Benchmark Administration™

U.S. Dollar ICE Bank Yield Index Update

October 2019

Contents

Executive Summary

Background

ICE Benchmark Administration (IBA), a leading provider of global interest rate and other financial benchmarks, introduced the U.S. Dollar ICE Bank Yield Index (the "Index" or the "Bank Yield Index") in a white paper in January 2019. The Index has been developed to measure the average yields at which investors are willing to invest U.S. dollar funds over one-month, three-month and six-month periods on a wholesale, senior, unsecured basis in large, internationally active banks. The Index is based entirely on unsecured, wholesale primary market funding and secondary market bond transactions of large, internationally active banks, adjusted, where necessary, by market data.

The U.S. Dollar ICE Bank Yield Index is a forward-looking, credit-sensitive benchmark designed specifically as a potential replacement for LIBOR for U.S. dollar lending activity. The Index incorporates some of the key properties of LIBOR that cash market participants have informed IBA they would like to retain in a U.S. dollar lending benchmark. These include:

- Measuring unsecured bank funding costs in U.S. dollars;
- Averaging these funding costs across a collection of large, internationally active banks; and
- Providing the most widely-used forward-looking term settings.

IBA published an update to the white paper in April 2019. This was followed by a second update in July 2019. These updates:

- Provided greater detail regarding certain aspects of the preliminary Index methodology;
- Explored potential enhancements to the methodology;
- Presented updated testing results;
- Summarized the feedback received on the Index; and
- Continued to request market feedback on the Index.

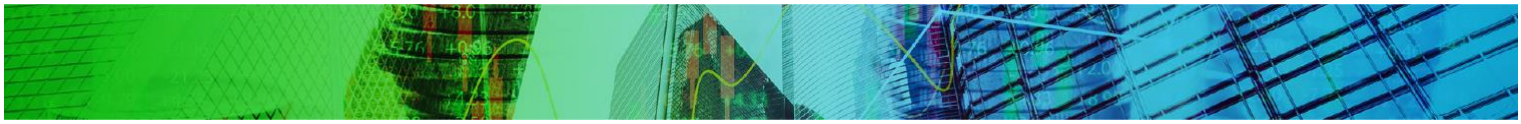
Updates to the Methodology and Updated Testing Results

Based upon feedback received on the white paper and the updates, which indicated a desire to broaden the input data set used to derive the Index, IBA intends to continue to develop and test the Index using an updated preliminary methodology based on a rolling five-day average of unsecured bank funding and bond transaction yields (subject to certain minimum transaction volume and transaction count thresholds). The use of a rolling five-day average should help to ensure that the Index is calculated from a large and diverse set of unsecured transaction yield data and, as a result, will be reflective of conditions in the market for unsecured, term bank obligations at any given time. Please see the *Constructing the U.S. Dollar ICE Bank Yield Index - Methodology Updates* section of this update for further details.

Over time, IBA will also evaluate the possibility of constructing the Index as a supplement to a term SOFR[1] curve, as further described in the *Constructing the U.S. Dollar ICE Bank Yield Index - Methodology Updates* section of this update. Any transition from the preliminary Index methodology to one built as a supplement to term SOFR rates will be guided by the paced transition plan implemented by the US Alternative Reference Rates Committee (the "ARRC").

As indicated in the previous update, IBA has continued to test the Index during Q3 2019. Revised testing results, using the preliminary methodology described in this update, are included in the *Testing Results to the end of September* 2019 section of this update. For the testing period from December 2017 to the end of September 2019, the Index has shown a good correlation with the corresponding U.S. dollar LIBOR rates. This factor could help facilitate lending market participants in their transition away from U.S. dollar LIBOR.

[1] The Secured Overnight Financing Rate (SOFR) is the alternative risk-free rate for U.S. dollars selected by the US Alternative Reference Rates Committee



Next Steps for the U.S. Dollar ICE Bank Yield Index

Over the coming months, IBA intends to:

- Seek contractual commitments from large, internationally active banks to provide primary market U.S. dollar funding data on an on-going basis to produce the Index;
- Develop a robust governance framework for the production of the Index; and
- Continue to develop and test the Index with a view to finalizing the Index methodology.

Provided that the outcome of testing is satisfactory and IBA is able to source funding data from large banks on an on-going basis, then IBA, as an authorized and regulated benchmark administrator, expects to be able to administer and provide the Index in compliance with applicable regulation for use by market participants during the second half of 2020. IBA will keep market participants informed of its progress.

There is no guarantee that IBA will continue to test the U.S. Dollar ICE Bank Yield Index, be able to source data to derive the Index or publish the Index in the future. Users of LIBOR should not rely on the potential publication of the U.S. Dollar ICE Bank Yield Index when developing and executing transition or fallback plans.

Constructing the U.S. Dollar ICE Bank Yield Index - Methodology Updates

Background

The U.S. Dollar ICE Bank Yield Index, as described in detail in the white paper and the subsequent updates[2], is designed to measure the average yields at which investors are willing to invest U.S. dollar funds over one-month, three-month and six-month periods on a wholesale, senior, unsecured basis in large, internationally active banks. The rates generated by the Index methodology implicitly incorporate a number of distinct elements, including:

- An underlying U.S. dollar risk-free rate of return (for example, SOFR);
- A term structure for this risk-free rate (i.e. the expected average term premium over the overnight risk-free rate for forward-looking time horizons); and
- An average credit risk premium that investors expect to earn for accepting wholesale, senior, unsecured bank credit risk over the various forward-looking time horizons.

Methodology Updates

Based upon feedback received on the white paper and the updates, indicating a desire to broaden the input data set used to derive the Index, IBA has decided to continue to develop and test the Index using an updated methodology based on a rolling five-day average of unsecured bank funding and bond transaction yields (subject to minimum transaction volume and transaction count thresholds). Each day of the input data collection window has been aligned to calendar days (i.e. the period between 12:00 midnight and 12:00 midnight Eastern Time on consecutive business days), rather than to the period between 11:00 am and 11:00 am UK time on consecutive business days used in the previous methodology. The use of a five-day window from which to collect data in order to calculate the Index should provide a larger and more diverse set of transaction yield information than the previous methodology, which should enhance the representativeness of the benchmark[3] and help to ensure that it is consistently reflective of conditions in the wholesale, unsecured bank funding market.

In order to calculate the Bank Yield Index based on a rolling five-day average of transaction yields, the key data inputs required are:

- Underlying transactional data over the five-day input data collection window, representative of the yields available to investors in both the primary funding and the secondary bond markets for senior, wholesale, unsecured U.S. dollar bank debt obligations. The updated preliminary Index methodology uses:
    - Primary market bank funding transactions sourced from thirteen of the sixteen U.S. dollar LIBOR Panel Banks[4], which are subject to eligibility criteria including a minimum transaction size of USD 10 million, and allowable values for counterparty type, product type, maturity and funding location[5]; and
    - Secondary market transactions in the bank level debt obligations of 30 large banking groups[6], sourced from the Financial Industry Regulatory Authority's™ (FINRA™) Trade Reporting and Compliance Engine™ (TRACE™)[7], which are subject to eligibility criteria including a minimum

[2] IBA published updates to the white paper in April 2019 and in July 2019
[3] Most banks do not have daily U.S. dollar unsecured term funding requirements that they need to meet in the non-overnight money markets. However, as displayed by the funding data on p.7 of this update, on a rolling five-day basis there is a significant and diverse set of unsecured bank term funding transactions, which will be more indicative of realized transactional activity in the money markets than a one-day snap shot. Bank funding requirements differ materially from the secured borrowing needs of broker dealers, which are often met in the overnight repo markets.
[4] Thirteen of the sixteen U.S. dollar LIBOR panel banks have consented to IBA using their funding transaction data for the purposes of testing the Index.
[5] See Appendix A of the Term Sheet attached as Appendix 1 to the January White Paper.
[6] See Appendix 1 of this update for details of the eligible bond issuers.
[7] Financial Industry Regulatory Authority, FINRA, Trade Reporting and Compliance Engine, and TRACE are trademarks of Financial Industry Regulatory Authority, Inc. (FINRA), in the US and/or other countries. All rights reserved. See http://www.finra.org/industry/trace for further details regarding TRACE. The U.S. Dollar ICE Bank Yield Index is not associated with, or endorsed or sponsored by, FINRA.

transaction size of USD 5 million, a minimum issuance size of USD 500 million, and allowable values for bond type, coupon range and maturity range[8]. Bond transaction volumes are weighted to ensure that no issuer represents over 10% of the transaction volume used in the Index calculation, and bond yields are normalized to represent yield on a money-market basis.

- A set of market rates (e.g. OIS for each tenor) for each day in the five-day input data collection window, from which day-on-day risk-free rate market movements can be estimated. This will allow previous days' transactions to be appropriately adjusted for movements in market rates.

In order to ensure that the Index is constructed from a sufficiently large and diverse data set, IBA has set a minimum aggregate transaction volume threshold of USD 15 billion and a minimum aggregate transaction count of 100 discrete transactions for each calculation. If these thresholds are not reached, IBA will source data over a longer collection period than the target five days. For example, if the USD 15 billion aggregate volume threshold were not achieved over five days, IBA would use transaction data from earlier days until the volume threshold was met (i.e. by looking-back to six, seven, eight days etc.).

A weighted robust regression process, rather than the weighted least-squares regression used in the previous methodology, will then fit a yield curve to the transaction data points (as adjusted) obtained from the relevant input data collection window. This yield curve can then be used to produce settings that are representative of the average yields at which investors are willing to invest U.S. dollar funds on a senior, unsecured basis in large, internationally active banks for set time horizons (e.g. one, three and six months).

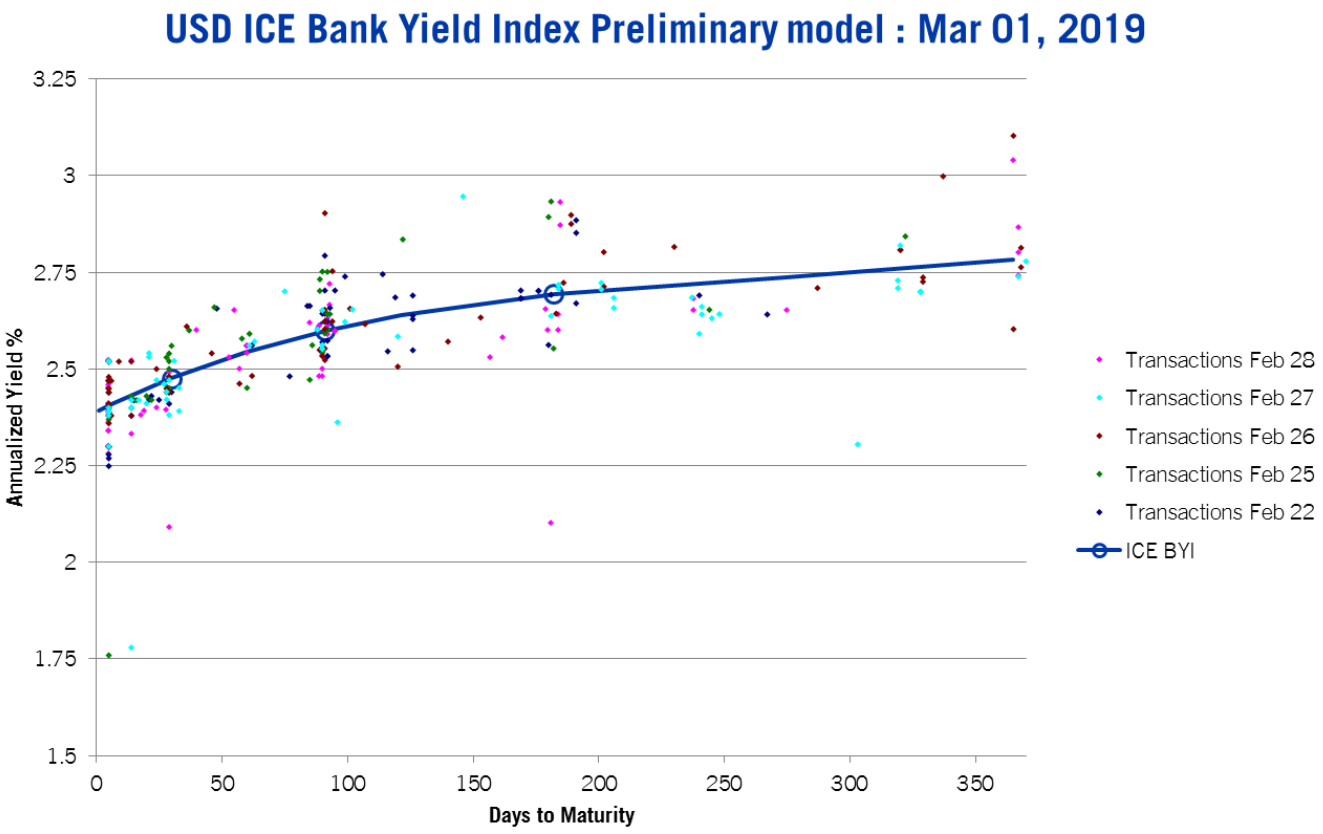
The robust regression process is designed to minimize the influence of outlier data points. The preliminary Index methodology described above does not identify specific outlier transactions for exclusion. In view of the possibility of occasional erroneous and unrepresentative transaction reports, IBA would expect to include a check for extreme outliers in the finalized Index methodology. This is expected to use a wide threshold, perhaps between 100 and 200 bps from the average for the relevant tenor, with the intention of excluding only clearly erroneous and unrepresentative transaction reports. IBA welcomes feedback from market participants on the appropriate potential outlier threshold.

Example Yield Curve and Term Settings

The chart below provides an example of how term settings will be produced for the Index based on this updated preliminary methodology. The dots in the chart are transactional data points sourced between February 22, 2019, and February 28, 2019, which are used to derive the published Index value for March 1, 2019. From these

[8] See Appendix C of the Term Sheet attached as Appendix 1 to the January White Paper. Please note that the minimum transaction size has been increased to USD 5 million in the current methodology.

transactional data points, a best-fit yield curve is constructed from which one-month, three-month and six-month settings (blue circles) can be determined.



This calculation used 355 transactions:

Source day	Funding Transactions	Bond Transactions
T	60	11
T-1	46	17
T-2	62	33
T-3	40	9
T-4	54	23

The aggregate volume of the funding transactions used was USD 26.1 billion[9].

The Index values for the one-month, three-month and six-month term settings are taken from the curve at the 30, 91 and 182 days to maturity points, respectively. These values are included in the below table, together with the corresponding U.S. dollar LIBOR rate published on the same day[10].

Tenor	ICE Bank Yield Index (%)	USD LIBOR (%)
One-month	2.48142%	2.48188%
Three-month	2.59911%	2.59850%
Six-month	2.69339%	2.68213%

[9] Volume data for secondary market bond transactions with volumes greater than USD 5 million is not available until 6 months following execution. Historical research by IBA has shown the average transaction size for these data points to be approximately USD 14 million.
[10] Note that U.S. dollar LIBOR and the U.S. Dollar ICE Bank Yield Index are produced using different methodologies and different data sources. As a result, care should be taken when comparing U.S. dollar LIBOR and the U.S. Dollar ICE Bank Yield Index on any day or for any period, including the period of testing.

Input Data Used to Construct the Index

As noted above, stakeholder feedback has indicated a desire to use an even larger and more diverse input data set to construct the Index relative to the previous Index methodology proposed in the January white paper, which is reflective of activity in the term (i.e. not overnight) bank funding market. As a result, IBA has chosen to base the updated preliminary Index methodology on a rolling five-day average of primary market bank funding and secondary market bank bond transactions.

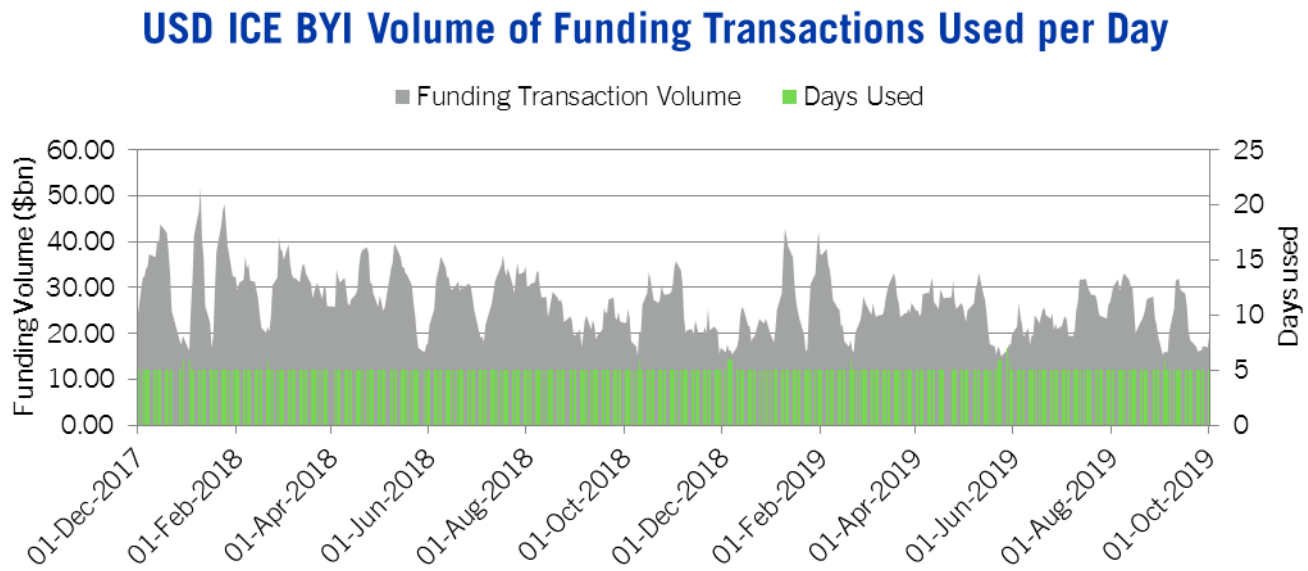
The below table shows the average number of transactions used to calculate the Index over the entire testing period from December 2017 to the end of September 2019 using the updated preliminary methodology described above.

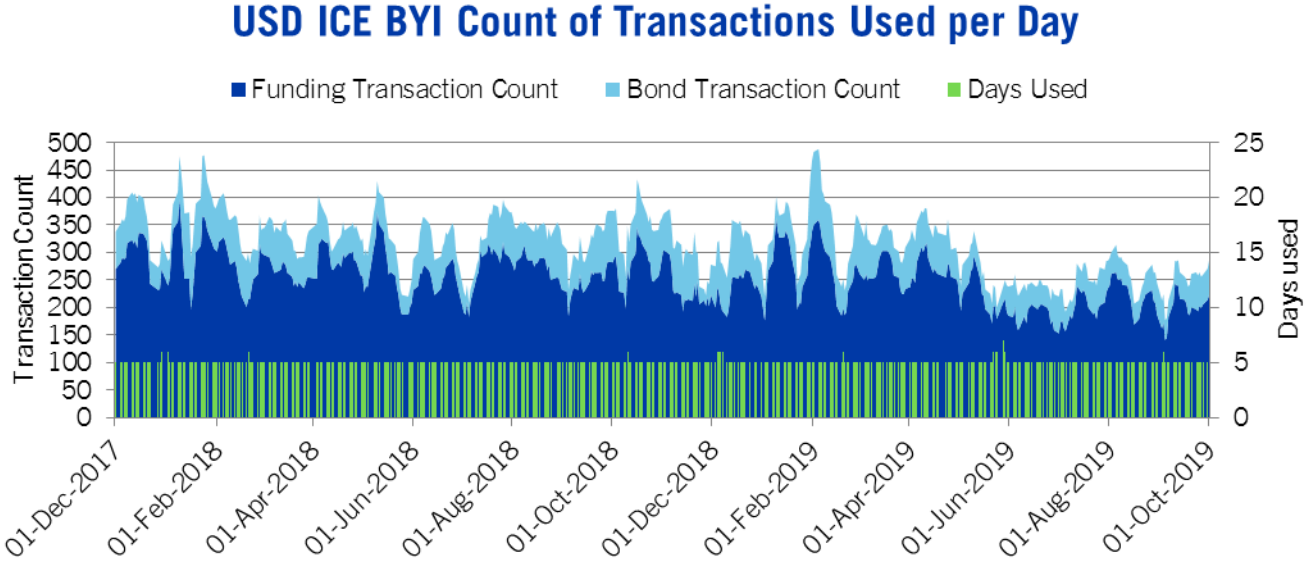
Testing Period Data	Number of Funding Transactions	Number of Bond Transactions	Aggregate Number of Transactions Used	Aggregate Volume of Funding Transactions Used (USD billion)
Average	253.9	62.5	316.4	27.0
Min	141	18	177	15.0
Max	398	133	488	51.7

On 446 out of the 461 Index calculation days during the testing period, the standard five days of transaction data were used to determine the Index. Index calculations required one additional day's look-back, using 6 days of transaction data to achieve the minimum volume threshold, on 14 calculation days. Just one Index calculation required 7 days of transaction data to achieve the threshold.

The charts below provide an overview of the aggregate transaction volumes and number of transactions used each day to construct the Bank Yield Index. They also indicate the number of days from which transaction data points

were used for each day of the testing period. This is typically the five days in the input data collection window, but on occasion transaction data from earlier days was utilized to meet the relevant thresholds.





Calculating the U.S. Dollar ICE Bank Yield Index as a Credit-Spread Supplement to Term SOFR

In the context of the transition to SOFR[11] as the alternative risk-free reference rate for U.S. dollars, a number of market participants have suggested that IBA consider constructing the U.S. Dollar ICE Bank Yield Index as a combination of a separate term SOFR curve and credit spread adjustment curve (i.e. as a credit spread supplement to term SOFR). The July update to the white paper presented a proposal for such a calculation methodology.

This approach acknowledges the different underlying dynamics of the credit and rates markets; with credit trends generally evolving over longer time periods and interest rate expectations potentially changing more rapidly based upon either realized rate changes or changes in expectations regarding monetary policy. Separating the yield curve

[11] SOFR is published by the Federal Reserve Bank of New York (The New York Fed) and is used subject to The New York Fed's Terms of Use (https://www.newyorkfed.org/markets/reference-rates-terms-of-use) for Select Rate Data. The New York Fed has no liability for your use of the data. The U.S. Dollar ICE Bank Yield Index is not associated with, or endorsed or sponsored by, The New York Fed.

into discrete parts allows for separate methodologies to be used for the credit risk and risk-free rate components of the transaction yield data reflecting these dynamics, i.e. permitting:

- the credit-spread curve methodology to more closely model the movement of credit-sensitive transaction data over the five-day transaction window when compared with a combined curve; and
- the term risk-free rate curve to incorporate more granular information on daily market rate adjustments (for example, based on realized SOFR data and derivatives transactional data relating to expected future SOFR settings) when compared with obtaining this information on a rolling five-day basis as provided for in the updated preliminary Index methodology described above.

This should lead to a rate which is representative of senior, unsecured bank credit risk in the wholesale funding market over time.

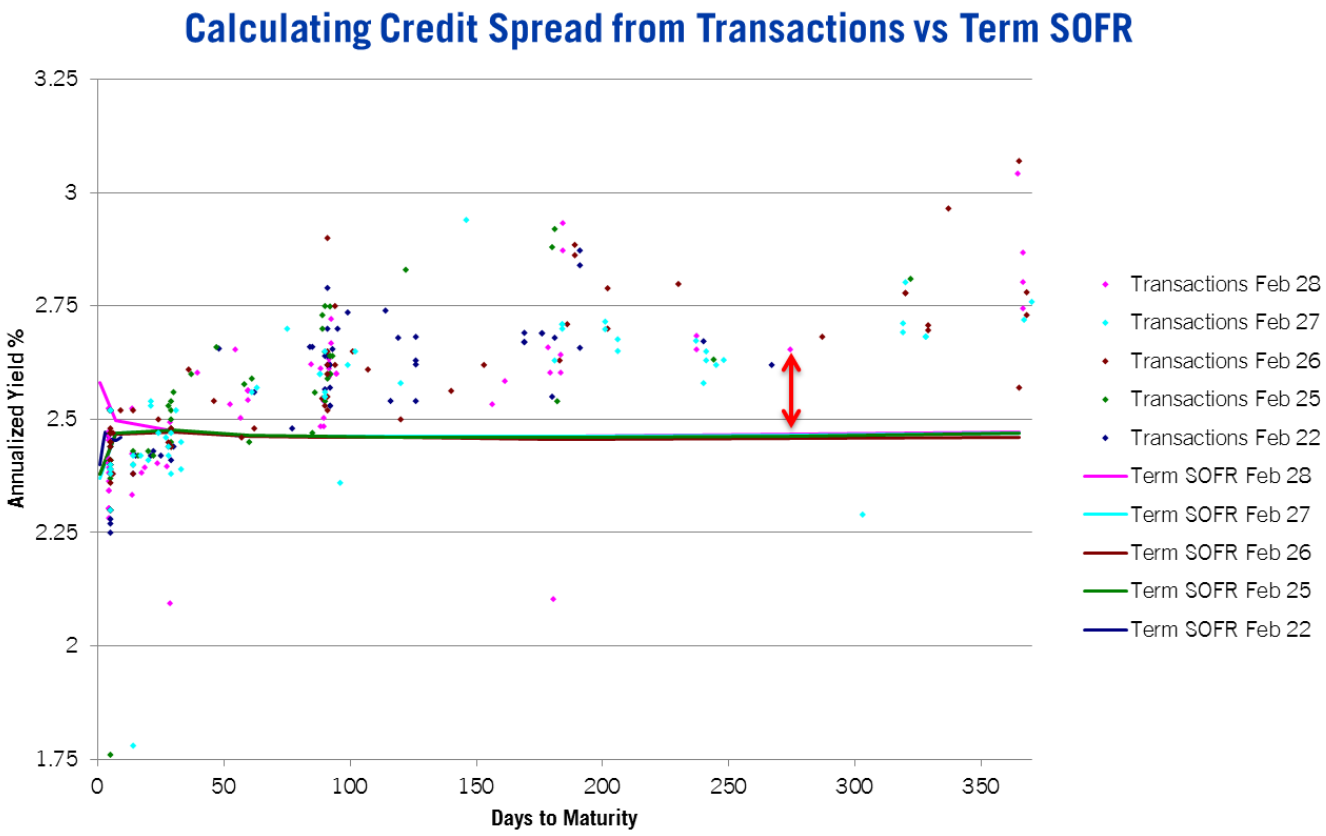
This approach also offers the possibility of publishing the credit spread and term risk-free rate elements of the Index separately, giving market participants greater transparency as to the constituent elements of the Index, whilst at the same time retaining a nexus to the alternative overnight risk-free reference rate for U.S. dollars selected by the ARRC.

In this alternative Index calculation methodology, primary market funding and secondary market bond transaction data points are sourced, filtered, weighted and normalized in the same manner as for the updated preliminary Index calculation methodology described above. However, the calculation process incorporates the following changes:

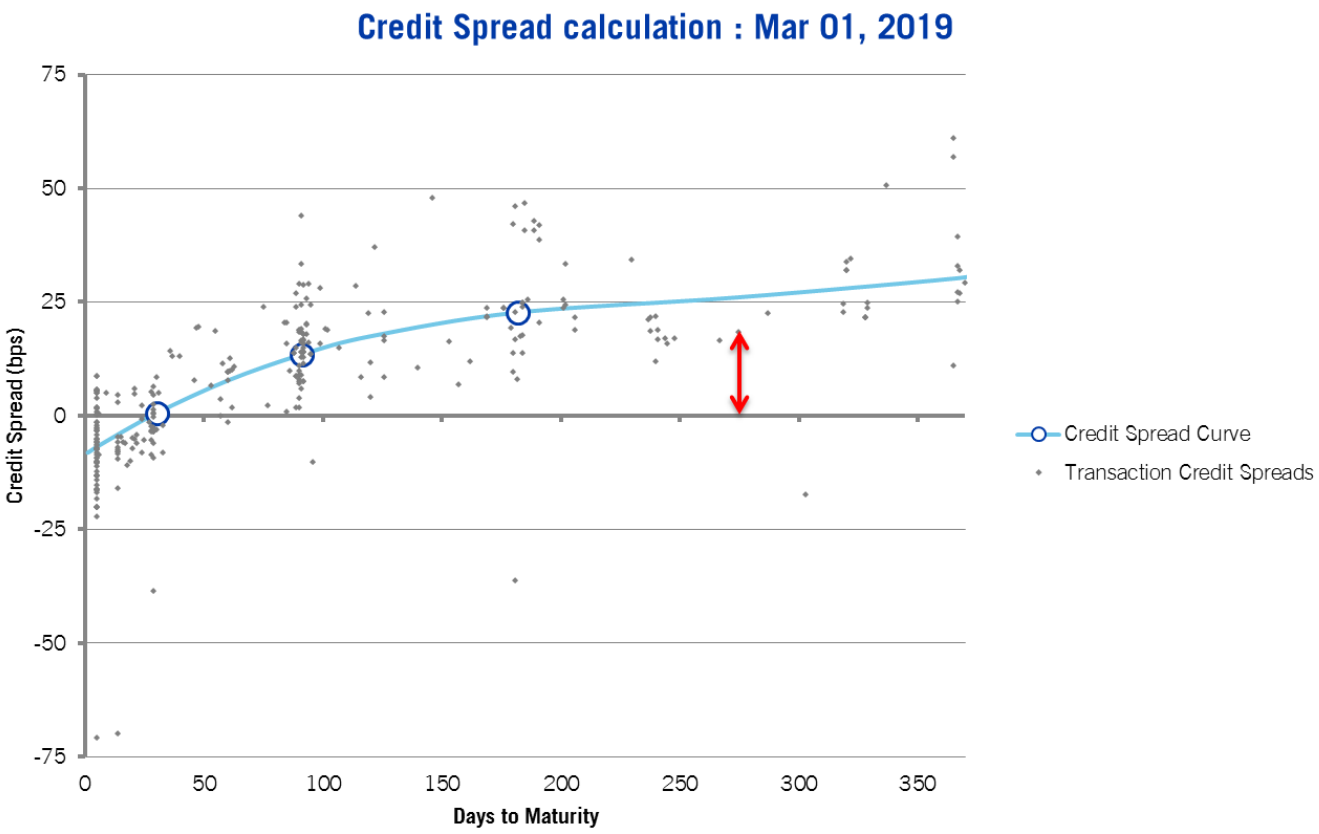
- A term SOFR yield curve is constructed (see an example methodology for doing this in the July update paper);
- There is no day-on-day adjustment for movements in market rates during the collection window. Instead, the value on the term-SOFR curve for a given day for the relevant maturity is subtracted from each transaction yield data point to generate implied credit spreads for each transaction;
- A curve is fitted to the implied credit spreads rather than to the transaction yields themselves; and
- This fitted credit spread curve is added to the current term SOFR yield curve to produce a composite U.S. Dollar ICE Bank Yield Index curve from which the required one-month, three-month and six-month settings can be obtained.

The following charts outline the process of constructing the U.S. Dollar ICE Bank Yield Index as a supplement to a term SOFR curve.

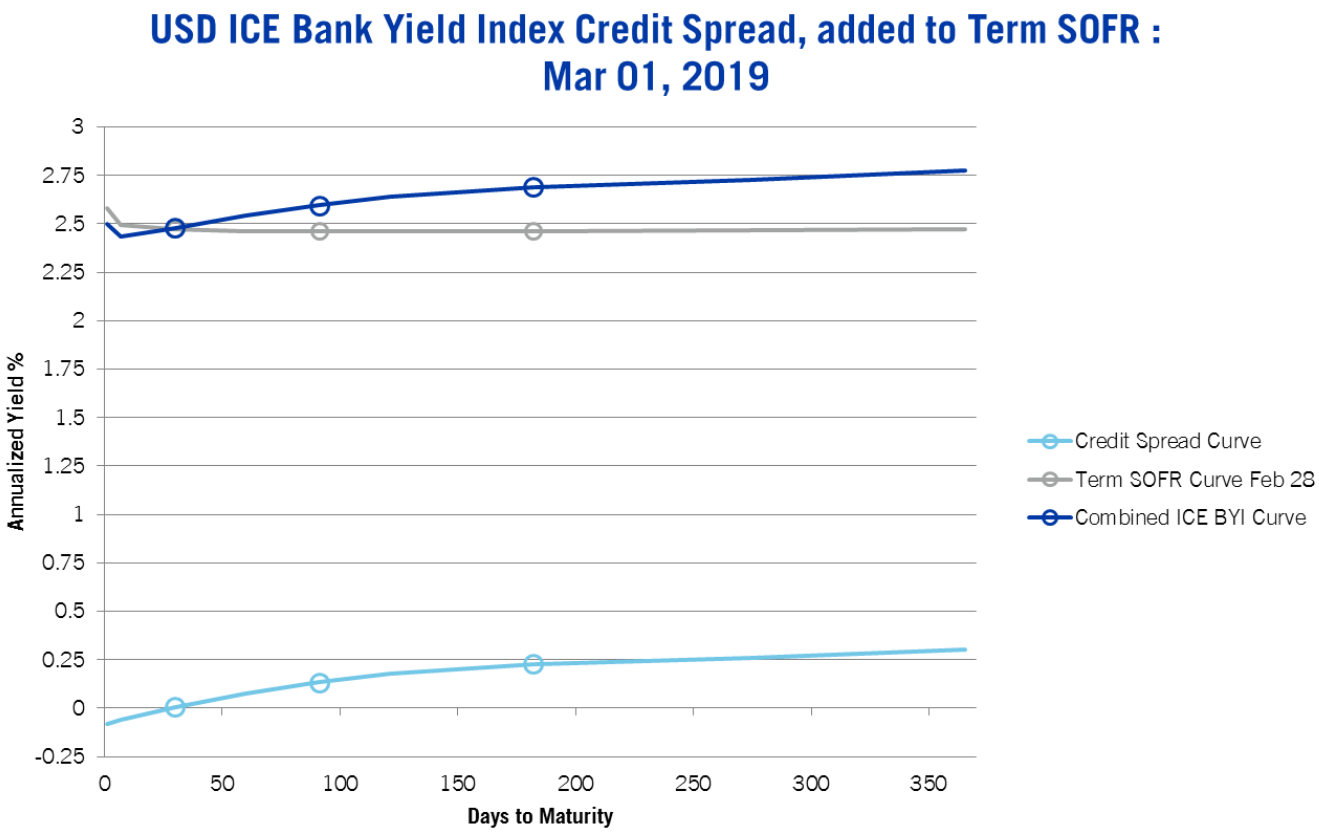
The first chart shows how an implied credit spread is derived for each transaction, based on its vertical distance from the term SOFR curve for the same day. The red arrow indicates the implied credit spread for a single transaction on February 28.



The second chart shows how the implied credit spread curve is constructed based upon these implied credit spreads. The red arrow indicates the implied credit spread for the same transaction highlighted on the previous chart.



The third chart shows how the implied credit spread curve can be added to the term SOFR curve to construct a credit sensitive yield curve from which one-month, three-month and six-month settings can be obtained.



The alternative Index calculation process for March 1, 2019, used the same 355 transaction data points as the updated preliminary Index methodology described above. The notional term SOFR curve was generated based upon realized SOFR rates and SOFR futures settlement prices in the manner described in the July update paper.

The Bank Yield Index values calculated using this methodology for the one-month, three-month and six-month settings are taken from the combined curve at 30, 91 and 182 days to maturity, respectively. These values are included in the below table, together with the corresponding U.S. dollar LIBOR rate published on the same day[12].

Tenor	ICE BYI - Combined Credit Spread over Term SOFR (%)	ICE BYI - Preliminary Methodology (%)	USD LIBOR (%)
One-month	2.48895%	2.48142%	2.48188%
Three-month	2.59734%	2.59911%	2.59850%
Six-month	2.68935%	2.69339%	2.68213%

[12] Note that U.S. dollar LIBOR and the U.S. Dollar ICE Bank Yield Index are produced using different methodologies and different data sources. As a result, care should be taken when comparing U.S. dollar LIBOR and the U.S. Dollar ICE Bank Yield Index on any day or for any period, including the period of testing.

The Bank Yield Index can also be shown in its component parts derived through this alternative methodology. The term SOFR rate (i.e. the term risk-free rate) can be separated from the credit-sensitive supplement (i.e. the credit spread) as illustrated in the below table.

Tenor	ICE BYI - Combined Credit Spread over Term SOFR (%)	Term SOFR Component (%)	Credit Spread Component (basis points)
One-month	2.48895%	2.47476%	1.4 bps
Three-month	2.59734%	2.46223%	13.5 bps
Six-month	2.68935%	2.46321%	22.6 bps

This approach allows end-users of the benchmark to have greater transparency regarding the economic drivers behind the constituent elements of the Index. In addition, it could also allow for the use of a credit spread component as a supplement in lending transactions that use realized compounded SOFR rates, where appropriate.

Conclusions

The preliminary methodology update described in this paper seeks to widen the input data collection window and strike the right balance between using a large and diverse data set to derive the Index, while still retaining a strong linkage to current market conditions. In addition, the ability to use a longer data collection window should allow for the U.S Dollar ICE Bank Yield Index to continue to be produced solely from transactional data in periods of low liquidity and volatility (i.e. no expert judgment will be used to determine the Index). IBA believes this approach should help to ensure the Index reflects underlying wholesale, senior, unsecured bank funding market conditions, as transacted, in less liquid and in more volatile market conditions.

IBA will continue to test the U.S. Dollar ICE Bank Yield Index using the updated preliminary Index methodology described above, with a view to potentially constructing the Index from separate term SOFR and credit-spread curves as term risk-free rates develop, and invites further feedback from market participants on this approach. Any transition from the preliminary Index methodology to one built as a supplement to term SOFR rates will be guided by the paced transition plan implemented by the ARRC[13].

Next Steps

In the coming months, IBA will work with large, internationally active banks in order to seek contractual commitments to provide primary market funding transaction data to calculate the Index. This will be necessary to ensure that IBA has access to a sufficiently diverse set of data to produce representative one-month, three-month and six-month term settings for the Index.

In addition, IBA will continue to monitor developments in the SOFR markets and engage with members of the ARRC to assess when it might be appropriate to explore moving from the preliminary Index methodology to one built as a supplement to term SOFR rates.

IBA's goal is to begin producing the U.S. Dollar ICE Bank Yield Index for use by market participants in the second half of 2020. This is contingent upon continued successful testing and IBA's ability to source enough bank funding data on an on-going basis to calculate a sustainable and representative benchmark. IBA will keep market participants informed of its progress in both of these areas.

Feedback

IBA continues to invite feedback from market participants on all aspects of the development of the U.S. Dollar ICE Bank Yield Index, including the input data and the updated preliminary Index methodology.

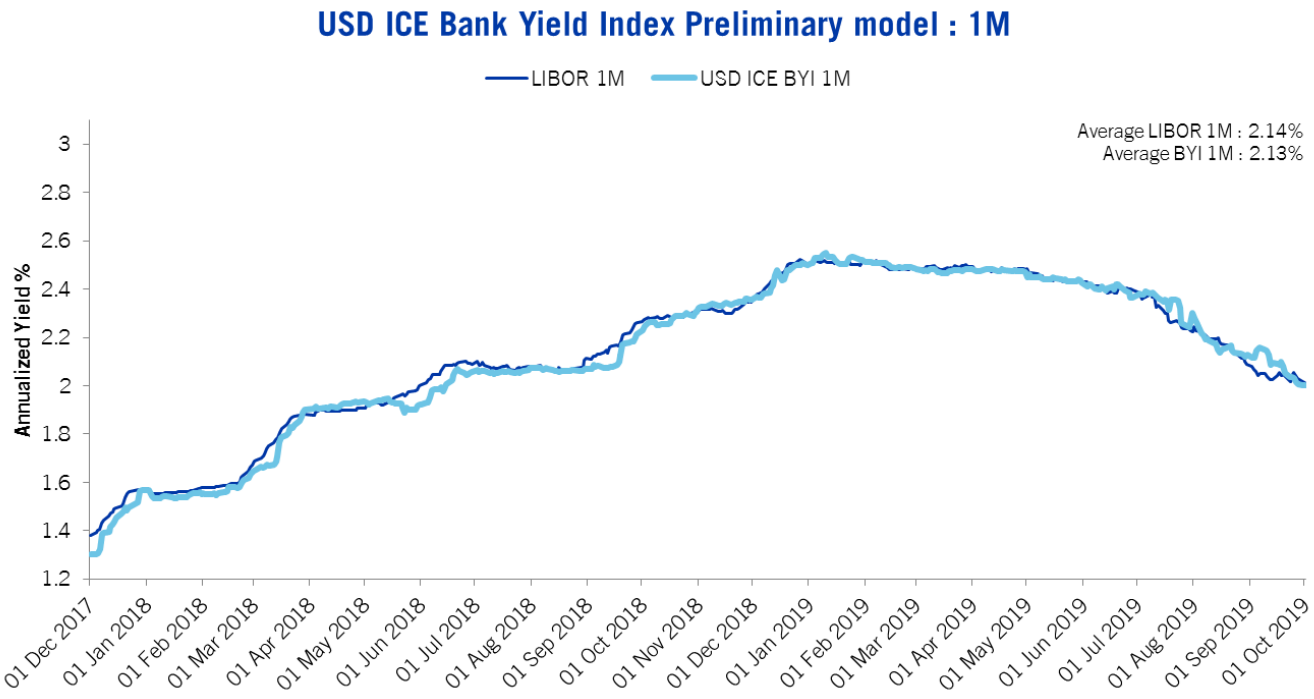
Respondents are requested to provide their feedback by email to IBA at IBA@theice.com.

[13] See https://www.newyorkfed.org/medialibrary/microsites/arrc/files/paced-timeline-plan.pdf.

Testing Results to the end of September 2019

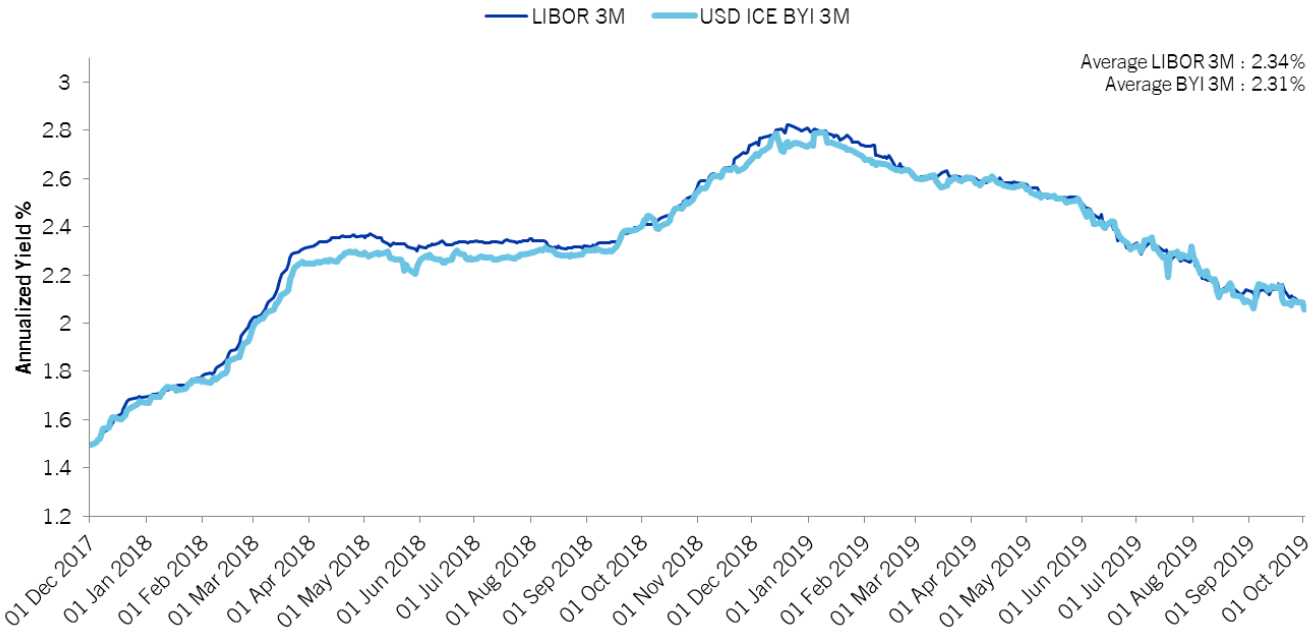
Since the previous update, IBA has continued to calculate the U.S. Dollar ICE Bank Yield Index. Results for the entire testing period from December 2017 to the end of September 2019 have been recalculated using the updated preliminary Index methodology described in this update.

Line charts showing one-month, three-month and six-month settings for the U.S. Dollar ICE Bank Yield Index, during the period from December 1, 2017, to October 1, 2019 are shown below, together with the corresponding U.S. dollar LIBOR settings for the same period[14]. The results are also available in CSV format on IBA's website.

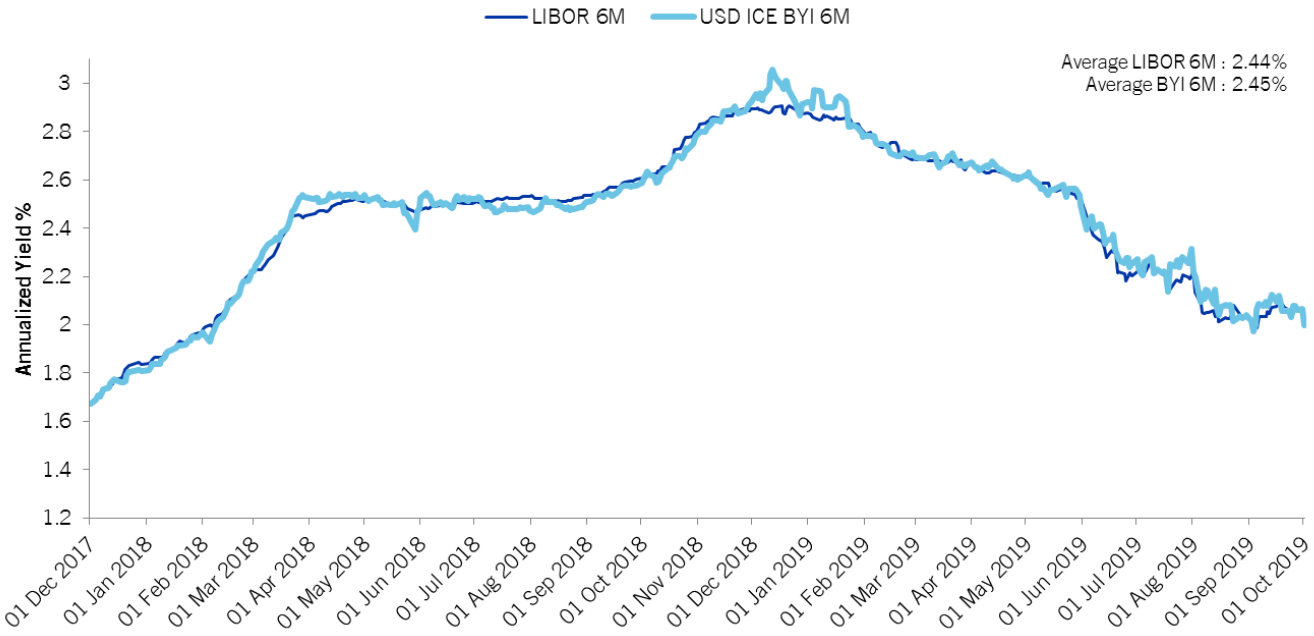


[14] Note that U.S. dollar LIBOR and the U.S. Dollar ICE Bank Yield Index are produced using different methodologies and different data sources. As a result, care should be taken when comparing U.S. dollar LIBOR and the U.S. Dollar ICE Bank Yield Index on any day or for any period, including the period of testing.

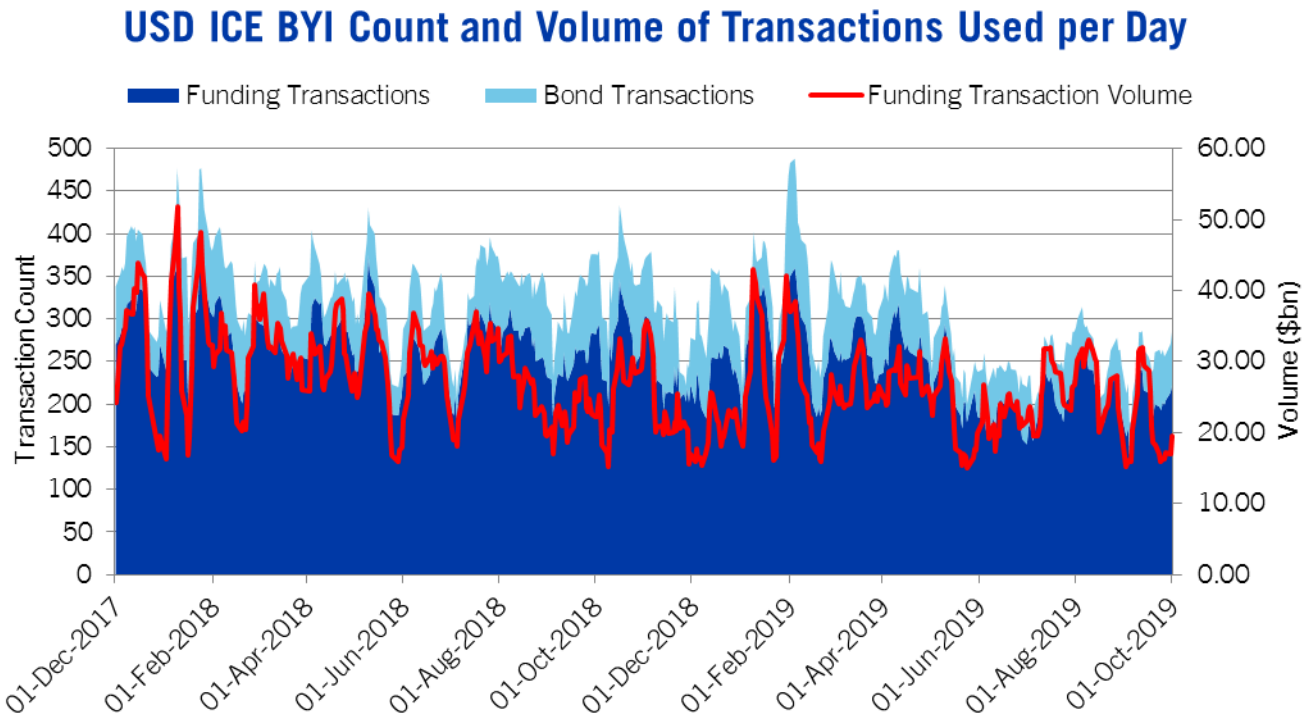
USD ICE Bank Yield Index Preliminary model : 3M



USD ICE Bank Yield Index Preliminary model : 6M



The average daily quantity of input data transactions used to calculate the Index in accordance with the updated preliminary methodology during the testing period, and volumes represented by the primary market funding transactions, are shown below.



Appendix 1: The U.S. Dollar ICE Bank Yield Index Eligible Bond Issuers

Eligible issuers identified by IBA in respect of secondary market bond transaction data used to calculate the Index are listed in the table below.

IBA also includes primary market transactional funding data from 13 of the 16 the U.S. dollar LIBOR panel banks in the Index calculation process.

Group Parent	Issuer Bank Entity Example (and associated branches)[15]
Bank of America Corporation	Bank of America, N.A.
Bank of Montreal	Bank of Montreal
Bank of New York Mellon Corporation	The Bank of New York Mellon
Barclays PLC	Barclays Bank Plc
BNP Paribas SA	BNP Paribas SA
Capital One Financial Corporation	Capital One N.A.
Capital One Financial Corporation	Capital One Bank
Citigroup Inc.	Citibank, N.A.
Credit Agricole SA	Credit Agricole SA
Credit Suisse Group AG	Credit Suisse AG
Deutsche Bank AG	Deutsche Bank AG
Goldman Sachs Group Inc.	Goldman Sachs Bank USA
HSBC Holdings Plc	HSBC Bank Plc
HSBC Holdings Plc	HSBC Bank USA, N.A.
ING Groep N.V.	ING Bank N.V.
JPMorgan Chase & Co.	JPMorgan Chase Bank, N.A.
Lloyds Banking Group Plc	Lloyds Bank Plc
Mizuho Financial Group, Inc.	Mizuho Bank, Ltd.
Mitsubishi UFG Financial Group Inc.	MUFG Bank, LTD.
Mitsubishi UFG Financial Group Inc.	Mitsubishi UFJ Trust & Banking Corporation
Morgan Stanley	Morgan Stanley Bank N.A.
PNC Financial Services Group Inc.	PNC Bank N.A.

[15] List of issuer banks may be amended by the Index administrator from time to time.

Group Parent	Issuer Bank Entity Example (and associated branches)[15]
Rabobank Group	Cooperative Rabobank U.A.
Rabobank Group	Cooperatieve Centrale Raiffeisen-Boerenleenbank B.A.
Royal Bank of Canada	Royal Bank of Canada
The Royal Bank of Scotland Group plc	National Westminster Bank Plc
Banco Santander S.A.	Santander UK Plc
Société Générale SA	Société Générale SA
Standard Chartered plc	Standard Chartered Bank
Sumitomo Mitsui Financial Group, Inc.	Sumitomo Mitsui Banking Corporation Europe Limited
Sumitomo Mitsui Financial Group, Inc.	Sumitomo Mitsui Banking Corporation
Sumitomo Mitsui Financial Group, Inc.	Sumitomo Mitsui Trust Bank Ltd
Toronto-Dominion Bank	Toronto-Dominion Bank
UBS Group AG	UBS AG
US Bancorp	US Bank N.A.
Wells Fargo & Company	Wells Fargo Bank N.A.

Appendix 2 - Disclaimers

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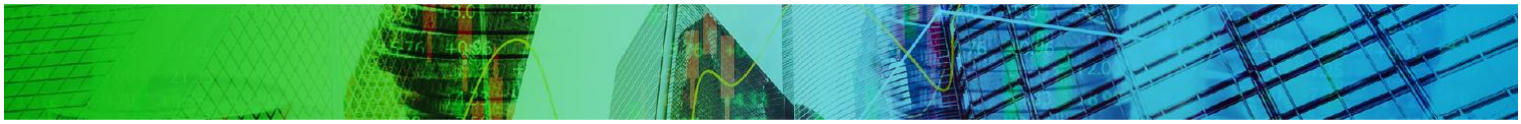
[16] IBA published updates to the white paper in April 2019 and in July 2019.



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