United States

The Mortgage Analyst

Credit Strategy Research

Tracking liquidity using trading volume data

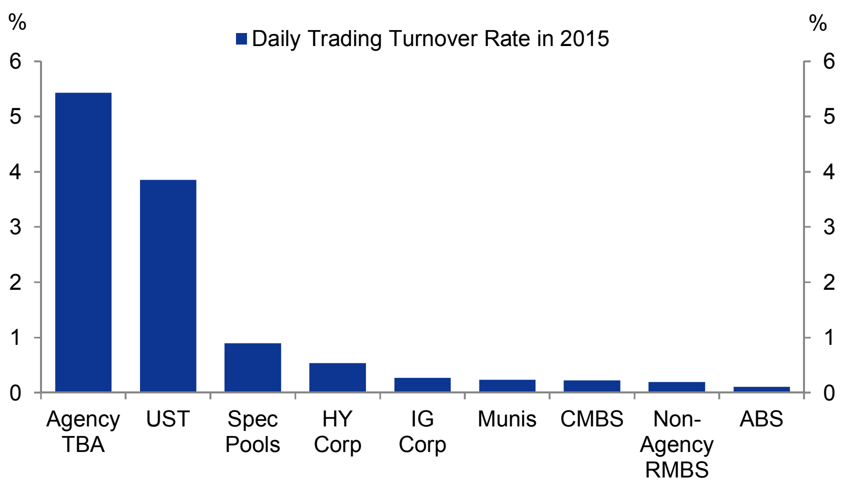
Trading turnover rates declined post-crisis

Market liquidity is front and center in our conversations with investors. We focus on trading volumes in measuring market liquidity. We find that trading turnover rates fell significantly post-crisis across asset classes. While turnover rates have since stabilized in some sectors, other products including CMBS continue to see turnover rates trending down.

Liquidity advantage supports agency MBS

The TBA market is substantially more liquid than many other bond markets. Its daily turnover rate exceeds even US Treasuries. As investors are placing an increasing premium on liquidity, we think the demand for agency mortgages will remain strong in 2016.

Agency TBA market has a higher daily turnover rate than US Treasuries



Source: FINRA TRACE, eMBS, FRBNY, Barclays, SIFMA, CoreLogic, and Goldman Sachs Global Investment Research.

Hui Shan
(212) 902-4447 hui.shan@gs.com
Goldman, Sachs & Co.

Marty Young
(917) 343-3214 marty.young@gs.com
Goldman, Sachs & Co.

Charles P. Himmelberg
(917) 343-3218 charles.himmelberg@gs.com
Goldman, Sachs & Co.

Chris Henson
(801) 741-5755 chris.henson@gs.com
Goldman, Sachs & Co.

Spencer Rogers
(801) 884-1104 spencer.rogers@gs.com
Goldman, Sachs & Co.

This research is focused on investment themes across markets, industries and sectors. It does not attempt to distinguish between the prospects or performance of, or provide analysis of, individual companies within any industry or sector we describe. Investors should consider this research as only a single factor in making investment decisions. For Reg AC certification and other important disclosures, see the Disclosure Appendix, or go to www.gs.com/research/hedge.html.

For the exclusive use of QYANG@SPMLLC.COM

Tracking liquidity using trading volume data

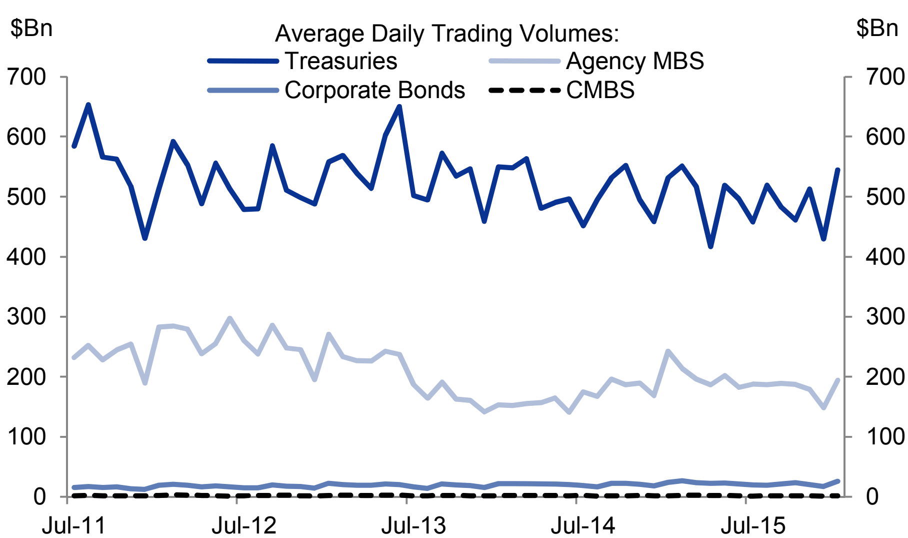
Market liquidity has been a recurring theme in our conversations with fixed income investors. Our colleagues have previously looked at dealer inventories, examined bid-ask spreads, and interviewed market participants in assessing the liquidity landscape ("Negative inventories bode poorly for corporate bond liquidity," *Global Markets Daily*, November 10, 2015, "Bond market liquidity has declined (but this decline is hard to measure)," *Global Markets Daily*, August 11, 2015, "A Look at Liquidity," *Top of Mind*, August 2, 2015). Their work highlights both the importance of the topic and the difficulties in measuring market liquidity.

The significance of market liquidity to the economy and financial stability has not escaped policymakers' attention. Researchers at the New York Fed have been publishing a series of blogs on liquidity conditions in the mortgage, corporate, and Treasury markets.[1] In this *Mortgage Analyst*, we focus specifically on trading volumes in the fixed income market. Our main finding is that, while trading volumes are generally trending down across all sectors, including agency MBS, the TBA market continues to enjoy a substantial liquidity advantage relative to other bond sectors, including even US Treasuries. As investors are placing an increasing premium on liquidity, we think the demand for agency mortgages will remain strong in 2016.

The correct way to measure liquidity using trading volumes

The average daily trading volumes vary dramatically across assets in the fixed income market (Exhibit 1). Treasuries and agency mortgage-backed securities (MBS) are among the most traded products, with approximately $500 billion and $200 billion, respectively, changing hands on average each day. By contrast, corporate bonds and commercial mortgage-backed securities (CMBS) have much lower daily trading volumes, running at a current pace of $20 billion and less than $2 billion per day, respectively.

Exhibit 1: Large variation in trading volumes across products
Average daily trading volumes by asset



Source: FINRA TRACE and Federal Reserve Bank of New York.

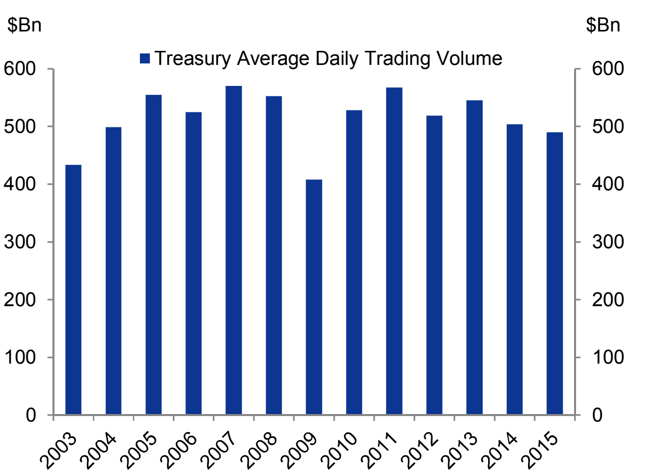
[1] See http://libertystreeteconomics.newyorkfed.org/2016/02/continuing-the-conversation-on-liquidity.html.

For the exclusive use of QYANG@SPMLLC.COM

Changes in trading volumes by themselves may not be a meaningful indicator of changes in market liquidity for three reasons. First, market size matters. Given the same liquidity, we expect a bigger market to have higher trading volumes. For example, average daily trading volumes of Treasuries in 2015 were similar to those seen in 2004 (Exhibit 2). But the total amount of Treasuries outstanding more than tripled from 2004 to 2015 (Exhibit 3). This suggests that the trading turnover rate has fallen notably in the Treasury market.

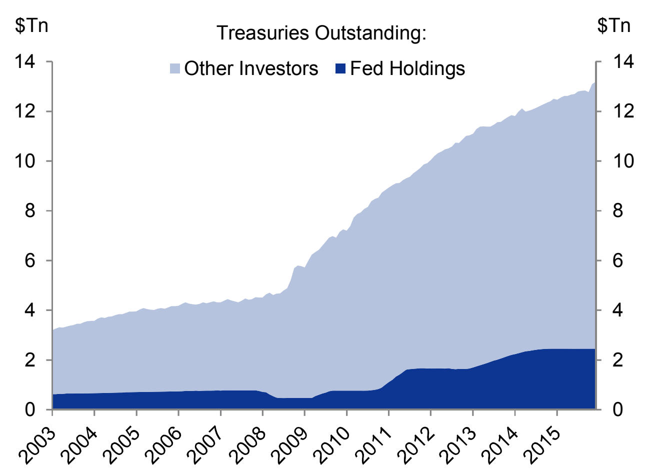
Second, investor base matters. From 2008 to 2015, agency MBS daily average trading volumes fell from $340 billion to $190 billion while total agency MBS outstanding increased 18%, implying drastically lower turnover rates (Exhibits 4 and 5). However, this calculation is misleading because the Federal Reserve purchased large amounts of agency MBS during its QE programs and the central bank does not actively trade its holdings. When the Fed share is excluded, total net agency MBS outstanding *fell* 18% from 2008 to 2015. Note that not all shifts in investor base need to be adjusted. This is because of the potential reverse causality problem: worsening market liquidity could lead to securities moving from high-frequency traders to buy-and-hold investors. In this case, changes in investor base are the consequence, not the cause, of deterioration in liquidity conditions.

Exhibit 2: Treasury trading volumes changed little…



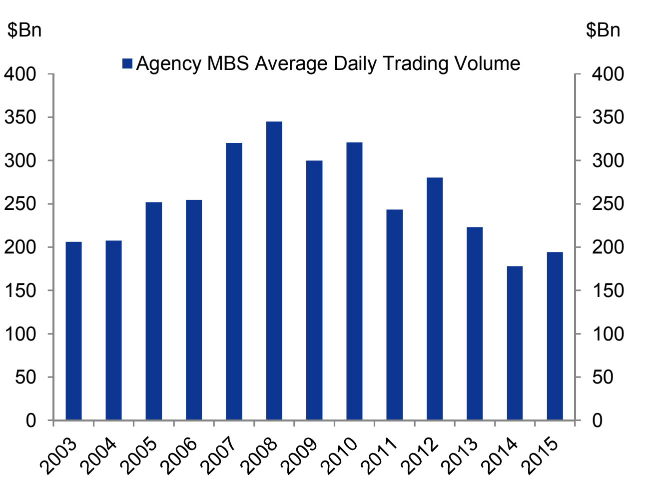
Source: SIFMA.

Exhibit 3: …while Treasury debt outstanding rose sharply



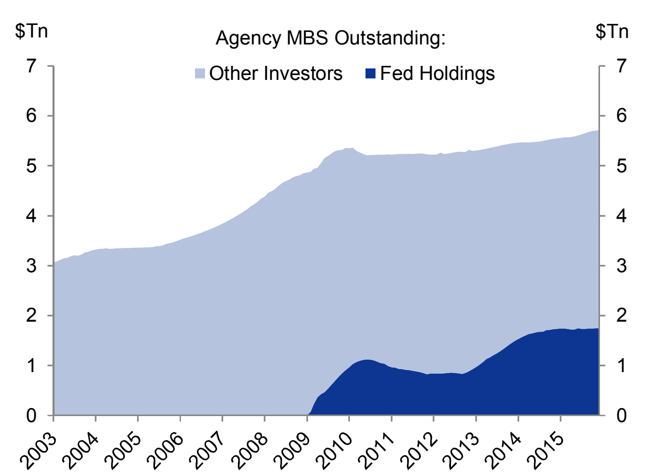
Source: Treasury Department and Federal Reserve.

Exhibit 4: Agency MBS trading volumes declined…



Source: SIFMA.

Exhibit 5: …when Fed holdings of agency MBS increased

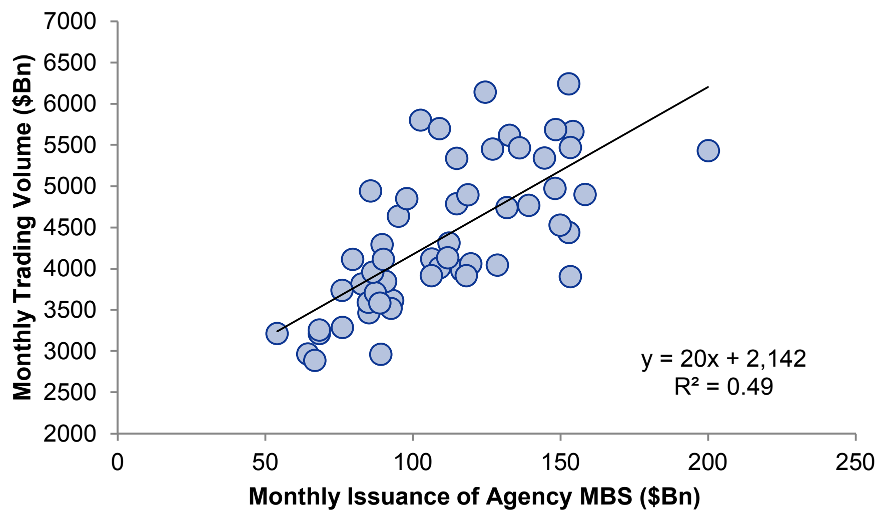


Source: eMBS and Federal Reserve.

For the exclusive use of QYANG@SPMLLC.COM

Third, issuance matters. In many fixed income markets, there is a close link between the gross issuance of securities and trading volumes. This link is partially mechanical since newly issued bonds need to be traded to reach investors. But the relationship can go beyond this mechanical link: investors often take the opportunity to adjust their portfolios when adding newly issued bonds, generating rippling effects on trading volumes. Exhibit 6 shows a large and strong correlation between monthly gross issuance and monthly trading volumes in the agency MBS market. When measuring market liquidity using trading volumes, we need to adjust for gross issuance because lower trading volumes driven by lower issuance are not indicative of worsening liquidity conditions.

Exhibit 6: Trading volumes rise when issuance increases
Monthly gross issuance and monthly trading volumes of agency MBS, 2011-2015



Source: eMBS, FINRA TRACE, and Goldman Sachs Global Investment Research.

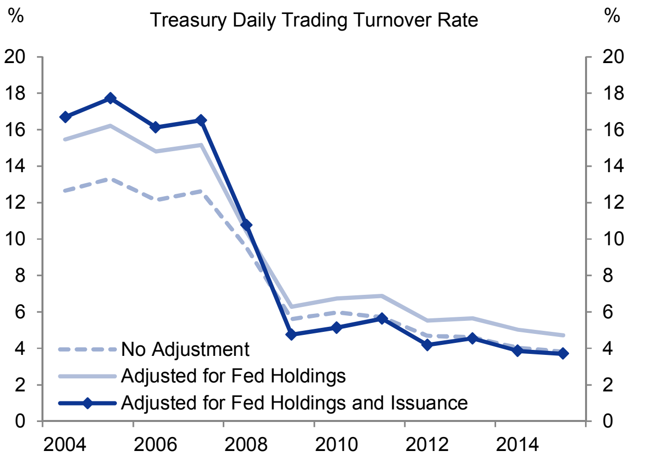
For the exclusive use of QYANG@SPMLLC.COM

Large decline in turnover post-crisis, small decline more recently

For reasons explained above, we examine daily average trading turnover rate adjusted for Fed holdings and issuance. We conduct our analysis on both annual and monthly trading volume data. The two sets of analysis have advantages and disadvantages: the annual data are less frequent but cover both pre-crisis and post-crisis periods. The monthly data only start in mid-2011 but are more frequent and timely.

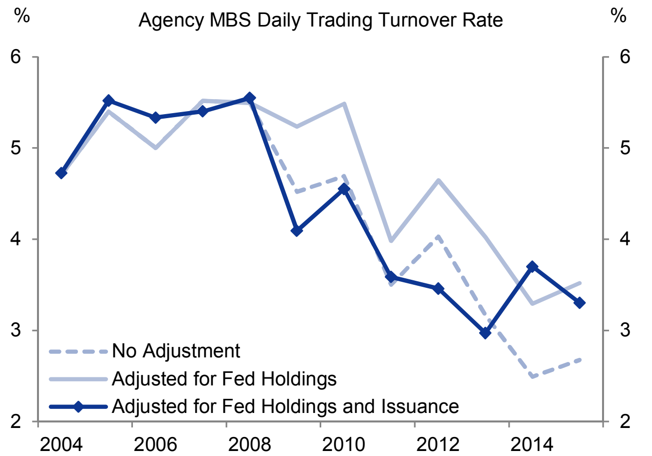
Exhibits 7 and 8 show the results from the annual data. While taking Fed holdings and changes in gross issuance into consideration makes a difference, the broad conclusion remains similar. Turnover rates decline for both Treasuries and agency MBS from pre-crisis to post-crisis. The drop in turnover rates in the Treasury market was most pronounced during the crisis years, with the adjusted daily turnover rate falling from 17% in 2007 to 5% in 2009. The drop in turnover rates was more gradual in the agency MBS market, with the adjusted daily turnover rate drifting from ~6% in 2008 to ~3% in 2013. Over the past few years, the annual data show that turnover rates have been relatively stable in both markets once Fed holdings and gross issuance are controlled for. This suggests that most of the liquidity pullback in the fixed income market may have taken place during the years immediately after the onset of the financial crisis.

Exhibit 7: A sharp decline in Treasury turnover rates



Source: SIFMA, Federal Reserve, Treasury Department, and Goldman Sachs Global Investment Research.

Exhibit 8: A gradual drift lower in agency MBS turnover



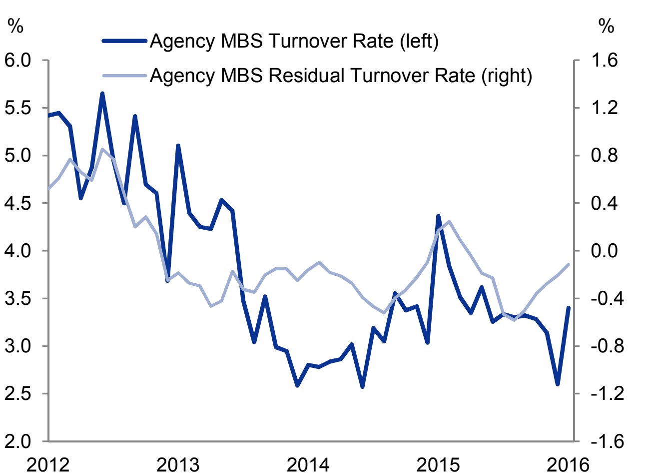
Source: SIFMA, Federal Reserve, eMBS, and Goldman Sachs Global Investment Research.

For the exclusive use of QYANG@SPMLLC.COM

Exhibits 9 and 10 display the results from the monthly data. While the unadjusted daily trading turnover rate in the agency MBS market fell from 5% in 2012 to 3% in 2014 and 2015, we estimate that Fed holdings and changes in gross issuance explain two thirds of the drop. This is consistent with the finding from the analysis of the annual data: the decline in turnover rates from pre-taper tantrum to post-taper tantrum is small compared to the decline from pre-crisis to post-crisis. Over the past two years, liquidity conditions measured by turnover rates appeared to be little changed in the agency MBS market.

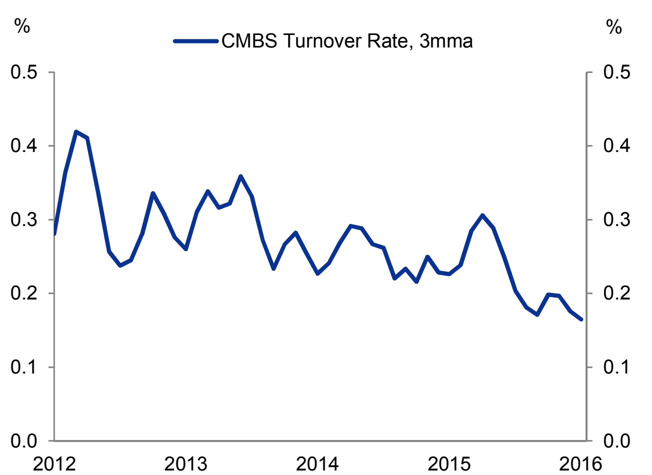
By contrast, turnover rates in the CMBS market has continued to decline. While the unadjusted daily trading turnover rate was 0.3% in 2012 and 2013, it averaged 0.2% in 2015. Because the Fed did not buy CMBS and because turnover rates do not have a strong correlation with issuance in the CMBS market, the adjusted series (not shown here) depicts an almost identical picture.

Exhibit 9: Agency MBS turnover was stable in 2015…
Residual turnover rate is the regression residual of trading volumes on issuance divided by non-Fed holdings



Source: FINRA TRACE, eMBS, Federal Reserve, and Goldman Sachs Global Investment Research.

Exhibit 10: …while CMBS turnover rate continued to decline in 2015
Unadjusted CMBS turnover rate, 3-month moving average



Source: FINRA TRACE, Trepp, and Goldman Sachs Global Investment Research.

For the exclusive use of QYANG@SPMLLC.COM

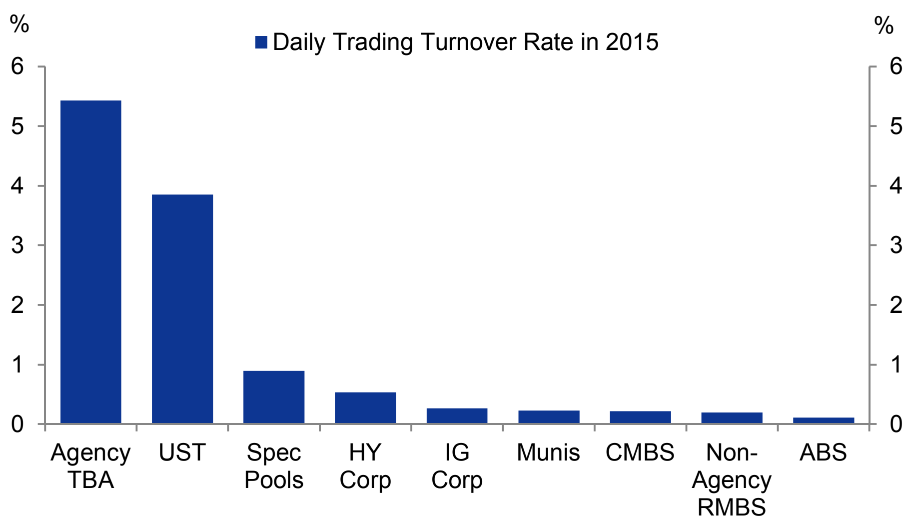
Liquid assets are poised to gain in an increasingly illiquid market

To be sure, market liquidity has multiple dimensions and is difficult to measure. A liquid market should be able to execute large trades within a short period of time at tight bid-ask spreads. Many aspects of liquidity, including depth of the market and the immediacy of the execution, are not observed by researchers. Even in cases when we do observe aspects of liquidity such as bid-ask spreads, the interpretation of the data is not straightforward: bid-ask spreads may narrow when liquidity dries up if only the easiest trades are being executed.

Similarly, measuring market liquidity using trading volume data are subject to many caveats. For example, other drivers affect trading volumes in addition to liquidity conditions. It is well known that trading volumes tend to pick up when market volatility is high. This may be why our adjusted daily turnover rates have been rising for high yield corporate bonds over the past year despite the fact that trading in the corporate bond market is increasingly difficult.

That said, we think that trading turnover rates are helpful in gauging market liquidity when combined with other measures. Our analysis above provides additional evidence that liquidity conditions deteriorated post-crisis in the fixed income markets. While market liquidity has stabilized for some asset classes, liquidity conditions have continued to worsen for other products (e.g., CMBS). Our conversations with clients have left us convinced that the lack of liquidity in the market has been weighing on investment and asset allocation decisions. To the extent that concerns over market liquidity are here to stay, we think agency MBS are poised to gain from its liquidity advantages going forward (Exhibit 11). This is another reason why we do not expect significant widening in mortgage spreads in 2016.

Exhibit 11: The agency TBA market has a higher daily turnover rate than US Treasuries
Average daily trading turnover rate in 2015, unadjusted for Fed holdings or issuance



Source: FINRA TRACE, eMBS, FRBNY, Barclays, SIFMA, CoreLogic, and Goldman Sachs Global Investment Research.

Hui Shan, Marty Young and Spencer Rogers

Disclosure Appendix

Reg AC

We, Hui Shan, Marty Young, Charles P. Himmelberg, Chris Henson and Spencer Rogers, hereby certify that all of the views expressed in this report accurately reflect our personal views about the subject company or companies and its or their securities. We also certify that no part of our compensation was, is or will be, directly or indirectly, related to the specific recommendations or views expressed in this report.

Unless otherwise stated, the individuals listed on the cover page of this report are analysts in Goldman Sachs' Global Investment Research division.

Disclosures

Regulatory disclosures

Disclosures required by United States laws and regulations

See company-specific regulatory disclosures above for any of the following disclosures required as to companies referred to in this report: manager or co-manager in a pending transaction; 1% or other ownership; compensation for certain services; types of client relationships; managed/co-managed public offerings in prior periods; directorships; for equity securities, market making and/or specialist role. Goldman Sachs trades or may trade as a principal in debt securities (or in related derivatives) of issuers discussed in this report.

The following are additional required disclosures: **Ownership and material conflicts of interest:** Goldman Sachs policy prohibits its analysts, professionals reporting to analysts and members of their households from owning securities of any company in the analyst's area of coverage. **Analyst compensation:** Analysts are paid in part based on the profitability of Goldman Sachs, which includes investment banking revenues. **Analyst as officer or director:** Goldman Sachs policy prohibits its analysts, persons reporting to analysts or members of their households from serving as an officer, director, advisory board member or employee of any company in the analyst's area of coverage. **Non-U.S. Analysts:** Non-U.S. analysts may not be associated persons of Goldman, Sachs & Co. and therefore may not be subject to FINRA Rule 2241 or FINRA Rule 2242 restrictions on communications with subject company, public appearances and trading securities held by the analysts.

Additional disclosures required under the laws and regulations of jurisdictions other than the United States

The following disclosures are those required by the jurisdiction indicated, except to the extent already made above pursuant to United States laws and regulations. **Australia:** Goldman Sachs Australia Pty Ltd and its affiliates are not authorised deposit-taking institutions (as that term is defined in the Banking Act 1959 (Cth)) in Australia and do not provide banking services, nor carry on a banking business, in Australia. This research, and any access to it, is intended only for "wholesale clients" within the meaning of the Australian Corporations Act, unless otherwise agreed by Goldman Sachs. In producing research reports, members of the Global Investment Research Division of Goldman Sachs Australia may attend site visits and other meetings hosted by the issuers the subject of its research reports. In some instances the costs of such site visits or meetings may be met in part or in whole by the issuers concerned if Goldman Sachs Australia considers it is appropriate and reasonable in the specific circumstances relating to the site visit or meeting. **Brazil:** Disclosure information in relation to CVM Instruction 483 is available at http://www.gs.com/worldwide/brazil/area/gir/index.html. Where applicable, the Brazil-registered analyst primarily responsible for the content of this research report, as defined in Article 16 of CVM Instruction 483, is the first author named at the beginning of this report, unless indicated otherwise at the end of the text. **Canada:** Goldman Sachs Canada Inc. is an affiliate of The Goldman Sachs Group Inc. and therefore is included in the company specific disclosures relating to Goldman Sachs (as defined above). Goldman Sachs Canada Inc. has approved of, and agreed to take responsibility for, this research report in Canada if and to the extent that Goldman Sachs Canada Inc. disseminates this research report to its clients. **Hong Kong:** Further information on the securities of covered companies referred to in this research may be obtained on request from Goldman Sachs (Asia) L.L.C. **India:** Further information on the subject company or companies referred to in this research may be obtained from Goldman Sachs (India) Securities Private Limited. Goldman Sachs may beneficially own 1% or more of the securities (as such term is defined in clause 2 (h) the Indian Securities Contracts (Regulation) Act, 1956) of the subject company or companies referred to in this research report. **Japan:** See below. **Korea:** Further information on the subject company or companies referred to in this research may be obtained from Goldman Sachs (Asia) L.L.C., Seoul Branch. **New Zealand:** Goldman Sachs New Zealand Limited and its affiliates are neither "registered banks" nor "deposit takers" (as defined in the Reserve Bank of New Zealand Act 1989) in New Zealand. This research, and any access to it, is intended for "wholesale clients" (as defined in the Financial Advisers Act 2008) unless otherwise agreed by Goldman Sachs. **Russia:** Research reports distributed in the Russian Federation are not advertising as defined in the Russian legislation, but are information and analysis not having product promotion as their main purpose and do not provide appraisal within the meaning of the Russian legislation on appraisal activity. **Singapore:** Further information on the covered companies referred to in this research may be obtained from Goldman Sachs (Singapore) Pte. (Company Number: 198602165W). **Taiwan:** This material is for reference only and must not be reprinted without permission. Investors should carefully consider their own investment risk. Investment results are the responsibility of the individual investor. **United Kingdom:** Persons who would be categorized as retail clients in the United Kingdom, as such term is defined in the rules of the Financial Conduct Authority, should read this research in conjunction with prior Goldman Sachs research on the covered companies referred to herein and should refer to the risk warnings that have been sent to them by Goldman Sachs International. A copy of these risks warnings, and a glossary of certain financial terms used in this report, are available from Goldman Sachs International on request.

European Union: Disclosure information in relation to Article 4 (1) (d) and Article 6 (2) of the European Commission Directive 2003/125/EC is available at http://www.gs.com/disclosures/europeanpolicy.html which states the European Policy for Managing Conflicts of Interest in Connection with Investment Research.

Japan: Goldman Sachs Japan Co., Ltd. is a Financial Instrument Dealer registered with the Kanto Financial Bureau under registration number Kinsho 69, and a member of Japan Securities Dealers Association, Financial Futures Association of Japan and Type II Financial Instruments Firms Association. Sales and purchase of equities are subject to commission pre-determined with clients plus consumption tax. See company-specific disclosures as to any applicable disclosures required by Japanese stock exchanges, the Japanese Securities Dealers Association or the Japanese Securities Finance Company.

Ratings, coverage groups and views and related definitions

Credit Research assigns ratings to issuing companies based on our view of the credit quality of the issuer and the expected return of the relevant debt securities as compared to the corresponding sub-sector of the Citi Yield Market index or other benchmark as specified in the relevant research report. The relevant debt securities for purposes of our ratings are the issuer's debt securities that meet the following criteria (the "Rated Bonds"): For Investment Grade, fixed rate stated coupon, at least one year remaining to maturity, at least one year before the bonds are callable, minimum issue size of USD 250 million, minimum credit quality of BBB- by S&P or Baa3 by Moody's, and issued pursuant to an SEC-registered offering or

For the exclusive use of QYANG@SPMLLC.COM

under Rule 144A with or without registration rights. For Non-Investment Grade, fixed rate stated coupon, at least one year remaining to maturity, minimum issue size of USD 250 million, minimum credit quality of C by S&P or Ca by Moody's and maximum credit quality of BB+ by S&P or Ba1 by Moody's, and issued pursuant to an SEC-registered offering or under Rule 144A with or without registration rights.

The rating assigned to an issuing company will not apply to bonds in the issuer's capital structure other than the Rated Bonds, or to the issuer's CDS or loans, if any. Analysts may recommend trade ideas in Rated or non-rated bonds, CDS or loans to clients of the firm, including Goldman Sachs salespersons and traders and such trade ideas may or may not be published in research.

Definitions of Ratings: OP = Outperform. We expect that over the next six months the return of the relevant debt securities will exceed the return of the corresponding sub-sector of the Citi Yield Market index or other benchmark as specified in the relevant research report. **IL = In-Line.** We expect that over the next six months the return of the relevant debt securities will be in line with the return of the corresponding sub-sector of the Citi Yield Market index or other benchmark as specified in the relevant research report. **U = Underperform.** We expect that over the next six months the return of the relevant debt securities will be less than the return of the corresponding sub-sector of the Citi Yield Market index or other benchmark as specified in the relevant research report.

NR = Not Rated. The investment rating, if any, has been removed pursuant to Goldman Sachs policy when Goldman Sachs is acting in an advisory capacity in a merger or strategic transaction involving this company and in certain other circumstances. **NC = Not Covered.** Goldman Sachs does not cover this company. **RS = Rating Suspended.** Goldman Sachs Research has suspended the investment rating for this company, because there is not a sufficient fundamental basis for determining, or there are legal, regulatory or policy constraints around publishing, an investment rating. The previous investment rating is no longer in effect for this credit and should not be relied upon. **CS = Coverage Suspended.** Goldman Sachs has suspended coverage of this company. **NA = Not Available or Not Applicable.** The information is not available for display or is not applicable.

Additional disclosures

The analysts named in this report may from time to time discuss with our clients, including Goldman Sachs salespersons and traders, catalysts or events that may have or have had an impact on the market price of debt securities of the issuer discussed in this report. In addition, such analysts may also discuss with our clients specific debt securities which exhibit pricing dislocation compared to other debt securities of the issuer, which may be temporary in nature and may be a reflection of differing characteristics, liquidity or demand for the security. In connection with these discussions, analysts may share their views and provide trade recommendations. These views and recommendations may not necessarily be reflected in published research to the extent such catalyst, event or other cause for the pricing dislocation does not change the analyst's published rating for the issuer. Nor should these views or recommendations be viewed as inconsistent with the views reflected in the currently published or pending research to the extent that the context in which they are provided, including investment objectives or time horizons, differs.

Coverage views: The coverage view represents each analyst's or analyst team's investment outlook on his/her/their coverage group(s). The coverage view will consist of one of the following designations: **Attractive (A).** The investment outlook over the following 6 months is favorable relative to the coverage group's historical fundamentals and/or valuation. **Neutral (N).** The investment outlook over the following 6 months is neutral relative to the coverage group's historical fundamentals and/or valuation. **Cautious (C).** The investment outlook over the following 6 months is unfavorable relative to the coverage group's historical fundamentals and/or valuation.

Global product; distributing entities

The Global Investment Research Division of Goldman Sachs produces and distributes research products for clients of Goldman Sachs on a global basis. Analysts based in Goldman Sachs offices around the world produce equity research on industries and companies, and research on macroeconomics, currencies, commodities and portfolio strategy. This research is disseminated in Australia by Goldman Sachs Australia Pty Ltd (ABN 21 006 797 897); in Brazil by Goldman Sachs do Brasil Corretora de Títulos e Valores Mobiliários S.A.; in Canada by either Goldman Sachs Canada Inc. or Goldman, Sachs & Co.; in Hong Kong by Goldman Sachs (Asia) L.L.C.; in India by Goldman Sachs (India) Securities Private Ltd.; in Japan by Goldman Sachs Japan Co., Ltd.; in the Republic of Korea by Goldman Sachs (Asia) L.L.C., Seoul Branch; in New Zealand by Goldman Sachs New Zealand Limited; in Russia by OOO Goldman Sachs; in Singapore by Goldman Sachs (Singapore) Pte. (Company Number: 198602165W); and in the United States of America by Goldman, Sachs & Co. Goldman Sachs International has approved this research in connection with its distribution in the United Kingdom and European Union.

European Union: Goldman Sachs International authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and the Prudential Regulation Authority, has approved this research in connection with its distribution in the European Union and United Kingdom; Goldman Sachs AG and Goldman Sachs International Zweigniederlassung Frankfurt, regulated by the Bundesanstalt für Finanzdienstleistungsaufsicht, may also distribute research in Germany.

General disclosures

This research is for our clients only. Other than disclosures relating to Goldman Sachs, this research is based on current public information that we consider reliable, but we do not represent it is accurate or complete, and it should not be relied on as such. We seek to update our research as appropriate, but various regulations may prevent us from doing so. Other than certain industry reports published on a periodic basis, the large majority of reports are published at irregular intervals as appropriate in the analyst's judgment.

Goldman Sachs conducts a global full-service, integrated investment banking, investment management, and brokerage business. We have investment banking and other business relationships with a substantial percentage of the companies covered by our Global Investment Research Division. Goldman, Sachs & Co., the United States broker dealer, is a member of SIPC (http://www.sipc.org).

Our salespeople, traders, and other professionals may provide oral or written market commentary or trading strategies to our clients and principal trading desks that reflect opinions that are contrary to the opinions expressed in this research. Our asset management area, principal trading desks and investing businesses may make investment decisions that are inconsistent with the recommendations or views expressed in this research.

We and our affiliates, officers, directors, and employees, excluding equity and credit analysts, will from time to time have long or short positions in, act as principal in, and buy or sell, the securities or derivatives, if any, referred to in this research.

The views attributed to third party presenters at Goldman Sachs arranged conferences, including individuals from other parts of Goldman Sachs, do not necessarily reflect those of Global Investment Research and are not an official view of Goldman Sachs.

Any third party referenced herein, including any salespeople, traders and other professionals or members of their household, may have positions in the products mentioned that are inconsistent with the views expressed by analysts named in this report.

Any trading recommendation in this research relating to a security or multiple securities within an industry or sector is reflective of the investment theme being discussed and is not a recommendation of any such security in isolation.

This research is not an offer to sell or the solicitation of an offer to buy any security in any jurisdiction where such an offer or solicitation would be illegal. It does not constitute a personal recommendation or take into account the particular investment objectives, financial situations, or needs of individual clients. Clients should consider whether any advice or recommendation in this research is suitable for their particular circumstances and, if

For the exclusive use of QYANG@SPMLLC.COM

appropriate, seek professional advice, including tax advice. The price and value of investments referred to in this research and the income from them may fluctuate. Past performance is not a guide to future performance, future returns are not guaranteed, and a loss of original capital may occur. Fluctuations in exchange rates could have adverse effects on the value or price of, or income derived from, certain investments.

Certain transactions, including those involving futures, options, and other derivatives, give rise to substantial risk and are not suitable for all investors. Investors should review current options disclosure documents which are available from Goldman Sachs sales representatives or at http://www.theocc.com/about/publications/character-risks.jsp. Transaction costs may be significant in option strategies calling for multiple purchase and sales of options such as spreads. Supporting documentation will be supplied upon request.

All research reports are disseminated and available to all clients simultaneously through electronic publication to our internal client websites. Not all research content is redistributed to our clients or available to third-party aggregators, nor is Goldman Sachs responsible for the redistribution of our research by third party aggregators. For research, models or other data available on a particular security, please contact your sales representative or go to http://360.gs.com.

Disclosure information is also available at http://www.gs.com/research/hedge.html or from Research Compliance, 200 West Street, New York, NY 10282.

© 2016 Goldman Sachs.

No part of this material may be (i) copied, photocopied or duplicated in any form by any means or (ii) redistributed without the prior written consent of The Goldman Sachs Group, Inc.

For the exclusive use of QYANG@SPMLLC.COM