From LIBOR to SOFR: A Multi-Maturity Clock Auction Design

Haoxiang Zhu
Associate Professor of Finance, MIT Sloan
Faculty Research Fellow, NBER

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SOFR as a robust benchmark interest rate

Market liquidity/depth

- SOFR is based on repo transactions with daily volume > $700B (ARRC 2018).
- Eurodollar futures daily volume $100-$300B, Fed Fund futures $100B (ARRC 2018).
- SOFR futures are recently launched by CME (~1500 contracts/day in May).
- Daily volume of (US) SEF-traded USD interest rate derivatives (including FRA) is about $400B from 2017 to 2018 Feb, according to the FIA.
- ⇒ Underlying repo volume and derivative volume are comparable, although one could argue swaps volume is more sensitive to benchmark rate given duration.

Methodology

- Volume-weighted median, more difficult to manipulate than the mean.

Governance/supervision

- SOFR's publisher, NY Fed, also retains discretion in its calculation and revision.
- Regulators can cross-check derivatives positions against repo activities.

⇒ The daily SOFR is probably difficult to manipulate, even if all LIBOR contracts fully migrate to SOFR.

The need for a SOFR curve

- **SOFR is an overnight rate.**
- **But markets for swaps and cash products require long-term rates based on SOFR.**

- **Most LIBOR-based derivatives, loans, and securitized products will mature by 2025, or in 7 years.**
- **But the fate of LIBOR is uncertain beyond 2021, in 3 years.**
- **The current CME SOFR futures (traded since May 7, 2018) have liquidity out to about 1 year.**

- **How do we replace legacy LIBOR contracts by SOFR ones?**
- **How do we discover a SOFR-based yield curve?**

Source: NY Fed/ARRC

		Volume (Trillions USD)	Share Maturing By: End 2021	End 2025	After 2030	After 2040
Over-the-Counter Derivatives	Interest rate swaps	81	66%	88%	7%	5%
	Forward rate agreements	34	100%	100%	0%	0%
	Interest rate options	12	65%	68%	5%	5%
	Cross currency swaps	18	88%	93%	2%	0%
Exchange Traded Derivatives	Interest rate options	34	99%	100%	0%	0%
	Interest rate futures	11	99%	100%	0%	0%
Business Loans[2]	Syndicated loans	1.5	83%	100%	0%	0%
	Nonsyndicated business loans	0.8	86%	97%	1%	0%
	Nonsyndicated CRE/Commercial mortgages	1.1	83%	94%	4%	2%
Consumer Loans	Retail mortgages[3]	1.2	57%	82%	7%	1%
	Other Consumer loans	0.1	---	---	---	---
Bonds	Floating/Variable Rate Notes	1.8	84%	93%	6%	3%
Securitizations	Mortgage -backed Securites (incl. CMOs)	1.0	57%	81%	7%	1%
	Collateralized loan obligations	0.4	26%	72%	5%	0%
	Asset-backed securities	0.2	55%	78%	10%	2%
	Collateralized debt obligations	0.2	48%	73%	10%	2%
Total USD LIBOR Exposure:		**199**	**82%**	**92%**	**4%**	**2%**

Outline

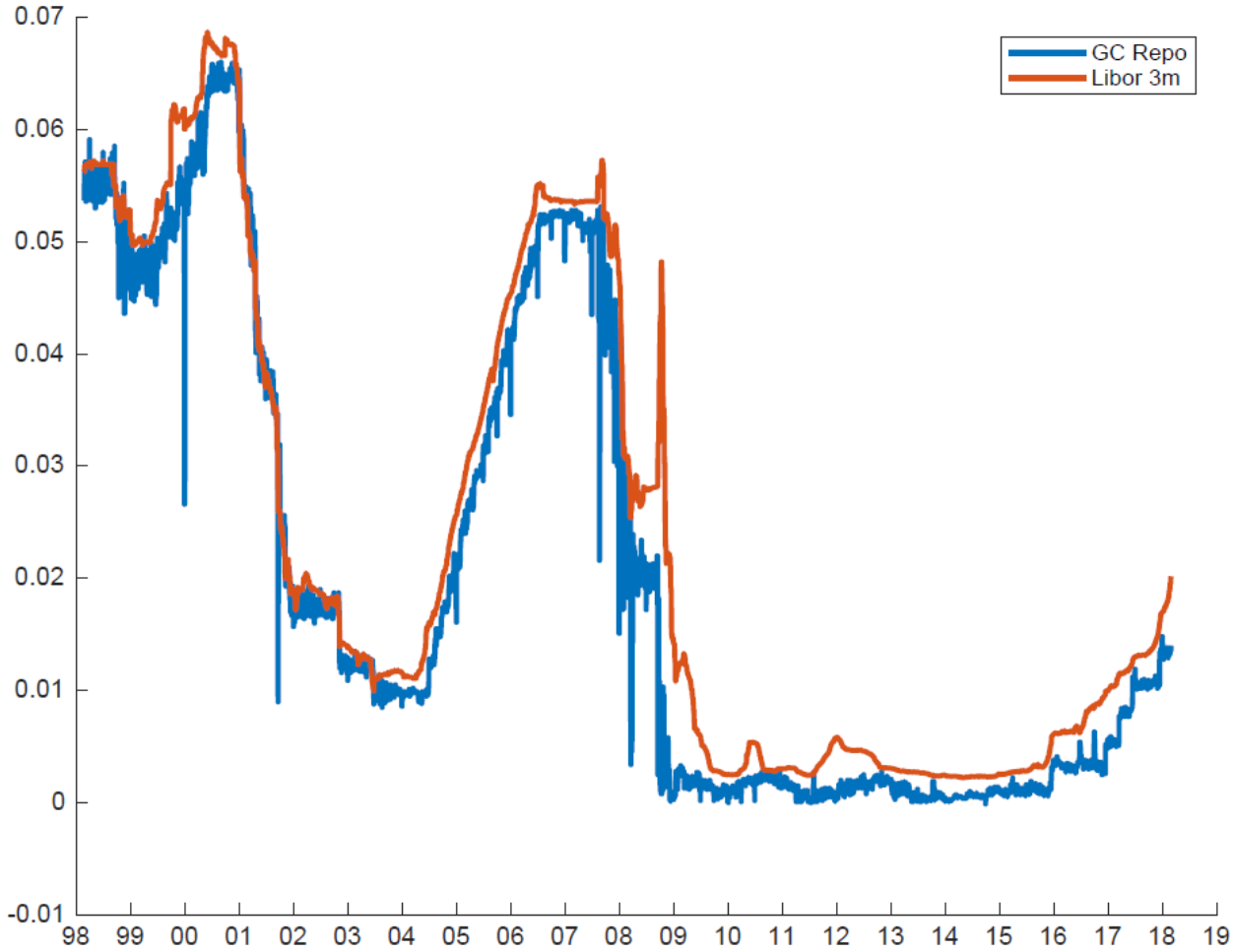
- A **Multi-Maturity Clock Auction (MCA)** Design for Replacing LIBOR by SOFR

- Design Considerations in Making Auctions Work

Why auctions for Libor transition?

- **Auctions are familiar to market participants.**
  - Treasury issuance auctions
  - Fed quantitative easing (reverse) auctions
  - CDS default auctions
  - Market mechanisms as auctions (order book, RFQ)
- **Auctions coordinate supply and demand, and provide price discovery.**
- **Auctions are already proposed in this context, see Darrell Duffie's "auction and protocol" proposal – My suggested auction format is related but different.**

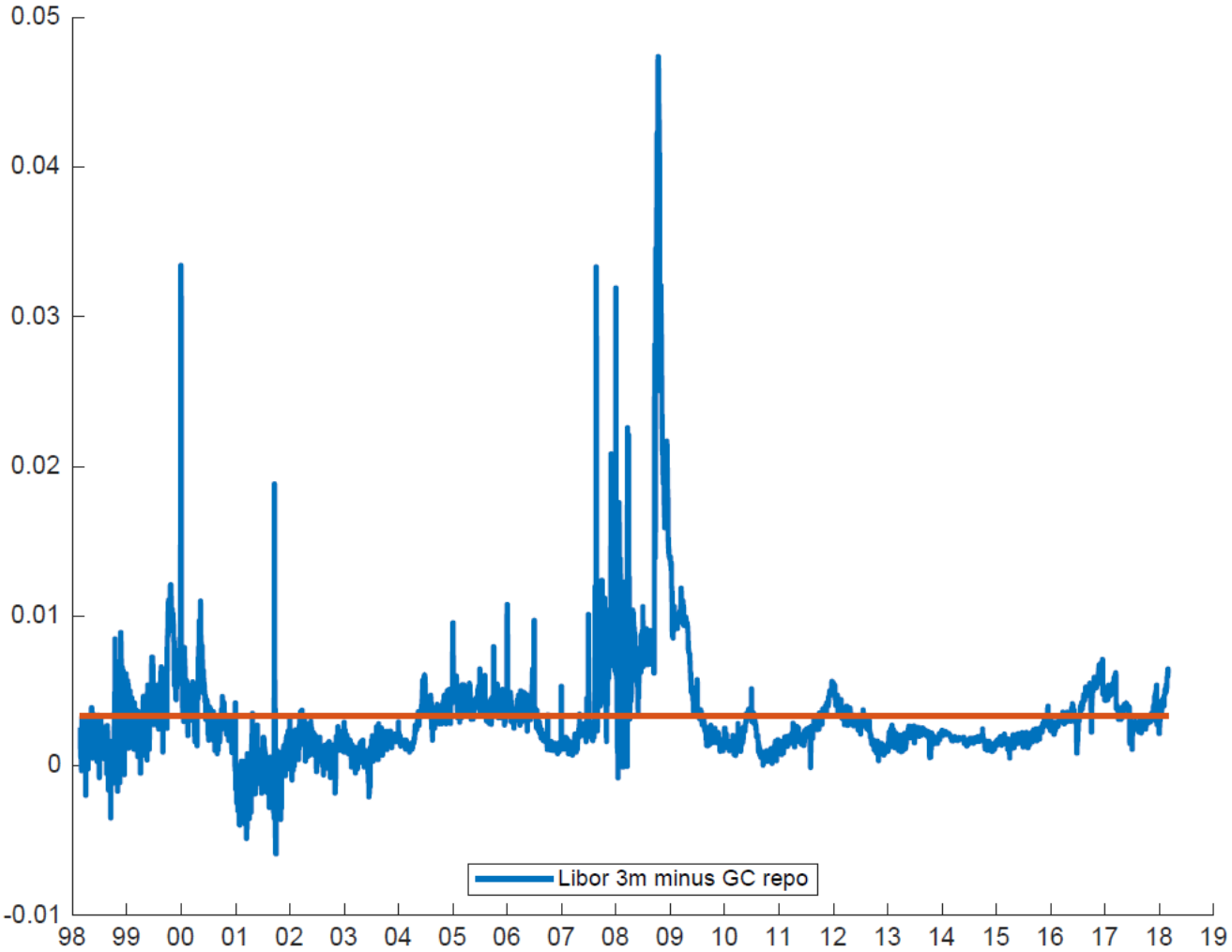
GC repo rate vs 3m Libor



GC repo rate: "Volume-weighted mean rate of the primary dealers' overnight Treasury general collateral repo borrowing activity" collected by a New York Fed survey.

Feb 1998—Feb 2018.

Libor-repo spread



Multi-maturity clock auction

- **This auction finds the spread adjustments to replace LIBOR cash flows to (compounded) SOFR cash flows at various maturities.**
  - Example 1: A firm pays LIBOR + 200 bps on a loan for 5 years. The firm “bids” to receive LIBOR and against SOFR + spread.

    ⇒ For the firm, the loan is transitioned from LIBOR to SOFR.
  - Example 2: A mortgage bank pays fixed and receives LIBOR on an interest rate swap, as a hedge of the mortgages. The bank “bids” to pay LIBOR against SOFR + spread.

    ⇒ For the bank, the swap is transitioned from LIBOR to SOFR.
- **Note: The auction aims to replace LIBOR cash flows as much as possible, but not necessarily all of them.**
- **Note: If end users prefer, they can subsequently convert daily compounded SOFR into “term” SOFR, say with a bank.**

Multi-maturity clock auction (1) – Start

Maturity	2y	5y	7y	10y
Spread (bps)	0	0	0	0

- **Various maturities open simultaneously.**
- **Example of a maturity grid: {1y, 1.5y, 2y, 2.5y, 3y, …, 30y}**
  - The grid could be made denser or sparser as desired.
  - For illustration, I only show a sparse grid of {2y, 5y, 7y, 10y}.
  - Multiple maturities encourage arbitrage across maturities.
  - Similar to FCC's spectrum auctions
- **LIBOR-SOFR spread on each maturity starts at zero (or sufficiently negative if SOFR is above LIBOR). All spreads are displayed to all bidders—as if on digital clocks.**

Multi-maturity clock auction (2) – Bidding

Maturity	2y	5y	7y	10y
Spread (bps)	0	0	0	0

Demand ($b)	0	0	0	0
Supply ($b)	100	200	200	250

- If the current spread on maturity j is s_j, each participant submits a quantity q_j.
- $q_j > 0$ means **demand**: pay LIBOR, receive SOFR $+s_j$.
- $q_j < 0$ means **supply**: pay SOFR + s_j, receive LIBOR.
- The process allows limit orders and market orders—they are automatically translated into bids at each step.

Multi-maturity clock auction (3) – Price discovery

Maturity	2y	5y	7y	10y
Spread (bps)	20	20	20	20

Demand ($b)	0	0	0	0
Supply ($b)	100	200	200	250

Demand ($b)	75	120	150	150
Supply ($b)	80	180	180	200

- **As long as Total Supply > Total Demand on a maturity, the algorithm raises the spread by a pre-defined increment.**
- **The new spreads will refresh the supply and demand.**
- **This iteration repeats.**
- **Since LIBOR > SOFR in the long run, s_j should come out positive.**

Multi-maturity clock auction (4) – Closing

Maturity	2y	5y	7y	10y
Spread (bps)	25	30	32	35

Demand ($b)	77	160	169	178
Supply ($b)	78	158	170	180

- **Once Demand and Supply are sufficiently balanced on all maturities (say within 5% of each other), the auction closes on all maturities simultaneously.**
  - Spreads across maturities are linked by arbitrage relations.
- **Heavy side is rationed (e.g. pro-rata or time priority).**

Multi-maturity clock auction (5) – Post auction

Maturity	2y	5y	7y	10y
Spread (bps)	25	30	32	35

- **Voluntary conversion at the final auction spreads**
  - After the auction, if two counterparties not in the auction both find the price acceptable, they can convert their legacy LIBOR contracts into SOFR ones at the market clearing price.
- **Compression**
  - Fine-tune the maturity of settled contracts
  - Example: A firm's LIBOR floating loan is due in 2.25 years, with face value $200m. The firm wins $200m in the auction to pay LIBOR and receive SOFR + 25 bps for 2 years. It could use compression to move the 2-year LIBOR-SOFR swap to a 2.25 year one.

What's the advantage relative to sealed bid?

- If bidders observe prices in real time, it reduces adverse selection and encourage participation.
- It also reduces guesswork in forming strategies—the only decision is submit demands at given prices.
- In sealed-bid auctions, it is not easy to condition on prices of other maturities.
- Treasury issuance auctions are sealed bids, but the when-issued market already reflects valuable information about supply and demand.
- Overall, transparent prices and simultaneous close encourage market making and arbitrage across the curve.

Is this kind of auction used elsewhere? Yes!

- **FCC spectrum auctions since early 1990s**
  - Bidders bid on multiple licenses that are substitutes or complements.
  - All prices are displayed and all licenses close simultaneously.
  - These auctions have been very successful in revenue generation.

Is this kind of auction used elsewhere? Yes!

- **Open and close auctions on US equity markets are close to "multi-stock clock auctions".**
  - Before settlement prices are determined, indicative prices are shown to the market—on all stocks.
  - Market participants submit buy and sell orders in each stock into the respective auctions, given the indicative prices on all stocks.
  - All auctions closes at 4pm, i.e., simultaneously.
  - Differences: In stock auctions, prices adjust two-way, and sometimes restrictions are placed on the direction of orders.
  - Open and close auctions are also very successful.

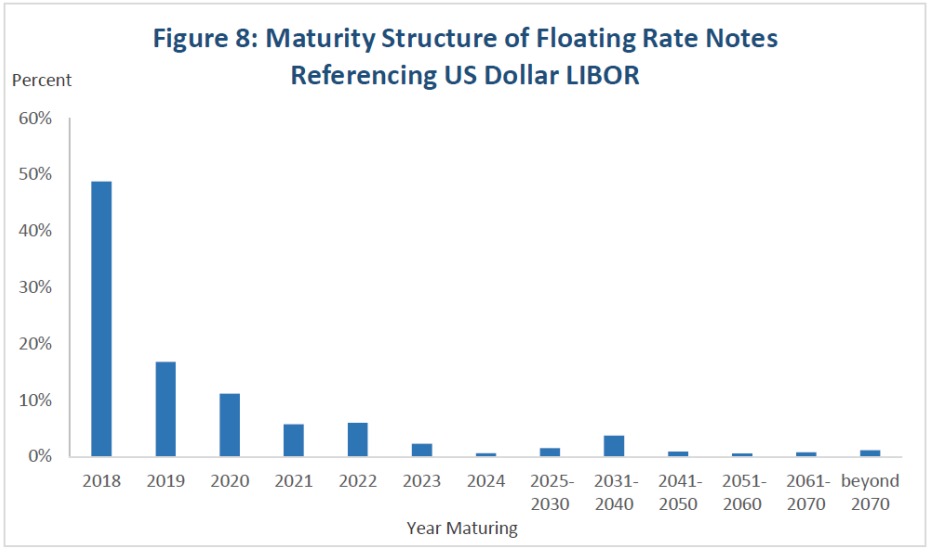
Outline

- A **Multi-Maturity Clock Auction (MCA)** Design for Replacing LIBOR by SOFR

➢ **Design Considerations in Making Auctions Work**

Design variables

- **What maturities?**
  - One possibility: Use a dense enough maturity grid to cover popular maturities.
  - Example of FRN from ARRC (2018):



Design variables

- **Should supply-demand imbalance be displayed or hidden?**
  - My instinct is to have them displayed, maybe with some range but not the exact numbers.
  - Open auctions and close auctions on stock exchanges disseminate order imbalances before prices are finally determined.
- **How large are the spread increments?**
  - Increments should be large at the beginning of the auction and small toward the end
  - Use data on price impact to come up with rules of thumb.

Design variables

- **How long does each round last? And how long does the whole auction last?**
  - It should be fast enough before market moves dramatically.
  - Desirable to run auction in “normal” times
  - Auctions in US equity markets use little time to run.
- **How closely should supply and demand match before auction finishes?**
- **If rationing is needed, which method?**
  - Pro-rata, time priority, size priority

Design variables

- **Who would run these auctions?**
  - The official sector, industry group like ISDA, or private firms like exchanges or clearinghouses?
- **Should market participants be charged?**
  - Lower fee would generates more participation and less incentive to trade outside of the auction.

Encourage participation and bidding

- **How to attract participation?**
  - Auctions could start with dealers, then expand to buy-side and end users.
  - Allow “non-competitive” bids. Example: Pay LIBOR and receive SOFR + spread for $100M and 5-year, at the market clearing spread.
  - Allow “limit orders.” Example: A firm specifies “Bid to receive LIBOR and pay SOFR + spread for $200m as long as the spread is less than 30 bps and if maturity is between 4.5 years and 5.5 years”.
  - Non-competitive bids and limit orders can be easily translated into bidding strategies in clock auctions by an algorithm.

Encourage participation and bidding

- **Multi-maturity clock auctions encourage participation of “market makers” and “arbitrageurs”.**
  - Example: the 4-year maturity sees very large demand to pay SOFR + spread and receive LIBOR, relative to 3-year and 5-year. Market makers or arbitrageurs can respond by supplying SOFR at the 4-year maturity and receive SOFR at the 3-year and 5-year maturities (against LIBOR).
  - Market makers would bear some basis risk, but make expected profits. Their LIBOR exposure can be managed down later.

Encourage participation and bidding

- **What if participants withhold bidding until the very end?**
  - One “solution”: Require that a bidder’s demand to pay (receive) the spread cannot go up (down) if spread goes up.
  - Similar to the “activity rule” in FCC spectrum auctions
  - In open and close auctions in US equity markets, certain types of orders cannot be entered close to the auction ending time.

Summary

- **Price discovery of a “SOFR yield curve” is a critical step in the transition from LIBOR to SOFR.**
- **I propose a “multi-maturity clock auction” to replace legacy LIBOR cash flows by new SOFR cash flows.**
  - Multiple maturities are substitutes, and the auction produces spreads on all of them together.
  - Spreads are displayed, and adjust to supply/demand.
- **The auction design should be carefully calibrated to maximize participation, efficiency and fairness.**