Interest Rate Derivatives Seminar Series

Intro to derivatives and the front-end: | September 2020

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What is a derivative?

- A derivative is any financial instrument with a payout that references another instrument
- Interest rate derivatives in particular are typically tied to the right to either pay or receive a given interest rate
- They are said to be “self-funded” in that they contain embedded leverage without the need to borrow explicitly to fully (or mostly) fund the position
- Commonly used for a variety of purposes including:
  - Hedging and portfolio risk management
  - Asset/liability management
  - Speculation
- At a very high level, two flavors
  - Exchange-traded
  - Over-the-counter

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The two branches of the interest rate derivatives family tree

- **Exchange Traded**
  - **Treasuries**
    - Futures
    - Options
  - **Eurodollars**
    - Futures
    - Options
  - **SOFR + Fed funds**
    - Futures
    - Options
- **Over the Counter**
  - **Swaps**
    - Fixed-to-float (vanilla swaps)
    - Float-to-float (basis swaps)
    - Overnight Index swaps
    - Cross-currency (FX) swaps
    - Total return swaps
  - **FRAs**
    - Libor forwards
    - THORs & rate locks
    - CMS/CMT
    - CMM
  - **Options**
    - Swaptions
    - Midcurves
    - Curve options
    - Caps & floors
    - Exotics (FVAs, Berms, hybrdids, etc.)

What are futures contracts?

- Futures are exchanged-traded derivatives that require the seller of the contract to deliver some pre-defined asset (physical thing, security, or cash, depending on the contract) to the buyer of the contract at some point in the future at a given price
- Essentially, they are forward contracts that trade on an exchange and follow consistent, pre-defined rules from the exchange
- Futures are bought and sold on margin, requiring buyers and sellers to only post a fraction of the notional when opening the trade and to

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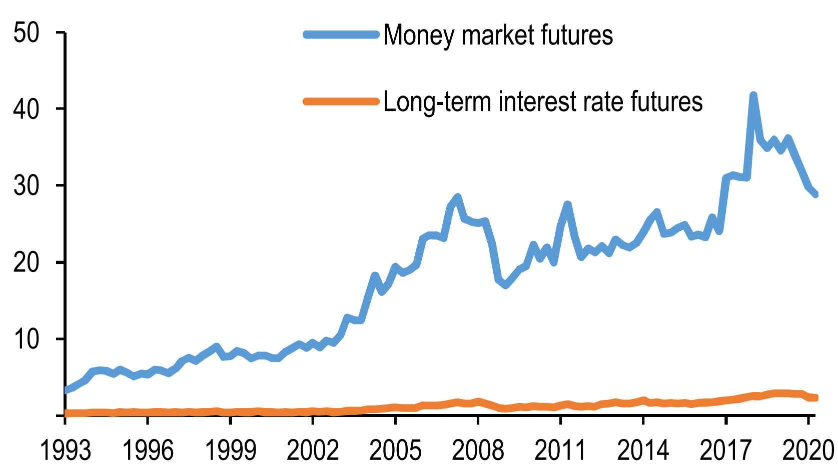
Money market futures are far and away the largest exchange-traded derivative market in the world by covered notional, dominated by USD …

Money market futures are the largest exchange-traded derivative market in the world, covering a much larger notional than long-term interest rate futures …

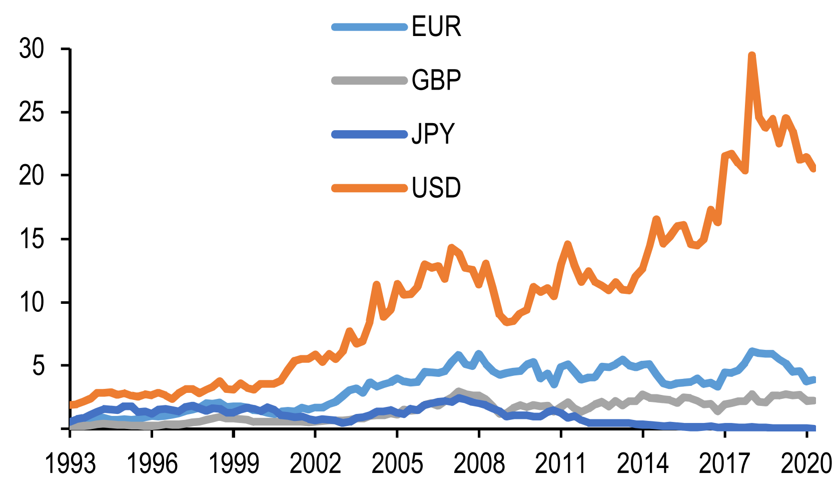
Quarterly notional of money market and long-term interest rate futures across all currencies; $tn



* Based on BIS Exchange-Traded Derivative Statistics.
Source: J.P. Morgan, BIS

… and the U.S. is by far the largest contributor to that covered notional balance

Notional balance of money market futures by currency; $bn



Source: J.P. Morgan, BIS

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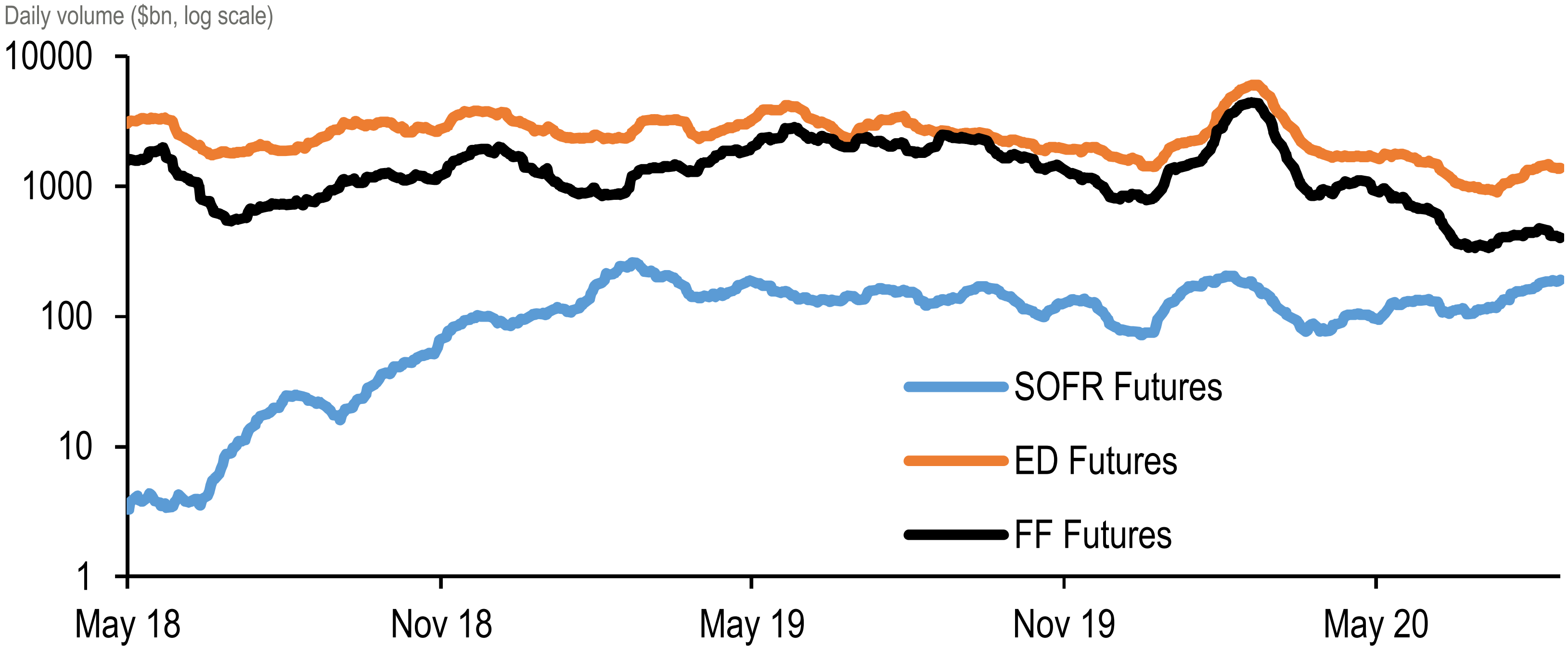
… Eurodollars are still the vast majority of the market, although SOFR futures volume has increased since the contracts were introduced

Eurodollars dominate volume in USD money market futures …



Source: J.P. Morgan, Reuters

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An overview of contract specifications for Eurodollars, Fed funds, and SOFR futures

Name	Eurodollars	Fed funds futures	SOFR futures	SOFR futures
Bloomberg symbol	ED	FF	SFR	SER
Globex Code	ED	ZQ	SR3	SR1
Underlying	3M Libor	EFFR	SOFR	SOFR
Contract frequency	Quarterly	Monthly	Quarterly	Monthly
# of contracts	40	36	20	7
Calculation	N/A	Simple avg	Daily compounding	Simple avg
Quoting convention	100-rate	100-rate	100-rate	100-rate
DV01	$25	$41.67	$25	$41.67
Trading Hours	Sun-Fri 5p-4p CT	Sun-Fri 5p-4p CT	Sun-Fri 5p-4p CT	Sun-Fri 5p-4p CT

Source: J.P. Morgan, CME

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Eurodollar time deposits

- Definition
  - A Eurodollar time deposit is simply a dollar deposit with a bank or branch outside of the U.S. or with an international banking facility (IBF) located in the U.S. The world's center for Eurodollar deposit trading is London.
  - **It has nothing to do with the FX conversion between EUR and USD, despite the name**
- Maturities and Settlements
  - The standard settlement period for Eurodollar transactions is two days, which means that the money must be wired to the bank two business days after the trade date.
- Interest Rate Conventions
  - Eurodollar interest rates are quoted on the basis of standard money market day counts; that is, ACT/360

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How Eurodollar futures work

- Eurodollar futures are cash settled to three-month LIBOR every month (40 quarterly contracts plus monthly serials).
- The Eurodollar futures price is equal to 100 less the futures rate (that is, Futures Price = 100 - Futures Rate) where the futures rate is expressed in percentage points.
- The minimum change in the price is one-half basis point (0.005 percent), and each basis point change is worth $25.
- A decrease of one basis point in the futures rate increases the futures price by one basis point, which produces a $25 gain for the long and a corresponding $25 loss for the short.
- Gains and losses are settled daily. Money is taken from the accounts of those with losses and paid through the clearing house to the accounts of those with gains.

Wait, what's Libor?

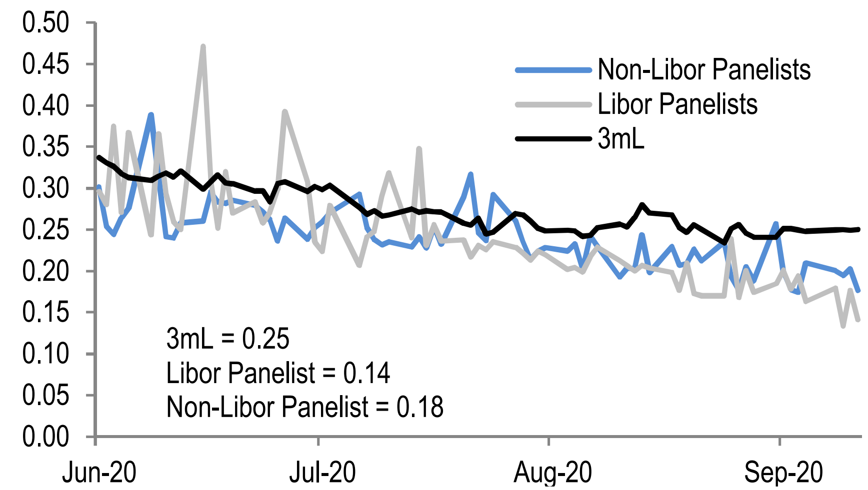
- The final settlement price for an expiring Eurodollar contract is based on the ICE fixing of 3m Libor.
- The rate is calculated by surveying 16 major global banks for the rate at which they could borrow funds. The top and bottom four responses are removed from the sample, and the average of the remaining eight submissions represents the current LIBOR rate for that tenor
- Because there are is no longer much true interbank, unsecured, term lending, a new “waterfall” methodology has the panel banks rely on other transactions (mostly CP/CD) falling back on models when none are available
- LIBOR submissions have increasingly been determined by “expert judgement” model-based estimates, rather than true transactions
- LIBOR is set to be phased out beginning in 2022

Summary of the LIBOR submission waterfall

Waterfall	Description	Eligible transactions
Level 1	Transactions	Unsecured deposits New issue CP and CD fixed rates
Level 2	Transactions-derived	Historical level 1 transaction 3d lookback for 1-3M, 5d for 6M & 10d for 12M
Level 3	Market-data based	FRAs/swaps, FRNs, **FX fwds**, OIS, repo Third party transactions/broker quotes Macro factors, e.g. policy rate changes

Source: J.P. Morgan

3m Libor versus 3m CP/CD transactions (%)



Source: DTCC

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Pricing Eurodollar futures

- Because a Eurodollar futures contract settles in cash to a final settlement price equal to 100 minus the value of spot three-month LIBOR, ED futures are usually treated as if they are a three-month forward deposit rate. The standard convention is to consider a Eurodollar futures price fair if it is equal to:
- 100 - 3 month forward LIBOR
- Forward LIBOR is considered fair if a bank's total borrowing costs are the same from:
  - borrowing long term, or
  - borrowing short term and financing at forward LIBOR.
- Put differently, forward LIBOR is fair if:

$$\left(1+R_L\times\frac{DAYS_L}{360}\right)=\left(1+R_S\times\frac{DAYS_S}{360}\right)\left(1+F\times\frac{DAYS_F}{360}\right)$$

borrow in 1 segment borrow in 2 segments

$$F=\left[\frac{1+R_L\times\frac{DAYS_L}{360}}{1+R_S\times\frac{DAYS_S}{360}}-1\right]\times\frac{360}{DAYS_F}$$

where

RL	=	spot LIBOR for the long period
RS	=	spot LIBOR for the short period
F	=	forward LIBOR
DAYSL	=	number of days in the long period
DAYSS	=	number of days in the short period
DAYSF	=	number of days covered by the forward period

Note: If the investment horizon is longer than 365 days, allowance must be made for annual compounding.

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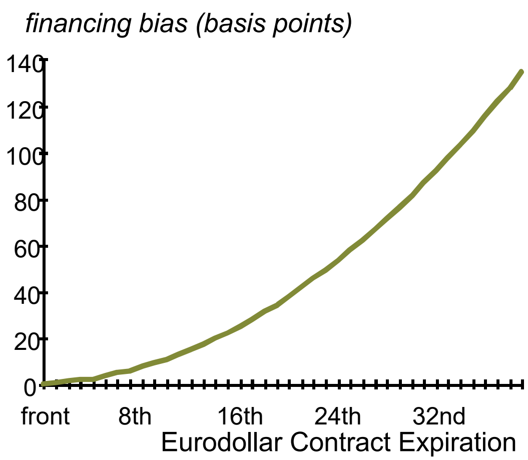
Word of caution

- The fair value of a long-dated Eurodollar futures contract (after 1st year) can't be reckoned accurately without accounting for the effect of futures variation margin.
- On a Eurodollar futures contract, a long position receives unencumbered variation margin when yields are falling so that gains are invested at lower rates. A long position pays variation margin, on the other hand, when yields are rising so that losses must be financed at high rates. On average, therefore, the interest expense of financing losses exceeds the interest income on gains. The net result is a distinct disadvantage to being long Eurodollar futures and a corresponding advantage to being short.
- This is very different from OTC FRAs, which have variation margin (Price Alignment Interest; PAI) but not daily final settlement
- To compensate for this imbalance, futures prices must be lower than they would otherwise be. That is, the futures rate must be higher than the implied forward rate.
- The effect of variation margin is most important for longer-dated Eurodollar contracts.

IMM Euros Financing Bias



Financing bias increases with

- Time to expiry
- Volatility of rates
- Correlation between spot and fwd

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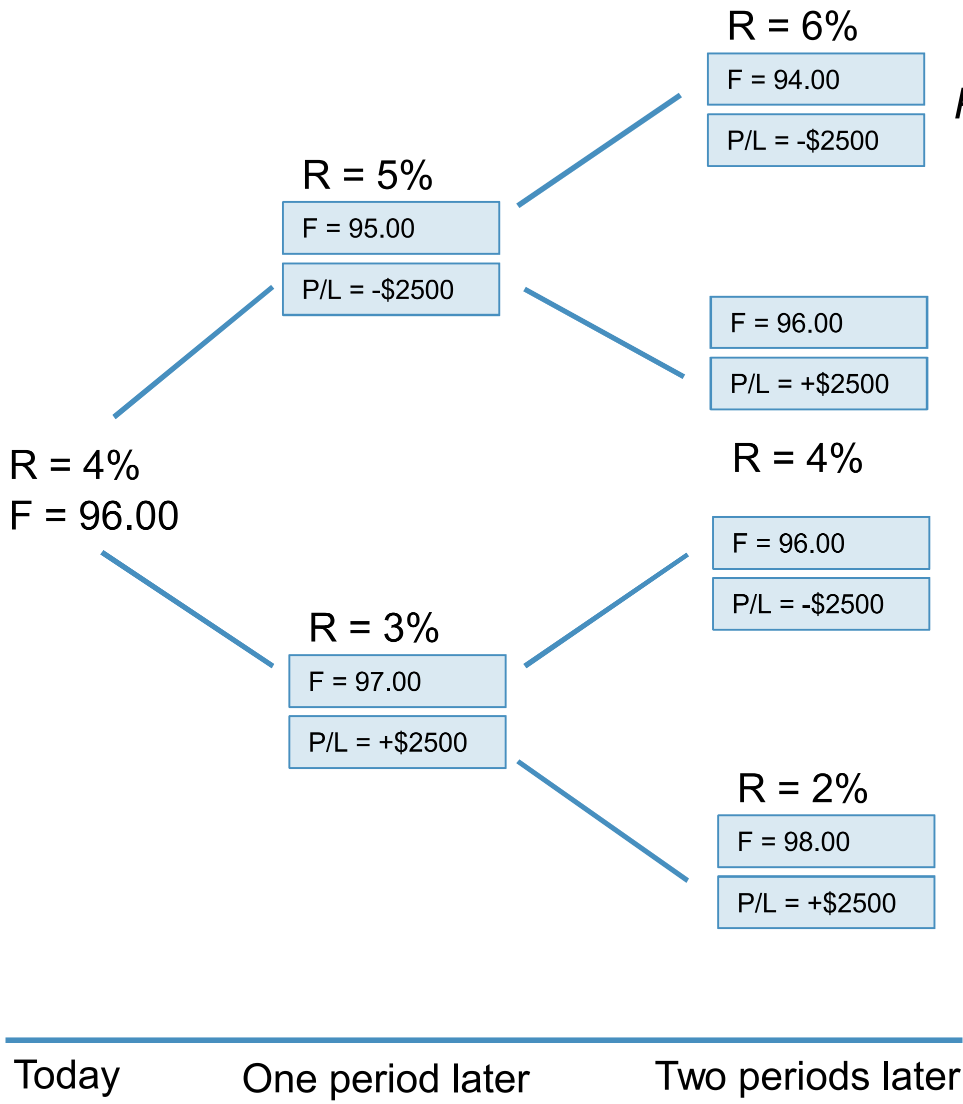
Financing variation margin on Eurodollar futures



Profit = -$2500 x 1.05 - $2500 = -$5125

Profit = -$2500 x 1.05 + $2500 = -$125

Profit = $2500 x 1.03 - $2500 = $75

Profit = $2500 x 1.03 + $2500 = $5075

Average Profit = -$25

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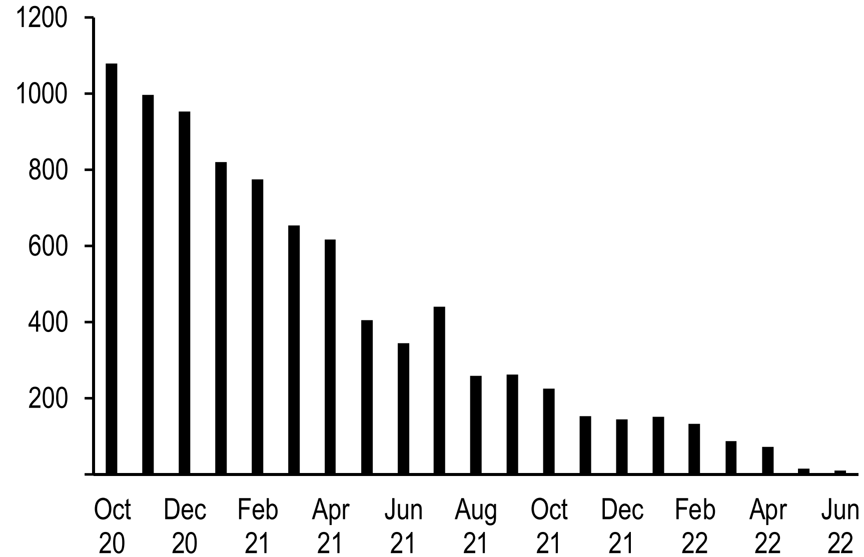
- CME has indicated that if/when a fallback event is triggered, it will use the following method for determining the futures assignment price of a ED futures contract:
  - *SR3 delivery price = ED price + Spread Adjustment*, where:
    - *SR3*: 3 month SOFR future
    - *Spread Adjustment*: ISDA's determination of the 5-year median historical spread between 3mL and adjusted SOFR (annualizes a 3 month compounded in arrears rate and adjusts for day count convetion)
- Example: You are long the EDZ1 future, currently trading at 99.70, a fallback event occurs
  - Hypothetical spread adjustment is 21.5 bp
  - You are now long SR3Z1 at 99.915

Most open interest in EDs is concentrated in the first year

Open interest in ED futures by contract month ($bn)



Source: J.P. Morgan, CME

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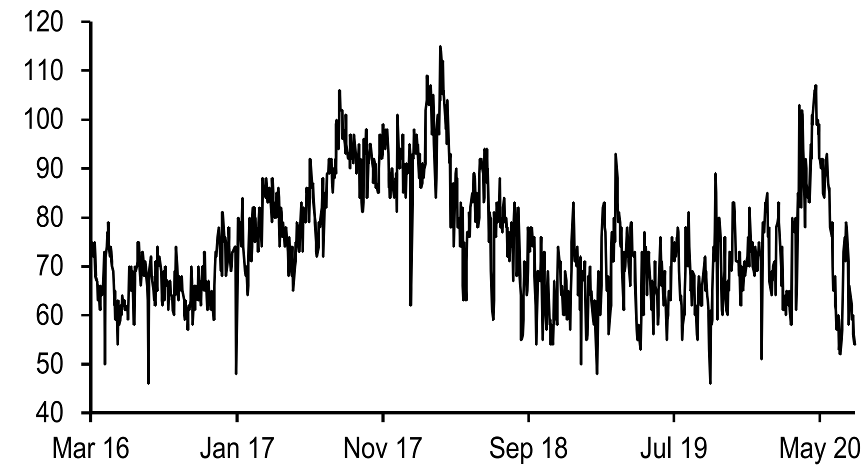
Effective Fed funds rate (EFFR)

Commentary

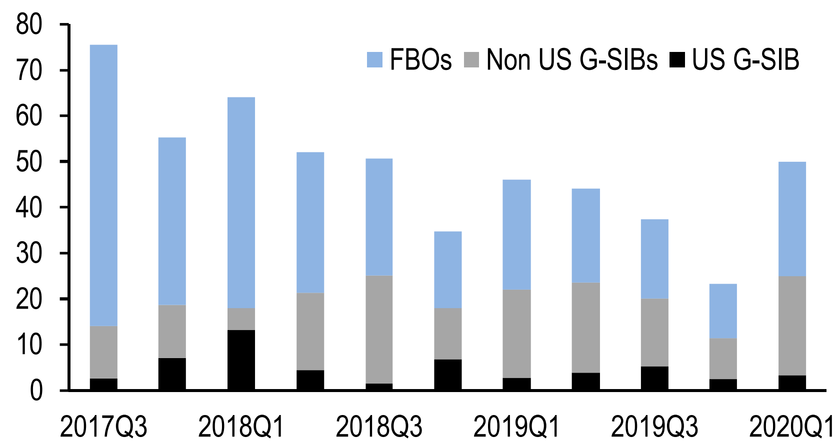
- EFFR is the prevailing rate at which financial institutions borrow and lend reserves to other financial institutions on an overnight basis in order to meet reserve requirements set by the Federal Reserve
- Relative to other overnight markets, the fed funds market is very small, running between $50bn and $100bn in size
- As a result, EFFR is heavily dependent on who borrows and lends in the marketplace
- Banks with excess reserves as well as GSEs (they do not earn IOER) can lend in the fed funds market

Fed funds volumes ($bn)



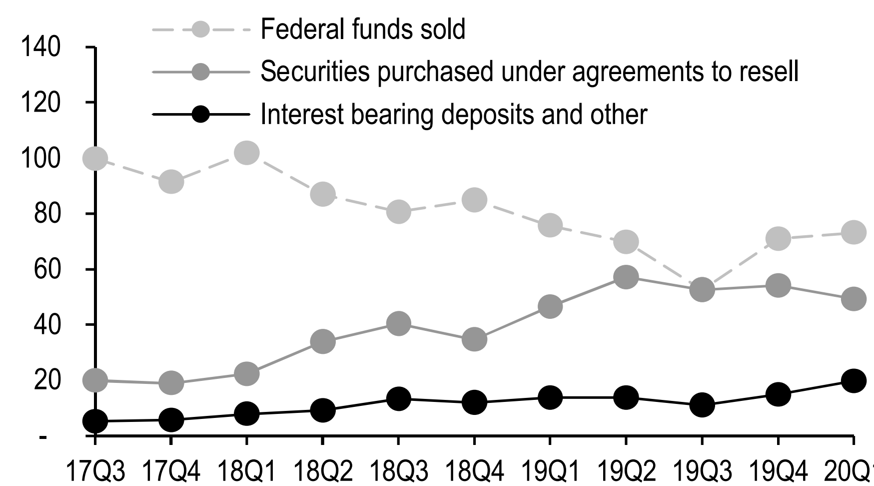
Source: NY Fed

Borrowers of fed funds



Source: FFIEC 002/003/004

FHLB cash investments ($bn)



Source: FHLB

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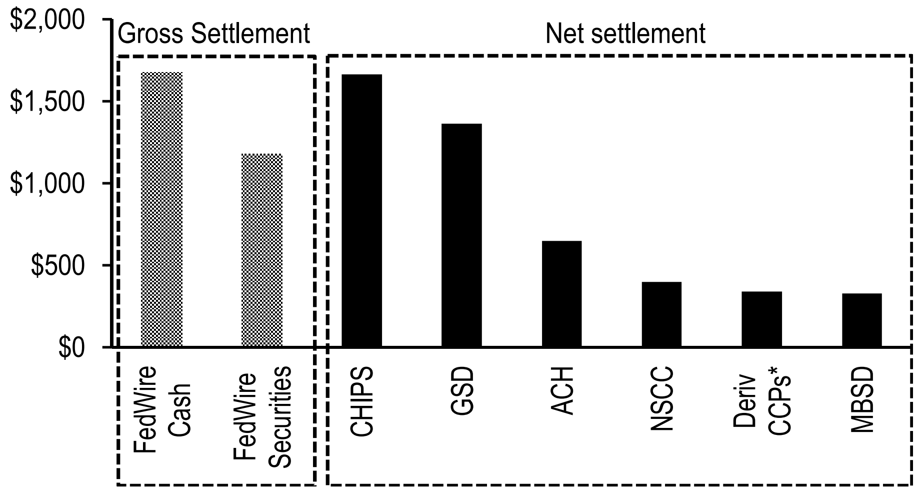
The interbank payments system is the backbone of U.S. markets, and drives tactical demand for reserves …

RTGS systems form the backbone of the U.S. payments system, but liquidity-savings mechanisms process more volume

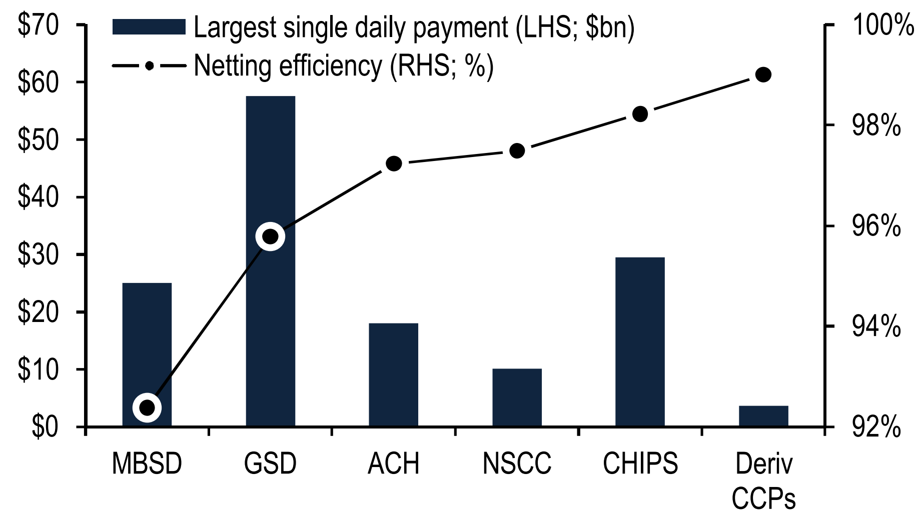
Average 2018 daily payment activity processed by each network, with gross and net settlement identified; $bn



* Gross activity based of total initial margin posted by clearing members, from the CFTC Cleared Margin Report.
Note: ACH activity taken from the 2016 Federal Reserve Payments Study, scaled by the publicly disclosed increase in ACH Network volumes through 2017. NSCC does not directly disclose total settlement activity, but we use total equity, corporate bond, and municipal bond daily trading volume (estimated by SIFMA) as a proxy.
Source: J.P. Morgan, DTCC, CHIPS, FRB, SIFMA, CFTC, NACHA

Though netting efficiencies are generally high, activity over these services can generate material daily outflows for the large banks that process the majority of these payments

Largest actual one-day liability of a member of each settlement system* (LHS; $bn) and netting efficiency estimate† (RHS; %)



* Based on 3Q 2018 Quantitative IOSCO disclosure for each central counterparty. For details on these reporting standards see Public quantitative disclosure standards for central counterparties, BIS and IOSCO, February 2015. Based on a 12-month lookback. CHIPS and ACH based on J.P. Morgan estimates.
† Largest one-day payment obligation divided by average daily overall notional settled. For GSD we use monthly data for total dollar value of obligations created, for MBSD we use total cleared par amount, and for NSCC we use daily trading volumes of U.S. equities, corporate bonds, and municipal bonds (from SIFMA data). Derivative CCPs include CME, LCH, and ICE, for which we compare one-day payment obligations to average initial margin (from the CFTC Cleared Margin Report).
Source: J.P. Morgan, DTCC, CME, LCH, CFTC, SIFMA

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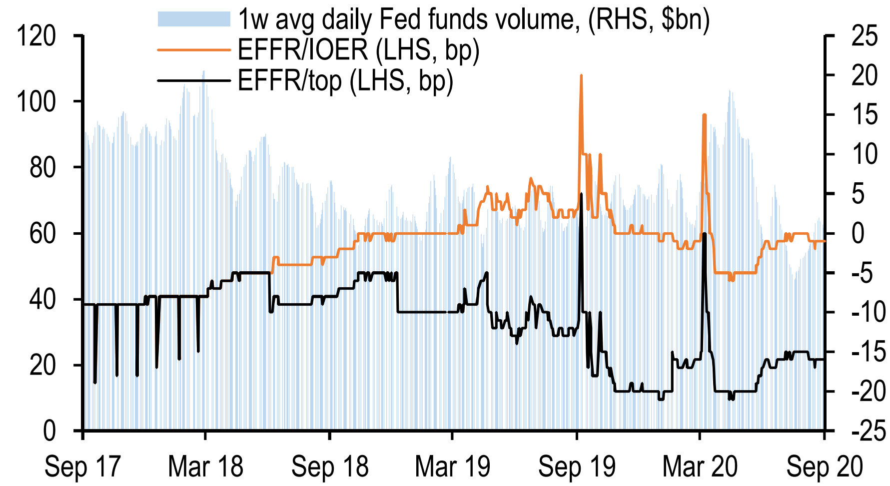
The Fed fnds market shows little evidence of reserve scarcity, which enables large banks to police the GC/IOER basis to some extent

Although EFFR has moved higher, we do not believe reserves are scarce. Lower traded Fed funds volumes and a lack of participation by larger banks suggest otherwise

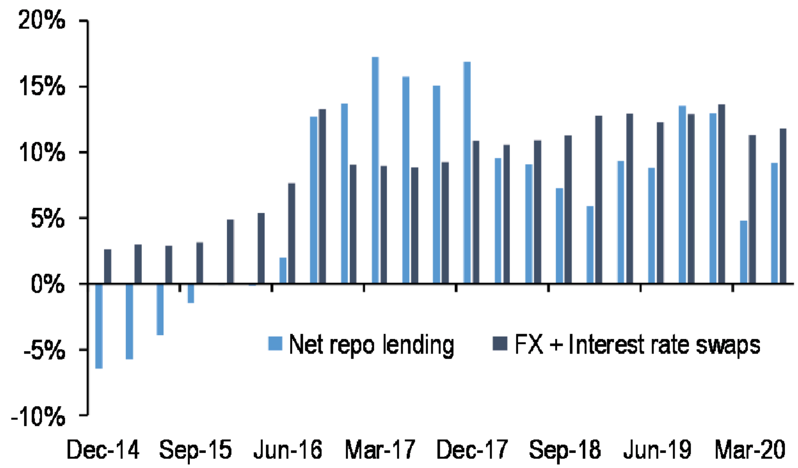
EFFR versus the upper end of the target range and IOER (LHS; bp) and 1-week moving average of daily Fed funds trading volume (RHS; $bn)



Source: J.P. Morgan, NYFRB

Non-GSIB share of net repo lending has been rising in recent quarters

Non GSIB bank holding company exposures as a percentage of GSIB exposures in net repo lending and FX and interest rate swap notional outstanding; %



Source: J.P. Morgan, FFIEC FY9c

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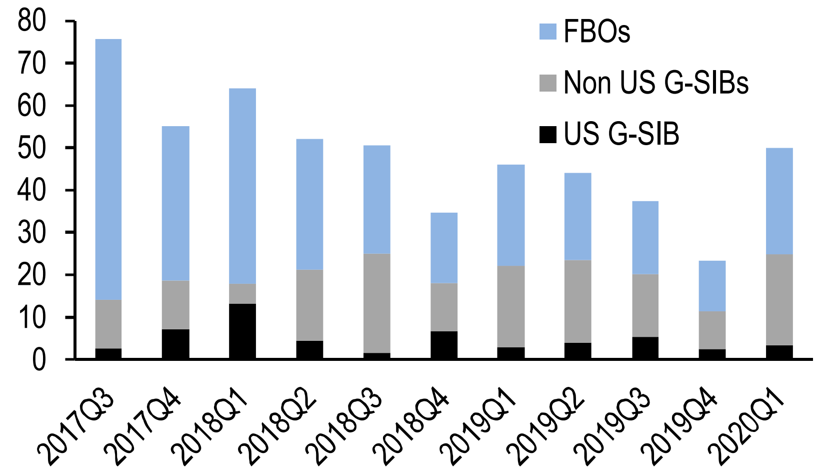
Demand: increasingly, buyers of Fed funds—including some FBOs—are relatively insensitive to IOER, making it a weaker anchor for policy rates

As of 1Q this year, domestic banks were nearly half of funds activity, suggesting a larger population of less IOER-sensitive buyers

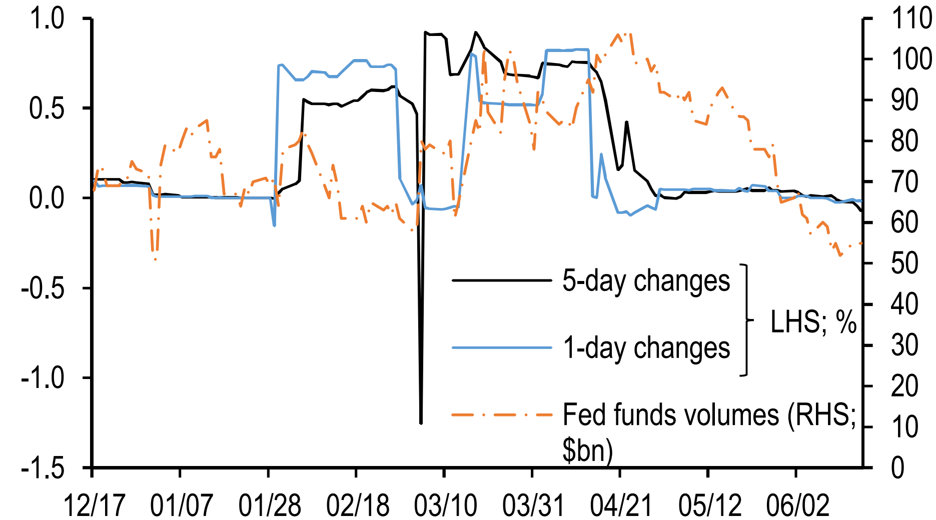
Net Fed funds purchased split into foreign and domestic banks, with the latter separated further by total assets; $bn



Note: As of Q1 2020 reporting.
Source: J.P. Morgan, FFIEC

As traded volumes have declined, correlation between changes in EFFR and GC has waned

21-day beta of changes in EFFR regressed on changes in GC (LHS) and Fed funds daily traded volumes (RHS; $bn)



Source: J.P. Morgan, FFIEC

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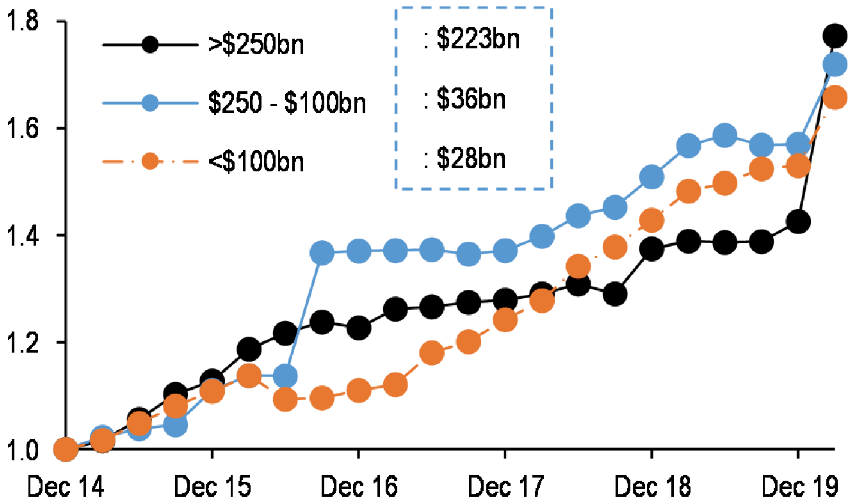
What happened to the Fed funds market during the beginning of the crisis?

Participation among small and regional banks jumped in 1Q alongside an increased demand for short-term funding…

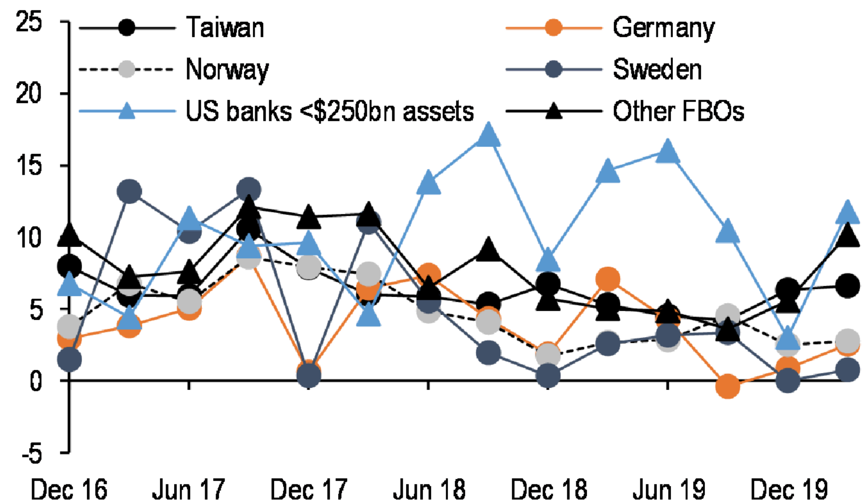
Commercial loans to U.S. domiciled businesses, by bank size; relative to 4Q14 level and 1Q20 change inset; $bn



Source: J.P. Morgan, FFIEC FR Y-9C

… and smaller banks resorted to the Fed funds market as one source for additional funding

Net Fed fund purchased by FBOs and small U.S. banks; $bn



Source: J.P. Morgan, FFIEC

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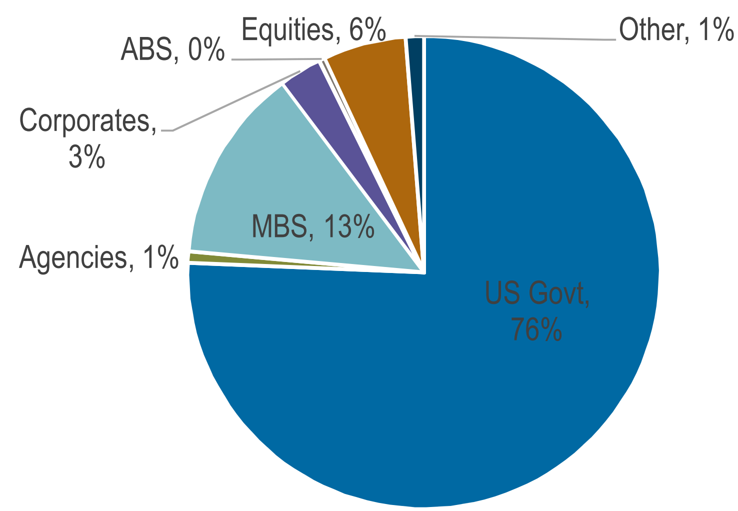
Repurchase agreements (repo)

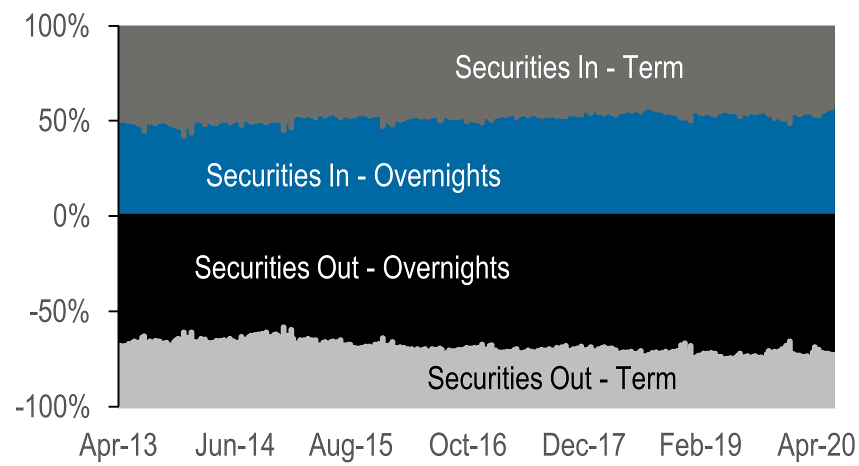
Commentary

- A repo involves two parties, cash, and securities acting as collateral. On the first leg of the transaction, the borrower sells securities in exchange for cash (minus a haircut) and promise to repurchase the securities in the future on a certain date and at a certain price. On the second leg, the borrower buys back the securities previously sold
- A reverse repo follows the same mechanics, and is only a matter of what side a party is on in the trade
- Repo serves a variety of purposes:
  - An investment vehicle to invest or raise cash (as an alternative to the unsecured money market)
  - Finance long or short positions in different securities (i.e. source collateral)
  - Collateral transformation (i.e. collateral upgrade or downgrade)
  - Obtain leverage
- The US securities financing market is a $5.3 trillion market (includes repo, reverse repo, securities borrow and loan, both DVP and tri-party)
- US repo activity is concentrated in predominately Treasury collateral (~75%) followed by MBS collateral (~13%)
- Financing activity can be constrained by a number of factors including balance sheet, capital and credit appetite (e.g., LCR, SLR, G-SIB, etc.)

Collateral composition



Maturity Profile



Source: Federal Reserve

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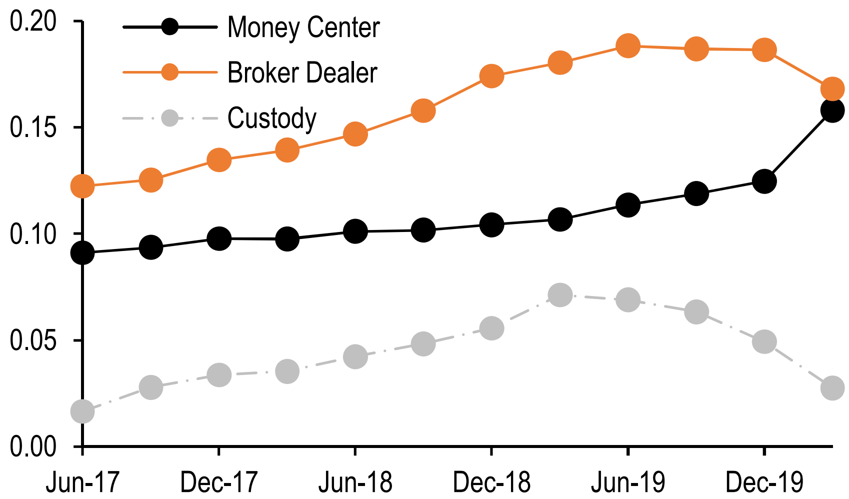
Repo is a far more direct input into bank funding cost, and benchmark reform should leave most loans directly tied to repo via SOFR

Market rates for secured lending are an important and growing input for bank funding…

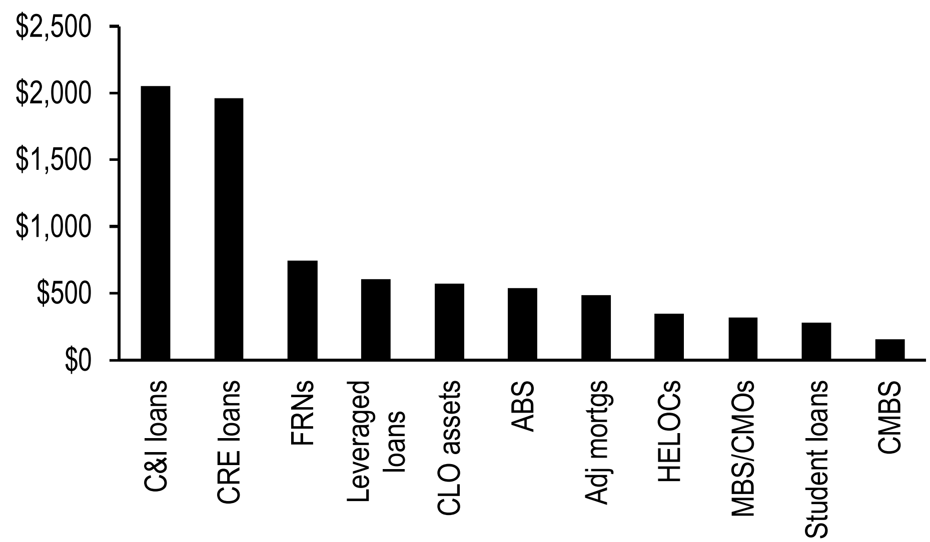
Bank wholesale funding secured by level 1 assets as a proportion of total bank liabilities



Source: J.P. Morgan, FFIEC FRY15, FRY9c

… and if benchmark reform succeeds in replacing Libor with SOFR, the vast majority of business and consumer lending will be directly tied to repo markets

Estimated Libor exposure by product as of June-19; $bn



Note: FRNs include high-grade issues with <1yr to maturity ($490bn) and longer ($250bn) as well as high-yield FRNs ($5bn). Leveraged loans are exclusive of CLO collateral. ABS includes both international and domestic transactions. Student loans are exclusive of ABS collateral. MBS/CMOs includes agency ($265bn) and non-agency ($56bn) paper. For details on the structured products subset , see *A dog's breakfast*, M. Jozoff et al., 9/14/18. Adjustable mortgages from FFIEC call reports, and C&I/CRE loans from FRB data.
Source: J.P. Morgan, FRB, FFIEC, Intex, Trepp

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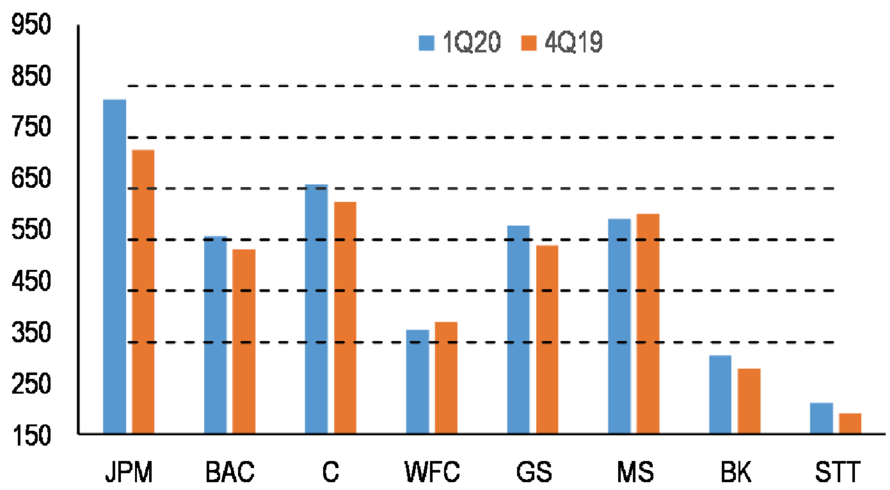
What happened to GSIB scores during the crisis?

GSIB scores swelled in the first quarter, increasing for all but 2 of the major US banks…

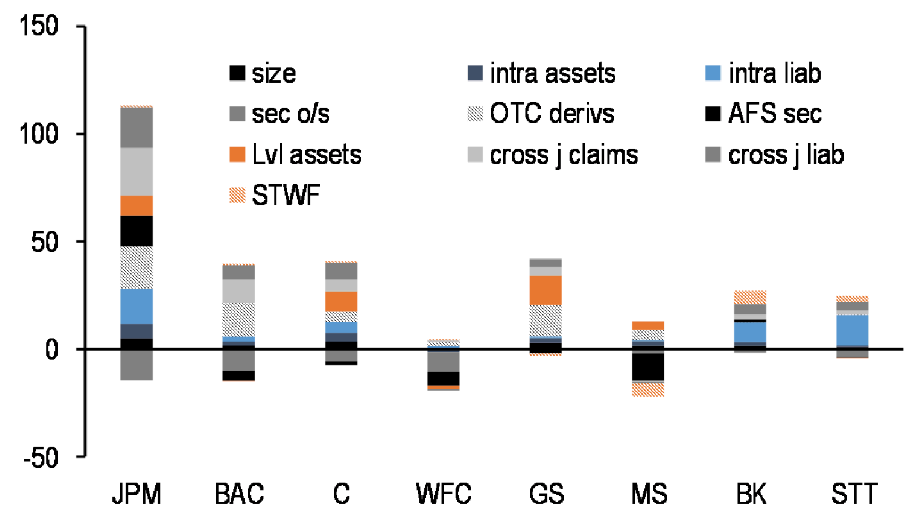
GSIB Method II score; pts



Source: J.P. Morgan, FR Y-15

… pressure came from virtually every corner, but cross-jurisdictional indicators and derivatives exposures were most persistent

Change in Method II score contribution from 4Q19 to 1Q20; pts



Source: J.P. Morgan, FR Y-15

SOFR futures, repo, and benchmark reform preview

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