SOFR Academy

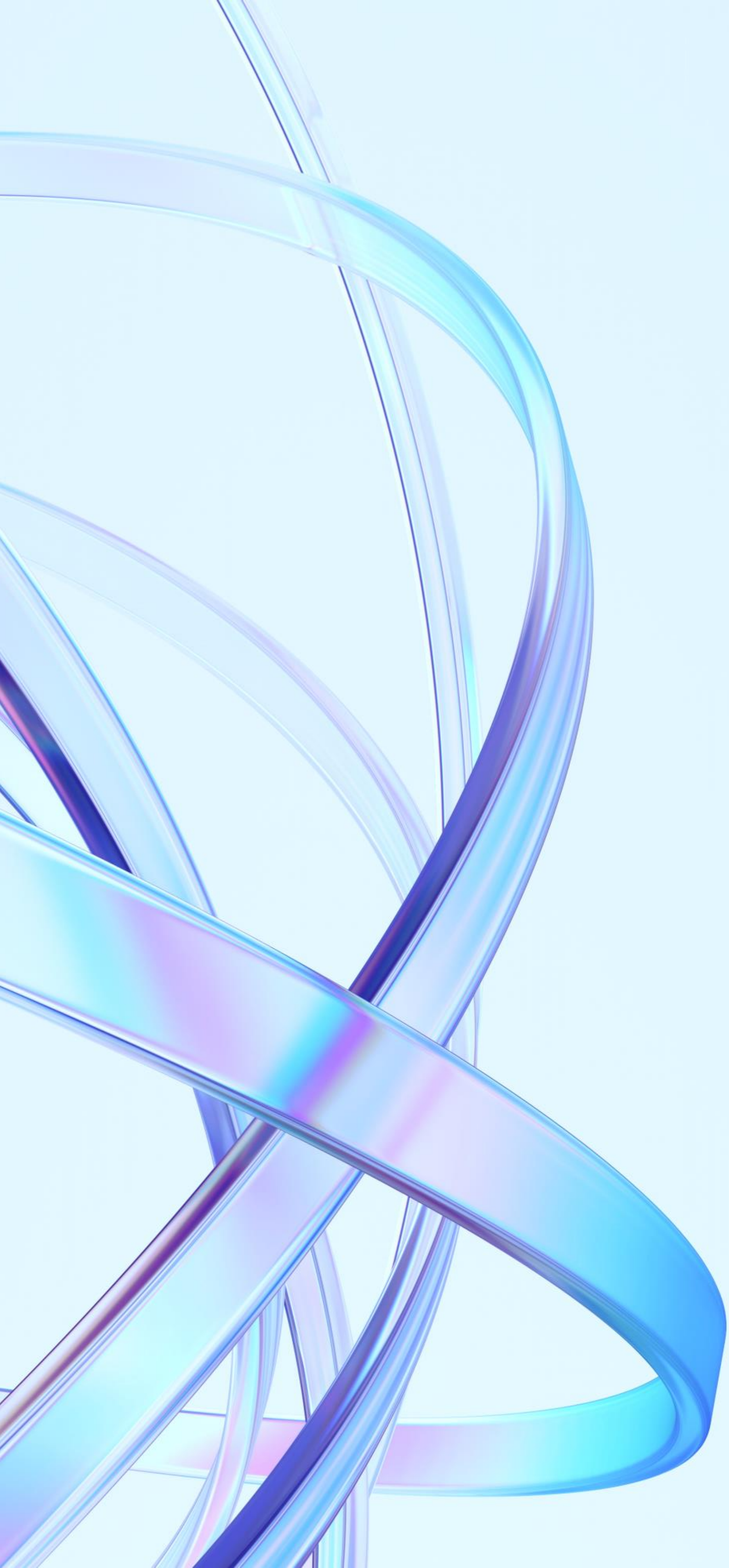
SOFR.org

Enhancing the efficiency, transparency, and stability of U.S. financial markets.

AXI & FXI

IOSCO-aligned credit spread reference benchmarks for the Secured Overnight Financing Rate.

November 2024



Contents

Executive summary

We support the Secured Overnight Financing Rate (SOFR).

In 2019, a collection of ten large American regional banks wrote to US bank regulators expressing their support for SOFR and requesting the creation of a SOFR-based lending framework that includes a credit risk premium. A credit sensitive element enables banks to avoid mismatches between their assets and liabilities in times of market stress and promotes their ability to "extend credit during both good times and bad." The USD Across-the-Curve Credit Spread Index (AXI) and its extension the USD Financial Conditions Credit Spread Index (FXI) were developed in 2021 and launched in July 2022 to satisfy this request.

Over the past decade, regulations have induced banks to term out their funding to longer maturities significantly reducing volumes of interbank unsecured term borrowing. Therefore, a robust and representative credit sensitive benchmark supplement must stay away from LIBOR and instead be primarily built upon the longer-term wholesale transactions that occur across the maturity spectrum. This is the fundamental premise behind the construction of AXI and FXI.

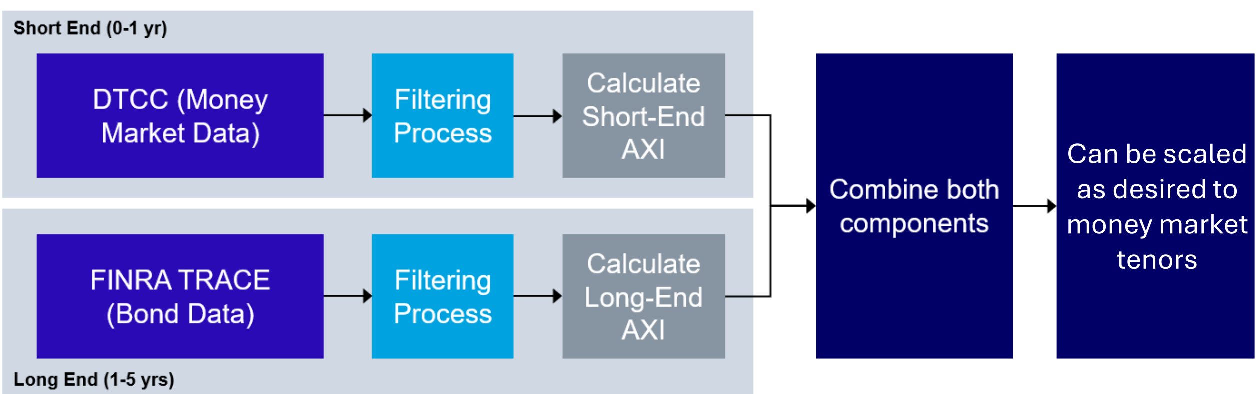
AXI is a fully transaction-based measure of the recent cost of wholesale unsecured debt funding for publicly listed US bank holding companies and commercial banks. It is the weighted average of credit spreads for unsecured debt instruments with maturities ranging from overnight to five years, with weights that reflect both transaction and issuance volumes. The primary underlying input data source is obtained from Financial Industry Regulatory Authority's (FINRA) Trade Reporting and Compliance Engine (TRACE) which is a mandatory post-trade transparency requirement. This long-term bond component is complemented by the short-term component obtained from the Depository Trust & Clearing Corporation (DTCC). No transactions from private markets or unregulated proprietary exchanges / platforms are used. FXI is constructed through the same methodology as AXI, however coverage is widened to include non-bank financial issuers and US corporate debt. AXI and FXI are generally highly correlated.

AXI and FXI are calculated and published each business day at approximately 9AM ET, using the prior day's transaction data. The indices are accessible via Bloomberg (tickers: AXIIUNS & FXIXUNS) and LSEG Data & Analytics (RICs: .IIAXI & .IIFXI).

AXI & FXI

AXI and FXI are available only as reference credit spread supplements to SOFR, and therefore their usage does not create a path for market participants to skip SOFR. Further, under a two-benchmark regime comprised of SOFR and AXI / FXI, market participants would trade both SOFR- and AXI / FXI-based instruments. Hence, AXI / FXI can grow without diverting any liquidity from SOFR. No combined 'all-in' rate involving SOFR or any Term SOFR and AXI or FXI will be produced .

We are committed to maximum transparency regarding AXI and FXI and to maintaining the benchmarks to the highest possible standards. Detailed statistical information is published each business day and links to obtain samples of input data are provided as well as detailed methodology documentation.



AXI and FXI are calculated, published and administered by Invesco Indexing LLC. Invesco Indexing LLC is an independent index provider owned by global asset management firm Invesco Ltd. The group is legally, technologically and physically separate from other business units of Invesco, including the various global investment centers. Invesco Indexing develops and administers a wide array of equity, fixed income, and multi-asset indexes. For more information, visit www.invescosofracademyaxi.com.

AXI and FXI are highly robust and unquestionably representative benchmarks that are underpinned by thousands of transactions. Underlying input data is obtained only from the highest quality sources and is not limited to the short-term markets. The benchmarks maintain their robustness and representativeness over time and the underlying bond transactions volumes do not decline in a crisis (e.g. U.S. Regional banking crisis of March 2023). Questions and feedback are welcome and can be directed to axi@sofr.org.

AXI & FXI continued

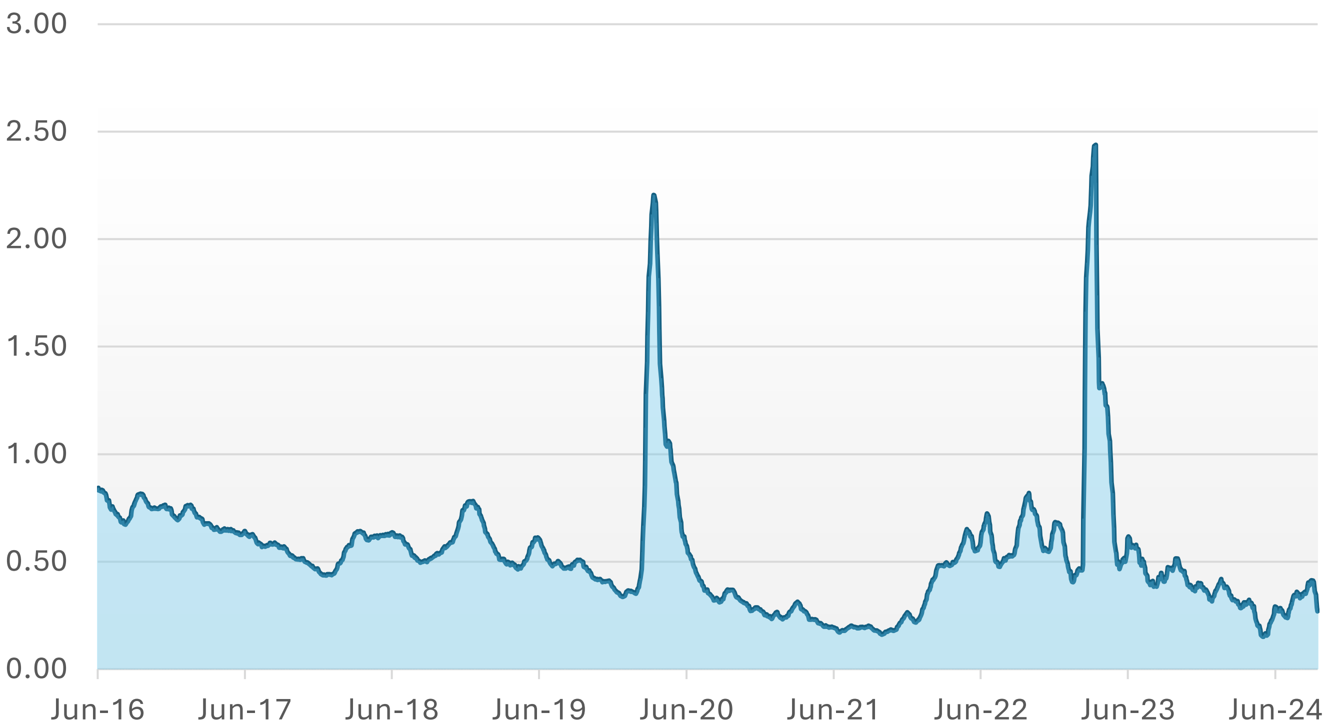
Robust - AXI captures bank funding across the yield curve - AXI is computed from a sufficiently large pool of market transactions so that it can underly actively traded derivatives instruments used by banks and their borrowing customers to hedge their floating-rate exposures, without significant risk of statistical corruption or manipulation. Expert judgement is not used nor are executable quotes. Adopting an across-the-curve methodology ensures that the maximum number of transactions are captured within the index. AXI is not limited to the short-term unsecured markets that once underpinned LIBOR.

Representative - AXI always reflects banks' true costs of funds -Since the 2008 Financial Crisis, banks no longer fund themselves at LIBOR and have shifted their funding further out the yield curve. AXI is highly correlated with banks' funding costs because it captures this deeper pool of funding transactions. The index is a weighted average of credit spreads for U.S. bank unsecured debt instruments with maturities ranging from overnight to five years, with weights that reflect both transactions volumes and issuance volumes. The input data for AXI is obtained only from publicly available sources.

Sustainable - AXI automatically adapts to changes in bank funding composition - AXI reference rates were designed to maintain their hedge effectiveness and robustness over time and can be reliably computed in all economic conditions, including in times of market stress. The indexes automatically adapt to future changes in bank funding composition ensuring the representativeness and robustness of the indexes are sustained through time. AXI works in conjunction with the Secured Overnight Financing Rate (SOFR) which was identified by the Alternative Reference Rates Committee (ARRC) and is therefore suitable for usage in a wide variety of products.

AXI historical performance

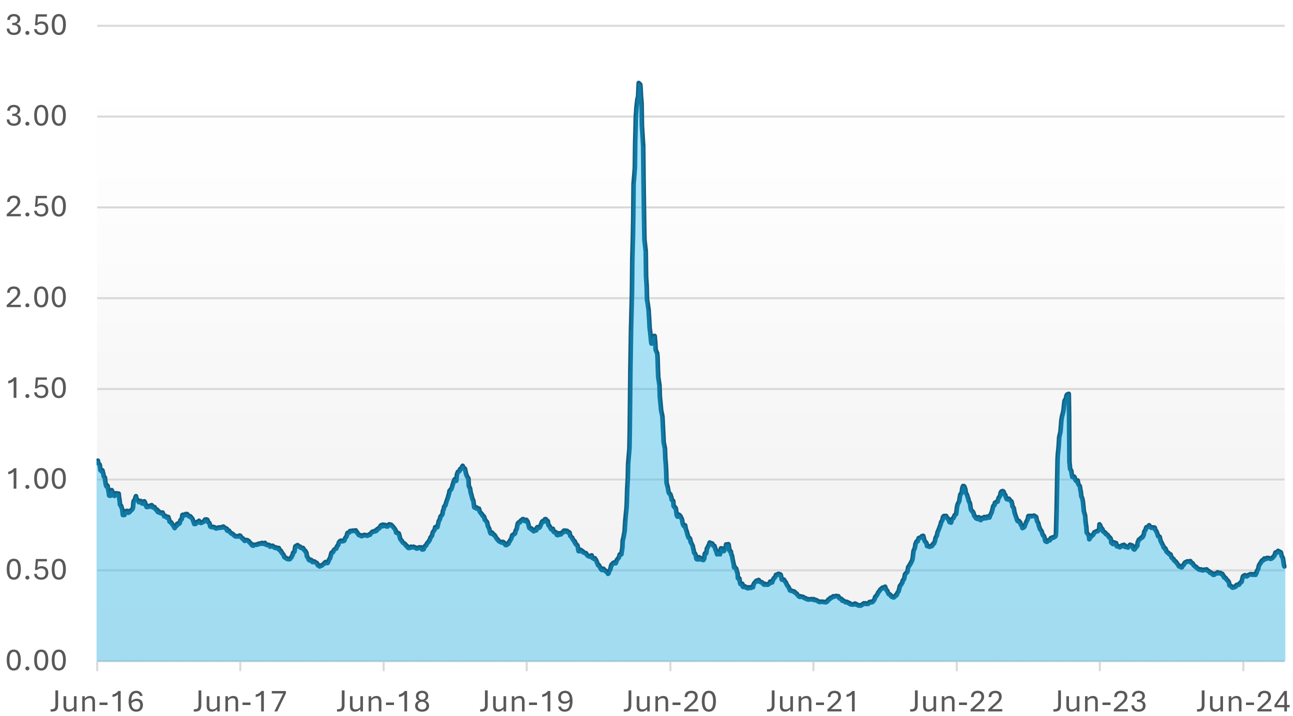
USD Across-the Curve Credit Spread Index (AXI). AXI is, by definition, highly correlated with banks' contemporaneous marginal costs of funds.



Source: Invesco Indexing. July 5, 2016, to October 11, 2024. The AXI Index was launched on July 12, 2022. The chart illustrated the daily rates of the AXI index. All data prior to a launch date is back-tested (i.e., calculations of how the index might have performed over that time period had the index existed). Back-tested performance is subject to inherent limitations because it reflects retroactive application of an index methodology and selection of index constituents with the benefit of hindsight. Past performance, actual or back-tested, is no guarantee of future performance.

FXI historical performance

USD Financial Conditions Credit Spread Index (FXI). FXI follows the same methodology as AXI, but the underlying transactions are expanded beyond banks to include all financial institutions as well as corporate funding transactions



Source: Invesco Indexing. July 5, 2016, to October 11, 2024. The FXI Index was launched on July 12, 2022. The chart illustrated the daily rates of the FXI index All data prior to a launch date is back-tested (i.e., calculations of how the index might have performed over that time period had the index existed). Back-tested performance is subject to inherent limitations because it reflects retroactive application of an index methodology and selection of index constituents with the benefit of hindsight. Past performance, actual or back-tested, is no guarantee of future performance.

Why use AXI and FXI?

For lenders

- Manages potential funding mismatches in times of markets stress[1]
- Provides loan pricing transparency and clarity
- Reduces conducts risks
- Improves efficiency of loan negotiations
- Provides market participants with pre-trade pricing visibility[2]
- Can be hedge via ISDA swaps

For borrowers

- Reduces expected overall (average) cost of obtaining credit lines[1]
- Provides pricing transparency and clarity
- Ensures that the borrower knows whether they are getting a 'fair deal'
- Provides market participants with pre-trade pricing visibility [2]
- Can be hedge via ISDA swaps

For policymakers

- Promotes financial stability[1]
- Embeds SOFR at the core of the U.S. financial system
- Input data comes from sources overseen by the U.S. Official sector
- Very large and deep pool of underlying transactions
- Sufficiently robust to avoid manipulation
- Provides market participants with valuable pre-trade pricing visibility [2]

[1] "Bank Funding Risk, Reference Rates, and Credit Supply" by Harry Cooperman, Darrell Duffie, Stephan Luck, Zachry Wang, and Yilin (David) Yang (2023)
[2] "Benchmarks in Search Markets" by Darrell Duffie, Piotr Dworczak, and Haoxiang Zhu (2016)

Use cases

- Commercial bank lending applications such as SOFR linked revolving lines of credit
- Banks may choose to hedge their balance sheet risk with derivatives that include swaps linked to AXI
- Private Credit and Private Equity financing applications
- Supply Chain and Trade Finance activities
- Hedge funds and asset managers may wish to express views on bank funding conditions (AXI) and broader credit conditions (FXI)
- Floating Rate Note (FRN) issuers may wish to reference AXI or FXI
- A special purpose vehicle may wish to reference AXI or FXI in conjunction with SOFR in collateralized loan obligation (CLO) issuances
- Internal funds transfer pricing and deposit book pricing
- Related derivatives risk management applications (ISDA swap definitions available)
- Policy makers and other market participants can use AXI and FXI as indicators to gauge the marginal funding costs for commercial banks and broader credit conditions

Financial stability

Built from a large pool of underlying transactions - Large banks no longer fund themselves at LIBOR, and there are not enough transactions to calculate it. Regulations have induced banks to “term out” most of their unsecured funding to longer maturities. AXI and FXI are not limited to short term funding markets such as Commercial Paper (CP) and Certificates of Deposit (CD). Rather, AXI and FXI are based on a broad set of debt issuances with maturities ranging from short term to multiple years.

Can be calculated in all economic conditions - Utilizing transactions from across the yield curve maximizes the underlying transaction volumes that are used to calculate the benchmarks. Transaction volume increased during the most recent market stress period. In mid-March 2023, underlying transaction volumes for the longer-term bond component of AXI increased by approximately 500%. FXI follows the same methodology as AXI, but the underlying transactions are expanded beyond banks to include all financial institutions as well as corporate funding transactions.

Always accurately reflects wider funding conditions - Recent research shows that in a SOFR-only regime, borrowers might be adversely affected during stress periods. AXI and FXI can help counteract the adverse impact on bank lending in distress times. AXI is, by definition, highly correlated with banks’ contemporaneous marginal costs of funds. FXI is, by definition, a direct reflection of wider funding conditions across the United States

Uses high-quality independent input data - Input data for AXI and FXI is obtained only from publicly available sources. The long-end component data comes from Financial Industry Regulatory Authority (FINRA) Trade Reporting and Compliance Engine (TRACE). The short-end component is obtained from Depository Trust & Clearing Corporation (DTCC) Money Market Kinetics. This provides a single, daily feed of anonymized CP and CD secondary settlement transactions data. No proprietary data is used in the construction of AXI or FXI. Neither AXI nor FXI rely on models or quoted rates

Financial stability continued

Adapts to future structural market shifts - AXI and FXI automatically adapt to changes in funding composition for banks (AXI) and the broader United States economy (FXI). The benchmarks were designed to maintain their hedge effectiveness and robustness over time and can be reliably computed in all economic conditions, including in times of market stress. If, for example, money market fund reforms or Basel III implementation resulted in banks shifting the maturity of volume weighted funding, AXI and FXI would automatically weight that part of the yield curve

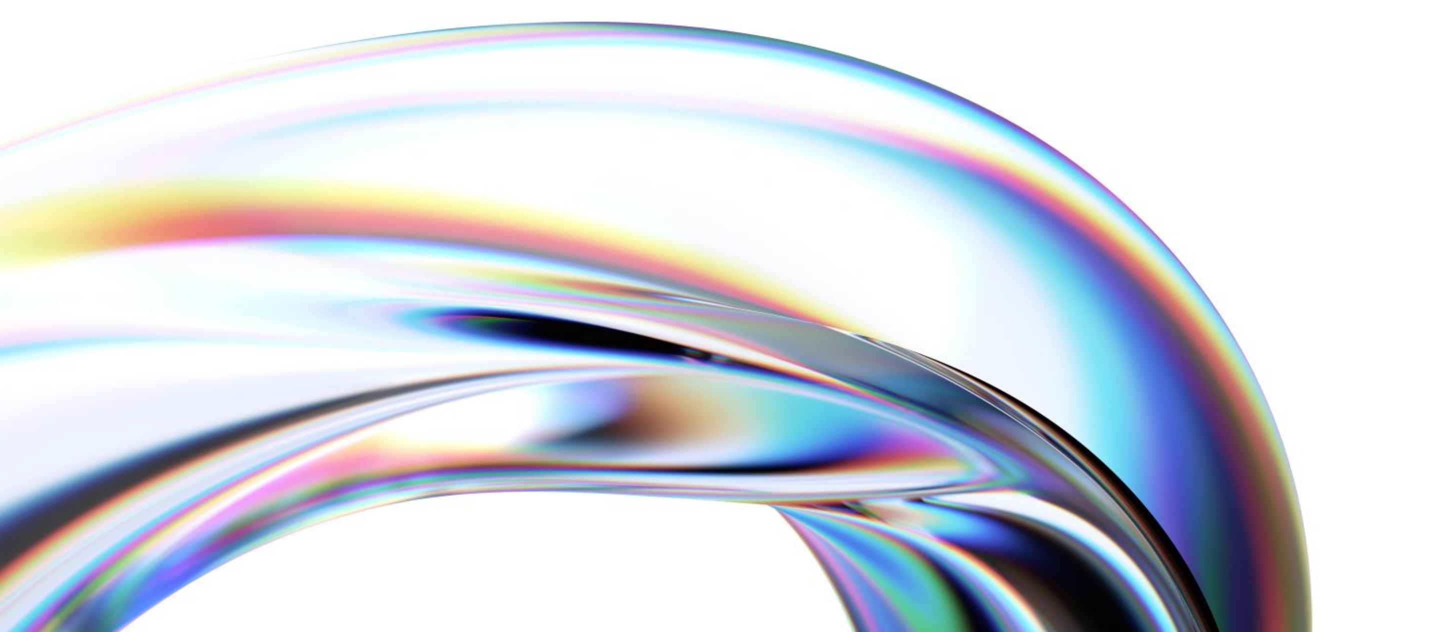
Leverages the robust foundation of SOFR - AXI and FXI are available only as credit spread supplements to SOFR, and therefore leverage the robust foundation of SOFR. Whenever a loan is indexed to an across-the-curve credit spread index, it would also reference SOFR. So, use of a credit spread index does not imply less frequent reference to SOFR.

"It is critical that banks have the capacity to continue lending to households and businesses through times of stress"

- Federal Reserve Vice Chair for Supervision Michael S. Barr, September 2024

Regulatory considerations

Speech	Attribute	Applicability	Explanation
Descending safely: Life after Libor - speech by Andrew Bailey., Governor, Bank of England. ARRC's SOFR symposium May 11, 2021	Use of executable quotes	Does not apply to SOFR + AXI or FXI	AXI and FXI do not use executable quotes
	Use of Regression approaches	Does not apply to SOFR + AXI or FXI	AXI and FXI are not model dependent
	Concern over how stable these rates will be in the future as these underlying markets continue to evolve	Does not apply to SOFR + AXI or FXI	AXI and FXI are not limited to the short-term unsecured markets.
	Concern over stability and representativeness against the backdrop of money market reform	Does not apply to SOFR + AXI or FXI	AXI and FXI automatically adapt to future changes in bank funding composition
Prepared Remarks Before the Financial Stability Oversight Council. SEC Chair Gary Gensler, June 11, 2021	"Term rate is underpinned primarily by trades of commercial paper and certificates of deposit"	Does not apply to SOFR + AXI or FXI	AXI and FXI are not limited to the short-term unsecured markets.
	"These markets underpinning a LIBOR-like rate not only are thin in good times; they virtually disappear in a crisis. Last spring, the primary commercial paper lending market evaporated for about five weeks during the initial stresses of the pandemic."	Does not apply to SOFR + AXI or FXI	AXI and FXI are not limited to the short-term unsecured markets.



IOSCO principles

In February 2024, IBM Promontory were engaged to perform an independent limited assurance review of AXI and FXI's degree of implementation of relevant IOSCO Principles for Financial Benchmarks. IBM Promontory is a leading consulting firm operating at the intersection of strategy, risk management, technology, and regulation. IBM Promontory's review considered IOSCO's messages and findings from September 2021 and July 2023 , as well as potential "inverted pyramid" risk. As previously confirmed in a public statement, neither AXI nor FXI were included in the scope of IOSCO's July 2023 review. IBM Promontory concluded that relevant Principles are fully implemented for AXI and FXI. In addition to IBM Promontory's dedicated review, the Benchmark Administrator completed independent assurance reviews against IOSCO Principles, conducted by PricewaterhouseCoopers LLP in 2022, 2023 and 2024. AXI and FXI are published and administered in compliance with the IOSCO Principles.

IOSCO Principle	**AXI Determination**	**FXI Determination**
Benchmark Design	Fully Implemented	Fully Implemented
Data Sufficiency	Fully Implemented	Fully Implemented
Transparency of Benchmark Determinations	Fully Implemented	Fully Implemented

Source: IBM Promontory (2024)

Resources

The development of AXI and FXI commenced in 2021, following a request from ten U.S. Regional banks for a credit sensitive supplement to SOFR. SOFR Academy and the Benchmark Administrator have made available a wide range of information and educations materials regarding AXI and FXI, including but limited to the following:

- A User's Guide to AXI & FXI - This paper provides an overview of the need for these credit spread reference benchmarks in commercial lending markets, their unique construction design, their potential application in cash products and derivatives markets, and the independent confirmation of compliance with relevant internationally developed and agreed principles for financial benchmarks.

- Methodology documentation – Detailed methodology documentation for both AXI and FXI , which includes a set of rules and criteria that govern the index's creation, calculation, and maintenance.

- IBM Promontory's IOSCO Review - Promontory Financial Group, a business unit of IBM Consulting completed a limited assurance review of AXI and FIX's degree of implementation of Principles 6, 7, and 9 of the IOSCO Principles for Financial Benchmarks. IBM have also released a case study.

- Frequently Asked Questions (FAQs) - These FAQs were prepared for use by market participants and are current as of the version date noted above. This list will evolve as new developments and questions arise.

- SOFR Academy Insights - Global markets require robust benchmarks. SOFR and other risk-free rates are now the foundation for fixed income markets, and markets are safer. But credit markets need more, they need robust metrics that communicate ever changing credit conditions AND work with risk-free rates, and that's where we can help.

For additional resources and further information please visit SOFR.org and questions can be submitted via the Contact Form.

Acknowledgement

AXI and FXI are based on work by leading Banking and Finance academics from the Stanford Graduate School of Business and the Australian National University. Antje Berndt, Darrell Duffie, and Yichao Zhu, "Across-the-Curve Credit Spread Indices," *Financial Markets, Institutions and Instruments*, Volume 32 (2023), pages 115-130. Instead of seeking to incrementally improve on LIBOR, this academic team elected to break the problem down into core truths and fundamentally redesign a credit sensitive element from first principles based on their deep understanding of credit markets and the evolution of large bank funding composition. In doing so, they designed something unique. In 2013-2014, Duffie Chaired the Market Participants Group, charged by the Financial Stability Board with recommending reforms to Libor, Euribor, and other interest-rate benchmarks. Duffie has no affiliation with SOFR.org.

This report is the culmination multiple years of work. We are grateful to the multitude of individuals who generously took the time to contribute towards the refinement of AXI and FXI and the associated careful and measured implementation strategy. This includes but is not limited to, input from key industry and trade associations, relevant academics, and helpful feedback from both private sector and public sector representatives.

Our People

Lawrence H. Summers
Special Advisor
Massachusetts, United States

Marcus A. Burnett
Chief Executive
New York, United States

Robert B. Litterman
Senior Advisor
California, United States

Alex Roever, CFA
Senior Advisor
South Carolina, United States

Alexander J. Matturri
Senior Advisor
New Jersey, United States

Samim Ghamami
Senior Advisor
Washington DC, United States

Xiaoyan Zhang
Senior Advisor
Beijing, China

Alex Edmans
Senior Advisor
London, United Kingdom

Joel Shapiro
Senior Advisor
London, United Kingdom

Christopher Babu
Senior Advisor
New York, United States

David A. Shore
Senior Advisor
Massachusetts, United States

Jorge A. Cosano-Martinez
Senior Advisor
London, United Kingdom

We welcome comments about AXI & FXI at axi@sofr.org.

About SOFR.org

SOFR Academy is a U.S-based economic education and market information provider. The Firm's mission is to enhance the efficiency, transparency, and stability of financial markets. The Firm is operationalizing first of their kind across-the-curve credit spread indices in certain major currency jurisdictions which work in conjunction with respective (near) risk-free rates. The Firm's panel of advisors includes former U.S. Treasury Secretary Lawrence H. Summers and academics from Harvard University, Tsinghua University, the University of California Berkeley, New York University, the University of Oxford and London Business School, as well as experienced financial services professionals. SOFR Academy is a member of the Asia Pacific Loan Market Association (APLMA), American Economic Association (AEA), the Loan Syndications and Trading Association (LSTA), the International Swaps and Derivatives Association (ISDA), the Bankers Association for Finance and Trade (BAFT) which is a wholly owned subsidiary of the American Bankers Association (ABA), the U.S. Chamber of Commerce (USCC) and the Bretton Woods Committee (BWC). SOFR Academy's backers include 8VC, and former Goldman Sachs partner Robert Litterman who developed the Black–Litterman model together with Fischer Black in 1990. For more information, please visit www.SOFR.org.

Disclaimer

SOFR Academy, Inc. (SOFR Academy) reserves all rights in the methodologies and outputs disclosed in this document, the white paper, the updates to the white paper and on SOFR Academy, Inc.'s website, and in the copyright in this document, the white paper, the updates and on SOFR Academy, Inc.'s website. SOFR Academy, Inc. holds the exclusive word-wide rights to operationalize the intellectual property (IP) associated with Across-the-Curve Credit Spread Indices (AXI)® and the Financial Condition Credit Spread Indices (FXI)® , this includes but is not limited to literary works, the algorithm / code, all trade secrets, know- how, trademarks, designs, copyright, whether or not registered or registrable or having to undergo any other process for grant, registration or the like. None of these rights may be used without a written license from SOFR Academy, Inc. SOFR is published by the Federal Reserve Bank of New York (The New York Fed) and is used subject to The New York Fed Terms of Use for Select Rate Data. The New York Fed has no liability for your use of the data. Neither AXI® nor FXI® are associated with, or endorsed or sponsored by, The New York Fed or the Federal Reserve System. SOFR Academy is not affiliated with the New York Fed or the Federal Reserve System.

This note is provided for informational purposes by SOFR Academy, an economic education and market information provider. This note is not designed to be taken as advice or a recommendation for any investment decision or strategy. Readers should make an independent assessment of relevant economic, legal, regulatory, tax, credit, and accounting considerations and determine, together with their own professionals and advisers, if the use of any index is appropriate to their goals.

SOFR Academy