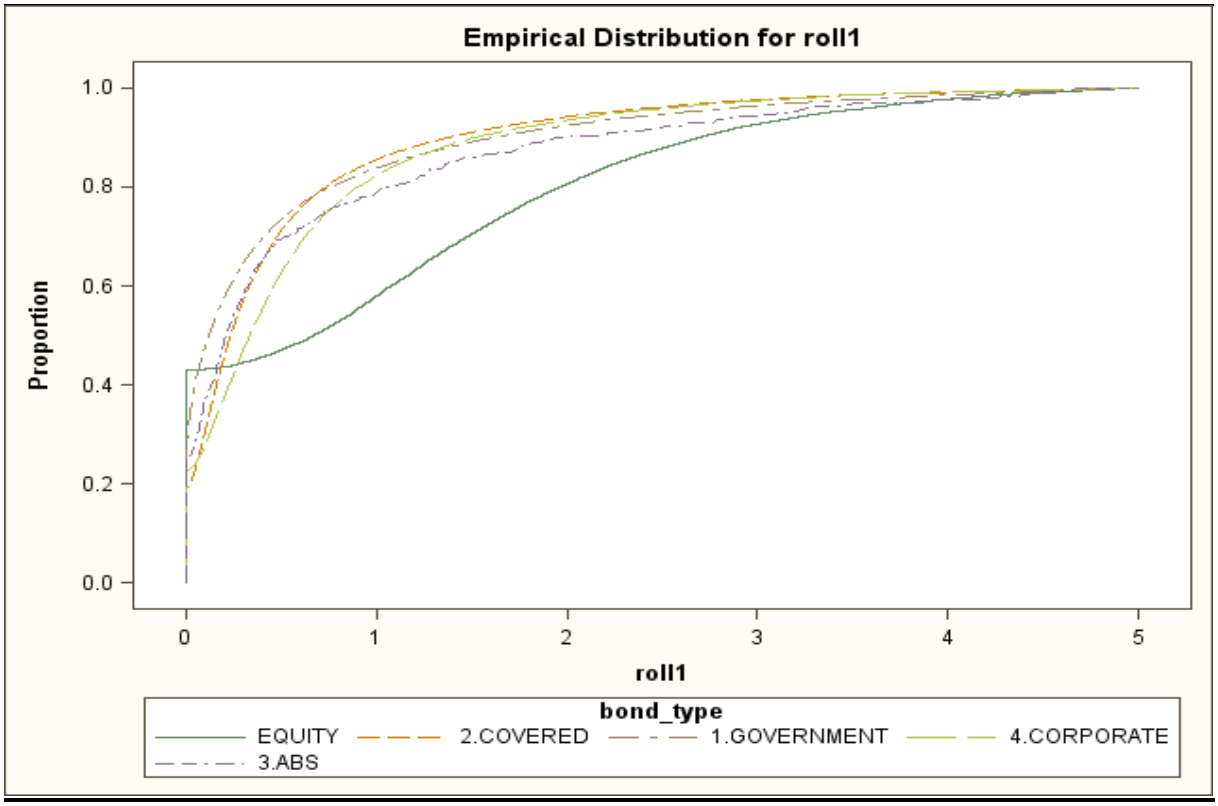
AMIHUD ILLIQUIDITY RATIO



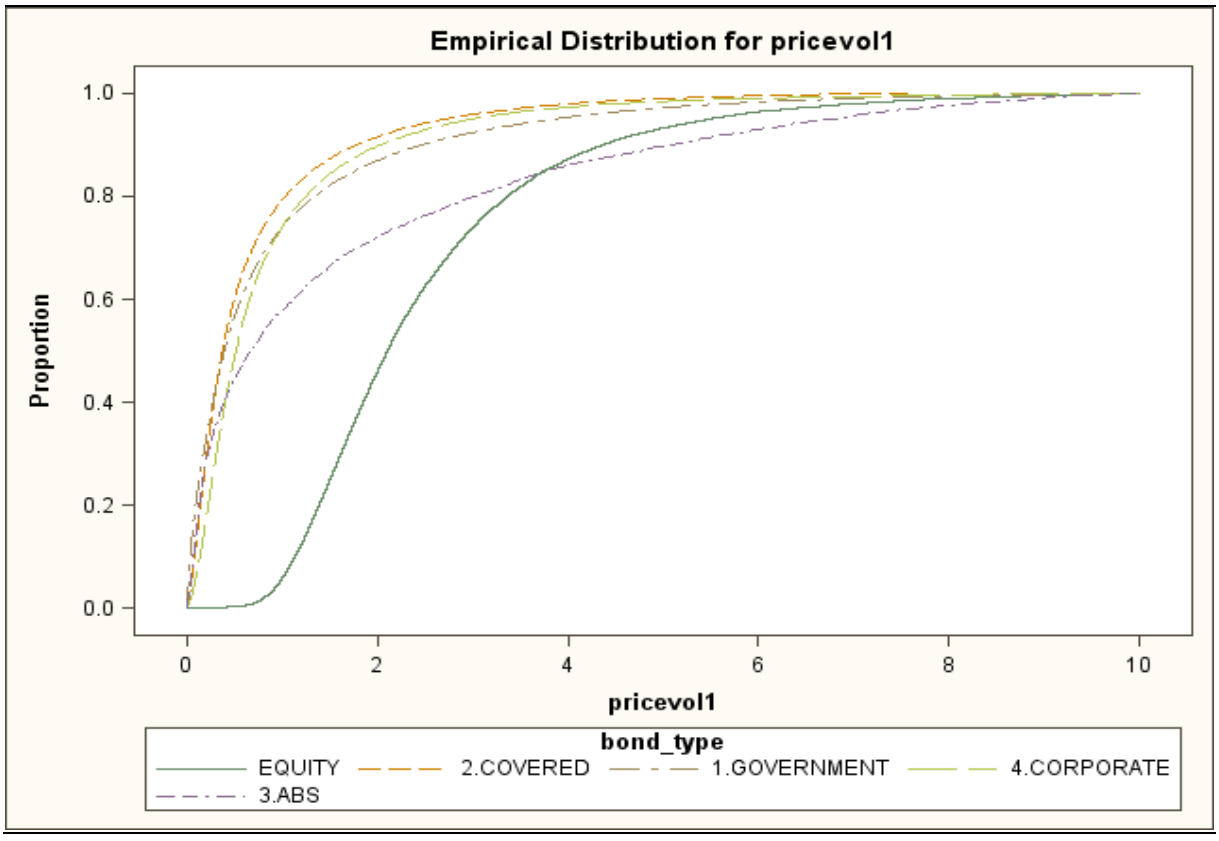
PRICE IMPACT



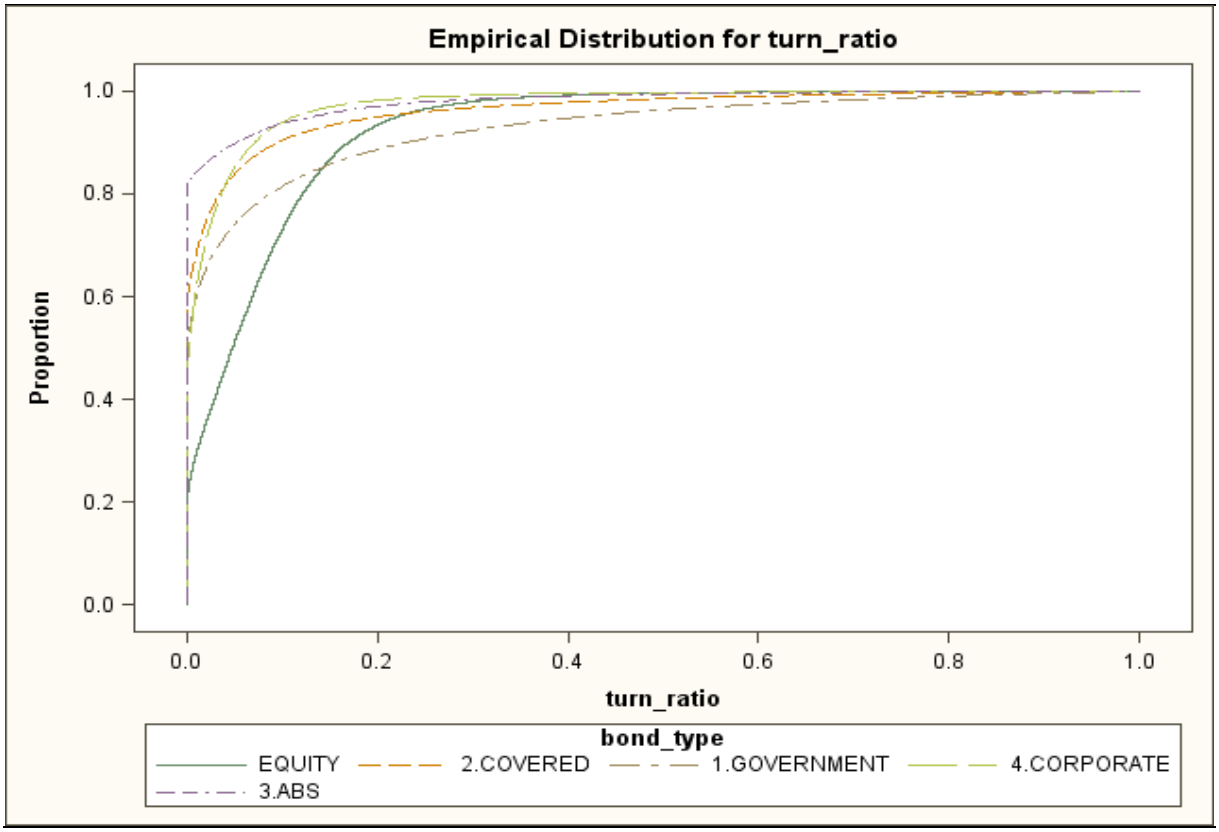
ROLL r



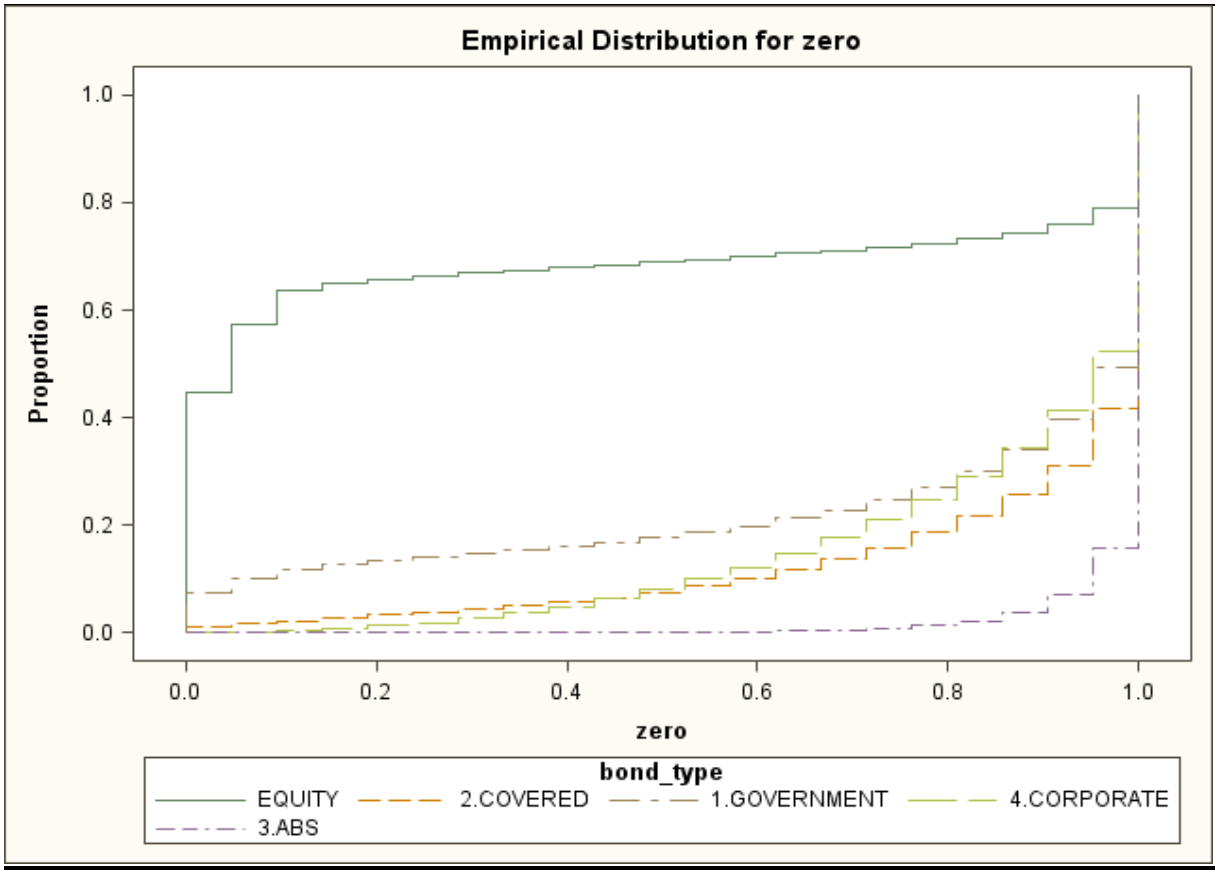
RETURN VOLATILITY



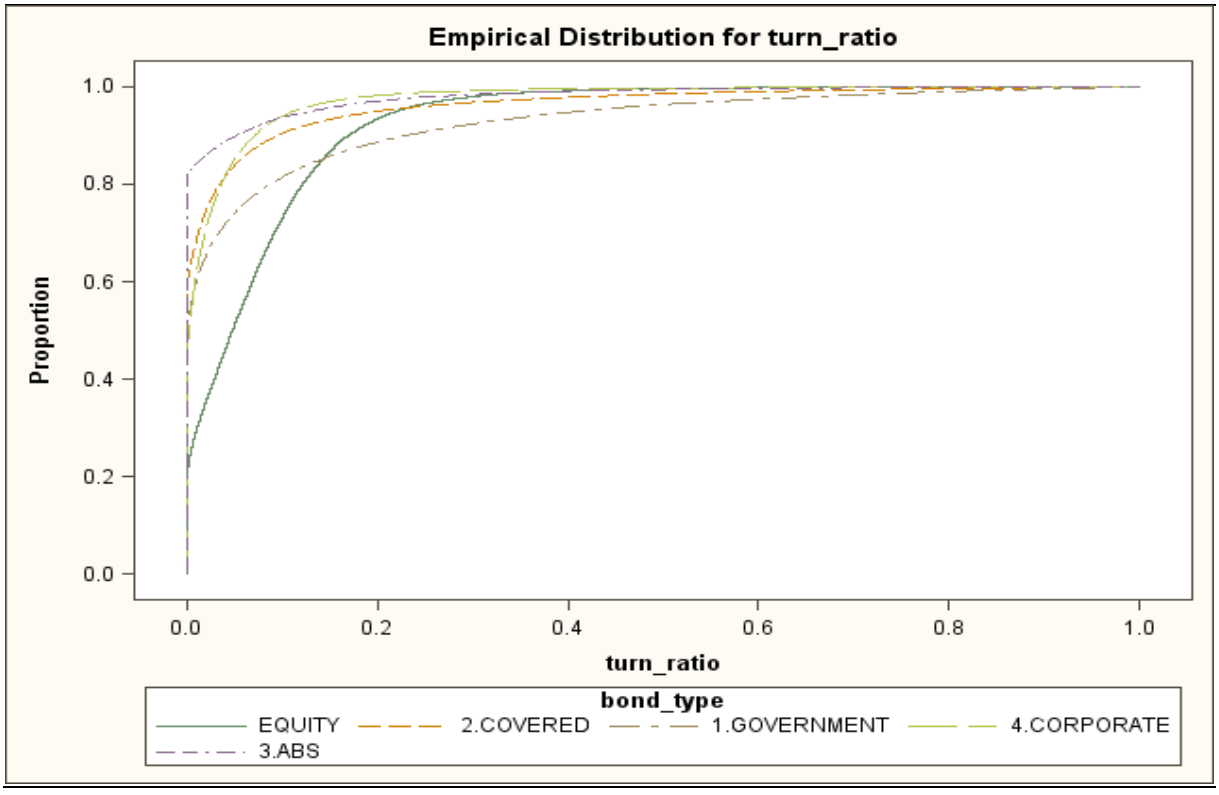
TURNOVER RATIO



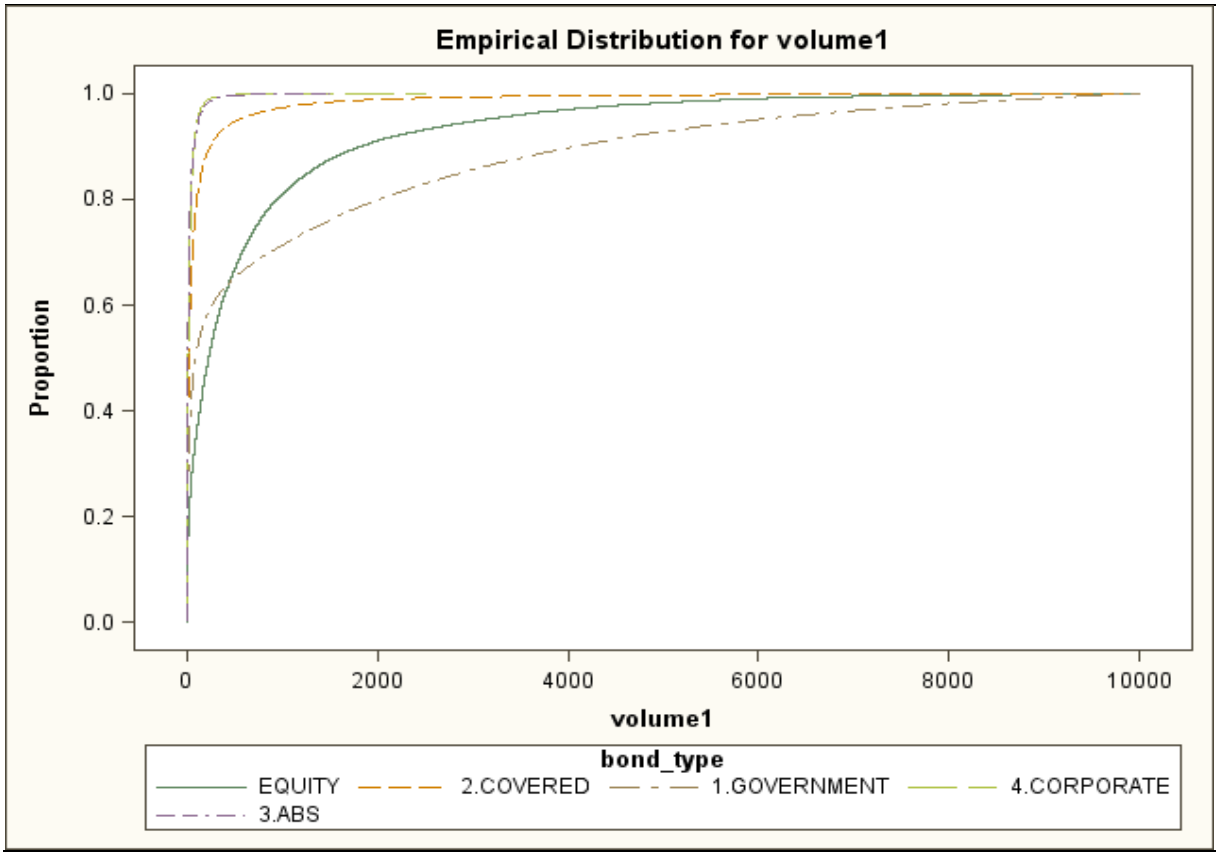
ZERO TRADING



PRICECHANGE



VOLUME


Empirical Distribution for volume1
Proportion
1.0
0.8
0.6
0.4
0.2
0.0
0
2000
4000
6000
8000
10000
volume1
bond_type
EQUITY
2.COVERED
1.GOVERNMENT
4.CORPORATE
3.ABS

Annex 11: ECAI rating mapping

One of the explanatory characteristics used in the analysis of bond asset classes is their ECAI rating. For the purposes of this analysis, this variable is formed as a direct mapping of bond credit ratings. The table below shows how the credit rating of individual bonds has been mapped into one of the 6 ECAI buckets.

ECAI	Moody's Rating	S&P/Fitch Rating
1	Aaa to Aa3	AAA to AA-
2	A1 to A3	A+ to A-
3	Baa1 to Baa3	BBB+ to BBB-
4	Ba1 to Ba3	BB+ to BB-
5	B1 to B3	B+ to B-
6	Caa1 and below	CCC+ and below

Annex 12: Relevant CRR articles on operational requirements

Article 417: Operational requirements for holdings of liquid assets

The institution shall only report as liquid assets those holdings of liquid assets that meet the following conditions:

a) they are appropriately diversified. Diversification is not required in terms of assets corresponding to points (a), (b) and (c) of Article 416(1);

b) they are legally and practically readily available at any time during the next 30 days to be liquidated via outright sale or via a simple repurchase agreement on approved repurchase markets in order to meet obligations coming due. Liquid assets referred to in point (c) of Article 416(1) which are held in third countries where there are transfer restrictions or which are denominated in non-convertible currencies shall be considered available only to the extent that they correspond to outflows in the third country or currency in question, unless the institution can demonstrate to the competent authorities that it has appropriately hedged the ensuing currency risk;

c) the liquid assets are controlled by a liquidity management function;

d) a portion of the liquid assets except those referred to in points (a), (c) and (e) of Article 416(1) is periodically and at least annually liquidated via outright sale or via simple repurchase agreements on an approved repurchase market for the following purposes:

    (i) to test the access to the market for these assets;

    (ii) to test the effectiveness of its processes for the liquidation of assets;

    (iii) to test the usability of the assets;

    (iv) to minimise the risk of negative signaling during a period of stress.

e) price risks associated with the assets may be hedged but the liquid assets are subject to appropriate internal arrangements that ensure that they are readily available to the treasury when needed and especially that they are not used in other ongoing operations, including:

    (i) hedging or other trading strategies;

    (ii) providing credit enhancements in structured transactions;

    (iii) covering operational costs.

The denomination of the liquid assets is consistent with the distribution by currency of liquidity outflows after the deduction of inflows.

Article 509: Liquidity requirements

(...)

By 31 January 2014, the EBA shall furthermore report on the following:

a) uniform definitions of high and extremely high liquidity and credit quality;

b) the possible unintended consequences of the definition of liquid assets on the conduct of monetary policy operation and the extent to which:

(i) a list of liquid assets that is disconnected from the list of central bank eligible assets may incentivise institutions to submit eligible assets which are not included in the definition of liquid assets in refinancing operations;

(ii) regulation of liquidity may disincentivise institutions to lend or borrow on the unsecured money market and whether this may lead to question the targeting of EONIA in monetary policy implementation;

(iii) the introduction of the liquidity coverage requirement may make it more difficult for central banks to ensure price stability by using the existing monetary policy framework and instruments;

c) the operational requirements for the holdings of liquid assets, as referred in points (b) to (f) of Article 417, in line with international regulatory developments.

Annex 13: Operational Requirements as set out in "Basel III: The Liquidity Coverage Ratio and the liquidity risk monitoring tools", Jan 2013 BIS

2. Operational requirements

28. All assets in the stock of HQLA are subject to the following operational requirements. The purpose of the operational requirements is to recognise that not all assets outlined in paragraphs 49-54 that meet the asset class, risk-weighting and credit-rating criteria should be eligible for the stock as there are other operational restrictions on the availability of HQLA that can prevent timely monetisation during a stress period.

29. These operational requirements are designed to ensure that the stock of HQLA is managed in such a way that the bank can, and is able to demonstrate that it can, immediately use the stock of assets as a source of contingent funds that is available for the bank to convert into cash through outright sale or repo, to fill funding gaps between cash inflows and outflows at any time during the 30-day stress period, with no restriction on the use of the liquidity generated.

30. A bank should periodically monetise a representative proportion of the assets in the stock through repo or outright sale, in order to test its access to the market, the effectiveness of its processes for monetisation, the availability of the assets, and to minimise the risk of negative signalling during a period of actual stress.

31. All assets in the stock should be unencumbered. "Unencumbered" means free of legal, regulatory, contractual or other restrictions on the ability of the bank to liquidate, sell, transfer, or assign the asset. An asset in the stock should not be pledged (either explicitly or implicitly) to secure, collateralise or credit-enhance any transaction, nor be designated to cover operational costs (such as rents and salaries). Assets received in reverse repo and securities financing transactions that are held at the bank, have not been rehypothecated, and are legally and contractually available for the bank's use can be considered as part of the stock of HQLA. In addition, assets which qualify for the stock of HQLA that have been pre-positioned or deposited with, or pledged to, the central bank or a public sector entity (PSE) but have not been used to generate liquidity may be included in the stock.[8]

32. A bank should exclude from the stock those assets that, although meeting the definition of "unencumbered" specified in paragraph 31, the bank would not have the operational capability to monetise to meet outflows during the stress period. Operational capability to monetise assets requires having procedures and appropriate systems in place, including providing the function identified in paragraph 33 with access to all necessary information to execute monetisation of any asset at any time. Monetisation of the asset must be executable, from an operational perspective, in the standard settlement period for theasset class in the relevant jurisdiction.

[8] If a bank has deposited, pre-positioned or pledged Level 1, Level 2 and other assets in a collateral pool and no specific securities are assigned as collateral for any transactions, it may assume that assets are encumbered in order of increasing liquidity value in the LCR, ie assets ineligible for the stock of HQLA are assigned first, followed by Level 2B assets, then Level 2A and finally Level 1. This determination must be made in compliance with any requirements, such as concentration or diversification, of the central bank or PSE.

33. The stock should be under the control of the function charged with managing the liquidity of the bank (eg the treasurer), meaning the function has the continuous authority, and legal and operational capability, to monetise any asset in the stock. Control must be evidenced either by maintaining assets in a separate pool managed by the function with the sole intent for use as a source of contingent funds, or by demonstrating that the function can monetise the asset at any point in the 30-day stress period and that the proceeds of doing so are available to the function throughout the 30-day stress period without directly conflicting with a stated business or risk management strategy. For example, an asset should not be included in the stock if the sale of that asset, without replacement throughout the 30-day period, would remove a hedge that would create an open risk position in excess of internal limits.

34. A bank is permitted to hedge the market risk associated with ownership of the stock of HQLA and still include the assets in the stock. If it chooses to hedge the market risk, the bank should take into account (in the market value applied to each asset) the cash outflow that would arise if the hedge were to be closed out early (in the event of the asset being sold).

35. In accordance with Principle 9 of the Sound Principles a bank "should monitor the legal entity and physical location where collateral is held and how it may be mobilised in a timely manner". Specifically, it should have a policy in place that identifies legal entities, geographical locations, currencies and specific custodial or bank accounts where HQLA are held. In addition, the bank should determine whether any such assets should be excluded for operational reasons and therefore, have the ability to determine the composition of its stock on a daily basis.

36. As noted in paragraphs 171 and 172, qualifying HQLA that are held to meet statutory liquidity requirements at the legal entity or sub-consolidated level (where applicable) may only be included in the stock at the consolidated level to the extent that the related risks (as measured by the legal entity's or sub-consolidated group's net cash outflows in the LCR) are also reflected in the consolidated LCR. Any surplus of HQLA held at the legal entity can only be included in the consolidated stock if those assets would also be freely available to the consolidated (parent) entity in times of stress.

37. In assessing whether assets are freely transferable for regulatory purposes, banks should be aware that assets may not be freely available to the consolidated entity due to regulatory, legal, tax, accounting or other impediments. Assets held in legal entities without market access should only be included to the extent that they can be freely transferred to other entities that could monetise the assets.

38. In certain jurisdictions, large, deep and active repo markets do not exist for eligible asset classes, and therefore such assets are likely to be monetised through outright sale. In these circumstances, a bank should exclude from the stock of HQLA those assets where there are impediments to sale, such as large fire-sale discounts which would cause it to breach minimum solvency requirements, or requirements to hold such assets, including, but not limited to, statutory minimum inventory requirements for market making.

39. Banks should not include in the stock of HQLA any assets, or liquidity generated from assets, they have received under right of rehypothecation, if the beneficial owner has the contractual right to withdraw those assets during the 30-day stress period.[9]

40. Assets received as collateral for derivatives transactions that are not segregated and are legally able to be rehypothecated may be included in the stock of HQLA provided that the bank records an appropriate outflow for the associated risks as set out in paragraph 116.

41. As stated in Principle 8 of the Sound Principles, a bank should actively manage its intraday liquidity positions and risks to meet payment and settlement obligations on a timely basis under both normal and stressed conditions and thus contribute to the smooth functioning of payment and settlement systems. Banks and regulators should be aware that the LCR stress scenario does not cover expected or unexpected intraday liquidity needs.

42. While the LCR is expected to be met and reported in a single currency, banks are expected to be able to meet their liquidity needs in each currency and maintain HQLA consistent with the distribution of their liquidity needs by currency. The bank should be able to use the stock to generate liquidity in the currency and jurisdiction in which the net cash outflows arise. As such, the LCR by currency is expected to be monitored and reported to allow the bank and its supervisor to track any potential currency mismatch issues that could arise, as outlined in Part 2. In managing foreign exchange liquidity risk, the bank should take into account the risk that its ability to swap currencies and access the relevant foreign exchange markets may erode rapidly under stressed conditions. It should be aware that sudden, adverse exchange rate movements could sharply widen existing mismatched positions and alter the effectiveness of any foreign exchange hedges in place.

43. In order to mitigate cliff effects that could arise, if an eligible liquid asset became ineligible (eg due to rating downgrade), a bank is permitted to keep such assets in its stock of liquid assets for an additional 30 calendar days. This would allow the bank additional time to adjust its stock as needed or replace the asset.

[9] Refer to paragraph 146 for the appropriate treatment if the contractual withdrawal of such assets would lead to a short position (eg because the bank had used the assets in longer-term securities financing transactions).

Annex 14: Guideline on Liquidity Buffers & Survival Periods, CEBS 9 December 2009

(…)

Guideline 5 – Credit institutions need to manage their stocks of liquid assets to ensure, to the maximum extent possible, that they will be available in times of stress. They should avoid holding large concentrations of single securities and there should be no legal, regulatory, or operational impediments to using these assets.

67. Depending on the structure of the asset, issuer-specific factors (such as the issuer's credit quality), issuance-specific factors (such as the maturity and size of the issuance), and institutional factors (such as whether the asset is traded in centralised markets or over the counter and whether it has a diversified investor base) can be important factors in determining the liquidity of asset classes and whether they will remain liquid in times of stress. Investors are more likely to regard an asset as a safe haven when the issuer's credit quality is high; the issuance is large; it is actively traded in organised markets and it has a diversified investor base.

68. Concentrations of particular securities should be avoided, as a market breakdown for these asset types could severely damage the institution's funding capacity. Banks should seek to diversify, for example, by issuer, maturity, and currency. The need to diversify holdings of assets becomes greater as the liquidity of the asset becomes lower (as indicated by the above factors). For example, it is more important to diversify a portfolio of high-quality corporate bonds than a portfolio of high-quality government bonds. Attempts to liquidate large concentrated positions of less liquid assets could trigger illiquidity in the market itself, with declines in market prices (fire sales), which may force other institutions to take write-downs on similar assets that they hold. That, in turn, could weaken the liquidity position of other banks, prompting further asset sales and an evaporation of market liquidity, adversely affecting the financial system as a whole.

    Firms should seek to be active on a regular basis in each market in which they hold assets for liquidity purposes. Accessing the market regularly will help to reduce the potential stigma of firms suddenly accessing markets, alerting other firms to the fact that they may be under liquidity pressure (in turn, causing more investors to withdraw funds, thereby accentuating the liquidity pressure)[10].

    In addition, as there may be legal or cross-border regulatory constraints that restrict firms' ability to use their buffer of liquid assets at particular times, or for particular purposes, firms should also ensure that they are aware of the specific constraints that apply in particular jurisdictions.

    To use certain funding markets (e.g., repo or securitisation), banks need to have well-established platforms that allow them to raise more funds promptly. Setting up arrangements from scratch typically requires significant due diligence and thus time. If such operational

[10] Based on the proportionality principle, smaller banks which access markets through another institution, will, in most cases, not have to be active in several advanced money and capital markets.

arrangements are not in place as a matter of normal business, rapid access in stressed times should not be relied upon.

The specification of the liquidity buffer (type and amount of assets) should also be driven by the degree to which legal entities should be self-sufficient in terms of liquidity, taking into account intra-group dependencies and the extent to which liquidity should be allocated to different currencies because of potential disruptions in swap markets, etc.

Guideline 6 – The location and size of liquidity buffers within a banking group should adequately reflect the structure and activities of the group in order to minimize the effects of possible legal, regulatory or operational impediments to using the assets of the buffer.

The buffer should differentiate between currencies, and should reflect legal entity specificities where appropriate, especially with regard to intra-group exposures. Determining the adequate location and size of buffers for legal entities, jurisdictions, and regions should be responsive to individual needs and situations. In general, several drivers of the decision process can be identified, such as operational risk considerations, the degree of centralisation of liquidity management, jurisdictional specificities in terms of winding up directives, deposit guarantee schemes and local regulatory requirements, different treatment of branches and subsidiaries, and differences in local business models, time zones and access to capital markets. A final decision should be made and applied through the dialogue between the group and its home and host supervisors.

There is no single model for the organisation of liquidity management: they range from fully centralised management to the fully decentralised independent local management of liquidity. Centralised management of the buffers may be acceptable once it has been established that there are no impediments to the transfer of liquidity within the group and the relevant regulators are satisfied that the ability to move funds between entities would be resilient in a stress situation[11].

69. As a general principle, when an entity responsible for liquidity management has a material holding of a currency, it, by implication, has a material level of liquidity risk in this currency and should hold a buffer for it. The holding of several buffers may impose additional costs on banks, but it addresses the risk of potential disruptions in the foreign exchange market that may impair the ability to convert across currencies.

[11] See CEBS' Technical Advice to the European Commission on Liquidity Risk Management, September 2008, paragraphs 94-96, for a discussion on the complexities that may arise in a banking group using centralised liquidity management.

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