

# IN SIGHT

## IN THIS ISSUE:

Factors Driving Hedge Funds to Implement a New PMS/OMS

Calibrating Interest Rate Curves for a New Era

Implementing ESG Principles in Trading and Risk Management

Quantifi Named Derivatives Technology Provider of the Year

Beyond Libor: The Impact of SOFR on Rates, Bonds and Loans



# Calibrating Interest Rate Curves for a New Era

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# CEO Message



Having just returned from a trip to Asia, it may be useful to share some colour from discussions with clients and other market participants. ESG is a significant focus, as it has been in Europe and the US - how to measure it more effectively and how to apply it. Adapting to the changing market environment of higher rates and inflation is also a focus, in particular its impact on the derivatives market and other markets such as property. Operational efficiency remains a focus, along with the potential of AI and technology in general to reduce costs and provide the ability to do things not previously possible. Fallout from the IBOR transition still impacts market participants with some areas of confusion and change remaining. A final point of note is the significant technical debt carried by many financial firms and the rapidly increasing cost of addressing this.

Many market participants face the prospect of complex and costly transformation programs with difficult build vs buy decisions. Our recent work partnering with clients demonstrates what is possible with modern technology and a data-science driven approach, resulting in the optimum hybrid solution with public APIs and low-code development tools. This provides the benefits of internal development focused on proprietary value-add without having to reinvent the wheel by leveraging out-of-the-box market-standard functionality.

The cover story in this issue looks the complex problem of calibrating interest rate curves post IBOR transition. It also provides insight into strategies for risk management and investment decision-making in a world of higher rate volatility. The cover story ties in nicely with the feature article on the impact of SOFR on rates, bonds and loans. Additionally, there is an article on integrating ESG principles into trading strategies and risk management processes, and another on the key factors driving investment managers to adopt a new PMS/OMS.

Quantifi was recently named 'Derivatives Technology Provider of the Year' at the GlobalCapital awards. This significant award reaffirms our commitment to innovation and excellence in technology. It is a testament to the team and all the great work they have done as we continue to re-invest in our platform.

As we approach the end of the year, it has been a period of significant progress for Quantifi - with major new client wins across the buy side, sell side, and commodity markets. I look forward to working with both our existing and new clients to help them succeed during these volatile times of increased geopolitical risks when the importance of accurate and timely market and credit risk could not be more important.

Best regards,

A handwritten signature in black ink, appearing to read 'Rohan Douglas'. The signature is fluid and stylized, with a large initial 'R' and 'D'.

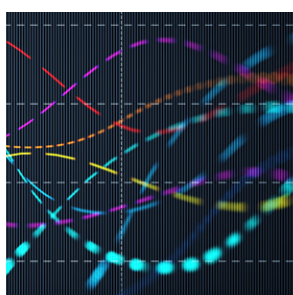
**Rohan Douglas, CEO, Quantifi**

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# Contents

04

Factors Driving Hedge Funds to Implement a New PMS/OMS



06

Calibrating Interest Rate Curves for a New Era



12

Implementing ESG Principles in Trading and Risk Management

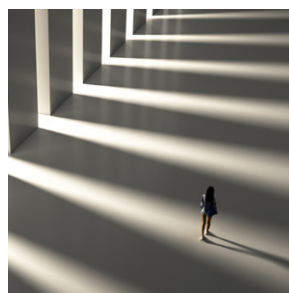


15

Quantifi Named Derivatives Technology Provider of the Year at GlobalCapital Derivatives Awards

16

Beyond Libor: The Impact of SOFR on Rates, Bonds and Loans



# Factors Driving Hedge Funds to Implement a New PMS/OMS

Investment managers are constantly striving to optimise their processes, improve accuracy, and bolster investor trust. As funds expand and adapt, the need for a reliable and effective Portfolio/Order Management System (PMS/OMS) becomes increasingly apparent. The primary motivations and objectives that drive the adoption of a new PMS/OMS are the desire to accommodate growth, enhance operational efficiency, expand asset coverage, attain accurate valuations, strengthening risk management, and foster investor confidence.

## Accommodating Growth

One of the primary reasons for considering a new PMS/OMS is when an existing fund outgrows its current system. As your fund grows, managing an increasing number of portfolios and strategies becomes more complex. Legacy systems may struggle to handle the scale and complexity of operations. A modern PMS/OMS can provide the scalability required to efficiently manage a growing fund, ensuring smooth execution, order routing, and trade allocation. Moreover, it can provide flexibility to accommodate different investment strategies, asset classes, and trading instruments, empowering you to adapt to changing market conditions and capitalise on diverse investment opportunities.

## Operational Efficiency

Efficiency is a critical factor in today's competitive investment landscape. Outdated or fragmented systems can hinder operational processes, resulting in inefficiencies, manual workarounds, and potential errors. By implementing a new PMS/OMS, investment managers can automate workflows, streamline trade processing, and optimise data integration and management. This enables faster execution, reduces operational risks, and frees up valuable time for portfolio managers to focus on strategic decision-making.

***"With Quantifi, we have access to market-leading analytics that are flexible and scalable. One of the key benefits is the ability to call Quantifi from Python. This makes it easy for us to extend the high-level functionality of the model library, which gives us an array of manipulation capabilities to perform advanced analysis."***

*Jeysson Abergel, Head of Trading and Cross-Asset Strategy, Arini*

## Broader Asset Coverage

Expanding into new markets or asset classes often requires an upgrade to a more sophisticated PMS/OMS that can handle both vanilla and complex products. Traditional systems may lack the necessary functionality to handle complex instruments or global trading capabilities. With a new system in place, investment managers can gain access to a wider range of investment opportunities, diversify portfolios, and seize emerging market trends. Improved asset coverage empowers portfolio managers to make informed decisions and capitalise on market inefficiencies.

## Cost Efficiency

Cost efficiency is a significant factor that firms consider when looking for a new solution. Aspects that these firms may take into account include implementation costs, ongoing maintenance, and customisation costs.

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Efficient PMS/OMS solutions can reduce operational costs by automating manual tasks and streamlined workflows. Cloud based solutions also eliminate the need for substantial upfront infrastructure investment.

***“Quantifi’s cloud-enabled platform will also allow us to scale faster and more efficiently as the fund expands. As a start-up fund we wanted to get up and running in a predictable timeframe.”***

*Michael Phelps, CIO, Tresidor*

## Timely, Accurate Valuations

Timely, accurate valuations are key for performance measurement, and risk management. A new PMS/OMS that leverages advanced modelling and data integration capabilities can provide precise valuations that align with bank counterparties and prime brokers. This alignment fosters greater transparency, reduces discrepancies, and enhances overall operational integrity.

## Risk Mitigation & Management

Risk management lies at the core of successful investment management. Outdated systems may lack comprehensive risk assessment capabilities, making it challenging to identify and mitigate potential risks effectively. A modern PMS/OMS integrates sophisticated risk analytics tools, enabling asset managers to assess risk at multiple levels, analyse portfolio exposures, and perform stress testing. This comprehensive risk management approach enhances decision-making, safeguards against market volatility, and ensures regulatory compliance.

***“With Quantifi’s strong emphasis on quantitative techniques for modelling and comprehensive risk management capabilities, we have enhanced how we track, trade and risk monitor investment opportunities and its platform facilitates the active management of our portfolios.”***

*Michael Hattab, Senior Portfolio Manager, LFIS*

## Enhanced Order Execution

The order management capabilities within a portfolio management solution optimise order routing, minimise trading costs, and ensure regulatory compliance. With features such as order routing, algorithmic trading, and access to multiple liquidity venues, portfolio managers can execute trades more effectively and seize opportunities swiftly.

## Complete Connectivity

Hedge funds are looking for systems that easily integrate with existing solutions and also offer seamless implementations and upgrades, with minimal disruption to their existing workflows and processes. Open APIs give users the flexibility to integrate open-source data science packages and programming environments with more traditional MtM risk platforms. This enables innovative integration between a standalone risk platform and programming environments that quants and traders can easily use on their desktops.

## Investor Confidence

Investor confidence is a critical aspect of fund management, particularly when managing third-party capital. A new PMS/OMS can instill trust and confidence in investors by providing transparent and accurate reporting, robust compliance controls, and improved risk monitoring. Enhanced operational efficiency, accurate valuations, and comprehensive risk management contribute to a credible and professional image, attracting and retaining investors over the long term.

## A Modern PMS/OMS for Sustainable Success

Adopting a new PMS/OMS is a strategic decision aimed at addressing the evolving needs of asset managers and fund operators. The desire to accommodate growth, achieve operational efficiency, broaden asset coverage, ensure accurate valuations, enhance risk management, and instill investor confidence are key drivers behind this decision. By embracing modern technology solutions, fund managers can optimise their operations, seize new opportunities, mitigate risks, and provide a solid foundation for sustainable growth in an increasingly competitive investment landscape.

Quantifi’s PMS/OMS delivers cross-asset trading, front-to-back operations, position management, enterprise risk management and regulatory reporting, all on an integrated platform. As well as supporting the key regulatory requirements, Quantifi’s investment in the latest technology – including data science, machine learning and APIs – provides clients with new levels of usability, flexibility and integration. This translates into dramatically faster time to market, lower total cost of ownership and significant improvements in operational efficiency.

# Calibrating Interest Rate Curves for a New Era

Building an accurate and robust interest rate curve has considerable implications for a broad range of financial operations, from setting benchmark rates to managing risk, and hinges on the use of liquid market instruments. Instruments, such as interest rate swaps, futures, and government bonds, provide insight into market expectations for future rates to ensure accurate pricing. High trading volumes make these instruments less vulnerable to manipulation, resulting in reliable, anomaly-resistant interest rate curves that reflect actual market conditions.

## Single Curve Bootstrap Versus Global Optimisation

Prior to the financial crisis of 2008, interest rate curve building conventionally followed a relatively straightforward process. However, the financial crisis reshaped market dynamics. The once negligible LIBOR-OIS (Overnight Indexed Swap) spread widened and became volatile. This led to the adoption of dual curve discounting, using LIBOR for forward rate projection and OIS for discounting.

As the paradigm shifted, a simultaneous solver for both curves became necessary, intensifying the problem's complexity. The challenge arises from a circular dependency between the curves, where instruments on one curve need information from the other for pricing. This is because various combinations of projection expectations and discount factors can yield the same arbitrage-free rate, requiring simultaneous estimation for realistic results. This entanglement rules out sequential curve construction, necessitating initial disentanglement or a global optimiser.

Despite LIBOR phasing out, diverse traded interest rates are referenced in derivatives and securities. Accurately constructing risk-free rate benchmarks like SOFR and Fed Funds in the US often demands a global optimisation approach due to complexity. In some markets, like Australian interest rates with four interconnected benchmark curves, disentanglement isn't feasible. These markets have required global optimisation for years and will likely continue to do so.

Global optimisation can outperform bootstrapping when constructing a single curve, especially with advanced interpolation methods like spline interpolation. This method operates globally across the entire curve, requiring multi-dimensional solving, underscoring the need for global optimisation. In the past decade, significant research has focused on enhancing the stability and performance of these global optimisation algorithms.

## Entangled Curves

Constructing inter-dependent or "entangled" curves is a challenge in quantitative finance. Using a multi-dimensional optimiser sometimes can be slow and unstable. This has prompted researchers and practitioners to seek alternative methods to sidestep the need for a global optimiser while ensuring accurate and reliable results.

An alternative method focuses on addressing cyclical dependencies, primarily through interest rate swaps, particularly basis swaps. In certain conditions, it's possible to construct synthetic fixed-to-floating swaps that replicate market data in basis swaps. For instance, a 10-year fixed-to-float swap for an IBOR rate and a 10-year basis swap between IBOR and OIS rates can be combined to create a synthetic 10-year OIS fixed-to-floating swap. This simplifies the entangled curve challenge into a single curve bootstrap problem.

However, this approach has limitations. The required market instruments may not always be sufficiently liquid. Liquidity varies across markets and time periods. Thus, performant global optimisations are essential in some markets. Quantifi has demonstrated that it is possible to implement stable and fast global optimisation algorithms, addressing performance issues.

## Calibrating SOFR Curves

Following the discontinuation of LIBOR in June 2023, attention shifted to USD’s SOFR and other global Risk-Free Rates (RFRs). Daily SOFR rates are now central in interest rate calculations, particularly for discounting purposes. Creating the SOFR curve mirrors the methodology used for the Fed Funds and LIBOR curves—bootstrapping with highly liquid market quotes, including overnight rates, futures, and swaps.

Since October 2018, CME has cleared SOFR swaps, notably SOFR OIS swaps (SOFR versus fixed rate) and basis swaps against EFR (Effective Federal Funds Rate). The graphs below illustrate SOFR OIS swap rates and EFR-SOFR basis. If choosing the SOFR curve for discounting, SOFR rates can be exclusively derived from SOFR quotes, while basis swaps can construct the EFR curve if needed.

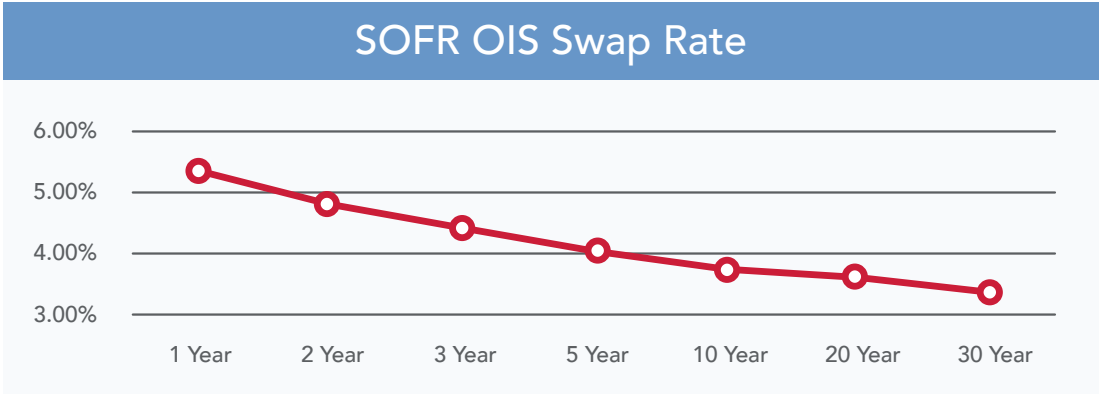


Figure 1 - SOFR rates

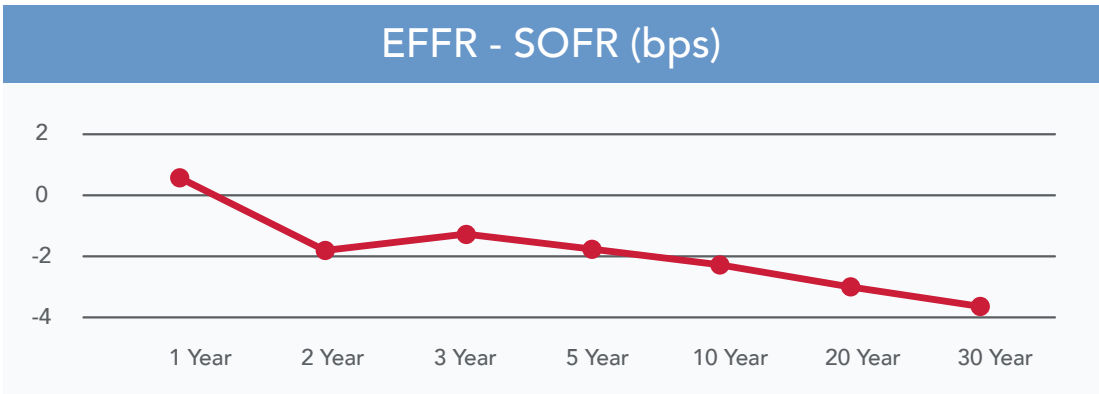


Figure 2 - Effective Federal Funds Rate to SOFR basis



Calibrating the SOFR curve is more complex compared to EFFR and LIBOR. This is due to daily averaging, retrospective nature of payments, geometric compounding, and the necessity to include historical and projected segments in calibration to futures rates, unique to SOFR.

To illustrate this last point, let's consider the current 3m SOFR futures contract. As of August 2023, this contract is denoted as SR3M3, which started on June 22, and will settle on September 20. The market quote reflects SOFR rates compounded from June to the current date, along with projected rates from the present to the settlement date. To put this in formulae, let's denote the start date for compounding, which is in the past and is measured in number of business days from today, as  $T_1^s$ . The endpoint of compounding, which is the future, is denoted as  $T_1^e$ . The initial portion of the compounding process, spanning from the beginning to the current date, has already been determined and can be represented as a term denoted by  $\prod hist$ .

$$\prod hist = \prod_{i=T_1^s}^0 \left(1 + \frac{r_{t_i} \cdot n_{t_i}}{N}\right)$$

The formula for calibrating to the current futures price  $Fut_{cur}$  involves projecting a flat SOFR rate  $R$  for the remaining period. The corresponding formula is:

$$1 - \frac{Fut_{cur}}{100} = \left[ \prod hist \cdot \prod_{i=1}^{T_1^e} \left(1 + \frac{R \cdot n_{t_i}}{N}\right) - 1 \right] \cdot \frac{N}{d_c}$$

Note that solving this equation for  $R$  requires a root-finder.

For the above formulae we used notations:

- $d_c$  = the number of calendar days in the interest period.
- $r_{t_i}$  = the SOFR interest rate applicable on business day  $t_i$ .
- $n_{t_i}$  = the number of calendar days for which rate  $r_{t_i}$  applies.
- $N$  = the market convention for quoting the number of days in the year (in the United States, the convention for money markets is  $N = 360$ , while in the UK it is  $N=365$ ).

Accounting for the convexity adjustment of forward-future rates is another challenge specific to SOFR rates. This adjustment reflects the distinction between the future rate, calculated under the risk neutral method, and the forward rate, calculated under the forward measure. Calculating the size of convexity adjustment requires information on market expectations of rate volatilities, obtained from implied volatilities of SOFR Futures options, e.g. those quoted on CME.

## Tackling Curve Complexity

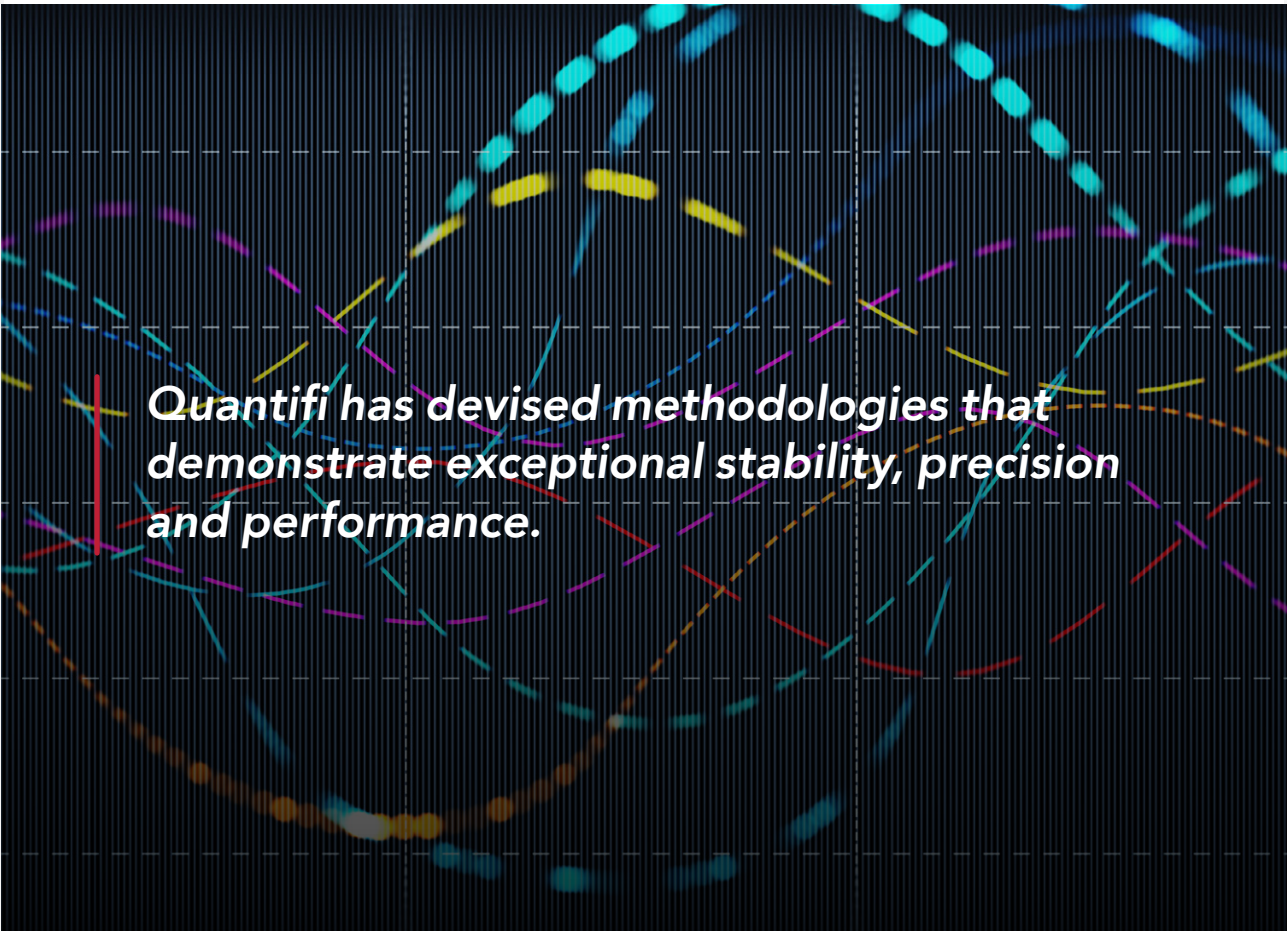
To navigate the complexity of rate curves and products, financial institutions must either build their own analytics and risk system or leverage third-party solutions. While the specifics of these solutions can vary considerably, they all must incorporate essential features to effectively address these challenges. The key features include:

- **Comprehensive interest rate coverage across products** such as repos, bonds, futures, forwards, IR and XCCY swaps, caps/floors, swaptions, curve options, scripted IR payoffs and their numerous variations.
- **Flexible curve construction** for a wide range of market instruments, often with overlapping quotes that require joint fit or disentanglement, as well as modelling central bank dates etc.
- **Live risk**, particularly important for buy side is the ability to observe their P&L and basic rate sensitivity in live, dynamic updates.
- **Ability to calculate sensitivities** per curve, per tenor, and per instrument used for the calibration, alongside the capacity to derive sensitivities to zero rates and reproject to instruments beyond those employed in the calibration process.
- **Flexible interfaces** to trading and risk management tools, such as Excel spreadsheets or applications written in Python or Java, is very important for traders engaged in analysis and structuring activities.

Quantifi has developed a comprehensive solution to address the multifaceted challenges of interest rate curve construction, which meets the aforementioned institutional requirements. Quantifi has devised methodologies that demonstrate exceptional stability, precision and performance. This remains true even when tackling the complexities of concurrent calibrations that encompass four interrelated curves. Given multiple curves can sometimes form part of one global calibration, it is advantageous to regard them as a single object rather than a collection of several. This approach enables comprehensive analysis of the entire dataset simultaneously.

In addition to these features, Quantifi offers a number of other optimisation possibilities in curve construction. This includes support for advanced curve interpolation algorithms, including a range of spline techniques, and the ability to independently interpolate the short and long ends of the curve. From capturing the relationships between the term structures of the curves to computing sensitivities across various risk dimensions, Quantifi offers its clients flexibility and consistency.

Find out how Quantifi can help you optimise your interest rate curve construction and overall market and counterparty credit risk management.



***Quantifi has devised methodologies that demonstrate exceptional stability, precision and performance.***

# Implementing ESG Principles in Trading and Risk Management

As firms navigate the evolving landscape of the ethical, social and governance implications of climate change, they are presented with opportunities and challenges. By incorporating climate change modelling into their strategies, firms can attract socially responsible investors and align their activities with global sustainability goals. However, they must also address the associated risks, such as regulatory compliance, reputation management, and exposure to climate-related financial impacts. Effective forecasting frameworks and robust due diligence processes are essential for identifying and mitigating potential climate change risks.

This survey was conducted during a webinar hosted by Quantifi and Tata Consulting Services on 'Navigating ESG & Climate Change: Opportunities, Challenges, and Modelling Strategies'. The guest speakers were Susan Urkevich, Head of Sustainability, Wholesale Credit & Lending at HSBC, Amitav Borkakoty, Enterprise Credit Risk Director at Lloyds Banking Group, and Navin Rauniar, Sustainability Partner at Tata Consultancy Services. More than 160 individuals from across the financial services industry registered for the webinar and were invited to participate in the survey.

## What are the primary challenges financial institutions will face in implementing ESG principles in trading and risk management?



As financial institutions increasingly adopt Environmental, Social, and Governance (ESG) principles in their trading and risk management practices, they will encounter several challenges. These challenges can vary depending on the specific institution and its existing processes. Overcoming these challenges requires commitment, investment in ESG research and expertise, collaboration with industry peers, and continuous adaptation to the evolving landscape of sustainable finance and responsible investing.

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Among the respondents, 36% consider the lack of standardised ESG frameworks and metrics as a primary challenge. The lack of standardised frameworks and metrics leads to varying criteria for measuring and reporting ESG performance, making it challenging for firms to compare and evaluate risks and opportunities accurately across different investments. The absence of clear and uniform metrics complicates the integration of ESG considerations into risk management models, thus further hindering the implementation of comprehensive ESG strategies. Furthermore, without standardised frameworks, transparency, accountability, and regulatory consistency are compromised, impacting investors' ability to make informed decisions in an ESG-conscious landscape. Standardisation is crucial for providing clarity, comparability, and reliability in ESG assessments, allowing firms to navigate the complexities of sustainable and responsible investing more confidently.

### The European Commission is proposing to regulate ESG rating providers. Do you support increased regulation of ESG evaluations?



The regulation of ESG evaluations has been a subject of interest and debate in the financial industry and regulatory circles. ESG ratings are used by investors, including banks, to assess the sustainability and ethical impact of potential investments.

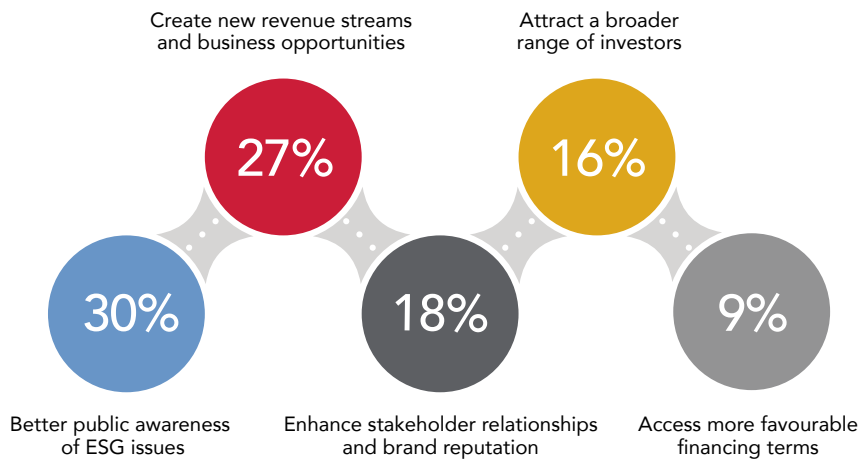
On 13 June 2023, the European Commission proposed new rules regarding the transparency and integrity of ESG rating practices. The proposal addresses concern about the dependability, comparability, and transparency of ESG ratings. If approved, it would establish new regulations for an unregulated market in Europe, mandating that EU and third-country market participants who commercially provide ESG ratings acquire authorization and oversight from ESMA. The majority (79%) of respondents either strongly or somewhat support increased regulation.

Banks and financial institutions have been supportive of increased regulation as they believe that more standardised and transparent criteria for ESG ratings can help prevent “greenwashing” – a situation where companies may overstate or misrepresent their environmental or social initiatives to appear more sustainable than they are. A regulated framework for ESG rating providers could enhance the credibility and reliability of ESG data. Greater clarity about which ESG ratings track will help firms across all industries improve their compliance efforts. It will also help banks fund companies and projects that promote a sustainable future more effectively.

On the other hand, there is concern among some firms that increased regulation could introduce additional compliance costs and bureaucratic hurdles. Additionally, the debate on what specific criteria should be used to evaluate ESG factors and how to effectively measure them has been ongoing. Only 6% of the survey respondents are opposed to increased regulation.

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## What opportunities do you believe ESG initiatives will bring over the next 12 months?



In 2023, businesses have been confronted with the far-reaching consequences of the pandemic, the possibility of a recession, and the challenges posed by climate change. As a result, their focus has shifted from mere profits to a broader perspective encompassing societal well-being. Customers, investors, and employees now expect businesses to actively contribute to creating a sustainable society. With the United Nations' ambitious 2050 carbon-neutral target in sight, businesses are compelled to rethink their strategies, placing ESG initiatives at the forefront of their agendas.

Looking ahead, ESG will serve as a core pillar for progressive and forward-thinking companies. The survey revealed that 30% of respondents believe that ESG initiatives will lead to increased public awareness of ESG issues. This indicates a growing interest in promoting sustainable practices and ethical business conduct. As this awareness continues to grow, businesses will face mounting pressure to prioritise ESG principles, not only to remain competitive but also to uphold their commitment to responsible and impactful practices. Ultimately, this heightened awareness creates a ripple effect, inspiring collective action towards a more sustainable and equitable future.

A significant proportion of respondents (27%) expect ESG initiatives to create new revenue streams and business opportunities. This underscores the transformative potential of sustainability-focused practices in today's business landscape. By embracing sustainability-driven practices, businesses can meet consumer demands, gain a competitive edge, access new markets, foster collaborations, comply with regulations, achieve cost savings, attract responsible investors, and enhance their reputation. ESG-driven innovation presents a path towards a more sustainable, socially responsible, and economically viable future for businesses and society alike.

### Finding Balance: Optimising Returns While Embracing Social Responsibility

ESG presents a unique set of opportunities and challenges for trading and risk management in financial markets. The growing demand for sustainable investments opens up new avenues to explore ESG-focused assets, such as green bonds. Integrating ESG factors into investment strategies can also lead to long-term risk reduction and improved portfolio performance.

However, challenges arise from the complexity of measuring and assessing ESG risks. Lack of standardised data and disclosure can hinder accurate risk analysis, making it difficult for traders to make informed decisions. Additionally, ethical considerations and potential reputational risks demand meticulous due diligence when selecting ESG-compliant assets. Embracing ESG requires a holistic approach that combines innovative data analytics and ethical considerations to optimise returns while managing risks responsibly.

# Quantifi Named Derivatives Technology Provider of the Year at GlobalCapital Derivatives Awards

Quantifi has been named Derivatives Technology Provider of the Year at the GlobalCapital Derivatives Awards. Judges selected the winners based on innovation, growth, contribution to the derivatives industry, and dedication to clients.

The global derivatives market is constantly evolving, influenced by regulatory change, Environmental, Social, and Governance (ESG) principles, and shifts in investor preferences. While these trends present opportunities, they also pose risk management and regulatory compliance challenges. Technology has always been an important part of finance. Frontier technologies like APIs, data science, AI, and machine learning are radically transforming the way firms operate. As firms continue to navigate a volatile market landscape, it is crucial for them to prioritise the adoption of new technology that can help them react to disruptive competitors, meet higher customer expectations, and reduce costs. Technology is often the edge that gives firms a competitive advantage.

***Open innovation plays a key role in developing technology that satisfies our clients' demands for ultra-fast, flexible technology that can harmonise operations and drive efficiencies.***

Quantifi's philosophy is to leverage standard, robust technologies and benefit from the significant innovation occurring in technology. Unlike systems saddled with years of legacy code, Quantifi is designed from the ground up using the latest, most advanced technology and design patterns to ensure optimal performance. This approach gives clients significant advantages in performance, scalability, usability, and ease of support. It also has a major impact on Quantifi's ability to rapidly turn around enhancements and new features.

"We are extremely proud to be recognised by GlobalCapital as the Derivatives Technology of the Year and are very grateful for the support shown from our clients. At Quantifi, open innovation plays a key role in developing technology that satisfies our clients' demands for ultra-fast, flexible technology that can harmonise operations and drive efficiencies," comments Rohan Douglas, CEO, Quantifi. "We are seeing an increasing number of firms replace their legacy systems with new solutions from Quantifi that leverage transformative technologies to provide integrated, flexible and tailored solutions adapted to their needs," continues Rohan.



# Beyond Libor: The Impact of SOFR on Rates, Bonds and Loans

The transition from Libor to SOFR has presented several challenges in the market. During the transition, financial institutions and market participants have been working to develop and adopt new products and contracts based on SOFR as a replacement for those previously linked to Libor.

The June 30, 2023 deadline for publishing US dollar Libor rates for the one-, three-, six- and 12-month tenors marked a critical milestone in the Libor transition process. This date signified the final stages of the Libor wind-down, as the cessation and atypical nature of these Libor rates triggered fallback provisions in many financial contracts. These fallback provisions outlined alternative reference rates to be used when Libor is no longer available.

## Market Readiness and Transition Challenges

During the transition, financial institutions and market participants have been working to develop and adopt new products and contracts based on SOFR as a replacement for those previously linked to Libor. Some of the key products that have been transitioned or developed based on SOFR include:

- SOFR futures and swaps: these derivatives allow market participants to manage their interest rate risk exposure based on SOFR
- SOFR-linked floating rate notes (FRNs): debt securities with interest rates tied to SOFR, providing an alternative to traditional Libor-linked bonds
- SOFR-indexed loans: loans with interest rates linked to SOFR have been introduced as an alternative to Libor-based loans  
SOFR-linked mortgages: some mortgage lenders have started offering mortgages with interest rates tied to SOFR
- SOFR-linked deposits: banks and financial institutions may offer deposits with interest rates based on SOFR
- SOFR-linked swaptions: swaptions – options on interest rate swaps – have been created with underlying SOFR-based swaps
- SOFR-linked structured products: various structured products, such as certificates of deposit and notes, have been designed using SOFR as the reference rate.



The transition from Libor to SOFR has presented several challenges in the market. One of the main hurdles is the fundamental difference between the two rates – Libor is a forward-looking rate, while SOFR is an overnight rate. This disparity necessitated adaptations to pricing and risk models to accommodate the new rate methodology. Another significant challenge was the need for liquidity in the SOFR derivatives market. Although the SOFR market has experienced substantial growth, it still lags behind Libor in terms of depth and breadth.

***Enhancing capabilities through robust analytic libraries and strong operational capabilities is crucial to overcoming these challenges successfully.***

### **Challenges for FRNs and Loans**

One challenge highlighted in Quantifi's white paper, 'Farewell Libor, hello SOFR: analytical hurdles and fixed income implications', is the impact of the new SOFR on floating bonds and loans. The challenge arises from replacing the Libor term rate with the daily SOFR, which is paid in arrears and complicates calculating the coupon for bonds and loans. Since SOFR is quoted daily, there is a possibility the rate might not be published on the day of the loan payment, making it difficult to calculate the coupon and prepare the payment in time.

During the transition period, attempts were made to alleviate this issue. The Alternative Reference Rates Committee (ARRC) recommended using a compounding formula based on daily rates for calculating SOFR FRNs and paying them in arrears without any payment delays. Additionally, a two- to five-day lookback period, with or without an observation shift, was recommended. The recommended approach for SOFR loans involved calculating rates using a compounding formula, paying them in arrears, and potentially incorporating several days of lookbacks and lockouts. However, the use of lookback and lockout methodologies is cumbersome, and many market participants still prefer a forward-looking approach – similar to how coupons were determined using Libor.

The 'SOFR-in-advance' method, commonly employed in agency bonds, calculates the coupon at the beginning of the period based on the average SOFR quoted on the US Federal Reserve's website, two days before the accrual period begins. However, significant convexity adjustments are necessary, particularly for longer periods, to account for the differences between forward-looking SOFRs and the fixed coupon rates associated with the bonds.

### **Term SOFR**

An alternative approach involves using CME term rates, which have gained popularity as the preferred rate for new loans and as contractual fallbacks following the discontinuation of Libor. These rates have seen significant trading activity in term SOFR loans and swaps. However, the use of term SOFR in swaps is restricted to hedging purposes and limited to end-users only, as per the ARRC's recommendation.

CME currently releases term rates for SOFR spanning one-, three-, nine- and 12-month periods. These rates are derived from the calculation of the most actively traded instruments, such as SOFR futures.

### Calibrating SOFR Curves

As SOFR daily rates have become the primary reference rates and the SOFR curve is predominantly used for discounting, the process of constructing the SOFR curve has gained significant importance in various rate calculations. Similar to the methodology used for the FedFund curve or previously employed for the Libor curve, the prevalent approach for calibrating the interest rate curve involves bootstrapping it from market quotes with high liquidity. In the case of SOFR, these quotes typically include the overnight rate, futures rates and swaps rates.

Since October 2018, CME has facilitated the clearing of SOFR swaps, which are similarly based on compounding daily SOFRs and settled retrospectively. Among these swaps, the most actively traded instruments are the SOFR overnight indexed swaps (OIS) – SOFR versus fixed rate – and basis swaps relative to the Effective Federal Funds Rate (EFFR). It is important to note that, if the SOFR curve is selected for discounting, the SOFRs can be bootstrapped exclusively from SOFR quotes, including overnight rates, futures rates and OIS. If necessary, the EFFR curve can be constructed using the basis swaps.

Figures 1 and 2 illustrate the rates for SOFR OIS swaps and the basis between EFFR and SOFR. It is important to note that, if the SOFR curve is selected for discounting, the SOFR rates can be bootstrapped exclusively from SOFR quotes, including overnight rates, futures rates and OIS swaps. If necessary, the EFFR curve can be constructed using the basis swaps.

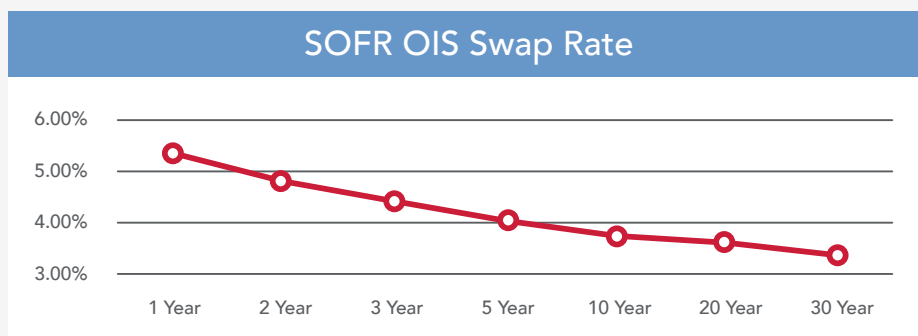


Figure 1: SOFR OIS Swap Rate

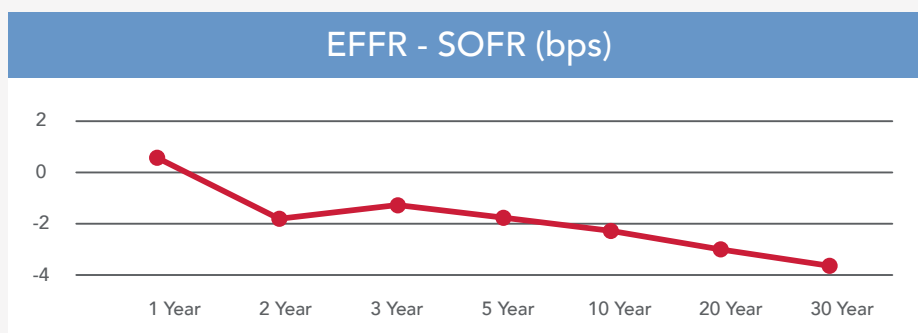


Figure 2: Basis points EFFR – SOFR



Compared with the EFFR and Libor curves, calibrating the SOFR curve presents new challenges. The daily averaging and retrospective payment nature of SOFRs, as well as the use of compounding formulas or geometric averages in SOFR three-month futures and swaps, adds complexity to the calibration process. Another challenge arises from the inclusion of historical and projected segments in the curve calibration, which is unique to the SOFR curve.

Accounting for the convexity adjustment of forward-future rates is another challenge specific to SOFRs. The adjustment considers the distinction between the future rate, calculated under the risk-neutral measure, and the forward rate, calculated under the forward measure. Calculating the convexity adjustment requires rate volatilities, obtained from implied volatilities of SOFR futures options cleared by CME.

While the daily published term SOFRs are available, they only extend up to a maximum maturity of 12 months, posing challenges when projecting rates into the future. Additionally, the SOFR curve is not directly calibrated to term SOFR, making it difficult to calculate the present value of a loan accurately. Synthetic Libor 'Synthetic Libor' is an alternative approach to determining Libor rates following its discontinuation. Its purpose is to ensure continuity and prevent market disruption. Regulators and industry organisations have devised a methodology for calculating these rates, aiming to replicate the economic conditions that would exist if Libor were still active.

It is important to note that, although synthetic Libor is quoted until September 30, 2024, it is a non-representative rate. It incorporates spread adjustments fixed by the ARRC and is a transitional solution rather than a true representation of the original Libor benchmark.

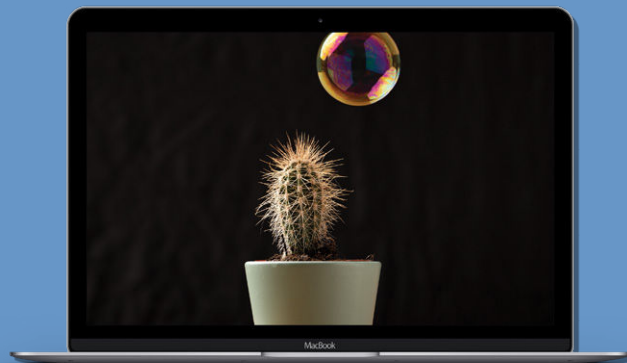
### **Enhancing Capabilities**

The transition from Libor to SOFR presents several market readiness and transitional challenges. These challenges include adapting pricing and risk models, addressing liquidity in the SOFR derivatives market, dealing with complexities in calculating coupons for FRNs and loans, calibrating the SOFR curve and incorporating synthetic Libor as a transitional solution. Enhancing capabilities through robust analytic libraries and strong operational capabilities is crucial to overcoming these challenges successfully. This can be achieved either through in-house development or by employing third-party solutions, such as Quantifi, to enhance the necessary functionalities.

## Webinar: Future-Proofing Credit Risk: Adapting to Market and Regulatory Shifts

Managing and mitigating credit risk requires agile strategies that anticipate market trends and regulatory change. Amid persistent complexity, many firms are realising that new approaches are required to navigate current conditions and to spot potential opportunities. This webinar explores the key considerations and strategies firms must employ to ensure the resilience of their credit risk management. It focuses on the failures in the Archegos case, key regulatory and market developments, and future credit risk developments including ESG.

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Quantifi is a provider of risk, analytics and trading solutions. Our award-winning suite of integrated pre- and post-trade solutions allows market participants to better value, trade and risk manage their exposures and respond more effectively to changing market conditions.

Quantifi is trusted by the world's most sophisticated financial institutions including five of the six largest global banks, two of the three largest asset managers, leading hedge funds, insurance companies, pension funds and other financial institutions across 40 countries.

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