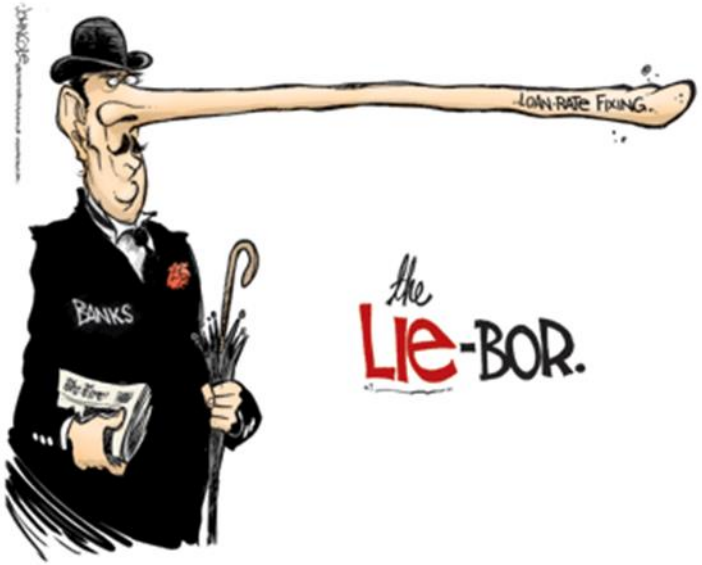
INTRODUCTION



LIE-BOR, NO MORE ?

INTRODUCTION

1 LIE-BOR, NO MORE ?

A. MANIPULATIONS AND DECREASING VOLUMES OF TRANSACTIONS UNDERLYING LIBOR LED TO THE NEED FOR A REFORM

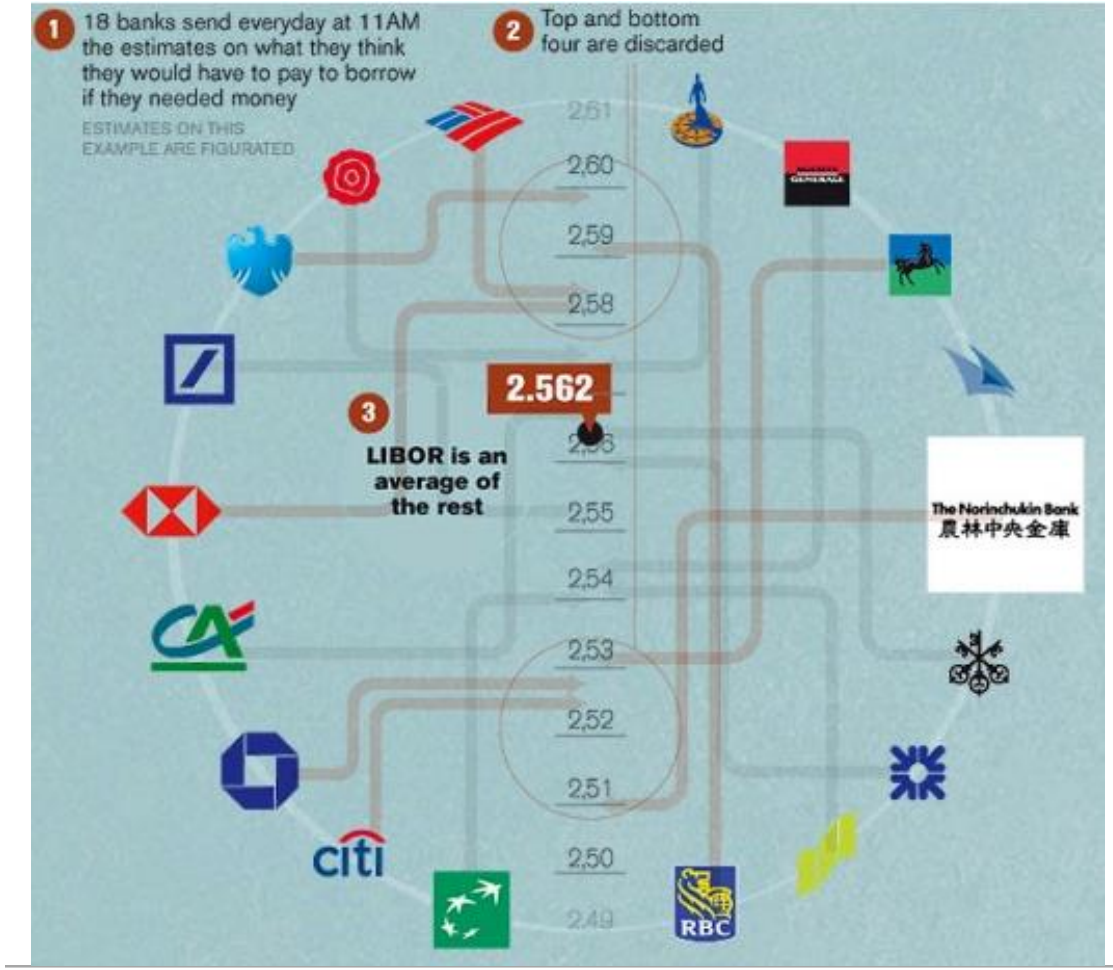
B. THE REFORM

C. END OF LIBORs MILESTONES

D. THE NEW RISK FREE RATES

« Lie-BOR » Manipulations (1/2)

How it was supposed to work…



… and what happened (extracts from hearings)

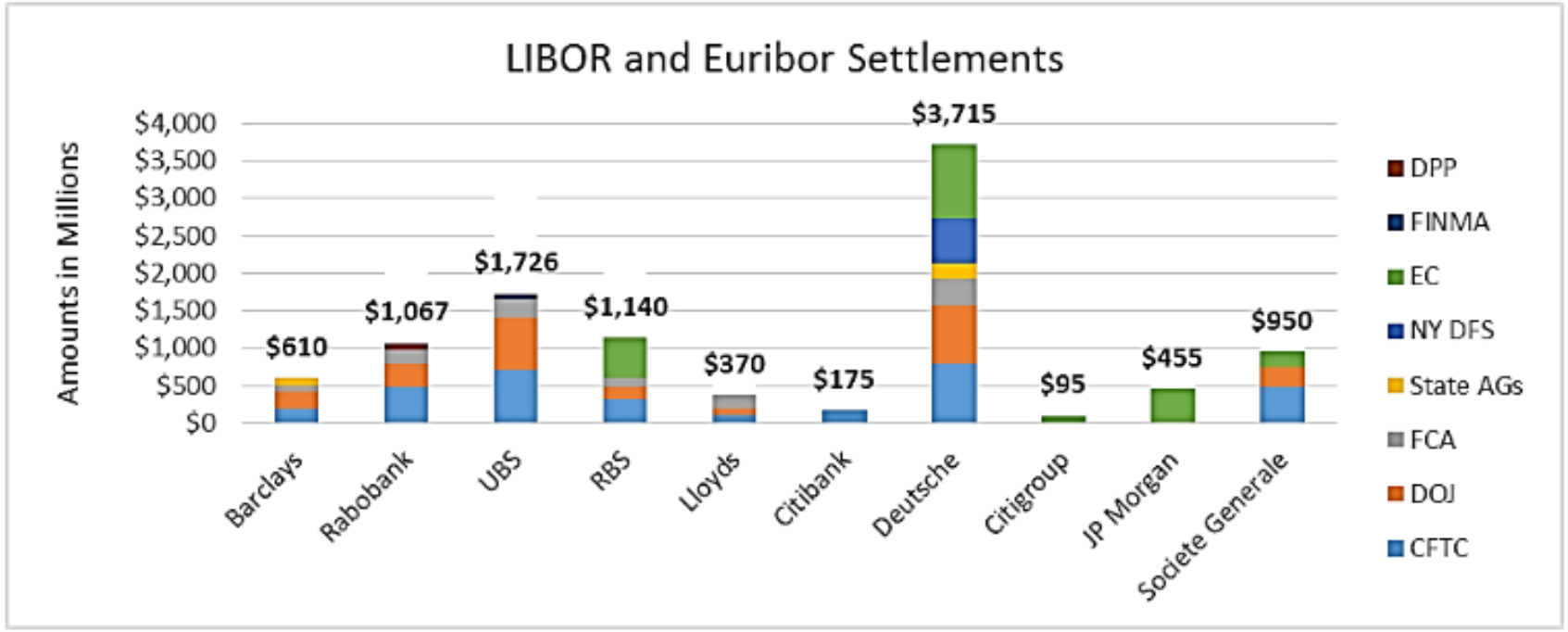
External trader to a Barclays trader [asking for a lower Libor submission]: “If it comes in unchanged I'm a dead man'. Barclays' trader promises to 'have a chat'.”
External trader to Barclays' trader [later that day]: “Dude. I owe you big time! Come over one day after work and I'm opening a bottle of Bollinger.”

Swaps trader: “Sorry to be a pain but just to remind you the importance of a low fixing for us today.”
Barclays’ senior Euribor submitter: “No problem, I had not forgotten. The brokers are going for 3.372, we will put in 36 for our contribution.”
Swaps trader: 'I love you'.

Trader to manager [complaining about a submitter]: “He is putting in the highest Libor of anybody … He's like, I think this is where it should be. I'm like, dude, you're killing us.”
Manager to trader: 'Just tell him to keep it, to put it low'.

« Lie-BOR » Manipulations (2/2)

IBORs fines and liability for LIBOR / EURIBOR Submitters



Triggering exit of some contributors from the panels, due to fear of further financial sanctions, and risks of personal liability for individuals directly in charge of the contributions

The need for a reform , and the principles of the reform

G20 commissioned the FSB to review and reform major interest rate benchmarks in Feb.2013, after some benchmark fixing misconduct has been evidenced.

The FSB objective is to strengthen the benchmarks, by relying as much as possible on actual transactions, and to replace some of those when they are no more sustainable.

Various axes frame this reform:

- **FSB established the Official Sector Steering Group (OSSG), bringing together central banks and regulatory authorities to undertake a fundamental review**
- **Increased regulation to ensure accuracy and integrity of benchmarks: IOSCO principles; Benchmark Regulation (BMR) in the EU, in application from Jan.2018**
- **Risk Free Rate ("RFR") Working Groups established by Central banks to bring together public sector and private-sector market participants, to create new rates and publish recommendations on their usage**

The 31 December 2021 and 30 June 2023 milestones

The LIBORs administrator (ICE BA) has announced its intention to stop publishing LIBORs, as follows:

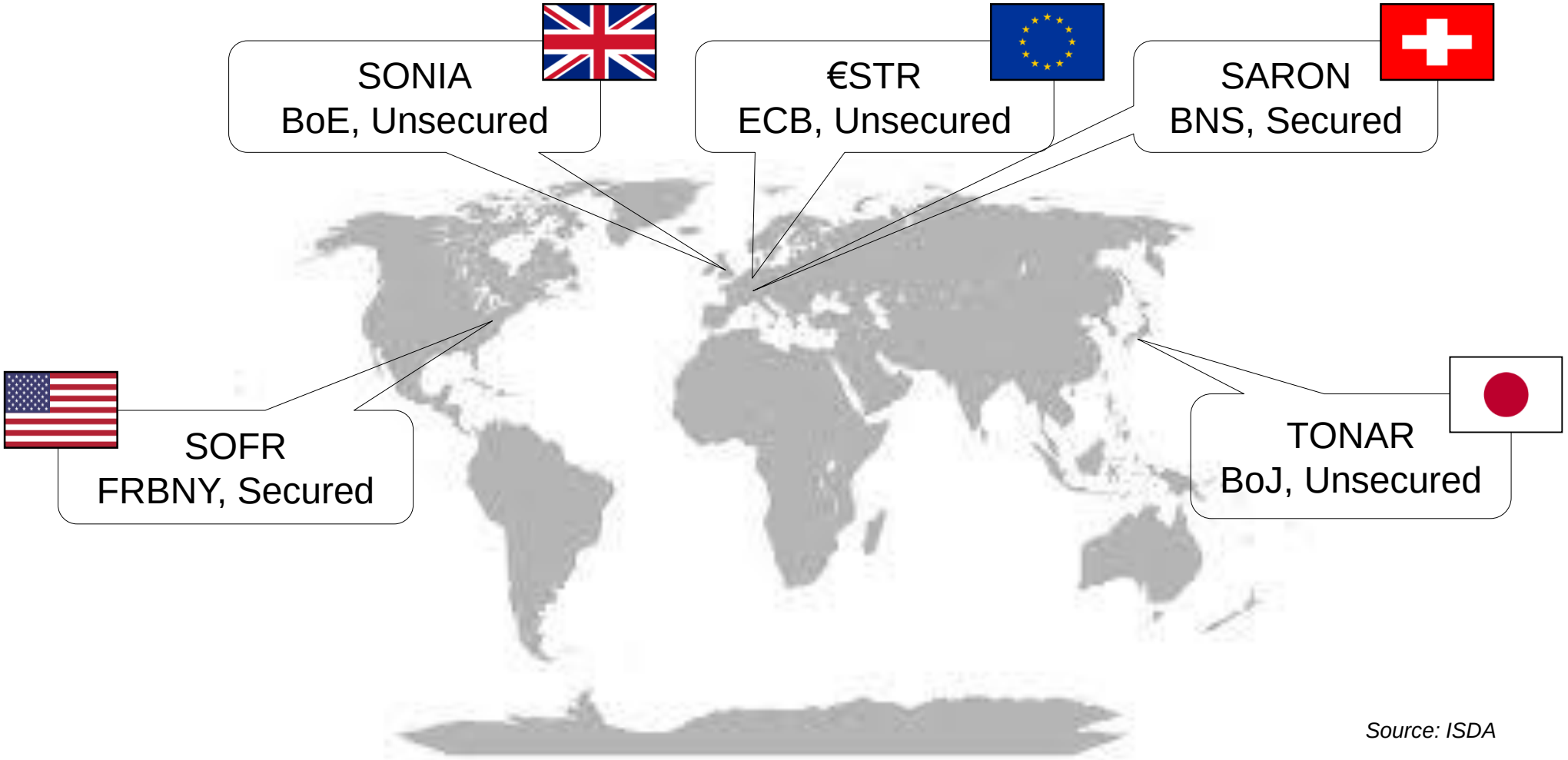
Last publication on Friday December 31,2021 for:

EUR LIBOR- all tenors
CHF LIBOR- all tenors
JPY LIBOR - all tenors
GBP LIBOR - all tenors
USD LIBOR- 1 Week and 2 Months settings;

Last publication on Friday June 30, 2023 of:

USD LIBOR – Overnight and 1, 3, 6 and 12 Months settings

New Overnight Rates – Known as RFRs (Risk Free Rates)



Source: ISDA

Risk Managing the Libor Transition

Claudio Albanese

Based on a collaboration with Stefano Iabichino

article on SSRN: Risk Managing the LIBOR Transition by Claudio Albanese, Stefano Iabichino :: SSRN

Role of LIBOR at the centre of the financial system

- Banks source funding in the form of debt and collateral from investors and reallocate to borrowers.

- Banks are intrinsically unable to hedge their own cost of funding as they cannot trade their own credit

- Managing interest rate risks has 4 distinct angles:
  (1) risk free rates => replicable
  (2) market-wide funding spreads => accomplished by LIBOR structuring
  (3) entity specific funding spreads => an open problem
  (4) term premium => LIBOR provides a partial solution

- Replacing LIBOR with SOFR represents a step backward, unless we find a solution that addresses all angles 1-2-3-4

Other priorities of a LIBOR fallback solution

- **Simple and general:** The restructuring principles should be stated in not more than a paragraph and apply to all product types, from loans to exotic derivatives
- **Legally unassailable:** Banks should be able to demonstrate at all times, and beyond any reasonable doubt, that they did not monetize unintended gains (or losses) as a consequence of the fallback process
- **Robust hedging:** Regardless of the fallback language, banks should be able to robustly hedge their funding risks for all product types and under all economic scenarios intrinsically, without shorting the credit of peers
- **Without model risk:** Model risk must be hedged at the structural level to ensure the auto-correcting value exchanges
- **Financially stable:** A transition process should be demonstrated not to cause systemic risk but to strengthen the resilience of the world financial system

The pitfalls of SOFR and risk-free fallbacks

- Exposes banks to the full impact of funding risk
- Forces the inclusion of a cost-of-capital adjustment in margins, i.e. fixed rate spreads
- Creates systemic liquidity risk and deteriorates the stability of the financial system
- Induces wealth transfers with consequential legal risk which requires a legislative offset (of dubious constitutional propriety)
- Neither simple nor general due to contractual ambiguities.
  - Marc Henrard has many examples
  - Credit Suisse FairFix attempts a solution to construct term rates based on the combination of a competitive auction and an index construction based on the totality of all transactions

Credit risk adjustments

- Several proposals similar in nature have been put forward by ICE, IHS-Markit and Bloomberg: all based on indices built on short term bank debt
- The AXI proposal by Duffie et al. attempts a construction across all term rates

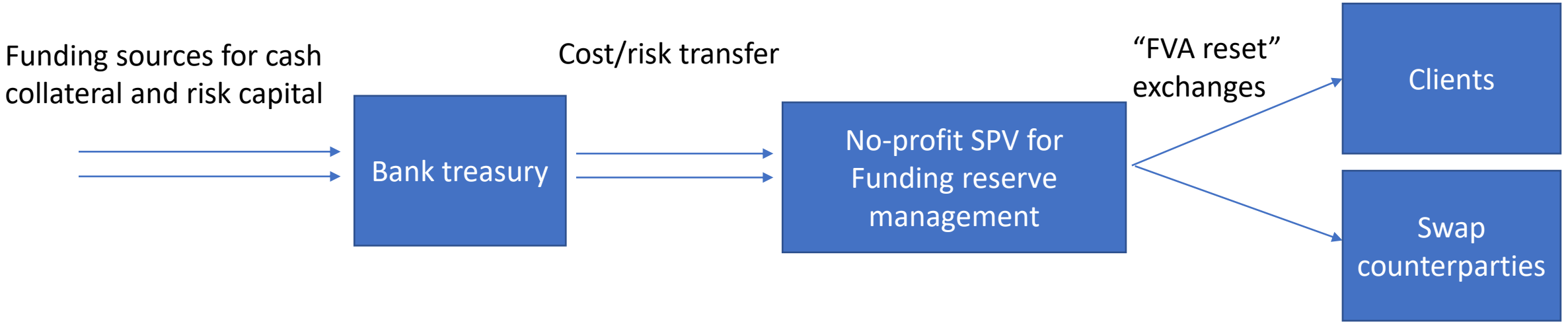
All these proposals suffer of a **fine-tuning problem:** In a market with 200T worth of IBOR exposure, a one basis point impact will transfer wealth corresponding to a substantial fraction of 20B

If the indices differ by more than 1 per mille of a basis point, the implied wealth transfers are unacceptable and legally unsustainable

Trading as many as 25 indices differing by a handful or tens of basis points across G10 currencies will have staggering complexity and transfer wealth on an unparalleled scale

Our proposal

- Our proposal aims at accurately hedging bank funding risk by preventing wealth transfers (both gains and losses to the bank)



- A stream of FVA resets are contractually overlayed upon all transactions subject to whatsoever LIBOR fallback
- FVA resets are apportioned periodically to all counterparties in proportion to their incremental FVA
- If the SPV is over-reserved, clients receive payments; if the SPV is under-reserved, clients pay a positive reset
- SPV reset levels are computed by projecting collateral and risk/reserve capital requirements on a run-off basis
- For clients that insist on fixed coupon payments, an offsetting FVA swap is issued

Managing FVA reserves

- Our proposal is inspired by FVA reserve management in bilateral OTC markets
- The FVA is the cost of funding for cash collateral
- The FVA is an entity level number
  - Computed by means of a forward projection for both collateral and capital requirements
  - Accounts for rehypothecation benefits at the legal entity level
  - Projects risk capital requirements as a fungible form of funding

Time of bank default

Exposures net of collateral received

Risk/economic capital

Reserve capital

$$\mathrm{FVA}(t) = \mathbb{E}_t\left[\int_t^{\tau_B} M_t(s)^{-1} s_B(s)\left(\sum_i \left(V_i(s) - \bar{c}_i(s)\right) 1_{t<\tau_i} - \mathrm{EC}(s) - \mathrm{RC}_t(s)\right)^+ ds\right]$$

C. Albanese, S. Caenazzo, S. Crepey: *Capital and funding*, Risk Magazine, May 2016, 71-76

The required FVA upgrade

- Current FVA reserve management practices are limited to OTC derivatives and need to be upgraded in various ways
- Existing FVA calculators are an offshoot of CVA systema and are siloed on a counterparty-by-counterparty basis
- FVA reserve calculations do not include explicit modelling of neither rehypothecation benefits nor the benefit of fungible use of risk and reserve capital as a form of collateral
- An entity-based calculation of FVA will trigger an immediate P&L benefit and CET1 capital release (which became binding in the post Covid environment)

Benefits of a fallback based on FVA resets

- While entity specific FVA are perfectly viable by their own, a LIBOR-like market index can also be constructed on the basis of FVA resets
- All 4 priorities of rates risk management are met accurately
- FVA model risk is intrinsically offset
- All payoff structures can be handled in the same way
- The mismatch between LIBOR fallback options is accurately compensated by the FVA reset layer as this is devised to prevent wealth transfers
- Accurate hedging zeroes out cost of capital and avoids embedding of a margin for risk compensation in fixed/swap rates
- A higher degree of transparency on bank funding costs
- Self-healing mechanism: A distressed bank will have higher cost of funding and automatically deleverage at a profit
- Financial stability is strenghtened

Conclusions

- LIBOR's dismissal potentially impairs funding risk management and could destabilise the financial system by amplifying GWWR

- Whereby there is risk there is opportunity, as the LIBOR transition can motivate banks to rethink capital and collateral management practices

- A structural reset is required
  - to risk manage the LIBOR transition
  - to make bank funding and capital management strategies more robust and accurate
  - to transition from the siloed business model of banking to entity level strategies

Benchmarks in transition

LIBOR fallback

Université de Paris – LIBOR transition workshop – January 2021

Marc Henrard

muRisQ Advisory and University College London

The current fallback: uncleared versus cleared

ISDA master agreement: *The Calculation Agent will request the principal London office of each of the Reference Banks to provide a quotation of its rate.*
Reference Banks means four major banks in the London interbank market

LCH rule 1.8.12 states: *[...] provided that where the rate for a Reset Date (i) is unavailable (including where such rate ceases, or will cease, to be provided by its administrators), [...] the Clearing House will determine an alternative rate at its sole discretion.*

LIBOR means LIBOR?

LIBOR coupon pay-off in w:

$$L^j(\theta)$$

LIBOR means LIBOR?

LIBOR coupon pay-off in w:

$$L^j(\theta)$$

Present value in $s < w$ (textbook):

$$N_s^c \, \mathrm{E}^{\mathbb{X}} \left[(N_w^c)^{-1} L^j(\theta) \middle| \mathcal{F}_s \right]$$

LIBOR means LIBOR?

LIBOR coupon pay-off in w:

$$L^j(\theta)$$

Present value in $s < w$ (textbook):

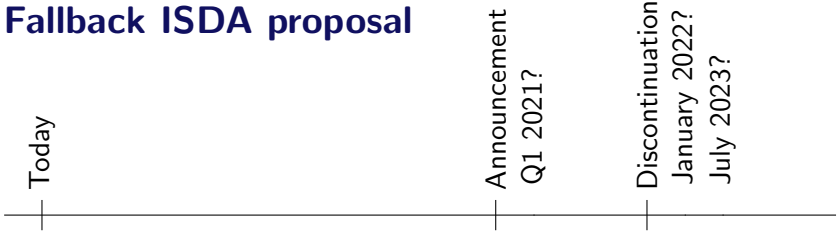
$$N_s^c \, \mathrm{E}^{\mathbb{X}} \left[(N_w^c)^{-1} L^j(\theta) \middle| \mathcal{F}_s \right]$$

Present value in $s < w$ (reality):

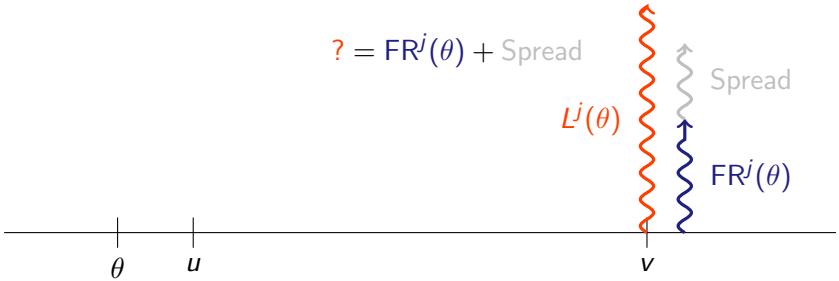
$$N_s^c \, \mathrm{E}^{\mathbb{X}} \left[(N_w^c)^{-1} \big(\mathbb{1}\{d > \theta\} L^j(\theta) + \mathbb{1}\{d \leq \theta\}? \big) \middle| \mathcal{F}_s \right]$$

with d the discontinuation date of the LIBOR.
The question mark in the formula is not a typo, it is the fallback!

Fallback ISDA proposal



Replacement of a discontinued benchmark by an *adjusted RFR* plus a *spread adjustment* (ISDA master agreement).



Fallback – Adjusted RFR options

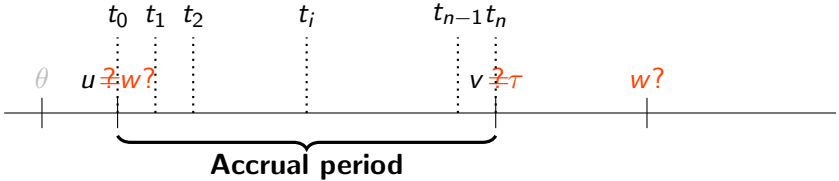
Option 3: Compounded Setting in Arrears Rate

Consultation text: "*The fallback could be to the relevant RFR observed over the relevant IBOR tenor and compounded daily during that period.*"

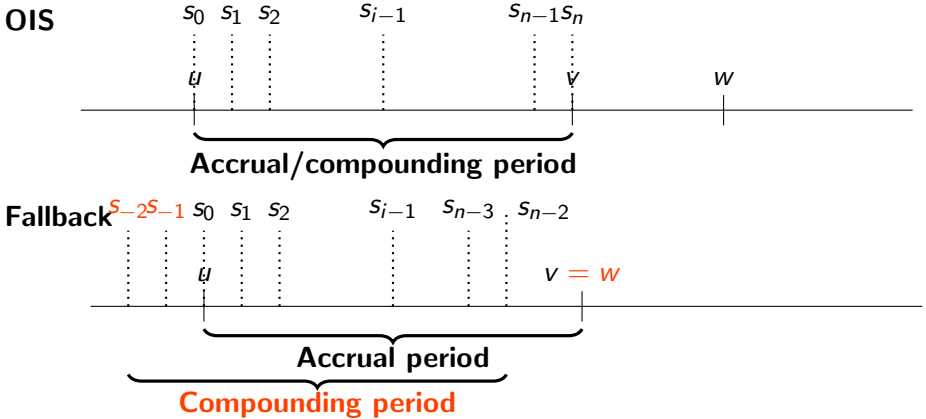
$$\mathrm{FR}^j(\theta) = \frac{1}{\delta^j}\left(\prod_{i=1}^{n}\left(1+\delta_i^O I^O(t_{i-1})\right)-1\right).$$

Pro: Interest rate, same term, similar to OIS, available?

Con: Available late, may not be available on time, wrong period.



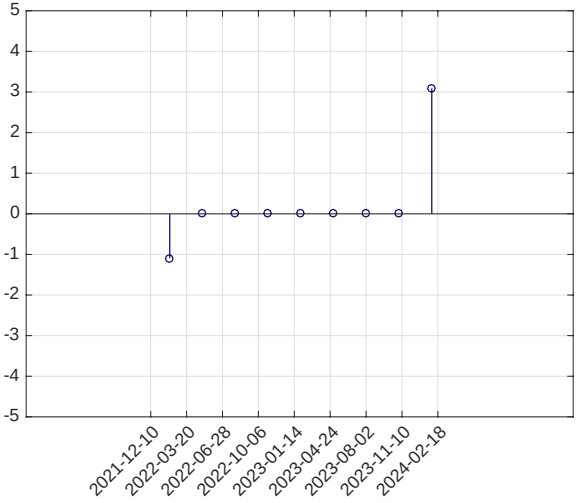
Fallback – ISDA workaround – backward-shift



Worked around further (no consultation): *Fallback Rate as most recently provided or published at that time for the most recent 'Original IBOR Rate Record Day.*

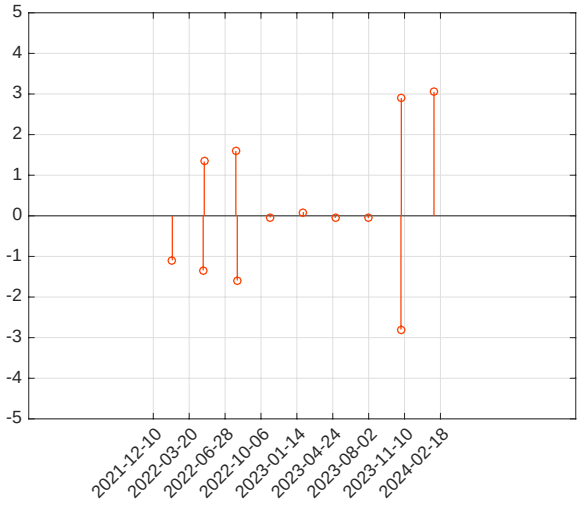
OIS – daily PV01

One Overnight Indexed Swap (OIS)
Starting 2022-02-02.
Maturity 2Y
Daily PV01



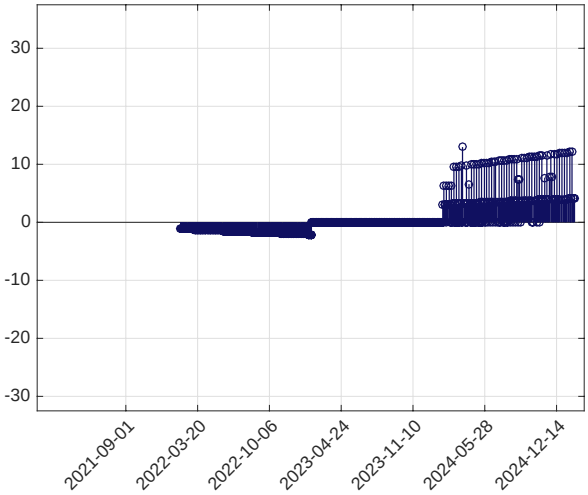
Fallback – daily PV01

StartDate	End Date	Overla
2022-02-02	2022-05-02	0
2022-04-29	2022-07-29	3
2022-08-02	2022-11-02	-4
2022-11-02	2023-02-02	0
2023-02-02	2023-05-02	0
2023-05-02	2023-08-02	0
2023-08-02	2023-11-02	0
2023-11-01	2024-02-01	1



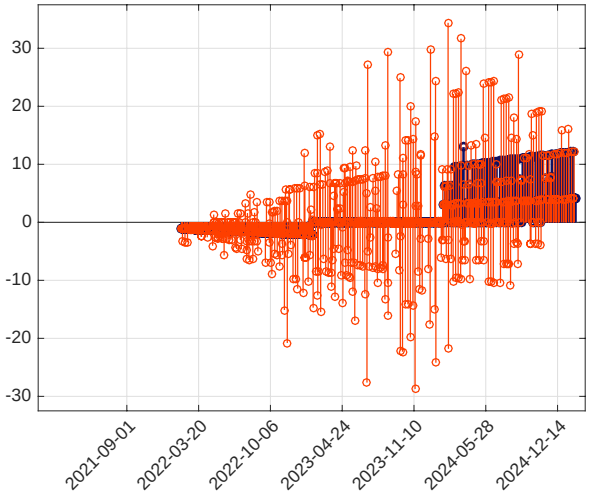
OIS portfolio – daily PV01

250 Overnight Indexed Swap (OIS)
Starting every business day from 2022-02-02.
Maturity 2Y
Daily PV01



Fallback portfolio – daily PV01

250 Overnight IRS with fallback
Starting every business day
Maturity 2Y
Daily PV01



Comparison – Bucketed PV01

Fallback USD-DSCSOFR-OIS		OIS USD-DSCSOFR-OIS		Difference
	USD		USD	
USD-FIXED-1Y-SOFR-OIS-1M	0	USD-FIXED-1Y-SOFR-OIS-1M	0	0
USD-FIXED-1Y-SOFR-OIS-3M	0	USD-FIXED-1Y-SOFR-OIS-3M	0	0
USD-FIXED-1Y-SOFR-OIS-6M	0	USD-FIXED-1Y-SOFR-OIS-6M	0	0
USD-FIXED-1Y-SOFR-OIS-9M	0	USD-FIXED-1Y-SOFR-OIS-9M	0	0
USD-FIXED-1Y-SOFR-OIS-1Y	-148	USD-FIXED-1Y-SOFR-OIS-1Y	-147	1
USD-FIXED-1Y-SOFR-OIS-2Y	-251	USD-FIXED-1Y-SOFR-OIS-2Y	-251	0
USD-FIXED-1Y-SOFR-OIS-3Y	355	USD-FIXED-1Y-SOFR-OIS-3Y	356	1
USD-FIXED-1Y-SOFR-OIS-4Y	547	USD-FIXED-1Y-SOFR-OIS-4Y	548	1
USD-FIXED-1Y-SOFR-OIS-5Y	4	USD-FIXED-1Y-SOFR-OIS-5Y	4	0
USD-FIXED-1Y-SOFR-OIS-7Y	0	USD-FIXED-1Y-SOFR-OIS-7Y	0	0
USD-FIXED-1Y-SOFR-OIS-10Y	0	USD-FIXED-1Y-SOFR-OIS-10Y	0	0

CCP steer away from fallback

CCPs plan not to use fallbacks:

> *We have proposed use of RFR flat in the output trades, with a correspondingly larger cash element to create PV neutrality, but are also aware of other approaches [...]*
>
> *LCH email, 22 December 2020*

> *CCPs to consider transitioning existing IBOR swap exposures into new OIS contracts that follow RFR standards, with a cash adjustment to compensate for any changes in valuation.*
>
> *CME Group Discussion Document, 14 January 2021*

Conclusion

The fallback mechanism as designed by ISDA/Bloomberg for vanilla swaps

- Creates gaps and overlaps in the overnight exposure
- Generates systemic local risks invisible to standard risk management tools
- Creates risks that cannot be hedged with standard products (OIS or ON futures)
- Will probably not be used by the most liquid market segments (cleared swaps).

For other products, like cap/floor, LIBOR in-arrears, range accrual, CMS, etc., the mechanism is even more impactful.

Contacts

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Available for advisory engagements related to interest rate modelling and benchmark transition.

Quantitative finance
Derivatives market
Model validation
Market infrastructure
Benchmarks' transitions

Discussion on Libor Transition

Albert-Ludwigs-Universität Freiburg

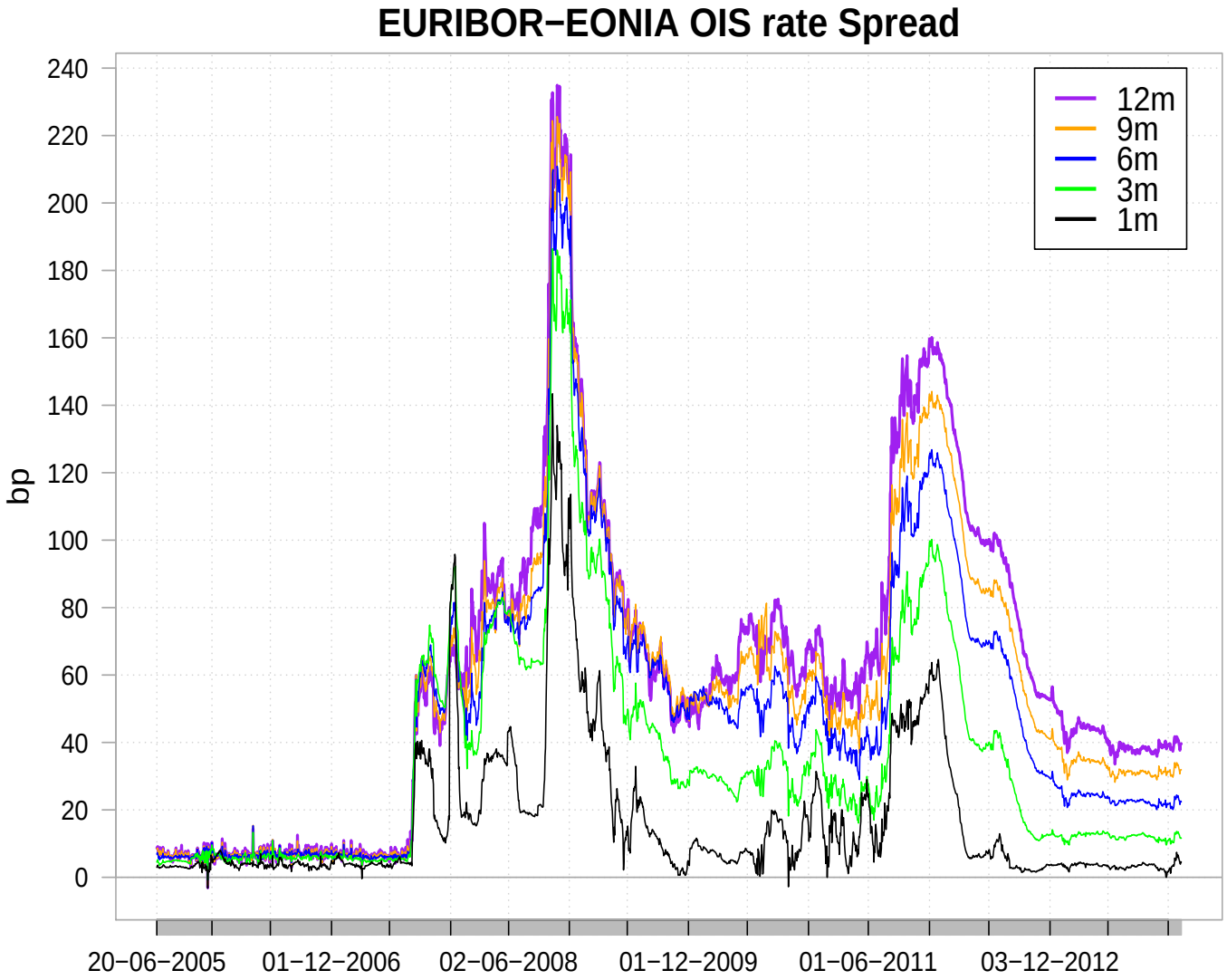
UNI FREIBURG

Ernst Eberlein
Department of Mathematical Stochastics, University of Freiburg

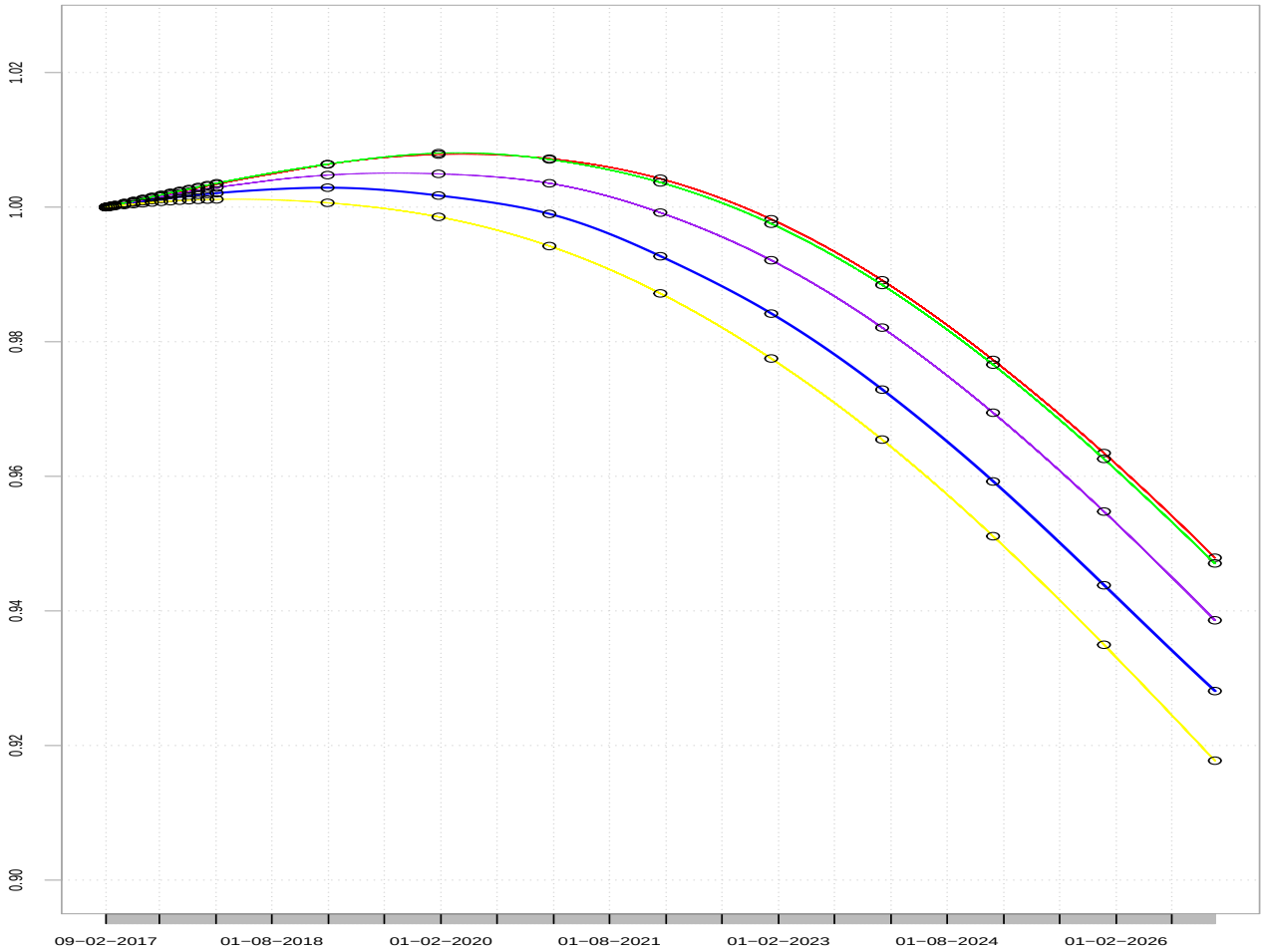
Université de Paris Workshop

Paris, January 21, 2021

The IBOR Spreads

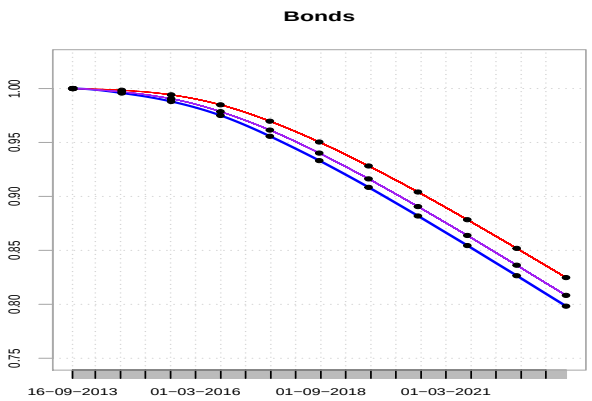


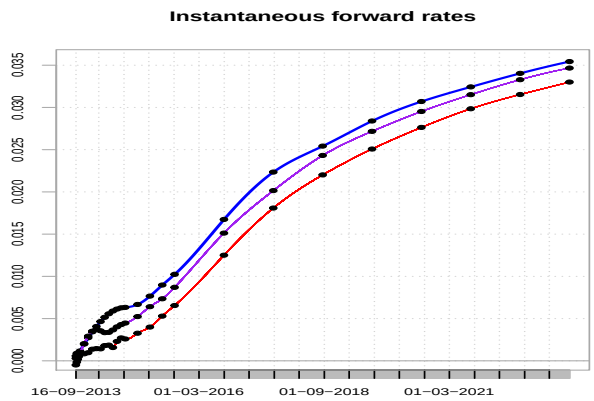
The Discount Curves

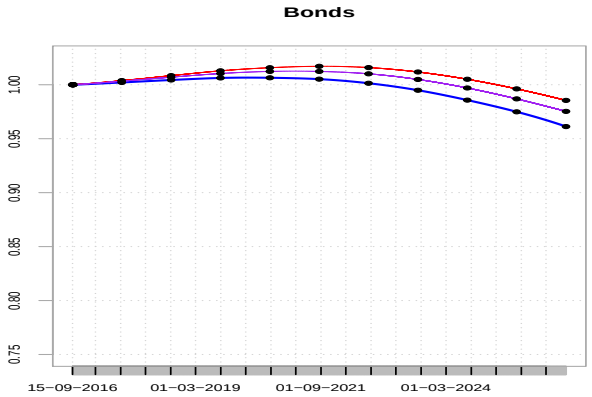


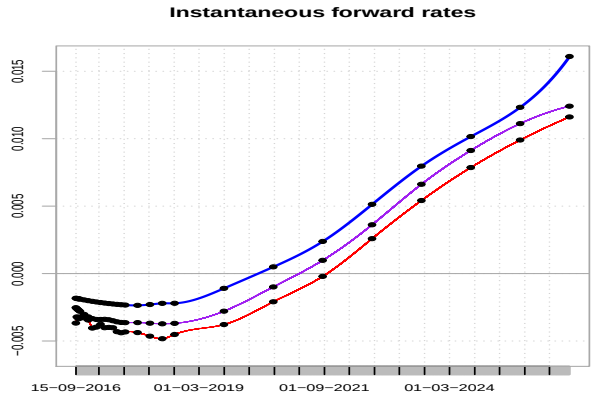
Discount Curves, February 9, 2017

Instantaneous Forward Rates









Derived Instantaneous Forward Rates 2013 and 2016

Some Key Aspects of Discontinuation

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- Loss of information
- Cost of funding no longer an issue
- Full term structure $\Rightarrow$ short(est) term rate
- Short term rate: Central Bank Decisions
- Forward looking rates $\Rightarrow$ backward looking rates
- Dynamics of the spreads independent of the RFR dynamics
- Consequently Overnight base creates systemic risk

Components of Rates

- Composition of a floating rate to be charged

$$R_t = Overnight_t^{comp} + SystemicSpread_t + BorrowerSpecificSpread$$

Systemic Spread

- Should allow to hedge the cost of funding on a systemic level

  Robust and transparent

  Regulatory impact (reserve capital)

- Tenor dependent $\Leftrightarrow$ Index across tenors

- Example: Across-the curve credit spread index (AXI)

  Weighted average spread across maturity buckets

  Derived from a deep pool of market transactions

- Such an index could spawn an active market for derivatives and thus offer hedging possibilities

Funding Value Adjustment (FVA)

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- Trade-by-trade approach
- Positive aspects
  - Technology available
  - Precise hedge of funding risk via periodic exchanges
  - Trade specific funding cost becomes visible
- Caveats
  - Market acceptance: Not a market-wide index
  - Undesirable signal to the market
  - Model assumptions (Model risk, calibration)
  - High administrative burden and cost (Self-standing legal entity)
  - Regulatory impact (Internal model)

- Critical issues of the transition process itself

  Contracts are not prepared for the discontinuation

  Assume IBORs would be available forever

  New rates refer to different economic reality $\Rightarrow$ value transfer

  Lack of reliable definitions (rule book)

  Contract terms (e.g. day count conventions) differ for market segments

  Authority to set standards?

- Marc's message

It is the little things that cause big problems

(*The devil is in the details*)

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Henrard, M. 'A quant perspective on IBOR fallback proposals', muRisQ Advisory (2018) (https://ssrn.com/abstract=3226183)