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Global Money Notes #22

Collateral Supply and o/n Rates

In this edition of Global Money Notes, we explain, in never-before-seen detail, the mechanics of intra-day Fed balance sheet operations. These mechanics show why reserves can be scarce enough on some days to create volatility and problems even after trillions of dollars in quantitative easing. We study the detail of how balance sheet reduction (colloquially referred to as "taper") has worked.

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Reserves are scarce…

…and this scarcity now feeds through to daily volatility in the o/n fed funds rate.

The volatility of the o/n FF rate is driven by the supply of Treasury collateral and some banks' increased reliance on daylight overdrafts on settlement days.

The flipside of daylight overdrafts are temporary daylight reserves which banks have to pay back to the Fed everyday by sunset, and these payments are funded by borrowing "permanent" reserves during the day through the o/n FF market.

The days when some clearing banks need to fund in the o/n FF market to settle daylight overdrafts at the Fed typically coincide with the days when bank HQLA portfolios couldn't lend enough reserves in the o/n GC market…

…typically because they hit their intraday liquidity limits.

When those limits are reached arbitrage flows kick in where foreign banks fund in the o/n FF market and lend in the o/n GC market and when arbitrage flows aren't enough, clearing banks bid hard to pay daylight overdrafts at the Fed.

Those are the tough days when the right tail of the distribution of o/n FF trades gets fatter, that is, the days when the volatility in the o/n FF rate picks up, and the effective o/n FF rate drifts higher within the Fed's target band.

Relative to the "ocean" of the o/n GC market, the o/n FF market is a "pond" and so it doesn't take much collateral supply at all to dislocate the latter.

Bill supply will fall between now and the fourth quarter, which should ease pressures on o/n rates. But the curve remains inverted and the trade war with China is getting out of hand and that's a near-term risk for collateral supply before we issue another round of $300 billion in bills in the fourth quarter.

Insurance cuts would ease the pressure on o/n rates and it wouldn't be wise to enter the fourth quarter without a mechanism in place to absorb excess bills.

"This financial plan is an outrageous demand and its too many damn pages for any man to understand."

Thomas Jefferson to Alexander Hamilton in the song "Cabinet Battle #1" in Hamilton

Watching paint dry is not the same as understanding the chemistry of how paint dries…

Paints are a mixture called a colloid. Paints are basically pigments suspended in a solution, which is the mix of a solvent and a binding medium. When paint dries, the solvent portion of the solution evaporates, leaving the pigment stuck in the binding medium in a hard layer.

When we are watching paint dry in the context of taper, Treasuries are like pigments, reserves are like a solvent and intraday liquidity needs are like a binding medium.

When there is too much collateral relative to the supply of reserves, the paint has too many pigments and not enough solvent and is hard to spread – the paint job looks messy, and on your screens the o/n GC rate trades outside the band, pulling the funds rate with it.

When you spread a pigment-heavy mixture on a hot summer day, the solvent evaporates quickly and you end up with hardened chunks of pigment that punctuate the surface – those are the tough days when intraday liquidity needs bind and the o/n GC rate spikes.

Our current issue has seven parts, each of which is a three-page essay supported by a set of maps showing *hour-by-hour* flows involved in taper intraday and overnight, and a detailed deck of *fifty slides* that systematically track the impact of collateral supply – coming from both taper and the deficits – on the o/n GC repo and o/n fed funds rates.

Part one uses taper as our analytical entry point to answer the bigger picture question of how collateral supply drives the constellation of o/n rates. It shows how dealers and the Bank of New York facilitate taper intraday, maps the channels through which collateral can be absorbed as the Fed tapers, and highlights how increased supervisory focus on intraday liquidity increased banks' demand for reserves just as taper was destroying them.

Part two maps what happens on the days when taper is not funded, but financed intraday, i.e., how daylight overdrafts provided by BoNY and the Fed help the system clear on some days and how the occasional use of overdrafts impacts the way o/n markets trade.

Part three takes the accounting framework presented in the first two parts and uses it to track who absorbed how much of the Treasury collateral that entered the system via taper and how these flows were financed. It explains how the curve inversion that began in October, 2018 drove stresses in the o/n GC repo market and finds that taper effectively forced the Treasury to fund $300 billion of supply overnight, in the o/n GC repo market!

Part four puts taper into a bigger context. It compares collateral supply coming from taper to supply coming from deficits, and shows how the balance between reserves and collateral evolved over time. It finds that the "free float" of reserves that's available to be lent into the o/n GC repo market on the margin is $200 billion and that taper should stop now.

Part five looks at how collateral supply has been driving the demand for reserves via daylight overdrafts and overnight GC repos and overnight fed funds. It shows that, collateral supply coming from taper and growing deficits was ill-timed from the beginning, as it coincided with the exhaustion of excess reserves outside the banking system and so it pressured excess reserves inside the banking system which has stressed o/n rates.

Part six shows how collateral supply and demand for reserves drove the price of reserves and concludes that the o/n GC repo rate is the system's core funding rate and that the o/n fed funds rate is a lagging and low-beta indicator of collateral-related stresses and so it should be demoted to be a peripheral funding rate. Finally, part seven concludes.

Part I – Taper and Intraday Flows

According to the Fed, taper is a simple affair (see here): it's a swap of reserves for bonds, where either banks or non-banks buy the bonds that the Fed no longer buys. Yes, but:

(1) How dealers underwrite and sometimes fund the process of taper matters.

(2) How the Bank of New York settles every single taper-related flow matters.

(3) How the pace of taper interacts with banks' demand for reserves matters.

First, taper doesn't just happen – primary dealers underwrite the process of taper.

Primary dealers underwrite newly issued Treasuries on settlement days in the morning and distribute them to various types of ultimate bank and non-bank buyers in the afternoon.

The map at the bottom of the page shows the Fed's conceptual framework of taper, where markets "magically" clear and bonds always flow to ultimate buyers post-taper – Scenarios 1 and 2 show non-banks and banks as ultimate buyers of bonds, respectively.

But ultimate buyers don't always buy. Banks and non-banks are price sensitive buyers – they only buy if it makes sense to buy. Rate hikes, curve slopes, and term premia determine if it makes sense to buy Treasuries, and, if the answer is no, primary dealers still have to, because hell or high water, the Primary Dealers Act of 1988 requires them to.

Since the fourth quarter of last year, it made no sense to buy Treasuries on the margin…

…because the yield curve inverted relative to all the relevant funding costs that matter – repo, Libor and FX hedging costs – and so ultimate buyers didn't gorge on Treasuries.

But primary dealers had to, and as they did, their inventories swelled (see Figure 1).

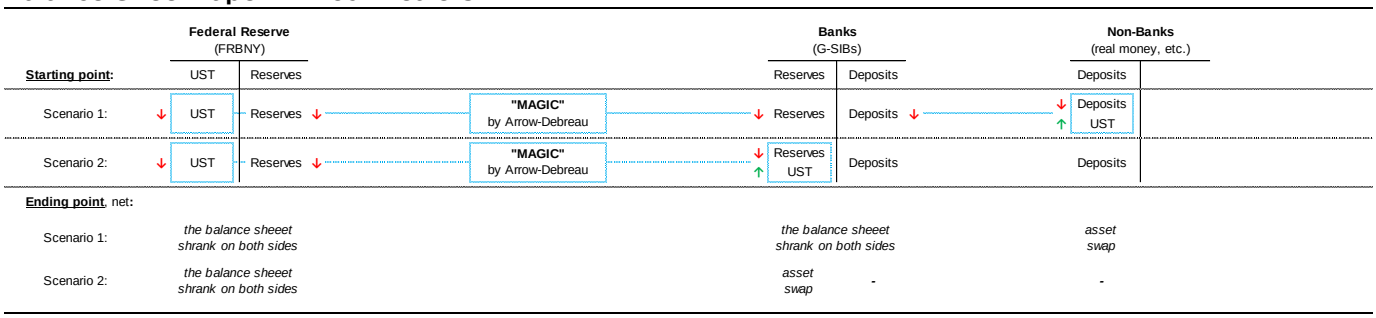
Primary dealers are not banks and their bread-and-butter marginal funding source is repo: the funding needs associated with expanding Treasury inventories drove the demand for o/n repo funding and pushed rates over the top of the target band (see Figures 2 and 3).

The map on the top of the next page shows how the slope of the Treasury yield curve can mess with the Fed's framework when it forces ultimate buyers to go on a buyers strike – Scenarios 3 and 4 show dealers as intermediate buyers when they are stuck with bonds.

Figure 4 tracks the volume of flows that went through some of these scenarios since the beginning of taper. It shows that large banks didn't buy that many Treasuries outright, but rather reversed them in via o/n GC repo from dealers as dealers leaned into banks to finance growing inventories – that's Scenario 4, which the Fed's framework didn't consider.

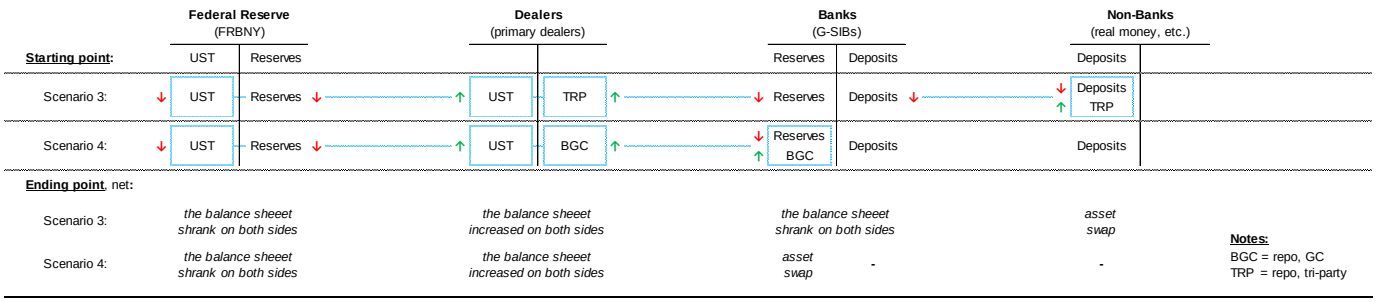
Inversions thus influence whether the Treasuries that enter the system via taper end up with ultimate buyers or intermediate buyers – i.e., primary dealers – and, because the two buyers fund in different money market segments, whether term or o/n rates are stressed.

Balance Sheet Taper Without Dealers



Source: Credit Suisse

Balance Sheet Taper With Dealers



Source: Credit Suisse

Second, the Bank of New York (BoNY) settles every single penny of taper-related flows – it collects reserves from banks in the U.S. and delivers them to the Fed for "shredding".

To understand how a clearing bank settles taper-related payment flows between banks, non-banks and Treasury, we first need to understand how dealers settle their payments.

Primary dealers aren't banks and because they aren't, they do not have reserve accounts and so cannot settle their payments using reserves. Instead, they settle their payments by drawing on their clearing accounts at BoNY – the sole clearing bank of every dealer.[1]

Primary dealers' settlement dynamics and BoNY are both ignored in the Fed's framework, but the four maps on the next two pages fix this omission and list the intraday flows that happen in the process of taper by building on the dealer-centric map atop this page. Thus:

(1) Dealers buy bonds and deplete their clearing accounts at 9:00 am [step 1A], and Treasury issues bonds and ups its general account balance (TGA) [step 1B].

(2) BoNY settles these flows by wiring reserves from its account at the Fed [step 2A], which deplete BoNY's account and increase the Treasury's account [step 2B].

(3) Treasury uses its balances to redeem maturing bonds at 9:30 am [step 3]…

(4) …and the Fed's balance sheet shrinks on both sides [step 4]; taper accomplished, and the Fed's framework conveniently ends here, but the process continues.

(5) Dealers sell the bonds and "re-fill" their clearing accounts by 3:30 pm [step 5A]; buyers buy the bonds outright or through repo and pay with deposits [step 5B]…

(6) …and these flows settle by buyers instructing their banks to wire money to the dealers' clearing accounts, which settle through reserves flowing from banks' reserve accounts to BoNY's reserve account at the Fed [steps 6A, 6B and 6C].

There is an order and "rhythm" to these flows – odd steps denote security flows and even steps denote reserve flows; securities get added and reserves get destroyed; BoNY is omnipresent, delivering reserves to Treasury for "shredding" in the morning and collecting reserves from banks in the afternoon for a new delivery at Treasury tomorrow.

The flows on each of the expanded maps are the same up through 9:30 – the red line – that is, up to the point where the Treasury redeems maturing Treasuries held by the Fed,

[1] Dealers used to have two clearing banks, J.P. Morgan Chase and BoNY, but today only BoNY clears for dealers. J.P. Morgan was effectively forced out of clearing for dealers by Basel III, as the accord's G-SIB framework deemed J.P. Morgan as the most complex and interconnected bank globally, which had major capital surcharge consequences (see here). In order to reduce its surcharges, J.P. Morgan decided to exit some businesses, like clearing for dealers.

Balance Sheet Taper With Dealers and Intraday Flows – Non-Banks as Ultimate Buyers (Scenario 1)

	Federal Reserve (FRBNY)		Dealers (Credit Suisse Securities LLC)		Banks (Citibank, N.A.)		Non-Banks (real money, etc.)	
7:00 AM	UST	$Reserves_{BoNY}$ $Reserves_{Citi}$ TGA	Deposits		$Reserves_C$	Deposits	Deposits	
9:00 AM		$Reserves_B$ ↓ [2B] TGA ↑	[1A] ↓ Deposits ↑ UST					
9:30 AM	↓ UST	TGA ↓ [4]						
3:30 PM		$Reserves_C$ ↓ [6C] $Reserves_B$ ↑	[5A] ↓ UST ↑ Deposits		↓ $Reserves_C$	Deposits ↓ [6A]	[5B] ↓ Deposits ↑ UST	
Scenario 1, net:	↓ UST	$Reserves_C$ ↓			↓ $Reserves_C$	Deposits ↓	↓ Deposits ↑ UST	
End-of-day, net:	*the balance sheeet shrank on both sides*		-	-	*the balance sheeet shrank on both sides*		*asset swap*	
Intraday:			Deposits (↓/↑)		$Reserves_C$ (↓)	Deposits (↓)		

	Treasury (Debt Management Office)		Clearing Bank (BoNY)	
7:00 AM	TGA	UST	$Reserves_B$	Deposits
9:00 AM	↑ TGA	UST ↑ [1B]	[2A] ↓ $Reserves_B$	Deposits ↓
9:30 AM	↓ TGA	UST ↓ [3]		
3:30 PM			↑ $Reserves_B$	Deposits ↑ [6B]
Scenario 1, net:	-	-	-	-
End-of-day, net:	-	-	-	-
Intraday:			$Reserves_B$ (↓/↑)	Deposits (↓/↑)

Source: Credit Suisse

Balance Sheet Taper With Dealers and Intraday Flows – Banks as Ultimate Buyers (Scenario 2)

	Federal Reserve (FRBNY)		Dealers (Credit Suisse Securities LLC)		Banks (Citibank, N.A.)		Non-Banks (real money, etc.)	
7:00 AM	UST	$Reserves_{BoNY}$ $Reserves_{Citi}$ TGA	Deposits		$Reserves_C$	Deposits	Deposits	
9:00 AM		$Reserves_B$ ↓ [2B] TGA ↑	[1A] ↓ Deposits ↑ UST					
9:30 AM	↓ UST	TGA ↓ [4]						
3:30 PM		$Reserves_C$ ↓ [6C] $Reserves_B$ ↑	[5A] ↓ UST ↑ Deposits		[5B, 6A] ↓ $Reserves_C$ ↑ UST	Deposits	Deposits	
Scenario 2, net:	↓ UST	$Reserves_C$ ↓			↓ $Reserves_C$ ↑ UST	Deposits	Deposits	
End-of-day, net:	*the balance sheeet shrank on both sides*		-	-	*asset swap*	-	-	
Intraday:			Deposits (↓/↑)					

	Treasury (Debt Management Office)		Clearing Bank (BoNY)	
7:00 AM	TGA	UST	$Reserves_B$	Deposits
9:00 AM	↑ TGA	UST ↑ [1B]	[2A] ↓ $Reserves_B$	Deposits ↓
9:30 AM	↓ TGA	UST ↓ [3]		
3:30 PM			↑ $Reserves_B$	Deposits ↑ [6B]
Scenario 2, net:	-	-	-	-
End-of-day, net:	-	-	-	-
Intraday:			$Reserves_B$ (↓/↑)	Deposits (↓/↑)

Source: Credit Suisse

Balance Sheet Taper With Dealers and Intraday Flows – Dealers as Intermediate Buyers (Scenario 3)

	Federal Reserve (FRBNY)		Dealers (Credit Suisse Securities LLC)		Banks (Citibank, N.A.)		Non-Banks (real money, etc.)	
7:00 AM	UST	$Reserves_{BoNY}$ $Reserves_{Citi}$ TGA		Deposits	$Reserves_C$	Deposits	Deposits	
9:00 AM		$Reserves_B$ ↓ [2B] TGA ↑	[1A] ↓ ↑	Deposits UST				
9:30 AM	↓ UST	TGA ↓ [4]						
3:30 PM		$Reserves_C$ ↓ [6C] $Reserves_B$ ↑	[5A] ↑	Deposits	TRP ↑	↓ $Reserves_C$	Deposits ↓ [6A]	[5B] ↓ Deposits ↑ TRP
Scenario 3, net:	↓ UST	$Reserves_C$ ↓	↑	UST	TRP ↑	↓ $Reserves_C$	Deposits ↓	↓ Deposits ↑ TRP
End-of-day, net:	*the balance sheeet shrank on both sides*		*the balance sheeet increased on both sides*		*the balance sheeet shrank on both sides*		*asset swap*	
Intraday:				Deposits (↓/↑)		$Reserves_C$ (↓) Deposits (↓)		

	Treasury (Debt Management Office)		Clearing Bank (BoNY)	
7:00 AM	TGA	UST	$Reserves_B$	Deposits
9:00 AM	↑ TGA	UST ↑ [1B]	[2A] ↓ $Reserves_B$	Deposits ↓
9:30 AM	↓ TGA	UST ↓ [3]		
3:30 PM			↑ $Reserves_B$	Deposits ↑ [6B]
Scenario 3, net:	-	-	-	-
End-of-day, net:	-	-	-	-
Intraday:			$Reserves_B$ (↓/↑)	Deposits (↓/↑)

Notes:
TRP = repo, tri-party

Source: Credit Suisse

Balance Sheet Taper With Dealers and Intraday Flows – Dealers as Intermediate Buyers (Scenario 4)

	Federal Reserve (FRBNY)		Dealers (Credit Suisse Securities LLC)		Banks (Citibank, N.A.)		Non-Banks (real money, etc.)	
7:00 AM	UST	$Reserves_{BoNY}$ $Reserves_{Citi}$ TGA		Deposits	$Reserves_C$	Deposits	Deposits	
9:00 AM		$Reserves_B$ ↓ [2B] TGA ↑	[1A] ↓ ↑	Deposits UST				
9:30 AM	↓ UST	TGA ↓ [4]						
3:30 PM		$Reserves_C$ ↓ [6C] $Reserves_B$ ↑	[5A] ↑	Deposits	BGC ↑	[5B, 6A] ↓ $Reserves_C$ ↑ BGC	Deposits	Deposits
Scenario 4, net:	↓ UST	$Reserves_C$ ↓	↑	UST	BGC ↑	↓ $Reserves_C$ ↑ BGC	Deposits	Deposits
End-of-day, net:	*the balance sheeet shrank on both sides*		*the balance sheeet increased on both sides*		*asset swap*	-	-	
Intraday:				Deposits (↓/↑)				

	Treasury (Debt Management Office)		Clearing Bank (BoNY)	
7:00 AM	TGA	UST	$Reserves_B$	Deposits
9:00 AM	↑ TGA	UST ↑ [1B]	[2A] ↓ $Reserves_B$	Deposits ↓
9:30 AM	↓ TGA	UST ↓ [3]		
3:30 PM			↑ $Reserves_B$	Deposits ↑ [6B]
Scenario 4, net:	-	-	-	-
End-of-day, net:	-	-	-	-
Intraday:			$Reserves_B$ (↓/↑)	Deposits (↓/↑)

Notes:
BGC = repo, GC

Source: Credit Suisse

which is where the Fed's framework ends. But the flows after 9:30 differ on each map, each showing a different way of dealers re-filling their clearing accounts by 3:30 pm, which is something dealers have to do every day so they have cash to trade with next day.

The first and second maps show dealers re-filling their clearing accounts by selling bonds. The third and fourth maps show dealers re-filling their clearing accounts by repoing bonds.

The main difference between the two sets of maps is that in the first set, ultimate buyers are ready to buy bonds and dealers can sell bonds, but in the second set, ultimate buyers are on a buyers strike, and the dealers are stuck with the bonds and need to fund them – more precisely they have to repo the bonds to raise cash to re-fill their clearing accounts.

The balance sheet entries in the cream-colored areas on each map are derived by netting all the balance sheet entries that were logged throughout the day; at the end of netting, we arrive at the four balance sheet scenarios we plotted on the simple maps at the outset.

Even though the clearing balances of primary dealers and the reserve balances of BoNY end the day flat, that is, unchanged, the fact that that they go through an intraday swing – see the blue areas in the maps above – has implications for banks' demand for reserves.

This brings us to our third discussion point: the impact that the accelerating pace of taper has on intraday liquidity risks and resolution liquidity adequacy and positioning (RLAP), at all banks with institutional clients and a primary dealer arm in the U.S. as well as BoNY.

Most readers of Global Money Notes are familiar with the liquidity coverage ratio (LCR), which requires banks to pre-fund 30-day outflows and invest the proceeds in HQLA, which include reserves or Treasuries bought outright or reversed in via reverse repos. Importantly, the LCR is based on end-of-day balance sheet snapshots, which means that intraday balance sheet dynamics do not impact how much HQLA banks need to hold.

RLAP supersedes the LCR, because it…

…forces large banks to hold HQLA over and above the quantum required by the LCR in order to ensure that banks are able to meet their intraday outflows as "gone concerns".

From the perspective of intraday payment flows, the main difference between a bank as a "going concern" and a bank as a "gone concern" is that if a bank is a "going concern", its outflows in the morning will come back as inflows in the afternoon, but if it becomes a "gone concern" at noon, there won't be any forthcoming inflows in the afternoon and it will end up short reserves for its LCR and hence breach one of its key Basel III metrics.

Banks with primary dealer arms and BoNY have large outflows of reserves in the morning and large inflows of reserves in the afternoon, and RLAP protects LCRs at these banks in a resolution setting by forcing them to pre-fund their intraday outflows (see Figure 5).

Importantly, because RLAP is all about intraday payment flows and intraday liquidity risks and because reserves are the only instrument that provide intraday liquidity for banks, the only way banks can become RLAP compliant is by holding more reserves at the Fed.

The accelerating pace of taper and increased supervisory focus on intraday liquidity risks and RLAP thus increases large banks' demand for reserves, as shown in Figure 6.

The left-hand panel in Figure 6 shows that as taper accelerates and settlement days grow, dealers draw on their clearing accounts more heavily and the intraday swings get bigger.

The middle panel shows how larger swings in dealers' clearing balances symmetrically drive larger intraday swings in BoNY's reserve balances at the Fed during the day.

The right-hand panel shows how bigger peak intraday outflows drive RLAP requirements and increase the demand for reserves at both primary dealers' parent banks and BoNY.

Part II – Taper and Daylight Overdrafts

Taper can get even more complicated…

…as sometimes primary dealers do not have enough money in their clearing accounts to take delivery of all the bonds that the Treasury puts into the system on settlement days.

Those are the "tough" days when some primary dealers incur daylight overdrafts at BoNY – the days when taper is not funded, but financed intraday.

In the examples discussed on the previous page, primary dealers had more than enough cash in their clearing accounts to take down more and more bonds due to faster taper, and faster taper mattered only because they increased dealers' peak intraday outflows which increased the amount of reserves parent banks and BoNY had to hold for RLAP.

Figure 7 shows what happens when dealers don't have enough cash to take the bonds.

The left-hand panel shows dealers incurring daylight overdrafts in their clearing accounts, that is, dealers taking intraday credit from BoNY. In turn, the middle panel shows that BoNY finances dealers' daylight overdrafts by incurring daylight overdrafts at the Fed, that is, by taking intraday credit from the Fed. As Professor Perry Mehrling would say…

…the payments system is a credit system, which is why interbank payments never bounce, even if the actors that need to pay do not have the money to pay when they have to pay.

Daylight overdrafts are no joke – they are expensive and can be reputationally damaging.

Daylight overdrafts at BoNY cost 60 bps per annum per minute for less than $5 billion, and 120 bps per annum per minute for amounts greater than $5 billion – all collateralized.

Daylight overdrafts at the Fed cost 50 bps per annum per minute when uncollateralized, and are free when collateralized (see here). Currently all daylight overdrafts at the Fed are taken on a collateralized basis; uncollateralized overdrafts are negligible (see here).

Daylight overdrafts at BoNY turn into o/n GC repo if they are not paid back by "sunset" – repo literally happens at night, that is, after sunset; that's why repo is "shadow banking".

Daylight overdrafts at the Fed turn into a discount window loan if unpaid by "sunset" – that's a reputational risk as under Dodd-Frank the Fed has to disclose who couldn't pay.

The pricing of and reputational risk around daylight overdrafts are a strong deterrent for dealers and BoNY to use overdrafts frequently and liberally on settlement days. That said, market making is an art, not a science and tough days and daylight overdrafts do happen.

When they do, dealers learn about it "T+2" when they receive their account statements from BoNY with all their negative balances and corresponding charges listed – per minute; dealers then go to their treasurers to present the bill and because the bill is so expensive, the treasurer will "seed" the dealer's clearing account with more cash the next morning.

Money does not grow on trees…

…and if dealers require more cash in their clearing accounts at BoNY, their parent banks will have fewer reserves at the Fed to cover their own intraday needs – which is a no-go; thus, to avoid overdrafts at BoNY, parent banks have no choice but to hold more reserves, and if parents have more reserves and can seed dealers with more cash in the morning, then BoNY's risk of incurring daylight overdrafts at the Fed is also lower (see Figure 8).

But calibrating the right level of reserves in real time is hard – overdrafts are unavoidable; the map overleaf shows how the settlement process of taper changes when we include daylight overdrafts. The map starts where the map depicting Scenario 4 on page 6 ends, and highlights the daylight overdraft-related extra balance sheet logs in light brown color.

Balance Sheet Taper With Daylight Overdrafts – Scenario (4) with Dealer Settlement Bottleneck at 9:00 AM

	Federal Reserve (FRBNY)		Dealers (Credit Suisse Securities LLC)		Banks (Citibank, N.A.)		Non-Banks (real money, etc.)	
7:00 AM	UST	$Reserves_{BoNY}$ $Reserves_{Citi}$ TGA	Deposits		$Reserves_C$	Deposits	Deposits	
9:00 AM		$Reserves_B$ ↓ [2B] TGA ↑ TGA ↑ +$20bn	[1A] ↓ Deposits ↑ UST +$20bn ↑ UST	Overdraft ↑ +$20bn				
	+$20bn ↑ Overdraft							
9:30 AM	↓ UST -$20bn ↓ UST	TGA ↓ [4] TGA ↓ -$20bn						
3:30 PM		$Reserves_C$ ↓ [6C] $Reserves_B$ ↑	[5A] ↑ Deposits	BGC ↑		[5B, 6A] ↓ $Reserves_C$ ↑ BGC	Deposits	Deposits
	-$20bn ↓ Overdraft	$Reserves_C$ ↓ -$20bn		Overdraft ↓ -$20bn BGC ↑ +$20bn		-$20bn ↓ $Reserves_C$ +$20bn ↑ BGC		
Scenario 4, net:	↓ UST -$20bn	$Reserves_C$ -$20bn ↓	↑ UST +$20bn	BGC +$20bn ↑		↓ $Reserves_C$ ↑ BGC	Deposits	Deposits
End-of-day, net:	*the balance sheeet shrank by $20bn more*		*the balance sheeet increased by $20bn more*		*asset swap of $20bn more*	-	-	
Intraday, normal:			Deposits (↓/↑)					
Intraday, with daylight overdrafts:			Deposits (↓/↑)	Overdrafts (↑/↓)				

	Treasury (Debt Management Office)		Clearing Bank (BoNY)	
7:00 AM	TGA	UST	$Reserves_B$	Deposits
9:00 AM	↑ TGA +$20bn ↑ TGA	UST ↑ [1B] UST ↑ +$20bn	[2A] ↓ $Reserves_B$ +$20bn ↑ Overdraft	Deposits ↓ Overdraft ↑ +$20bn
9:30 AM	↓ TGA -$20bn ↓ TGA	UST ↓ [3] UST ↓ -$20bn		
3:30 PM			↑ $Reserves_B$ -$20bn ↓ Overdraft	Deposits ↑ [6B] Overdraft ↓ -$20bn
Scenario 4, net:	-	-	-	-
End-of-day, net:	-	-	-	-
Intraday, normal:			$Reserves_B$ (↓/↑)	Deposits (↓/↑)
Intraday, with daylight overdrafts:			Overdrafts (↑/↓)	Overdrafts (↑/↓)

Notes:
BGC = repo, GC

Source: Credit Suisse

Thus, every step gets $20 billion bigger and the problems start at 9:00 am with step 1A – the dealer has to take down $120 in bonds but only has $100 in its clearing account.

Treasury can still issue the bonds and increase its general account by $120 in step 1B – it's the credit nature of the payment system that ensures that the settlement doesn't fail.

BoNY helps the dealer out with the missing $20 by extending an intraday credit of $20, and BoNY funds this credit extension by borrowing $20 intraday from the Fed in step 2A.

The Fed effectively funds the 9:00 am settlement bottleneck by letting its balance sheet expand on both sides intraday – BoNY's overdraft funds larger TGA balances in step 2B.

Larger TGA balances enable Treasury to redeem $20 more in Treasuries at 9:30 am, and these larger redemptions shrink the Fed's bond holdings $20 more in steps 3 and 4.

In addition to "re-filling" its clearing account at BoNY by 3:30 pm, the dealer also has to scramble to replace its intraday funding at BoNY – the charges are piling every minute – and bids for an additional $20 in o/n repos which a bank will provide in steps 5A and 5B.

The bank wires an additional $20 to the dealer's clearing account, which settles through BoNY receiving an additional $20 in its reserve account from banks, which BoNY uses to pay its overdraft at the Fed, and the Fed's balance sheet shrinks $20 more in step 6.

Taper that's financed intraday thus always involves stresses in the GC repo market in the morning. The driver of these stresses is always a dealer that's scrambling to pay off its daylight overdraft at BoNY which is ticking at 60-120 bps per annum per minute, and the solution to these stresses is typically a reserves-rich bank that swaps its reserves for repo.

But sometimes reserves-rich banks cannot lend more because they hit their limit – whatever reserves they have they need to cover their intraday liquidity risks and RLAP.

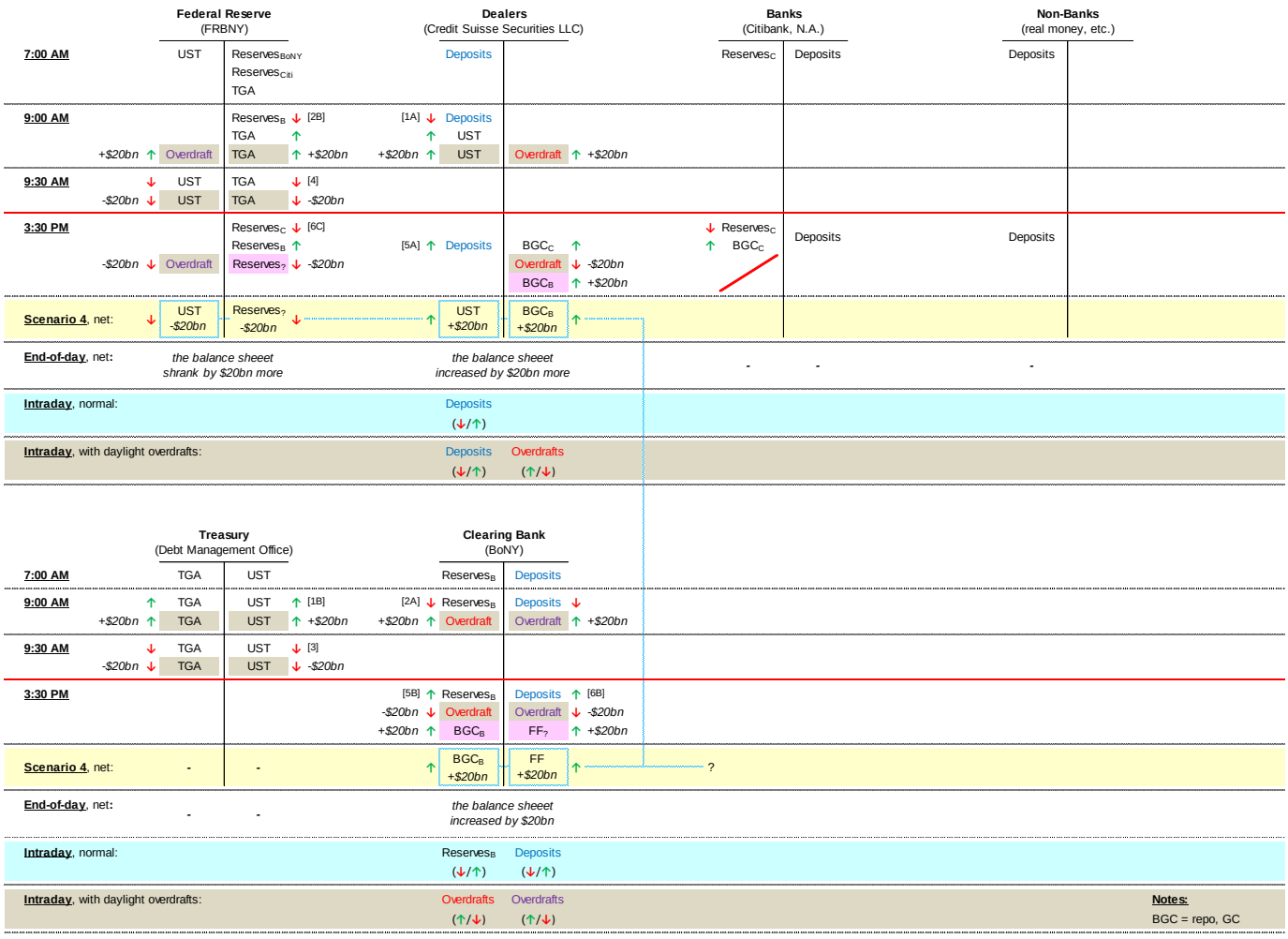
The map below shows the scenario where banks cannot lend an additional $20 to dealers through o/n repos and so dealers have a settlement bottleneck with BoNY at 3:30 PM – the settlement bottleneck with the Treasury at 9:00 am becomes a settlement bottleneck with BoNY at 3:30 pm, effectively because reserves get scarce in banks' HQLA portfolios.

The map is identical to the prior map except for the cells highlighted with light purple color, which show the new funding arrangement dealers have to find to pay off their overdrafts.

Thus, instead of borrowing an extra $20 from a bank HQLA portfolio through o/n repos, dealers have to roll their daylight overdrafts into o/n repos with BoNY in step 5A and 5B.

That's a problem for BoNY, because unlike the previous example, it receives no inflows from banks to pay off its daylight overdraft at the Fed – BoNY has to fund on the margin in the fed funds market to fund dealers and to pay back the Fed in steps 6A, 6B and 6C.

Daylight Overdrafts Turn into Overnight Funding – Scenario (4) with Dealer Settlement Bottleneck at 3:30 PM



Source: Credit Suisse

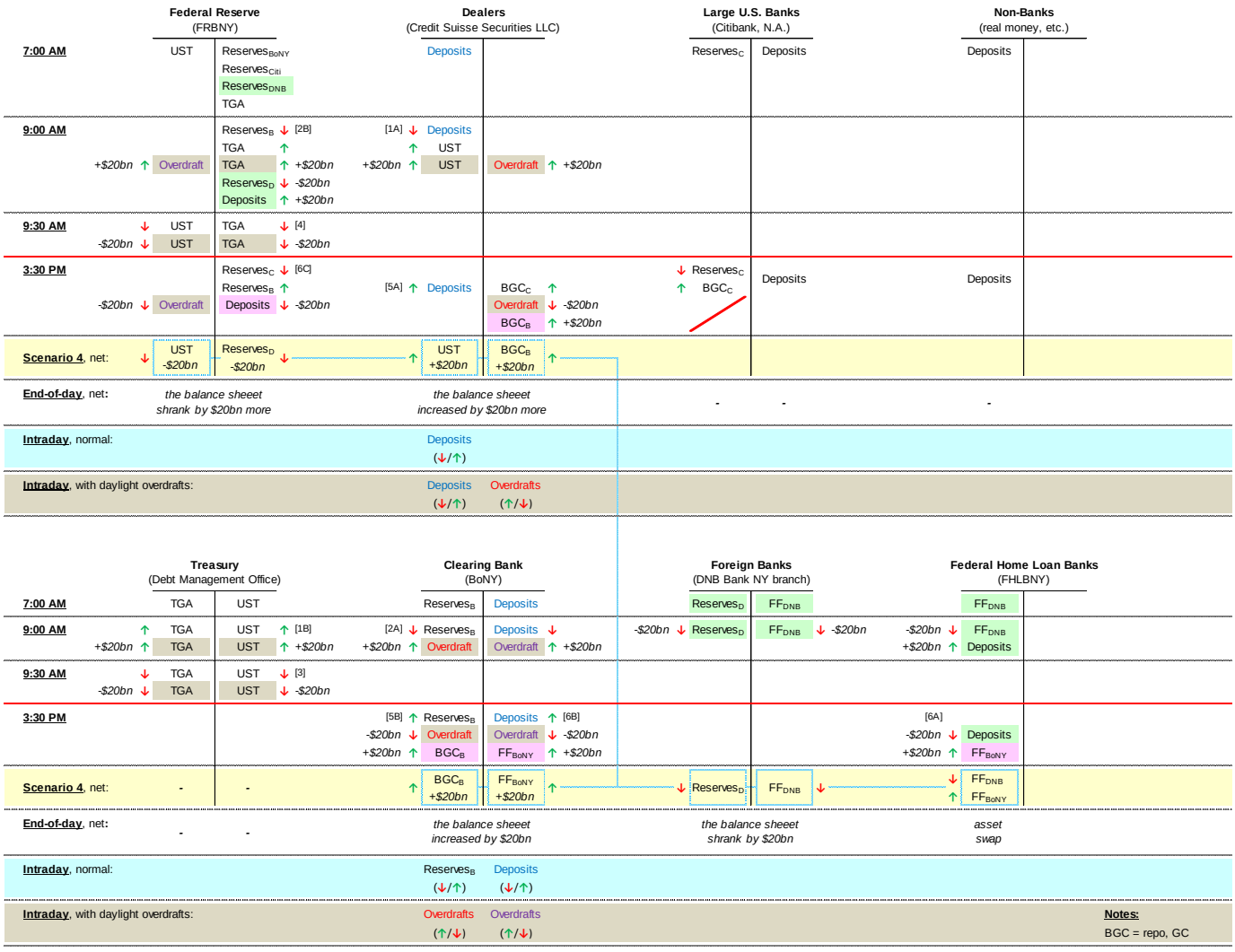
Readers that pay attention will naturally ask the next question – who lends to BoNY in the fed funds market and where will the reserves come from so BoNY can pay back the Fed?

The map below continues where the previous map left off and highlights with light green all the steps that happen earlier in the day that enable BoNY to bid fed funds away from someone else at the end of the day. It includes two new entities that didn't feature before – the New York branches of foreign banks that arbitrage fed funds and some other rate, and the Federal Home Loan Banks which account for all lending in the fed funds market.

Thus, well before 9:00 am, foreign banks repay their fed funds loans to the FHLBs, which reduces foreign banks' reserve accounts and increases FHLBs' deposit accounts at the Fed. Normally the FHLBs will roll the same amount with the same foreign banks, unless there was a tough day and dealers and BoNY struggle with settlement bottlenecks.

On a typical tough day dealers roll their daylight overdrafts into o/n GC repos at BoNY and BoNY pays its overdrafts at the Fed with borrowing in the o/n fed funds market. BoNY's motivation is to settle with the Fed, which trumps foreign banks arbitrage needs and so BoNY's bid for fed funds will be more aggressive. BoNY's settlement needs crowd out arbitrage needs, and we just had a day when the fed funds rate printed higher!

Settlement Needs Crowd Out Arbitrage Needs – Scenario (4) with Crowding Out in the o/n Fed Funds Market



Source: Credit Suisse

Part III – Taper and the Curve Inversion

We now know all the moving parts that influence funding markets as taper progresses: we can now chart taper-related flows within our Flow of Funds and Collateral framework.

Figure 9 shows that since the beginning of taper in October, 2017, the Fed "shredded" over $500 billion in reserves, which means that banks have $500 billion fewer reserves to settle payments. $300 billion was lost due to the taper of the Fed's Treasury portfolio, and a smaller $200 billion was lost due to the taper of the Fed's agency MBS portfolio.

To understand how the changing mix between reserves and Treasury collateral impacts o/n GC repo rates, we first have to understand how the Fed controls the pace of taper.

Figure 10 shows that the headline pace of Treasury taper has two distinct components: the notes in the Fed's portfolio are maturing a bit faster than the pace of Treasury taper, and the Fed slows this pace by buying bills, which Treasury issues outside of auctions; this way, as reserves get shredded a bit faster than the target pace due to note maturities, the Fed adds reserves by purchasing just enough bills to keep taper at its target pace.

Importantly, Treasury supply is shaped by the pace of decline of the Fed's notes portfolio, as that's the amount of collateral the market has to absorb at auctions; we will use this as the base to check what type of investor absorbed how much collateral since taper began.

But first, let's take a look at the general fixed income market backdrop to taper, that is, the shape and slope of the U.S. Treasury curve and how it impacts the flow of collateral.

Thus, the beginning of the fourth quarter of 2018 marked a special event – that's when the curve inverted relative to all the actual term funding costs that matter for carry traders.

Under Basel III, curve inversions shouldn't be tracked by points along the Treasury curve: measures such as 3s/10s spreads used to have meaning to them before Basel III, because most money market spreads traded quite tight relative to three-month bill yields, and 3s10s spreads were a pretty good proxy for the carry earned by most carry traders.

Under Basel III, 3s10s spreads are meaningless, because carry traders fund at sizeable spreads over three-month bill yields: three month GC repo, Libor and FX hedging costs can at times be more than 50 bps above bill yields, and it's these actual funding costs that the 10-year Treasury yield should be compared against to track the curve inversion – for more on inversions see here and also our interview on Bloomberg's Odd Lots podcast.

Figure 11 shows that relative to actual FX hedging costs, the Treasury curve has been inverted since October 2018, and at around -25 bps, that inversion has been material; comparing the 10-year yield to U.S. dollar Libor and term GC repo yield inversions too, but less negative ones. Fed officials are on the record saying that one should worry about inversions if they show persistence, "meaning they last for months, not weeks" (see here).

Well, according to our measures the curve has been inverted for eight months now – that's months, not weeks – and so it's time to worry, if for no other reason than the fact that inversion is making taper counterproductive by pushing o/n rates outside the band!

Here is how…

Figure 12 shows that when the Treasury curve inverted – see the vertical orange line – ultimate non-bank buyers stopped absorbing Treasuries that entered the system via taper; these flows correspond to Scenario 1 on the simple map showing the Fed's framework.

Ultimate non-bank buyers include domestic real money accounts with dollars to spend, hedge funds that borrow dollars through repo, and also the foreign real money accounts who swap local currency for dollars – i.e., who FX hedge – through the FX swap market.

Figure 13 shows the flipside of ultimate non-bank buyers strike as discussed in Part I – primary dealers' inventories absorbed $150 billion of Treasuries as the curve inverted and carry traders – FX hedged buyers and hedge funds – stopped buying Treasuries.

Foreign real money accounts fund in the term FX swap market and hedge funds fund in the term repo market and when the curve inverts and dealers have to buy instead of them, they fund with o/n repos because they are in the moving business, not the carry business.

In English, when the curve inverts, funding pressures go from term funding markets to o/n funding markets – from three-month cross-currency bases and U.S. dollar Libor, to o/n GC repo and tomorrow-next (t/n) cross-currency bases and by extension spot dollars.

Indeed the curve inversion has been the most extreme relative to o/n GC repo rates.

Banks are largely immune from inversions relative to o/n and even term funding rates as they have cheap deposits to fund with – this advantage is greatest for U.S. banks.

Figure 14 shows how much of the Treasury collateral that entered the system via taper was absorbed by ultimate bank buyers, which include banks and foreign central banks – these flows correspond to Scenario 2 on the simple map showing the Fed's framework.

Banks absorbed $30 billion of the supply from taper until the end of September, 2018, and then bought $70 billion during the fourth quarter of 2018, after the curve inverted – banks thus absorbed $100 billion of $300 billion of Treasuries since the start of taper.

Figure 15 shows that foreign banks' New York branches absorbed about a half of this, largely before the curve inversion, and large U.S. banks – mostly the G-SIBs – absorbed the other half after the curve inversion as ultimate non-bank buyers turned into net sellers; Figure 16 shows that J.P. Morgan bought three-fifths of the notes bought by U.S. banks.

Foreign central banks' purchases – proxied by FRBNY's custody holdings of Treasuries – were quite unimpressive. Their trend is flat, with a bout of purchases during early 2018, then nothing for the rest of 2018, and then some modest purchases again in early 2019.

Foreign central banks did not absorb much of the Treasury supply that entered via taper.

Ultimate non-bank buyers resumed their Treasury purchases at the beginning of this year, as fixed income markets started to price in expectations for a Fed rate cut later this year, and these flows helped primary dealers' reduce their Treasury inventories on the margin.

However, these purchases are driven mostly by domestic carry traders, i.e. hedge funds, and for their trade to work, the Fed will indeed have to cut interest rates later this year – if it does, repo rates get lower and current negative carry becomes future positive carry; if not, hedge funds may have to sell and some parts of the Treasury curve can sell-off.

Figure 17 shows a summary of the previous charts. It highlights the deterioration of the balance between reserves and collateral supply in the o/n GC repo market on the margin – the supply of Treasury collateral increased by $300 due to taper and reserves declined by a much bigger $500 billion. The worsening mix between reserves and collateral in the repo market is being made worse by the rising demand for repo from two groups – primary dealers and relative value hedge funds, which are shown in red and purple areas.

Figure 18 shows beautifully how large U.S. banks lending in the o/n GC repo market lines up with primary dealers' needs to fund their growing Treasury inventories, and also how hedge funds' funding needs since the beginning of 2019 were also filled by large banks, – these flows correspond to Scenario 4 on the simple map that shows taper with dealers.

From our previous work we know that one bank accounts for the bulk of this marginal lending in the o/n GC market, which is the same bank that bought the most Treasuries…

…J.P. Morgan Chase Bank, N.A. (see here).

Figure 19 shows the amount of reserves held by each major U.S. and foreign bank with a direct pipe into the GC repo market as of June 30, 2018 – before the bid for repo began.

The first column shows J.P. Morgan as an entity unto its own – the reserves slice of its bank's balance sheet is the "bastion" of global money markets, which enables it to function as the system's lender of next-to-last resort in whichever market trades stressed.

The second and third columns show that no other U.S. bank or no group of foreign banks come close to J.P. Morgan's singular firepower in money markets. The fourth column shows foreign banks by name and the fifth shows Japan's consolidated claims on FRBNY – the amount of money the Japanese Ministry of Finance keeps at the foreign repo pool plus the amount of reserves the three largest Japanese banks keep in their Fed accounts.[2]

Figure 20 shows the same entities' reserve balances as of December 31st, 2018, which was the day when the repo market struggled to clear and printed as high as 6.5%.

What stands out is that J.P Morgan's reserve balances shrank dramatically. Importantly, the $150 billion in reserves J.P. Morgan held on December 31st, 2018 likely represents the amount of reserves it held for intraday liquidity needs (RLAP) as discussed above – otherwise it would have lent more in the o/n repo market to chase stratospheric yields.

What also stands out is that Japanese banks – and only Japanese banks – increased their reserve holdings at the Fed by about $30 billion, which, when combined with the Japanese Ministry of Finance's deposits at the foreign repo pool, puts "Japan Inc.'s" consolidated claims on FRBNY at close to $250 billion. Japan is thus the new "bastion" of global money markets, and just as J.P. Morgan was the solution to the repo market's stresses last year, the liquidity in the foreign repo pool could have solved current stresses.

We've made our case for capping the foreign repo pool here, and our current analysis provides further support to our case. It's incomprehensible that the Fed is forcing a redistribution of reserves among banks while turning a blind eye to accumulation elsewhere.

Figure 21 shows the change in reserves between the second and fourth quarters of 2018 and Figure 22 shows the uses of reserves. It shows how the entities in each column spent their reserves, that is, whether they used reserves to buy Treasuries outright or if they reversed them in through repos. The numbers here correspond to our earlier points: that banks spent their reserves mostly by lending in the repo market to primary dealers; that banks spent a relatively small share of their "excess" reserves on Treasuries; and that J.P. Morgan was the dominant lender in the o/n GC repo market at the end of 2018.

Data aren't yet available for the first quarter of 2019, but our weekly taper-tracking charts suggest not much change from the status quo presented in Figure 20: large banks' holdings of Treasuries and presence in the o/n GC repo market are broadly unchanged.

Thus, the picture that emerges is that taper effectively makes Treasury fund its deficits in o/n markets on the margin where funding is coming from one bank, which is J.P. Morgan.

That's not a viable funding strategy, in our view.

The broad message from this part of our analysis is that the Fed should not taper into a curve inversion, because the marginal buyers of Treasuries in such an environment are dealers and hedge funds. Dealers buy because they have to, not because they want to, and hedge funds buy because they think the Fed will soon cut rates. It is their funding needs that pressure o/n repo rates and the o/n fed funds rate outside the target band, and if rate cuts do not materialize, pressures can ricochet to the long-end of the curve.

[2] We proxy the Ministry of Finance's deposits in the foreign repo pool using public disclosures (see here and here).

Part IV – Taper and Collateral Supply

Let's next broaden our perspective and examine how balance sheet taper compares to broader market trends, such as the growing supply of Treasuries due to rising deficits.

Figure 23 shows that the net supply of Treasuries has increased materially during 2018, primarily due to the growing federal deficits. The dashed lines show the portion of supply that came from taper, and are identical to the dashed lines we plotted on previous charts.

The taper-related supply of notes is thus relatively small, but because such supply destroys reserves on the margin, it has an outsized impact on o/n markets on settlement days.

Treasury supply falls into three categories:

(1) Supply that destroys reserves.

(2) Supply that sterilizes reserves.

(3) Supply that circulates reserves.

Supply that destroys and sterilizes reserves are functionally equivalent and so both have an outsized impact on o/n money markets on settlement days – tearing up dollar bills is the same as putting them under the mattress, and shredding reserves is the same as the U.S. Treasury raising reserves but not spending them, which is why we've referred to sterilization as "shadow taper" in the past (see here). Taper, combined with shadow taper, has a current run-rate of $800 billion, faster than the run-rate of taper at $500 billion.

Supply that circulates reserves is more benign from the perspective of funding markets, as the reserves raised by the Treasury are spent right away and so the banking system does not lose reserves to settle with. Supply that circulates effectively drains reserves from BoNY and dealers' parent banks in the morning, but then sends them right back to the banks as the private sector receives payments from the government in the afternoon.

Readers that wish to practice mapping out the reserve and collateral flows generated by the three types of supply can do so by using the template map provided in the Appendix.

Regardless of which type of Treasury supply we map, several "universal" rules emerge: primary dealers are central to the underwriting and distribution of all three types of supply; BoNY is also central to the movement of reserves involved under all three types of supply; primary dealers' clearing balances have an intraday swing under all three types of supply; and, regardless of the type of supply, primary dealers will do everything they can to ensure that their clearing balances at BoNY end the day flat, that is, unchanged, and so will work hard during the day to outright sell or repo the Treasuries that they absorbed on inventory.

Furthermore, similar to how the accelerating pace of taper leads to bigger auction days, bigger settlement days, bigger intraday outflows and more collateral supply on the margin, growing deficits do the same and hence lead to more demand for reserves under RLAP.

Where things are different under the three scenarios is that under circulation supply, banks don't lose reserves and day-end liquidity that funds unsold inventory doesn't suffer, but under taper and sterilization supply, banks lose reserves and day-end liquidity suffers.

Let's next examine how the three types of supply evolved over time.

Figure 24 shows the net supply of Treasuries each year since Basel III went live in 2015, the net amount of reserves that were "shredded" and sterilized each year since then, and how the "shredding" and sterilization of reserves shaped the stock of reserves over time.

Thus, Treasury supply increased by about $500 billion each year and by $1 trillion in 2018; the supply of reserves was broadly unchanged in 2015; fell by about $400 billion toward the end of 2016 due to sterilization – a $200 billion increase in Treasury's cash balances;

increased by about $100 billion during 2017; and then fell by over $500 billion in 2018 – due to a combination of about $200 billion in sterilization and about $300 billion in taper.

Thus, the mix between reserves and Treasury collateral has been worsening on the margin every year since the rollout of Basel III – because the net supply of Treasuries has been increasing relentlessly and the supply of reserves has been either flat or down considerably.

Who cares you say – the stock of reserves remain elevated in the banking system and so there is plenty of liquidity around to underwrite and fund net issuance on settlement days; settlement days are seldom bigger than $50 billion and only a portion of supply is funded on repo and the top line in Figure 24 suggests the system has plenty of liquidity at hand.

Not so fast…

Figure 25 shows the effective supply of reserves to grease Treasury supply on the margin, and effective supply is now alarmingly close to zero. What follows isn't a precise exercise, but rather a "guesstimation" that's useful to frame the current state of funding markets.

To arrive at the effective supply of reserves, we subtract from the total amount of reserves the amount of reserves banks hold due to reserve requirement as per the H.3 release; reserves held to satisfy reserve requirement are not available for trading in repo markets.

Next, we subtract $300 billion from the previous subtotal, and do this from 2018 onwards, when supervisory focus on resolution liquidity began. This $300 billion is our estimate of the amount of reserves that large U.S. banks have to hold so they are RLAP compliant; $300 billion is realistic, as it appears that J.P. Morgan's intraday needs are $150 billion – see our discussion above – and other G-SIBs likely have a similar need in the aggregate.

Next, we subtract from the previous subtotal all of the reserves held by foreign banks; we do this because in the previous section we've shown that foreign banks did not lend a lot into the o/n GC repo market when o/n GC rates were trading stressed last year-end – presumably because large foreign banks keep these reserves for "internal" stress tests.

Foreign banks' holdings of reserves for internal stress tests are similar to U.S. banks' holdings for intraday stress tests: foreign banks operate not only in the U.S. but also in their home jurisdiction, where they are major providers of U.S. dollar liquidity. Fedwire, the Fed's payments system, is open for nearly 24 hours which means that for foreign banks, reserves held at the Fed provide dollar liquidity during Tokyo hours and London hours – i.e. intraday in offshore jurisdictions. Were foreign banks to lend their reserves during New York hours in the o/n GC repo market to fund dealers' inventories, they would lose liquidity during Tokyo and London hours and expose their internal operations to stresses.

Finally, we subtract from the previous subtotal – the light blue line – the amount of reserves that large U.S. banks have already deployed in the GC repo market to fund dealers and hedge funds as discussed above, which show up as borrowed reserves at other banks.

The bottom line – the orange line – is our estimate of the effective supply of reserves that's available to fund collateral supply on the margin. Call this the "free float" of reserves or whatever you want to, but the point is that this is the amount of "excess" reserves in the system, i.e. the amount that stands between o/n rates printing within *vs*. outside the Fed's target band – the amount that serves as the Fed's operational margin of safety.

Figure 26 shows how the stock of excess reserves compares to the current pace of collateral supply: the two are practically in line, which, in an environment where dealer inventories are elevated and are likely to grow more due to the ongoing curve inversion, means that losing reserves on the margin can have a big impact on o/n GC repo rates.

The recent experience with U.S. tax payments – which sterilized $200 billion of reserves – also points to the same conclusion: reserves are now tight, with no margin of safety left.

Part V – Collateral Supply and Demand for o/n Funding

Let's next switch into a higher-gear and switch from weekly frequency to daily frequency and track how collateral supply drives daily demand for o/n GC repos and o/n fed funds.

Our discussion will frequently refer back to the concepts introduced in the previous parts:

(1) How primary dealers and BoNY are central to the process of taper and how the pace of taper interacts with intraday liquidity risks and banks' demand for reserves.

(2) How daylight overdrafts provided by BoNY and the Fed help out on some days, and how such days are usually characterized by stresses in o/n funding markets.

(3) How curve inversion impairs the flow of collateral and bloats dealers' inventories, and how one large U.S. bank funds dealer's bloated inventories on the margin.

(4) How growing federal deficits supercharge the system's intraday liquidity risks and hence demand for reserves and how this cuts into the "free float" of reserves.

We'll start our analysis of how Treasury supply drives demand for o/n funding by dividing supply into its parts, which are bills, notes and bonds, and taper and non-taper supply. Figure 27 shows bills, notes and bonds supply alongside the volume of total supply, and Figure 28 breaks notes supply down into its taper and non-taper-related subcomponents.

We'll analyze the impact of bill and coupon supply separately, starting with bill supply.

The first thing to note about bill supply is that it's the most volatile part of Treasury supply, and this volatility can easily overwhelm the "free float" of reserves as shown in Figure 26. For example, the $300 billion increase in bill supply that occurred at the start of 2018 would completely overwhelm the "free float" of reserves in bank HQLA portfolios today.

The second thing to note about bill supply is that it's the most important driver of demand for o/n GC repo on the margin and also government money market mutual funds' use of the Fed's o/n RRP facility outside of quarter-end turns. Historically, when bill supply fell, the use of the facility went up, and when bill supply increased, the use of the facility fell.

Treasury's issuance of over $300 billion of bills and sterilization of $100 billion of reserves during the first quarter of 2018 pushed the use of the o/n RRP facility all the way to zero – we highlight this this period with the two vertical thin red lines in Figures 29 and 30.

Functionally, the flows absorbed by the o/n RRP facility provide a home for the reserves that clearing banks don't want to retain, and banks or primary dealers don't want to borrow either due to a lack of balance sheet, available collateral or arbitrage opportunities, and so the usage of the o/n RRP facility falling to zero was an important milestone – it basically told us that the mount of reserves unwanted by intermediaries reached zero.

In English, the Fed's o/n RRP facility is the system's true barometer of excess reserves outside the banking system: the reserves that flow into the RRP facility are funds that money funds couldn't place with banks at reasonable rates because they weren't needed, and conversely, when reserves stop flowing into the RRP facility and its usage is zero, every penny of reserves is bid as they are needed by U.S. and foreign banks and dealers.

By this metric, excess reserves outside the banking system were thus nil by early 2018…

…and so collateral supply – due to the accelerating pace of taper and growing deficits – was going to lean heavily on excess reserves inside the banking system. Excess reserves inside the banking system refer to the amount of reserves banks hold in HQLA portfolios over and above the amount they need to cover their intraday liquidity needs and RLAP.

Taper was thus shredding "inside" liquidity, not "outside" liquidity from the very beginning, and so we expected stresses in o/n markets to soon follow on a daily basis (see here).

Figure 31 shows bills-only and total net supply of Treasury securities on settlement days, with the horizontal red lines marking the $25 billion and $50 billion amounts respectively, to help separate average settlement days from chunky settlement days, where we define chunky settlement days as days when net supply of bills or coupons exceeds $25 billion.

It shows that as taper and federal deficits grew in 2018, settlement days got bigger, and days when net supply exceeded $25 billion or even $50 billion became more frequent. Supply was initially concentrated in bills, but as 2018 wore on, supply got coupon-heavy, largely due to increased note supply due to the faster pace of taper as discussed above.

We'll use the daily net supply data from this chart to track the impact that collateral supply has had on the demand for o/n GC repos, fed funds and daylight overdrafts at the Fed; furthermore, all charts from here on forward will include thin lines that mark quarter-ends to make it easier to identify on the charts the intra-quarter trends we refer to in the text.

Figure 32 shows the daily net supply of bills-only and total Treasury collateral at the bottom and o/n GC repo volumes on top. Repo volumes include both bilateral and GCF® trades and come from the Fed's daily SOFR release. The yellow squares along the repo series mark chunky bill supply days, i.e., days when bill supply was greater than $25 billion.

It shows that o/n GC repo volumes trend higher during periods when bill supply is heavy: bill supply pulled o/n GC volumes above $450 billion during the first quarter of 2018, and when supply fell during the second quarter, repo volumes fell to around $400 billion; bill supply was flat during the third quarter and then rose again early in the fourth quarter, which pushed volumes toward $450 billion. Dynamics then changed as discussed below.

The relationship between bill supply and demand for o/n GC repo is simple and intuitive: more bills mean less lending by money market funds in the tri-party repo market, which dealers need to replace with GC repos by borrowing from banks' HQLA portfolios.

Figure 33 shows chunky coupon supply days, that is days when net coupon supply – non-taper and taper-related note supply and bond supply – exceeded $25 billion. Compared to net bill supply, which drives demand for o/n GC repos around its trend, chunky coupon supply days tend to drive episodic spikes in o/n GC repo volumes.

Figure 34 shows the orange squares and red squares lumped together to show the "trends *vs*. extremes" theme in one place. It also shows that the fourth quarter of 2018 was an exception to the "trends *vs*. extremes" rule of chunky bill and chunky coupon days.

What made the fourth quarter unusual was the inversion which bloated dealer inventories, as discussed in Part III: as inventories increased by $150 billion, demand for GC repos increased too, and during a quarter with three days when net coupon supply was above $50 billion it wasn't difficult for inventories and hence GC demand to leap by $150 billion, the bulk of which was met by J.P. Morgan deploying reserves from its HQLA portfolio.

Let's next examine how chunky days drive demand for daylight overdrafts and demand for o/n fed funds (FF). Like before, we examine the impact of bills and coupons separately.

Figure 35 shows the volume of peak collateralized daylight overdrafts at the Fed and the volume of o/n FF borrowed by U.S. banks – i.e., excluding borrowing by foreign banks. Like before, the orange squares mark chunky bill supply days and like with GC volumes, we see chunky bill supply days driving trends in demand for daylight overdrafts and o/n FF.

The first quarter of 2018 was quite a remarkable episode in overnight funding markets – as discussed above that's the quarter when Treasury issued $300 billion of bills and sterilized $100 billion of reserves, which completely exhausted excess "outside" reserves.

The chart shows beautifully how the disappearance of excess "outside" reserves triggered an increase in the demand for daylight overdrafts at the Fed – as discussed in Part II,

the flipside of daylight overdrafts are injections of temporary daylight reserves by the Fed, which banks have to pay back by the end of the day by borrowing in the o/n FF market; as one would expect, demand for daylight overdrafts and o/n FF move closely together.

The co-movement of daylight overdrafts and o/n FF is strongest during periods when bill supply is extremely chunky for several weeks – like the first quarter of 2018 when out of a total of $300 billion in net new bills, $200 billion were issued over a four week period.

Bill supply has been a lot more manageable since the first quarter of 2018 so the impact of chunky bill supply days wasn't as pronounced on the demand for daylight overdrafts and o/n FF as it was back then, but the relationship that we described above still holds.

Figure 36 shows the impact that chunky coupon supply days have on the demand for daylight overdrafts and o/n FF; like in the case of o/n GC repos, chunky coupon days, tend to drive extremes, rather than trends or inflexion points in the demand for o/n FF.

Figure 37 shows total versus collateralized peak daylight overdrafts: as noted in Part II, currently, nearly all daylight overdrafts at the Fed have been taken on a collateralized basis, i.e., they are being extended for free as per the Fed's pricing policy of daylight overdrafts.

The fact that most overdrafts are collateralized tell us that banks use them to get through the tough days discussed in Part II – when taper is not funded, but financed intraday, or when the system goes through a regime shift like when excess "outside" reserves disappear and dealers and banks have to change their daily funding and lending routines.

Who was driving the demand for collateralized overdrafts during the first quarter of 2018? If the framework we presented in Parts I and II of our analysis is correct, it must be that:

(1) If peak collateralized overdrafts correspond to chunky Treasury settlement days, it must be that BoNY was running a matched book of overdrafts during the period.

(2) It must also be that if BoNY was running overdrafts at the Fed it did so because it let primary dealers run overdrafts in their clearing accounts – the matched book – and so BoNY had to borrow in the o/n FF market to pay back the Fed at day-end.

Indeed, Figure 38 shows a huge increase in BoNY's borrowing of o/n FF at the end of the first quarter of 2018, in line with the use of collateralized daylight overdrafts at the Fed; the data are from BoNY's call reports and refer to borrowings on spot quarter-end dates.

The big increase in BoNY's borrowing of o/n FF at the end of the first quarter of 2018 is actually an understatement. The spot amount of o/n FF that U.S. banks borrowed was $20 billion on March 31st, 2018, compared to a peak of $30 billion a week before – see Figure 35 above. BoNY's presence in the o/n FF market was thus $10 billion larger than what's shown in its call reports, that is, it peaked around $20 billion, not $10 billion!

In English, it appears that all of the $20 billion increase in U.S. banks borrowing in the o/n FF market during the first quarter of 2018 was driven by just one large bank – BoNY.

Demand for daylight overdrafts at the Fed and BoNY's presence in the o/n FF market fell sharply in subsequent quarters. It was particularly low during the third quarter of 2018, which corresponds to the fairly slow pace of collateral supply during the summer months.

BoNY's borrowings in the o/n FF market then jumped $5 billion during the fourth quarter, and, like before, that level likely understates its presence in the market during the quarter.

BoNY's borrowing in the o/n FF market is not yet available for the first quarter of 2019, but Figure 39 shows some familiar patterns – a spike in peak daylight overdrafts early in the first quarter of 2019, which corresponded to a sizeable spike in demand for o/n FF, which in turn corresponded to a $30 billion increase in primary dealers' inventories of bills – an inversion-related build from $150 billion of supply during the quarter (see Figure 40).

Part VI – Collateral Supply and o/n Rates

Let's finally take a look a look at how demand for o/n funding impacts o/n interest rates.

Since the launch of the Fed's SOFR release, we can track repo stresses quite precisely as we know the rates associated with the 99th and 75th percentile of o/n GC repo trades. Such granular data however starts from the second quarter of 2018 and so doesn't cover the period when bill supply stressed out funding markets during the first quarter of 2018.

As a solution, we'll analyze o/n repo rates in two steps: first, we use o/n GCF® rates to show trends stretching back to the first quarter of 2018, and then we use SOFR rates to show repo stresses at a more granular level from the second quarter of 2018 onwards.

Thus, Figure 41 shows the o/n GCF® repo rate relative to the target band for o/n rates: it shows that the o/n GCF® rate structurally drifted outside the band around the end of the first quarter of 2018, and it never went back. The line around the horizontal axis shows the o/n GCF®-IOR spread, and how it went from trading structurally negative, to trading structurally positive also sometime around the end of the first quarter of 2018.

Figure 42 shows the o/n GCF® rate with the familiar orange and red markers to mark the chunky bill and coupon days. As one would expect, chunky days correspond to higher repo rates, and, like before, bill supply drives trends and coupon supply causes spikes.

Figure 43 shows the more granular SOFR data from the second quarter of 2018 onward: the 99th and 75th percentile of o/n GC trades have been printing at a structurally positive spread to IOR, and these spreads went from 5 bps during the second and third quarters to around 15 bps by the fourth quarter of 2018 and have been trading there ever since.

The obvious candidate that explains why o/n GC rates have been trading more stressed since the fourth quarter of 2018 is the inversion and related backup of dealer inventories, and the fact that one bank serves as the GC repo market's lender of next-to-last resort.

Figure 44 adds the orange and red markers to show the usual "trends *vs*. spikes" pattern.

These four charts support the theme that has featured throughout our entire analysis – that the increasing supply of Treasury collateral, the declining stock of reserves, the exhaustion of excess "outside" reserves and the low level of "free floating" reserves, that is, excess "inside" reserves, is driving repo rates farther and farther outside the band.

One can see this from o/n GCF® rates going from trading at structurally negative to structurally positive spreads to IOR, and from the 99th and 75th percentile of trades printing at ever wider spreads to IOR, not to mention the growing frequency of spikes in chunky coupon days and the growing size of spikes since the start of the curve inversion.

Let's next see how stresses in o/n GC rates bleed through to the o/n FF rate.

Figure 45 shows day-to-day changes in the interest rates paid on the 75th percentile of o/n FF trades with the usual markers. Increases tend to correspond to chunky days, but less frequently than in the case of o/n GC rates. That's because the o/n FF market is driven by things other than collateral supply and also because the o/n FF market is small, and inflows and outflows can and do influence the o/n FF rate on the margin (see here).

There are two links between stressed o/n GC trades and stressed o/n FF trades – the days when primary dealers roll daylight overdrafts at BoNY into o/n GC repos, and BoNY has to pay its daylight overdrafts at the Fed by borrowing in the o/n FF market; these are the days when BoNY outbids foreign bank arbitrageurs in the o/n FF market.

The second link is established by foreign arbitrageurs on days when BoNY does not have to bid for o/n FF to cover daylight overdrafts at the Fed. These arbitrage trades involve borrowing reserves in the o/n FF market and lending them in the GC repo market

– a process that enables dealers to pay their daylight overdrafts at BoNY, and BoNY to pay its daylight overdrafts at the Fed. This arbitrage link flows from the map at the end of Part II, and readers who wish to map it out may use the template map in the Appendix.

In essence, foreign bank arbitrageurs are the buffer between very stressed and stressed days in the o/n FF market – that is, days when BoNY has to scramble to get o/n FF to pay the Fed because primary dealers could not get enough reserves from other banks via o/n GC repos and so couldn't pay BoNY, and days when arbitrageurs lent dealers enough reserves via o/n GC repos so that BoNY can pay all its overdrafts at the Fed.

Figure 46 shows the total volume of o/n FF-GC arbitrage trades by foreign banks; the orange and red markers start from the second quarter of 2018 as that is when the o/n FF-GC trade replaced the o/n FF-IOR trade as the dominant o/n arbitrage trade.

Figure 47 shows how the o/n FF-GC trade took over from the o/n FF-IOR trade as the dominant o/n arbitrage trade. Thus, until about the end of the first quarter of 2018, average spreads on o/n FF-IOR trades were better than spreads on o/n FF-GC trades, with a bonus spike on month-ends. Then, starting around the second quarter of 2018, the spreads flipped: o/n FF-IOR started to shrink and hit zero by the third quarter of 2018, and went negative by the second quarter of 2019, and contrariwise, o/n FF-GC spreads started to widen and averaged better than o/n FF-IOR spreads thanks in large part to periodic spikes on chunky bill and coupon days, which often corresponded to month-ends.

Figure 48 shows the same themes but not with the volume-weighted median SOFR rate, but with the more elevated rates on the 99th and 75th percentile of o/n GC repo trades.

Collateral and o/n GC rates are thus the new "magnet" to o/n rates.

O/n markets are now trading on the other side of the previous magnet – the IOR rate – and so IOR is now pushing money away into the o/n GC repo market, not attracting it, like it used to, and this process is also aided by the Fed's repeated cuts to the IOR rate.

Figure 49 shows the day-to-day changes in the effective o/n fed funds rate (EFFR) – which is everyone's favorite o/n rate and the Fed's target rate. It shows that relative to day-to-day changes on the 75th percentile of trades, up days are less frequent for EFFR, which means that EFFR is a lagging and low-beta indicator of collateral-related stresses.

Figure 50 shows in red the updrift of EFFR in bps during each quarter since 2018, and the cumulative updrift of EFFR since 2018 in orange. What you see is a tradeoff where a $1.5 trillion of collateral has pushed the "core" of the constellation of o/n rates – EFFR – up by 10 bps within the target band since the beginning of 2018, but has already pushed the "periphery" of the constellation of o/n rates – o/n GC repo rates – outside the band.

And then you wonder – is the periphery the core or is the core the periphery?

Our analysis has shown that collateral supply is the main driver of o/n rates on the margin, and that the first "point of contact" between collateral supply and money markets is the o/n GC repo market. The o/n GC repo market is typically able to absorb collateral supply, but the balance between the "free float" of reserves and collateral supply is deteriorating.

When that balance is out of whack, the system taps the Fed for daylight overdrafts on chunky settlement days, and the need to pay back daylight overdrafts is what drives the o/n FF rate. But relative to the $650 billion "ocean" that's the o/n GC repo market, the o/n FF market is a $65 billion "pond" that can be easily squeezed by collateral supply.

And then what? How will the Fed police the effective funds rate? Directly or indirectly? If indirectly, will it do so with a fixed price, full allotment o/n repo facility, and if so, will it switch from adding temporary daylight reserves to temporary overnight reserves? In turn, will that facility elevate the periphery into the core and demote the core into the periphery?

Conclusions

How does the balance between collateral supply and the free float of inside reserves drive the price of reserves? What's the price of overnight reserves and how to measure it?

These are the two fundamental questions we need to understand before we get into the discussion of how the Fed should administer additional reserves when the time comes.

This issue of Global Money Notes answered the first two questions and concluded that taper is a bit more complex than watching paint dry…

We believe taper was ill timed from the very beginning…

…because it coincided with the exhaustion of excess reserves outside the banking system and so taper was shredding excess reserves inside the banking system from the get go.

Taper should have stopped the moment the curve inverted…

…because the inversion impeded the flow of collateral to ultimate buyers and forced dealers to absorb collateral as intermediate buyers, which pressured o/n GC rates higher; through taper, the Fed effectively forced Treasury to fund $300 billion of supply overnight.

Taper is not the only thing that has been worsening the "collateral *vs*. reserves" mix…

…sterilization – or shadow taper – has been equally damaging, mainly through Treasury issuing bills to fund a $300 billion increase in its balances at the Fed since taper began.

Taper, combined with growing deficits and RLAP are also worsening the above mix…

…because bigger auctions increase intraday liquidity risks and hence demand for reserves, while taper is destroying reserves. In essence, growing deficits make taper worse than its headline pace. That's because for every dollar of reserves destroyed through taper, a dime gets "locked down" for RLAP, and as the deficits grow, dimes turn into quarters.

Taper destroys reserves and IOR cuts aim to redistribute reserves…

…but redistribution has its limits as the one bank that's the marginal lender of reserves in the o/n GC repo market appears to have reached its limits, and the marginal lenders in the o/n FF are small fish. We need central banks, not private banks as marginal lenders.

Redistribution has one last shot…

…the capping of the foreign repo pool, but the New York Fed seems undisturbed by the fact that some are hoarding reserves while redistribution among banks reached its limits.

Redistribution is achieved through taxation…

…and who should the Fed tax – banks or sovereigns? If banks hold reserves for regulatory and not for relative-value reasons, further IOR cuts will only tax bank earnings without delivering an improvement in where o/n interest rate rates print relative to the target band.

Don't be fooled by the stock of reserves…

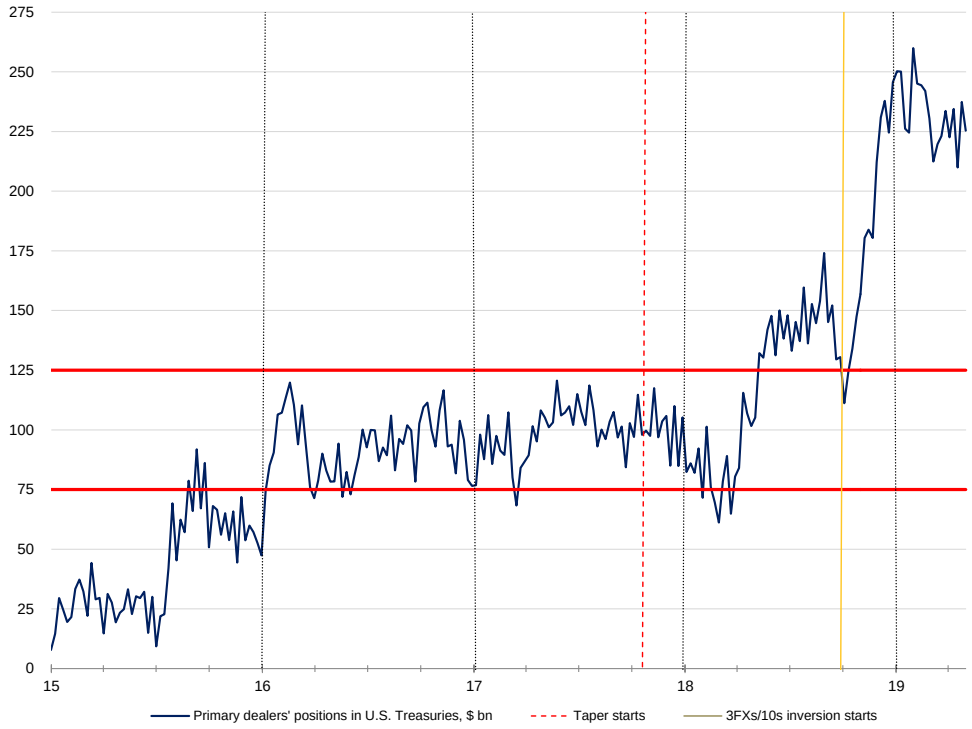
…dollar funding markets suffer from the disease of "macro liquidity and micro illiquidity" – the money that's there isn't really there because intraday and internal liquidity needs impede their free movement. Capital controls impede the flow of money across borders and liquidity rules impede the flow of reserves across various money market segments.

Dealer of Last Resort is nigh…

…and a fixed price, full allotment o/n repo facility or a framework to administer mini-QEs better be ready by the fourth quarter when the summer collateral reprieve is over and the Treasury will once again flood the market with another round of $300 billion of bills.

Figure 1: Dealer Inventories and the Curve Inversion

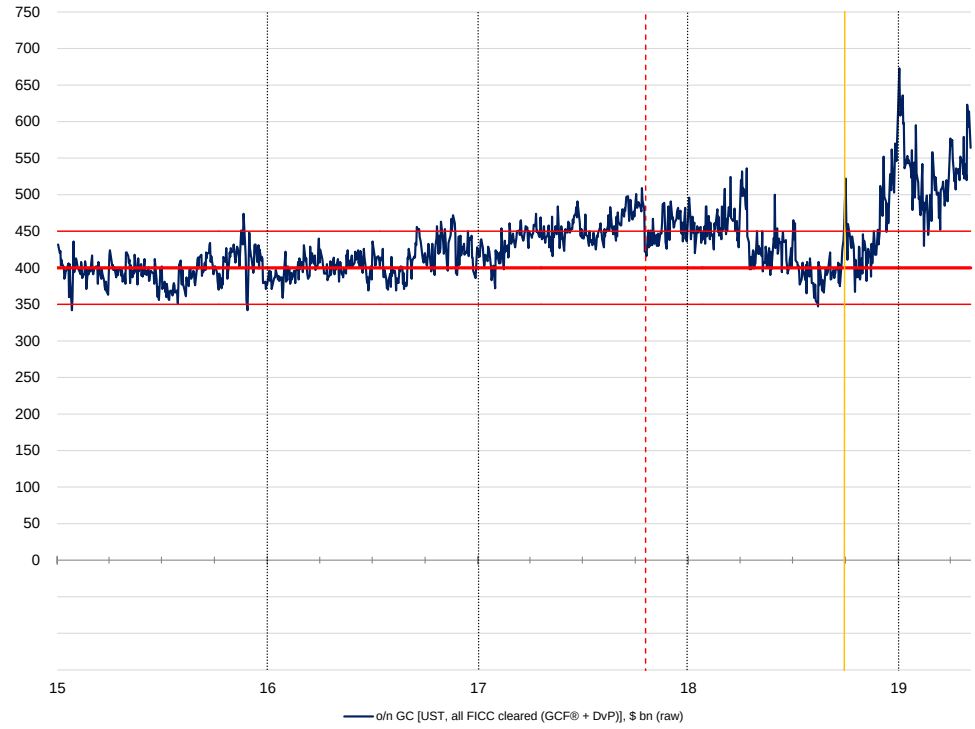
$ billion



Source: Federal Reserve, Credit Suisse

Figure 2: Demand or o/n GC Repo and the Curve Inversion

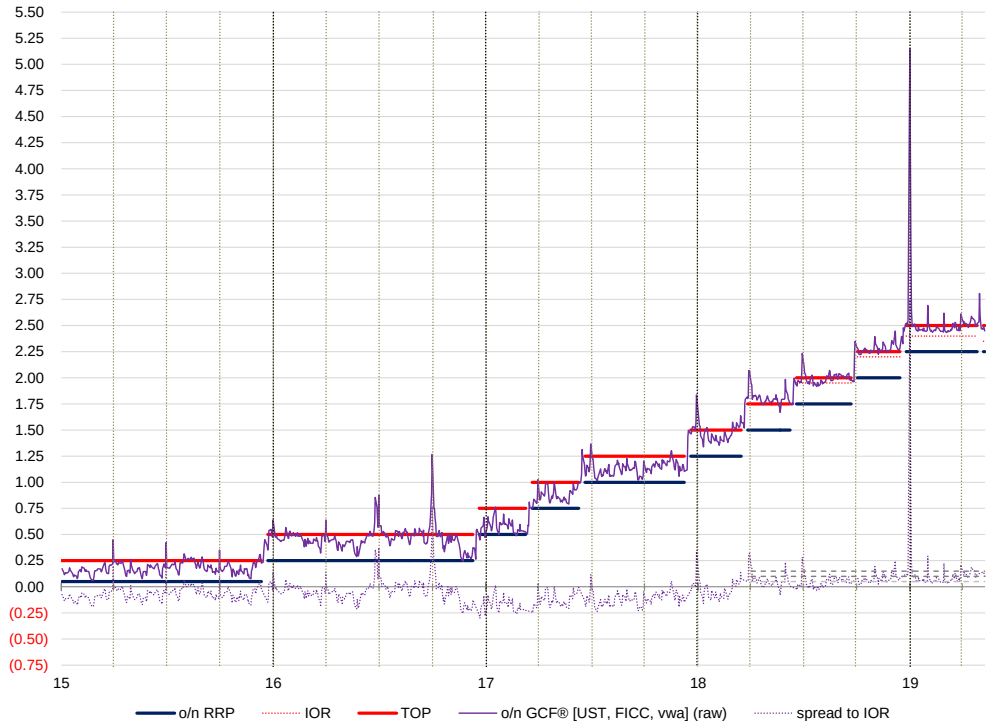
$ billion, dashed red line marks the start of taper and the orange line marks the start of the curve inversion relative to FX hedging costs



Source: Federal Reserve, Credit Suisse

Figure 3: The "Super-Spike" that Sealed the Fate of Taper

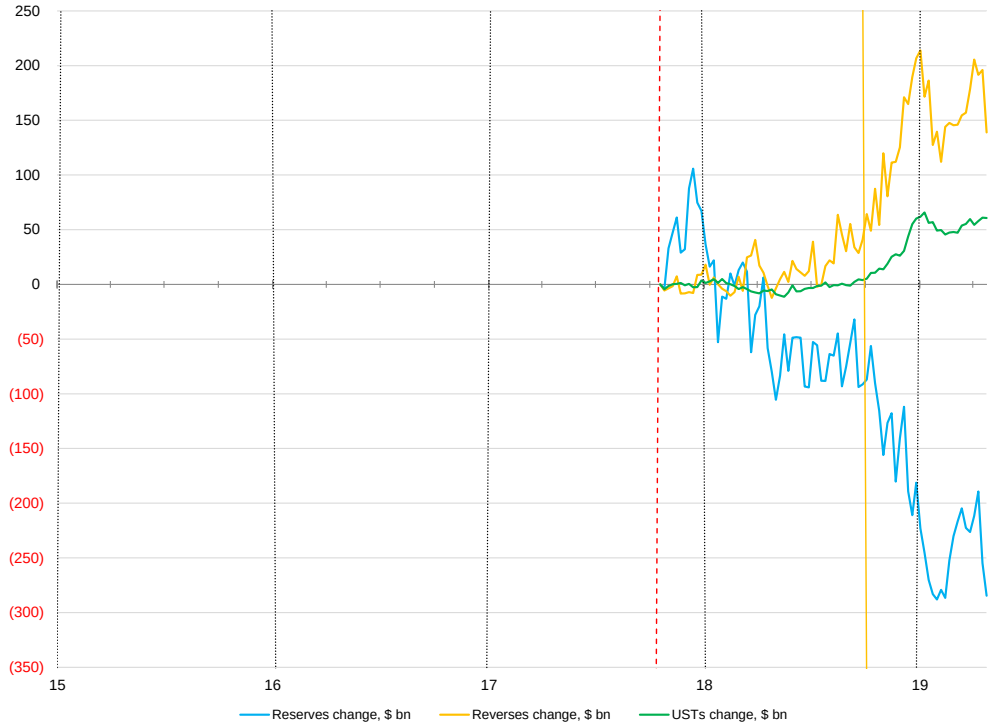
percent



Source: the BLOOMBERG PROFESSIONAL™ service, Credit Suisse

Figure 4: Inversion Impedes the Flow of Collateral to Ultimate Buyers

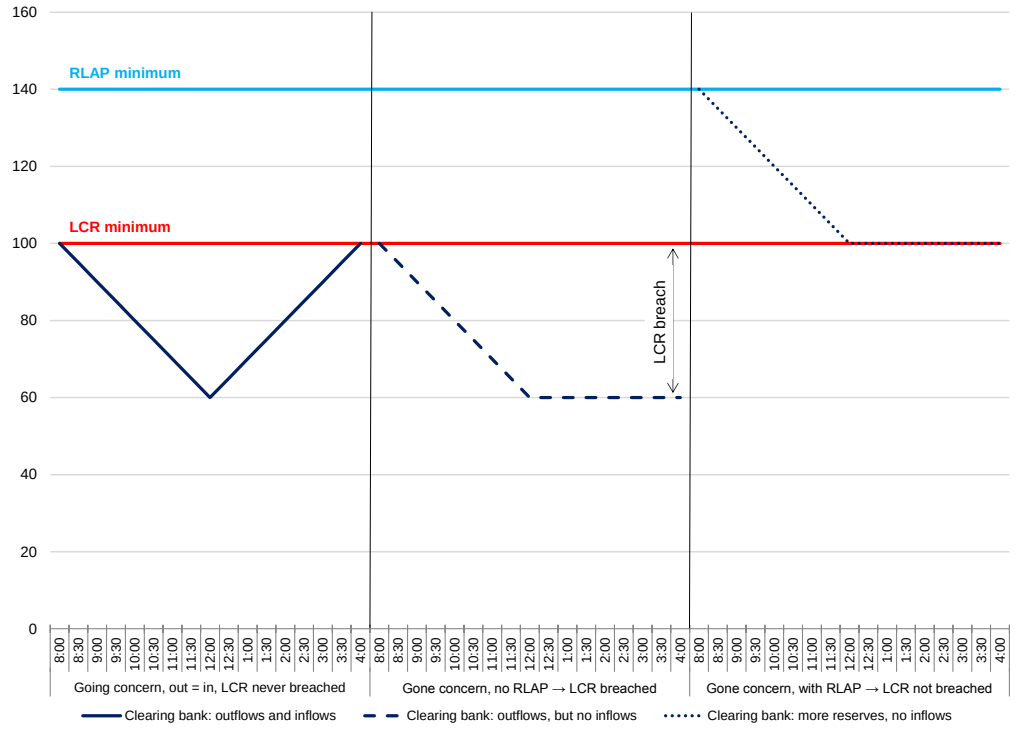
$ billion, dashed red line marks the start of taper and the orange line marks the start of the curve inversion relative to FX hedging costs



Source: Federal Reserve, Credit Suisse

Figure 5: How RLAP Protects LCRs

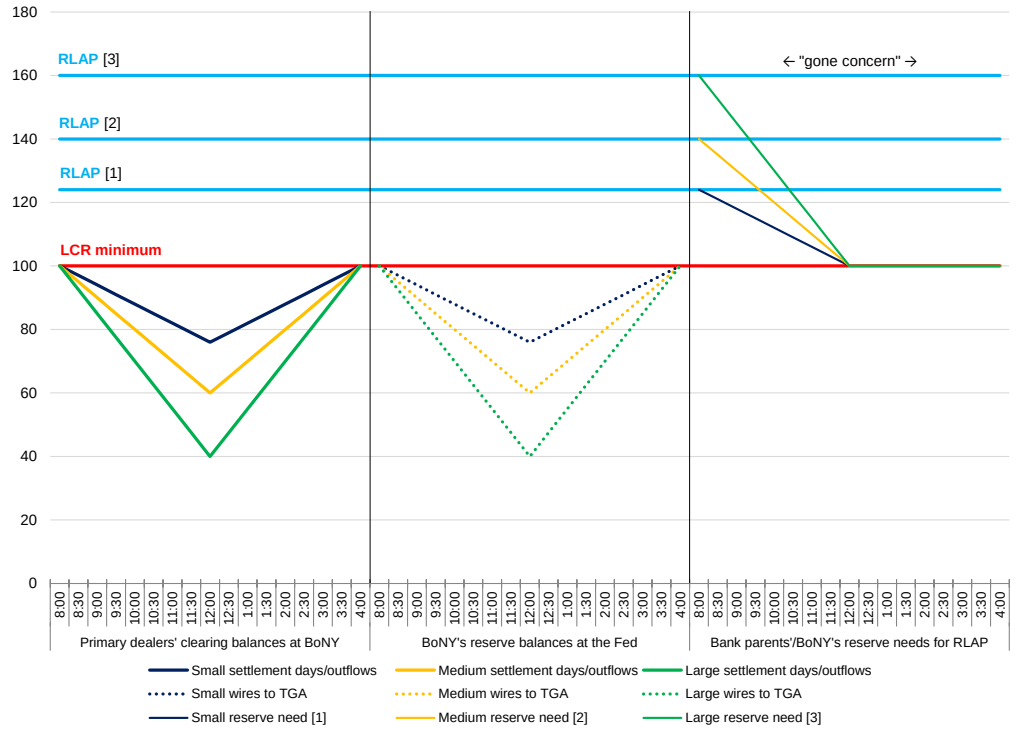
$ billions, *stylized*



Source: Credit Suisse

Figure 6: The Faster the Pace of Taper, the Higher Banks' Reserve Needs!

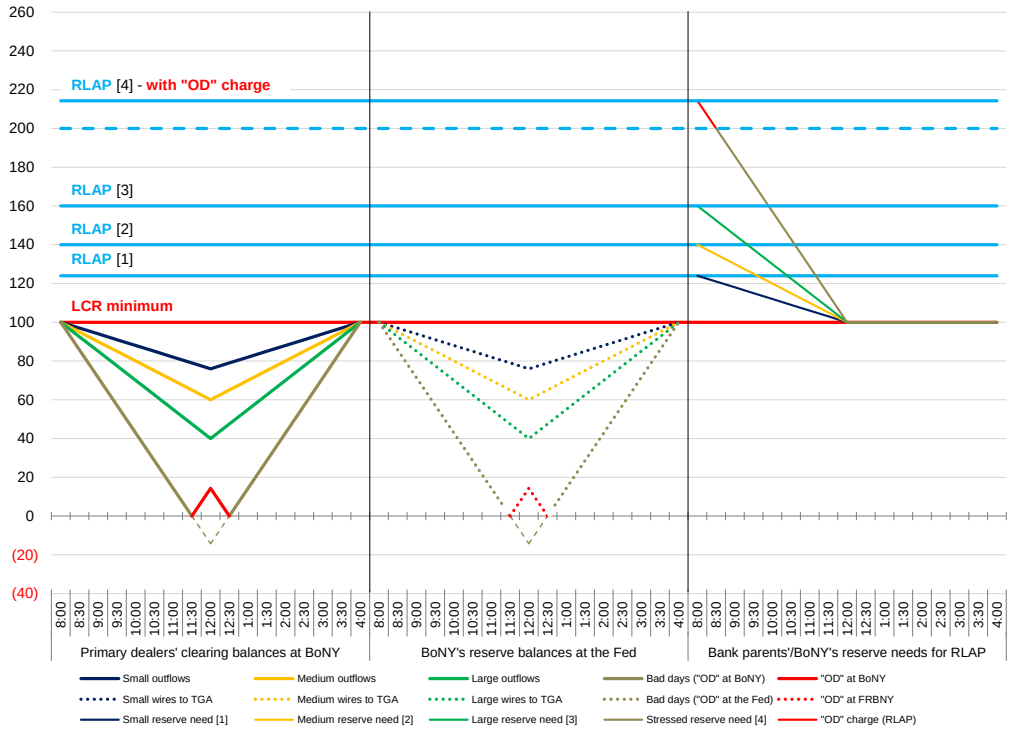
$ billions, *stylized*



Source: Credit Suisse

Figure 7: Daylight Overdrafts

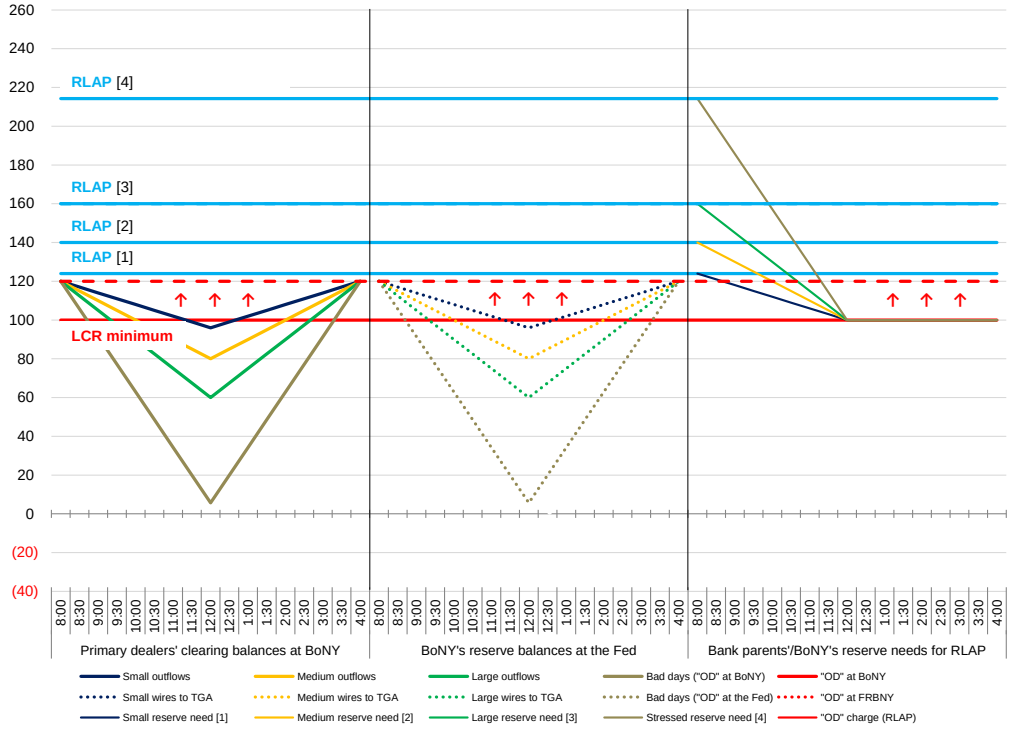
$ billions, *stylized*



Source: Credit Suisse

Figure 8: Avoiding Daylight Overdrafts by Holding More Reserves

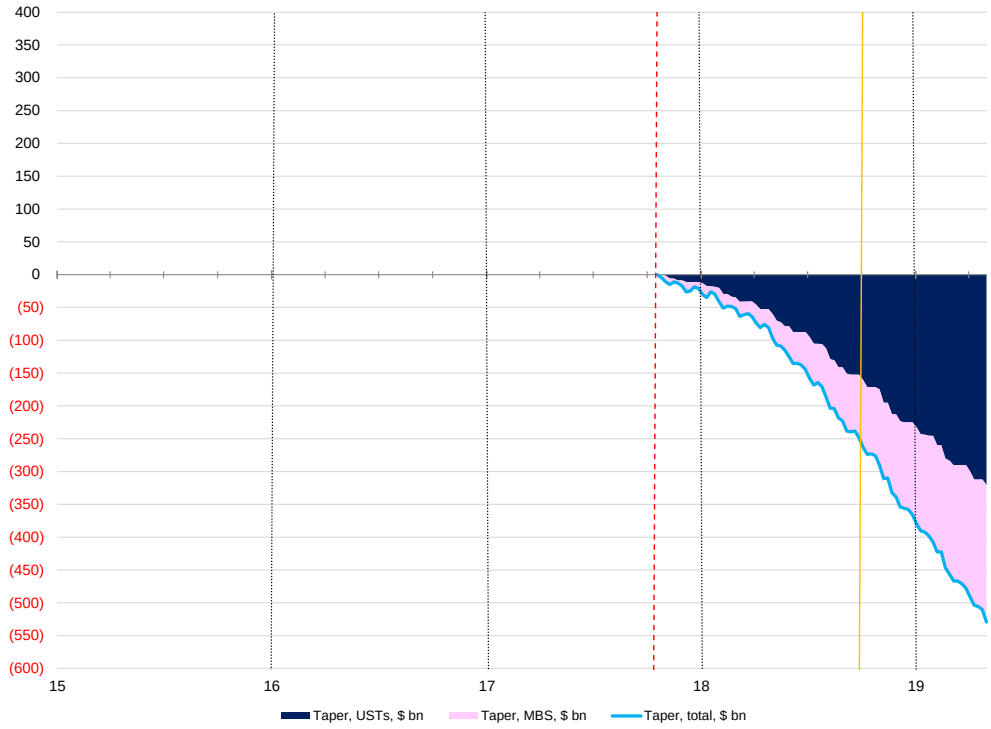
$ billions, *stylized*



Source: Credit Suisse

Figure 9: Reserves Destroyed and Collateral Added via Taper

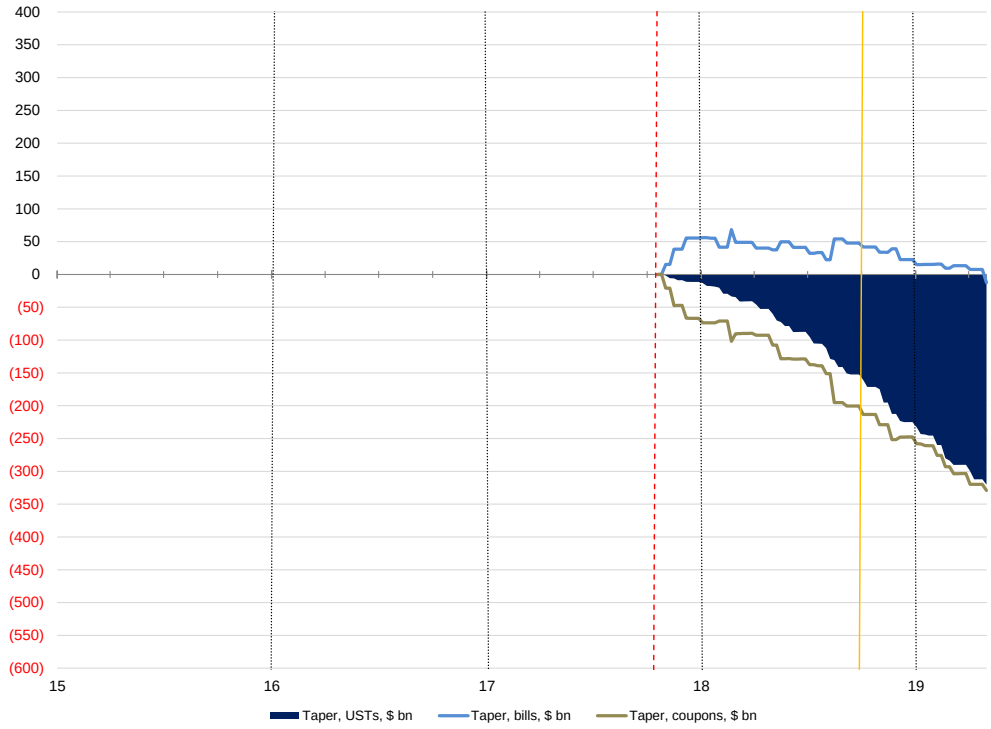
$ billion, dashed red line marks the start of taper and the orange line marks the start of the curve inversion relative to FX hedging costs



Source: Federal Reserve, Credit Suisse

Figure 10: How the Fed Controls the Pace of Treasury Taper

$ billion, dashed red line marks the start of taper and the orange line marks the start of the curve inversion relative to FX hedging costs



Source: Federal Reserve, Credit Suisse

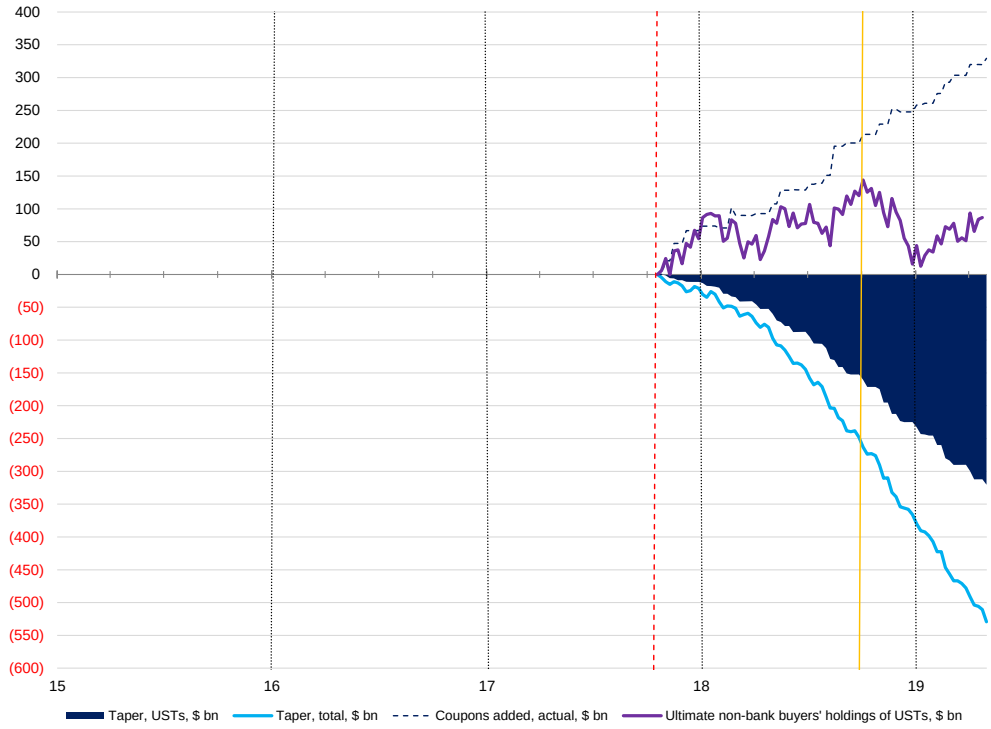
Figure 11: The Treasury Curve Has Been Inverted Since Last October

percent, orange line marks the start of the curve inversion relative to FX hedging costs

Source: the BLOOMBERG PROFESSIONAL™ service, Credit Suisse

Figure 12: The Inversion and Ultimate Investors' Buyers Strike

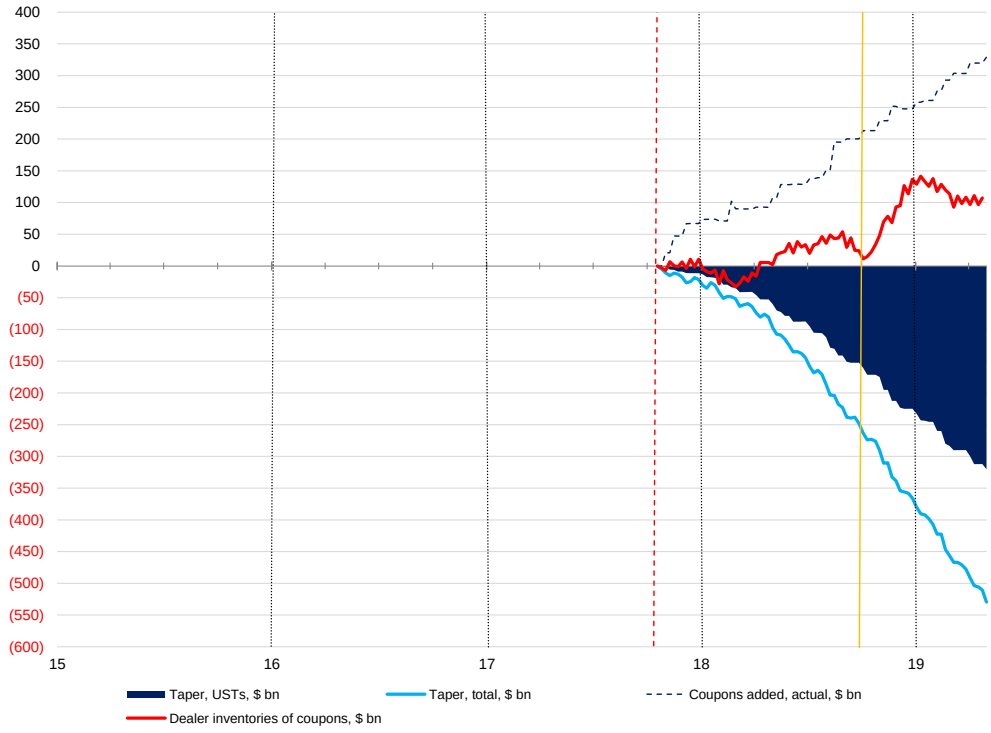
$ billion, dashed red line marks the start of taper and the orange line marks the start of the curve inversion relative to FX hedging costs



Source: Federal Reserve, Credit Suisse

Figure 13: The Inversion and Dealer Inventories

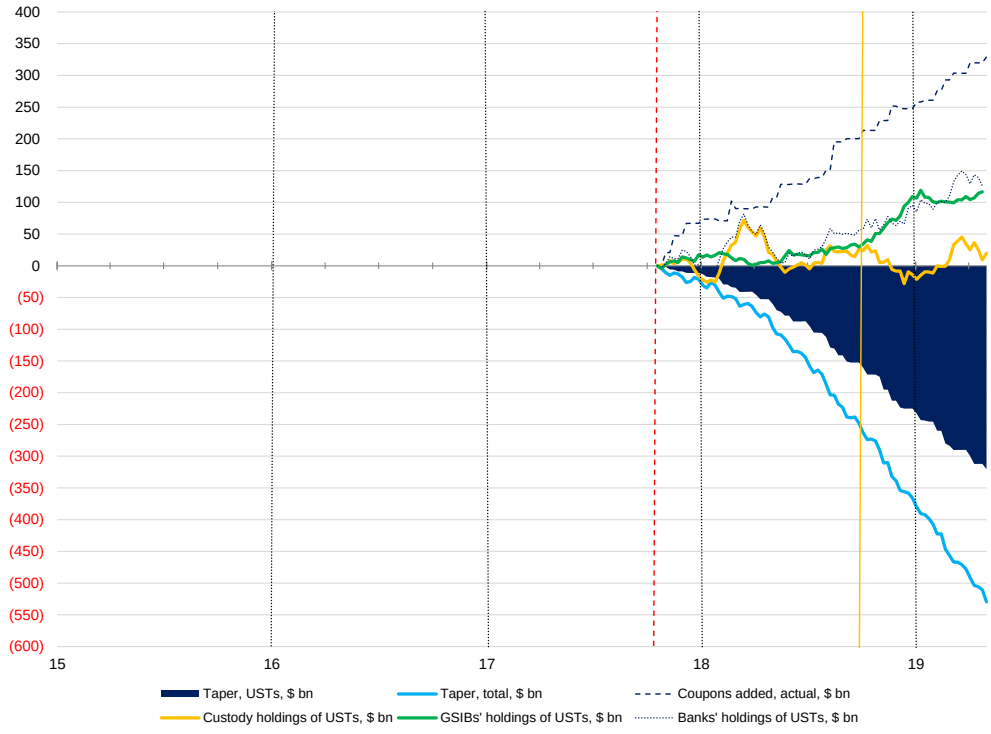
$ billion, dashed red line marks the start of taper and the orange line marks the start of the curve inversion relative to FX hedging costs



Source: Federal Reserve, Credit Suisse

Figure 14: The Inversion and the Banks' Bid for Treasuries

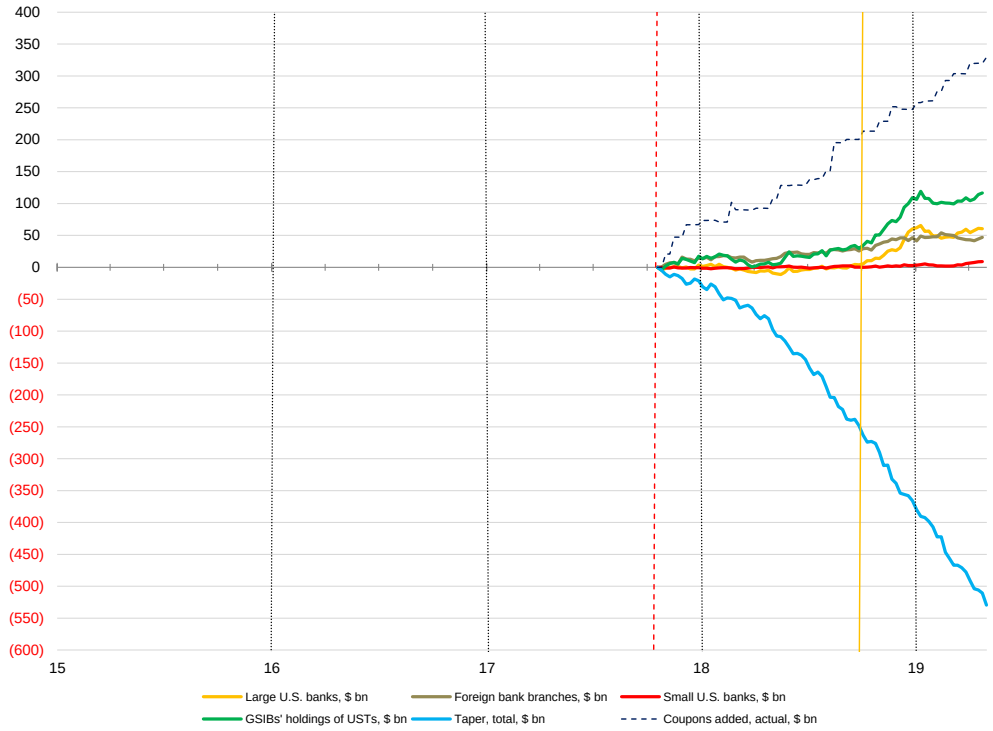
$ billion, dashed red line marks the start of taper and the orange line marks the start of the curve inversion relative to FX hedging costs



Source: Federal Reserve, Credit Suisse

Figure 15: U.S. Banks Bought Most of the Treasuries Since Taper Began

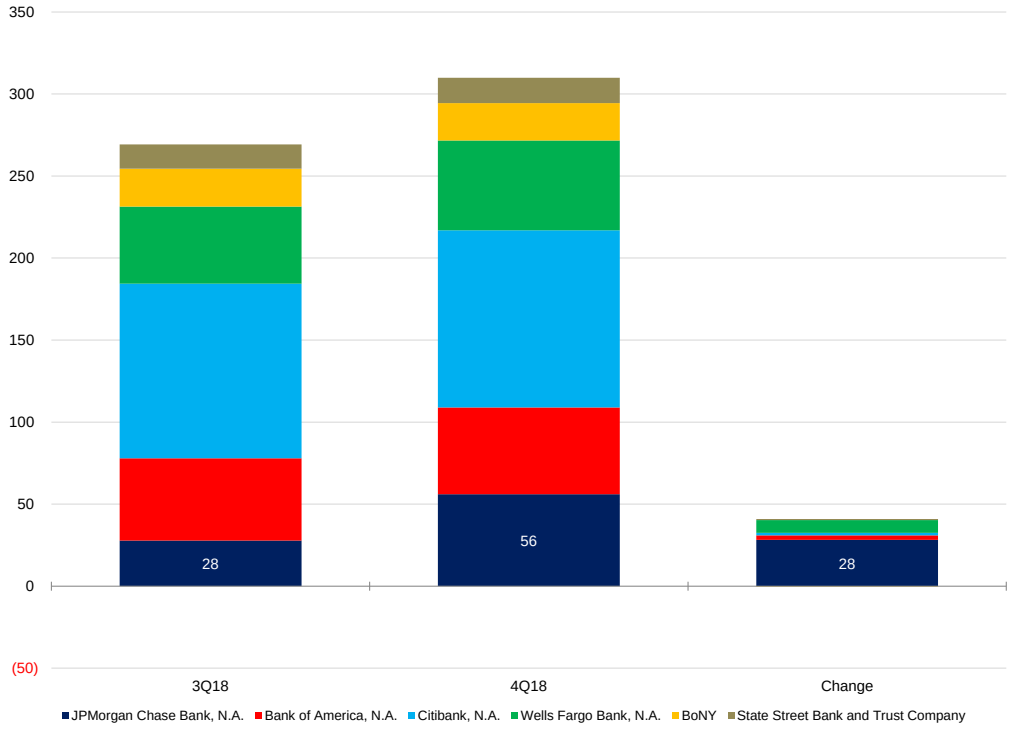
$ billion, dashed red line marks the start of taper and the orange line marks the start of the curve inversion relative to FX hedging costs



Source: Federal Reserve, Credit Suisse

Figure 16: J.P. Morgan Chase Bank, N.A. Bought Most of the Treasuries Since Taper Began

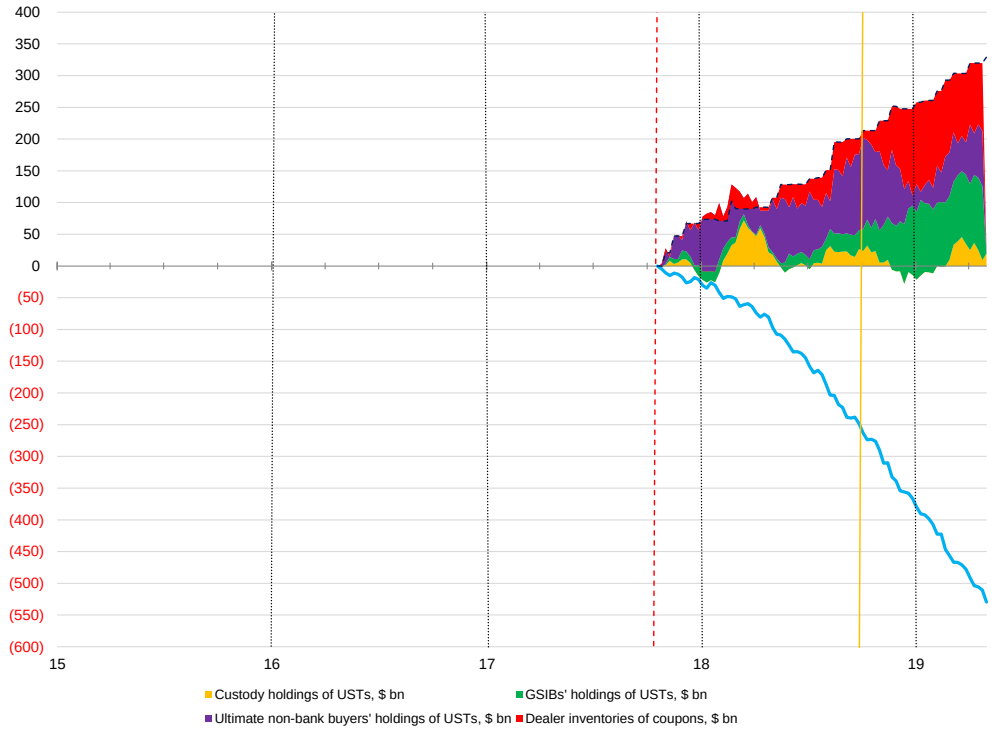
$ billion



Source: Call reports, Credit Suisse

Figure 17: More Demand for o/n GC Repo and Fewer Reserves to Fund It

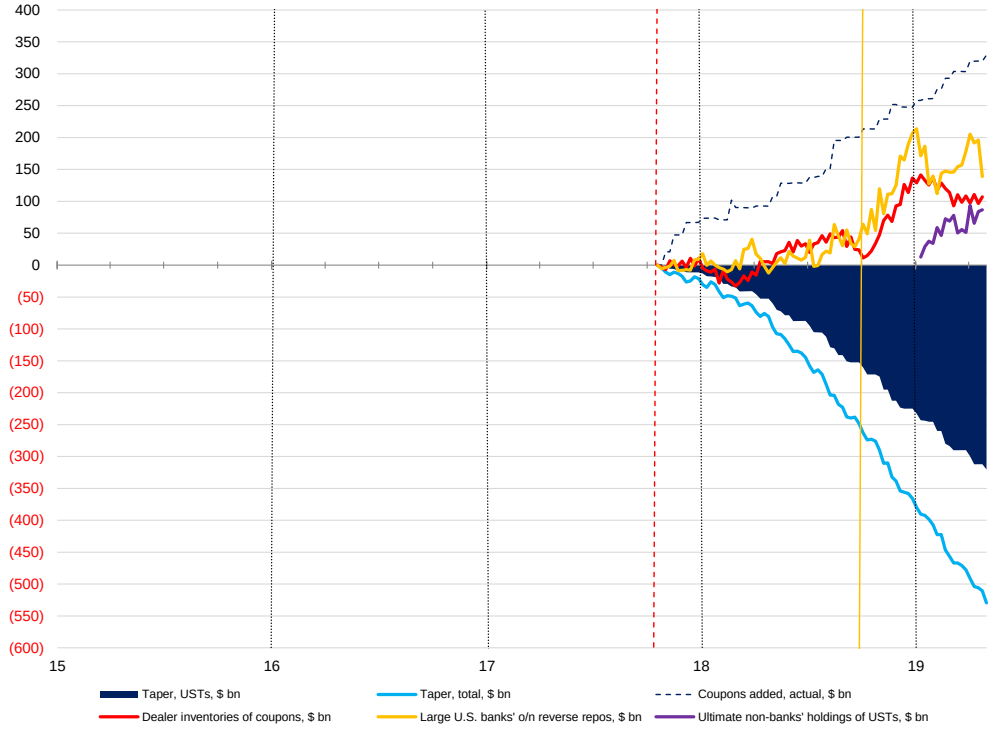
$ billion, dashed red line marks the start of taper and the orange line marks the start of the curve inversion relative to FX hedging costs



Source: Federal Reserve, Credit Suisse

Figure 18: Large U.S. Banks Funded Dealers' and Hedge Funds Repo Needs

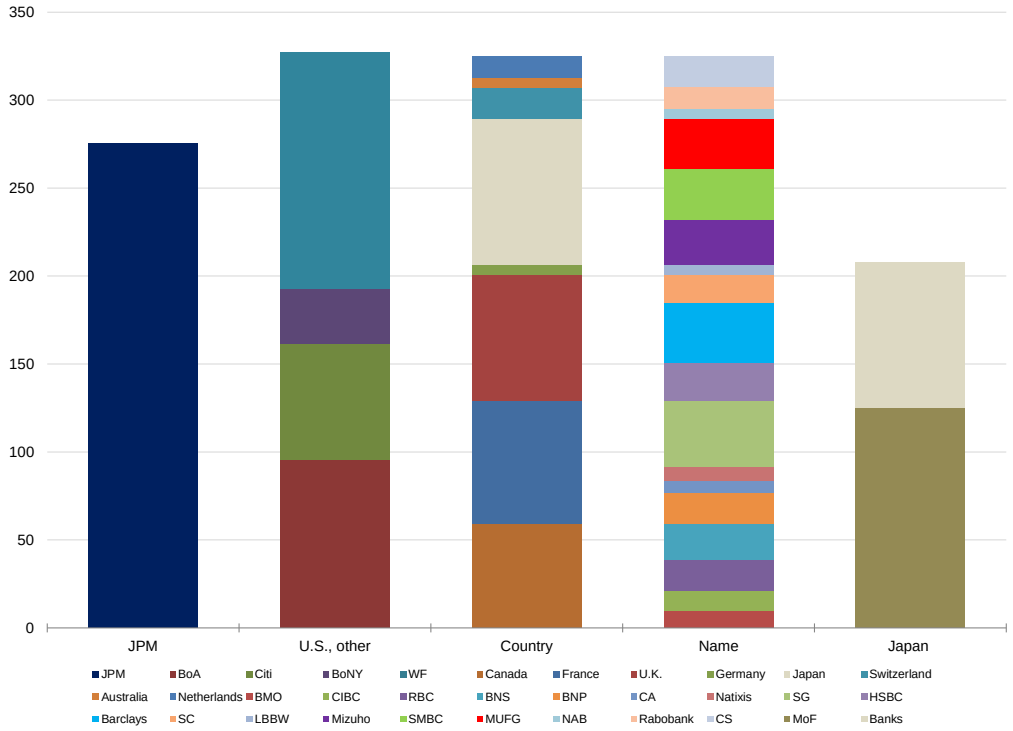
$ billion, dashed red line marks the start of taper and the orange line marks the start of the curve inversion relative to FX hedging costs



Source: Federal Reserve, Credit Suisse

Figure 19: The Reserve Pools that Backstop the o/n GC Market (1)

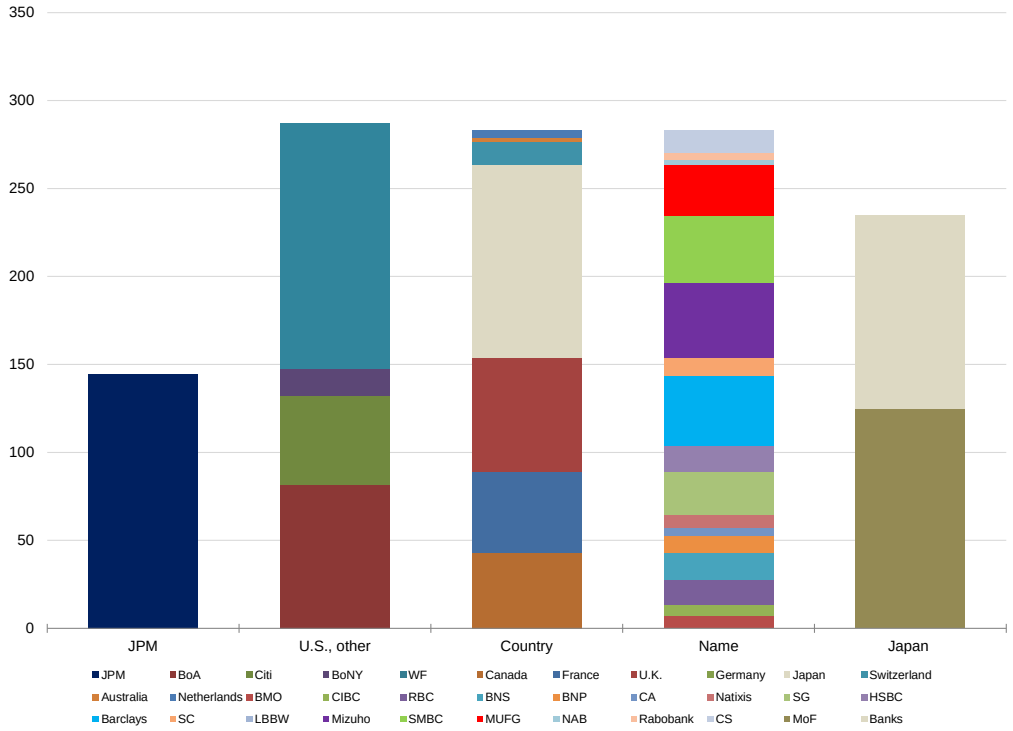
$ billion, as of 2018Q2



Source: Call reports, Japan's Ministry of Finance, Credit Suisse

Figure 20: The Reserve Pools that Backstop the o/n GC Market (2)

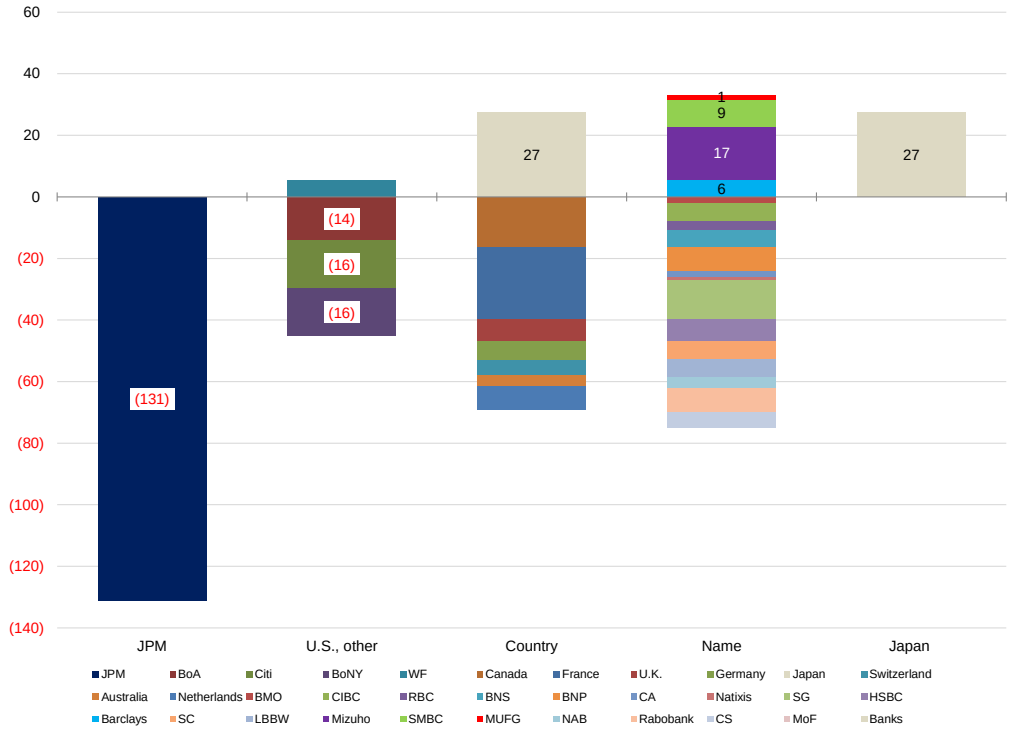
$ billions, as of 2018Q4



Source: Call reports, Japan's Ministry of Finance, Credit Suisse

Figure 21: The Reserve Pools that Backstop the o/n GC Market (3)

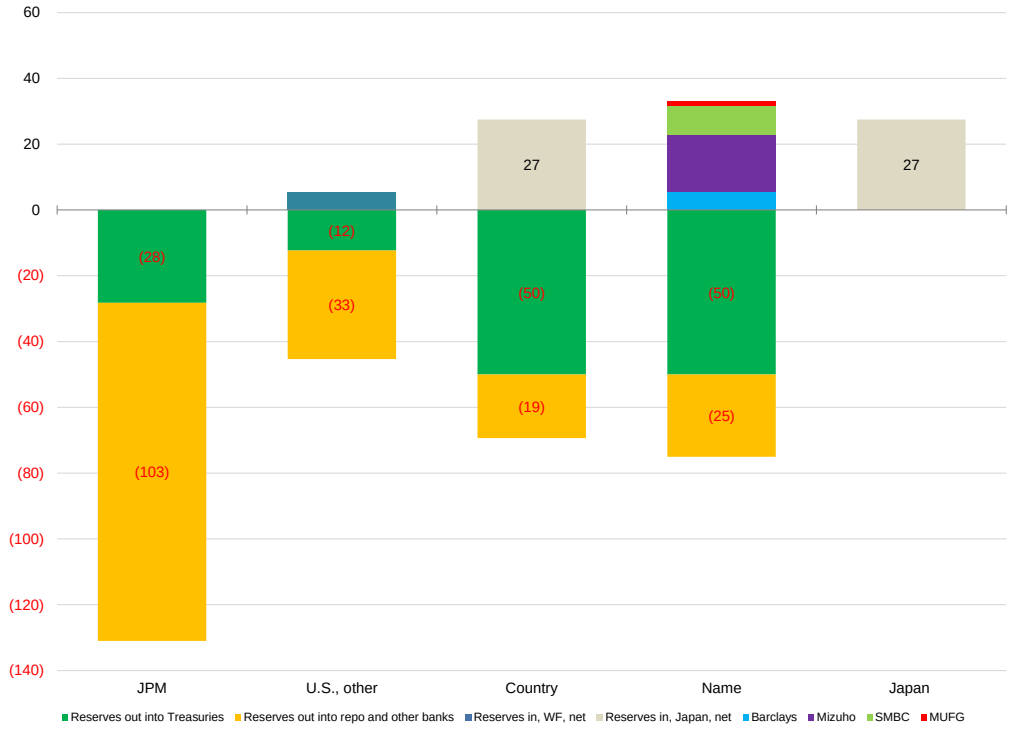
$ billion, change between 2018Q2 and 2018Q4



Source: Call reports, Japan's Ministry of Finance, Credit Suisse

Figure 22: The Reserve Pools that Backstop the o/n GC Market (3)

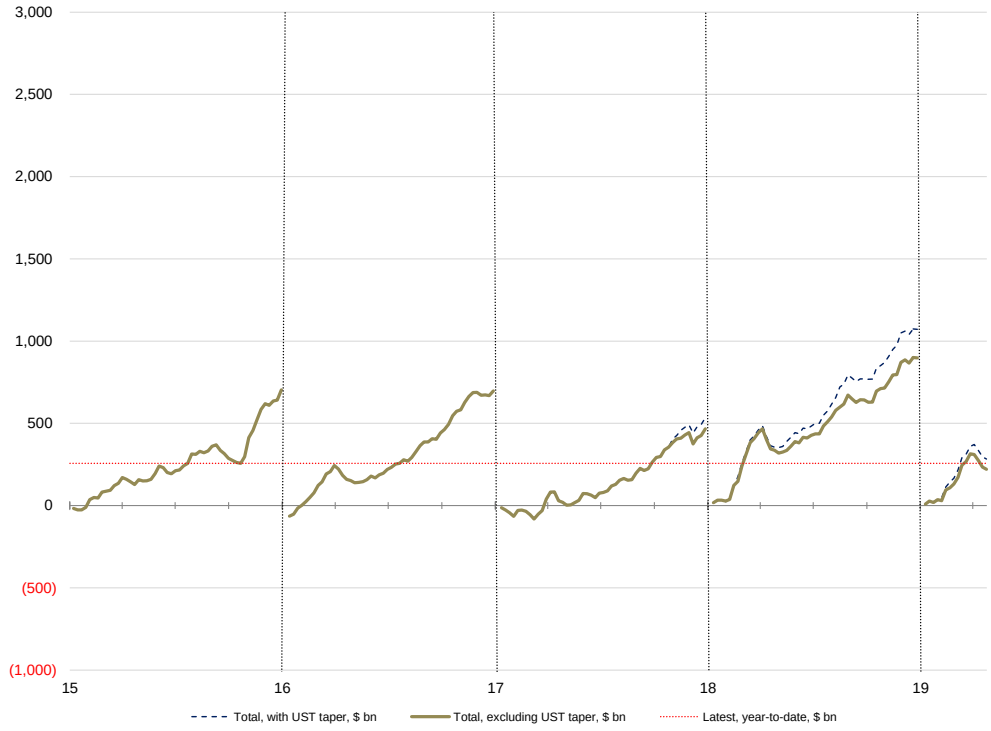
$ billion, uses of reserves, change between 2018Q2 and 2018Q4



Source: Call reports, Japan's Ministry of Finance, Credit Suisse

Figure 23: Taper and the Bigger Picture

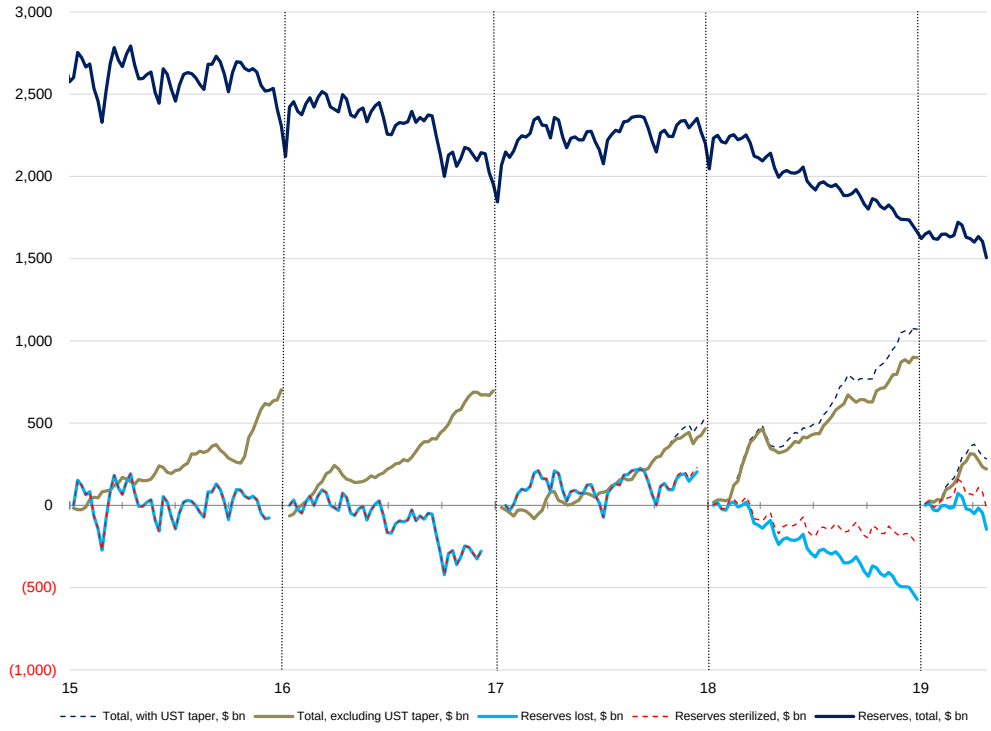
$ billion



Source: U.S. Treasury, Federal Reserve, Credit Suisse

Figure 24: Taper and Sterilization *vs.* Collateral Supply

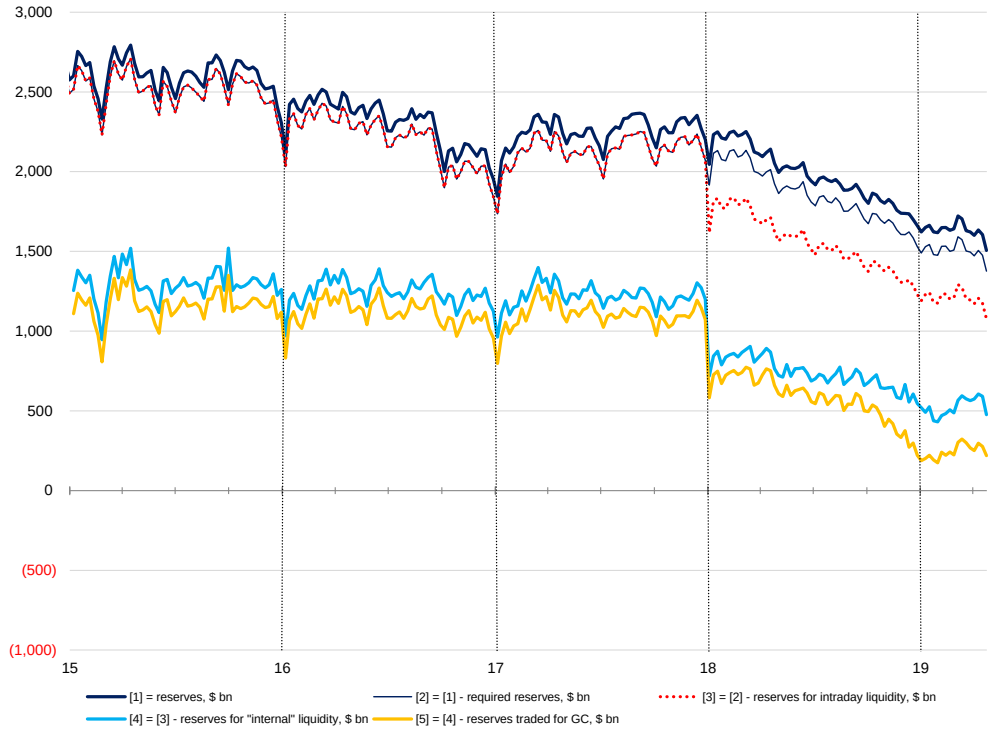
$ billion



Source: U.S. Treasury, Federal Reserve, Credit Suisse

Figure 25: The "Free Float" of Reserves

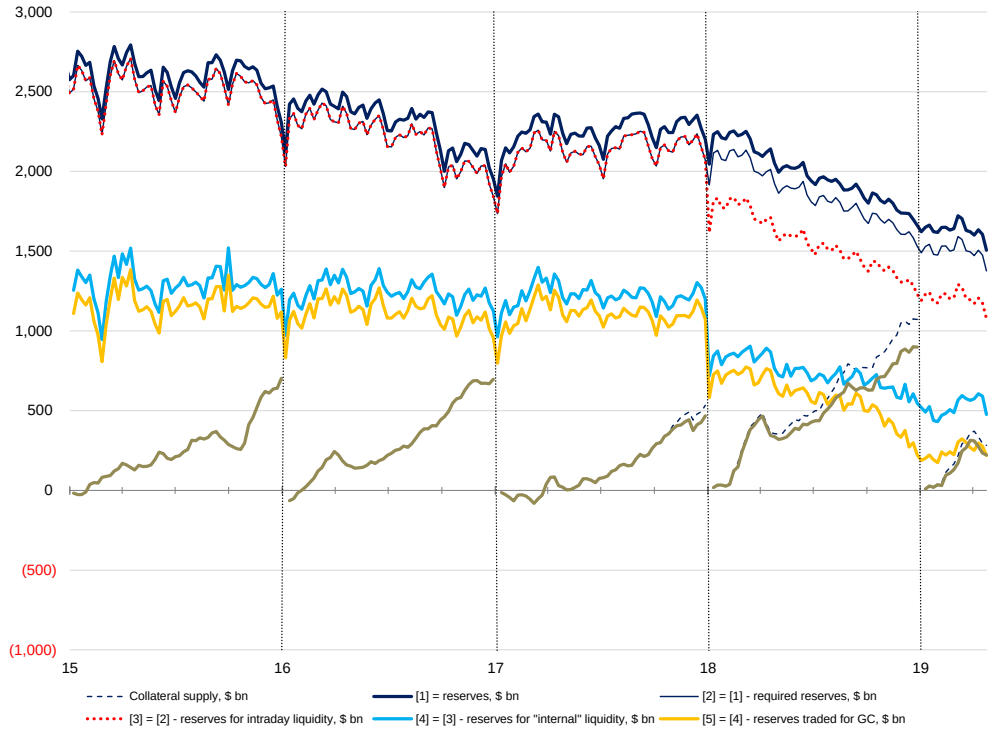
$ billion



Source: Federal Reserve, Credit Suisse

Figure 26: There Is No Margin for Error Left!

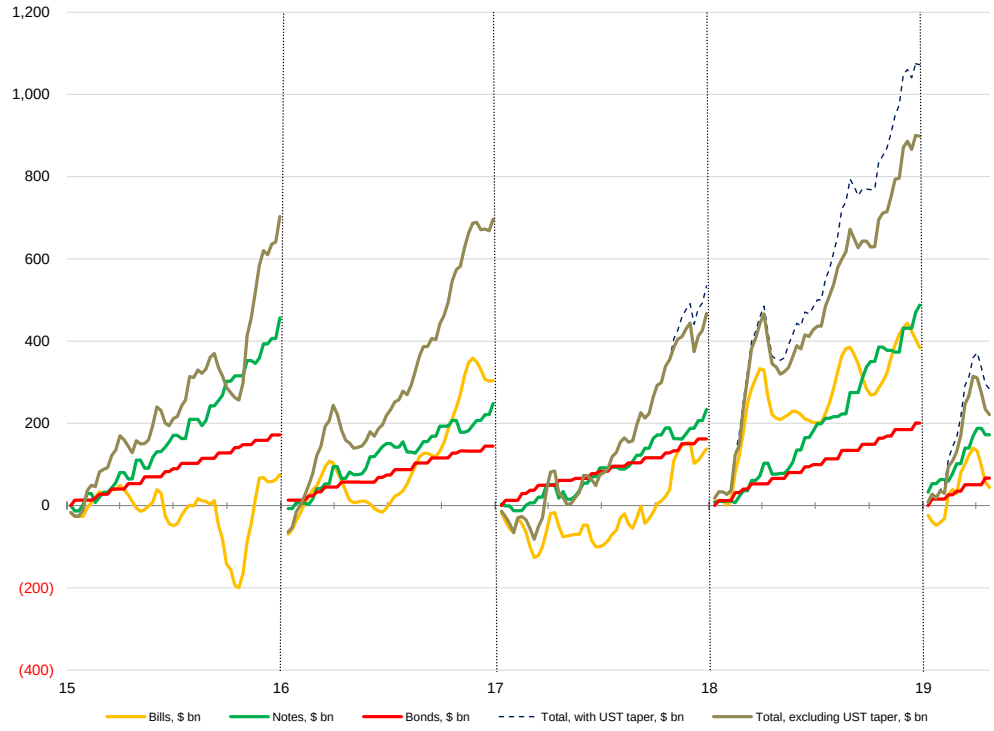
$ billion



Source: U.S. Treasury, Federal Reserve, Credit Suisse

Figure 27: Treasury Supply and Its Components

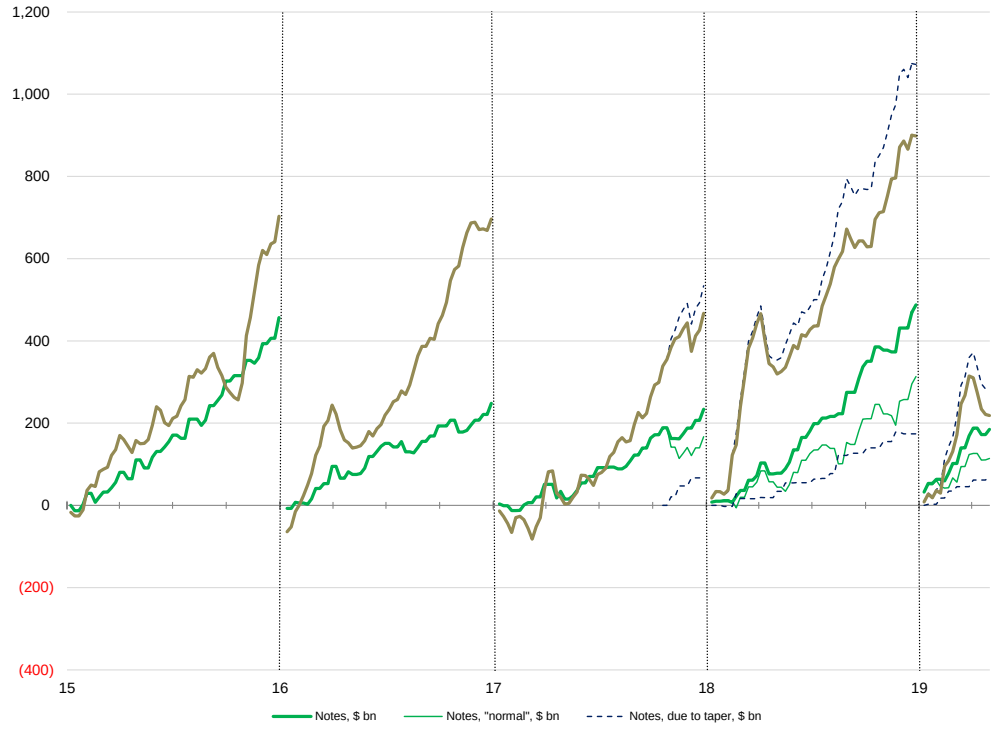
$ billion



Source: U.S. Treasury, Federal Reserve, Credit Suisse

Figure 28: Non-Taper and Taper-Related Note Supply

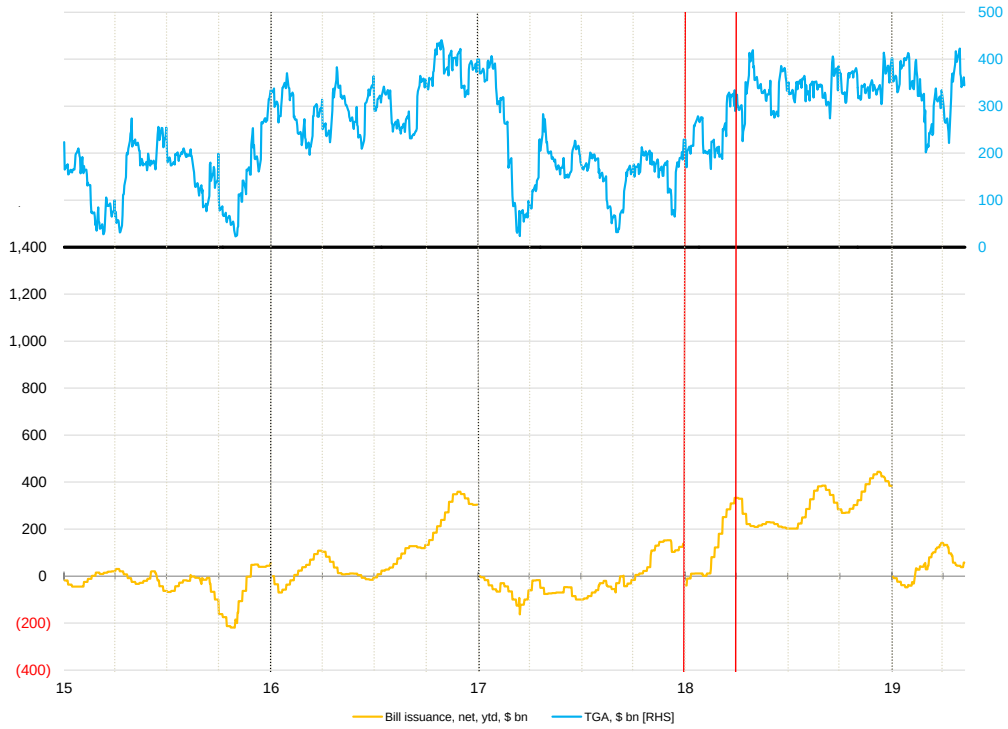
$ billions



Source: U.S. Treasury, Federal Reserve, Credit Suisse

Figure 29: Sterilization and the Volatility of Bill Supply

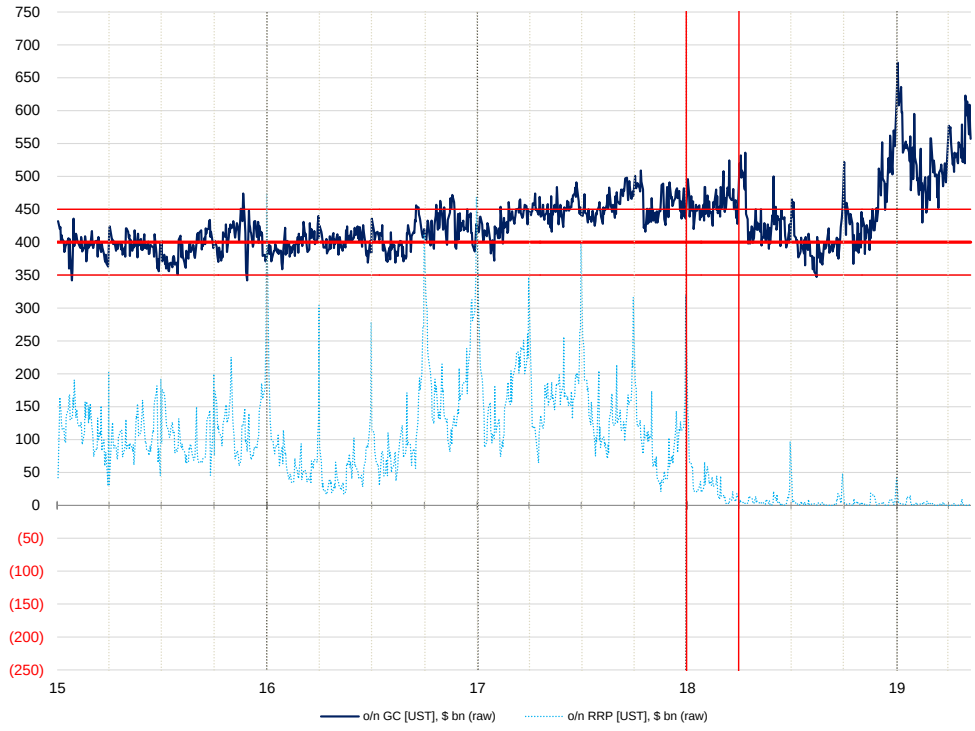
$ billion



Source: U.S. Treasury, Credit Suisse

Figure 30: Excess "Outside" Reserves Go to Zero

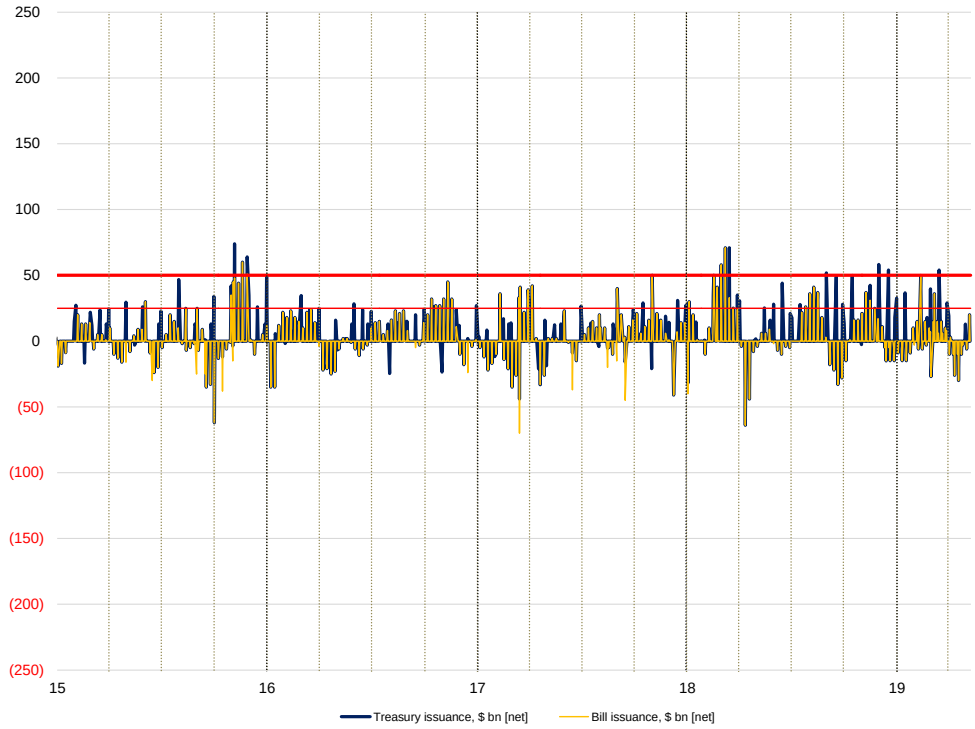
$ billion



Source: Federal Reserve, Credit Suisse

Figure 31: Daily Treasury Supply

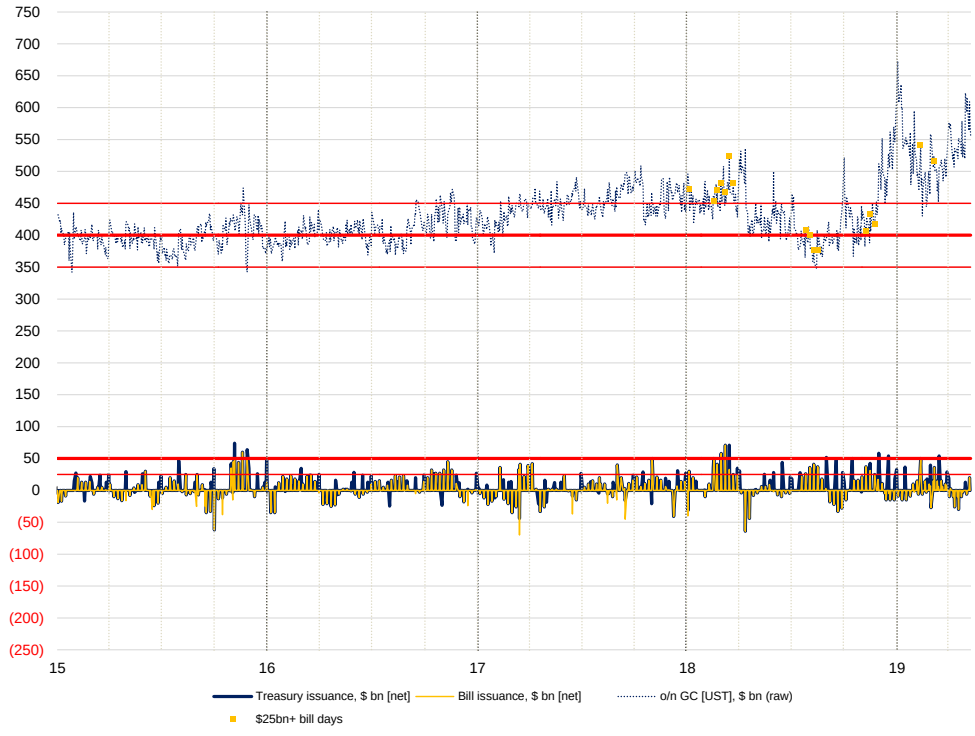
$ billion



Source: U.S. Treasury, Credit Suisse

Figure 32: Chunky Bill Settlement Days and Demand for o/n GC Repo

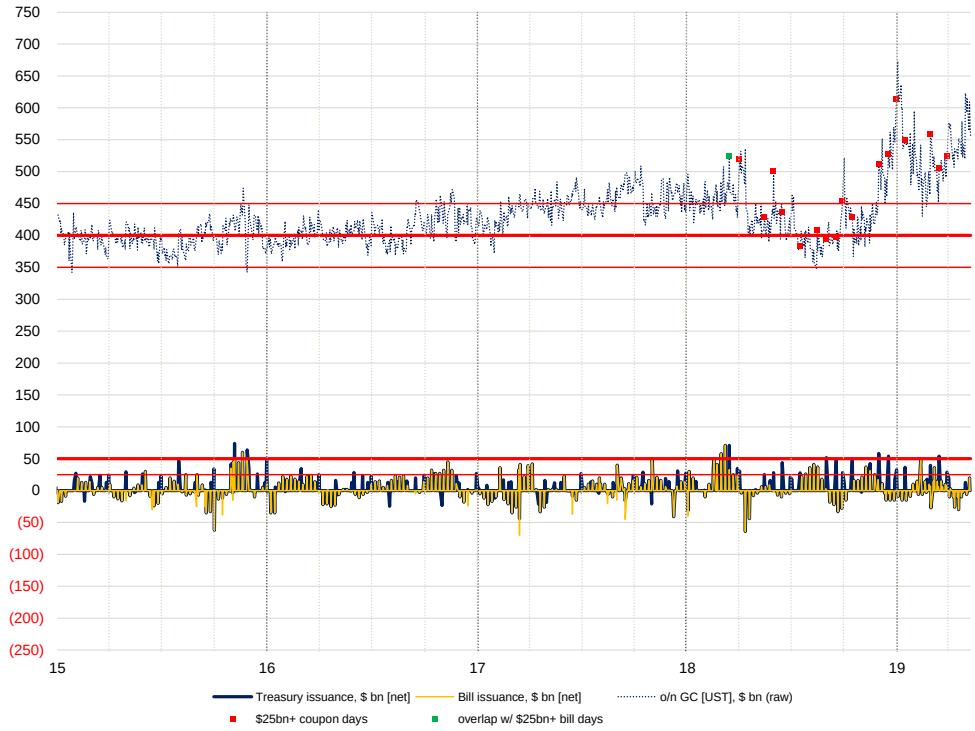
$ billions



Source: U.S. Treasury, Federal Reserve, Credit Suisse

Figure 33: Chunky Coupon Settlement Days and Demand for o/n GC Repo

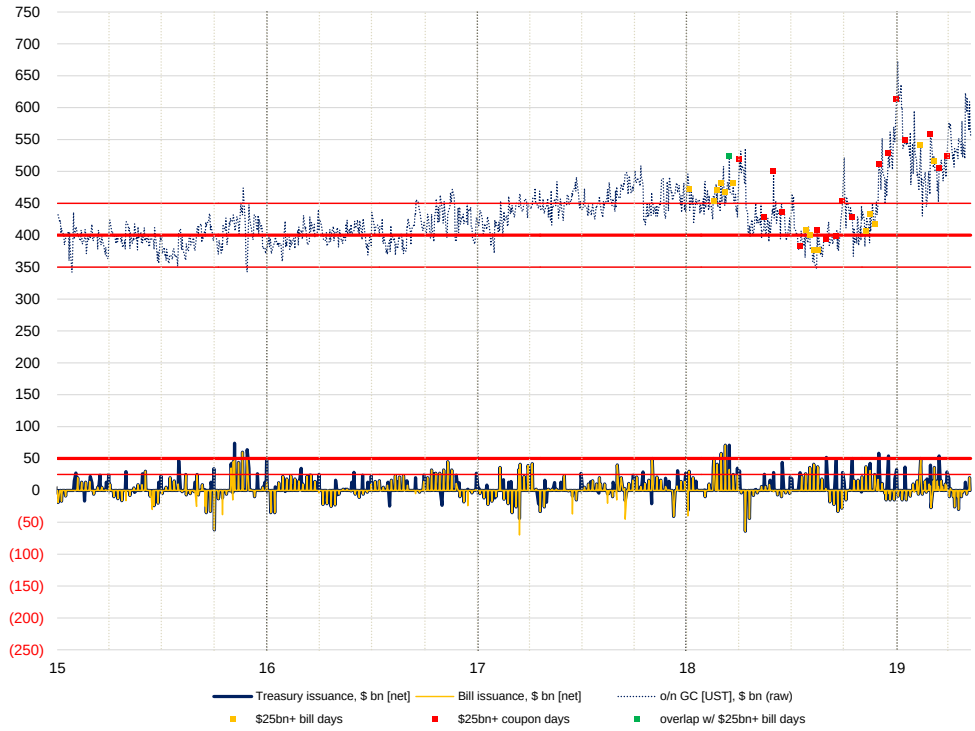
$ billions



Source: U.S. Treasury, Federal Reserve, Credit Suisse

Figure 34: "Trends *vs.* Extremes"

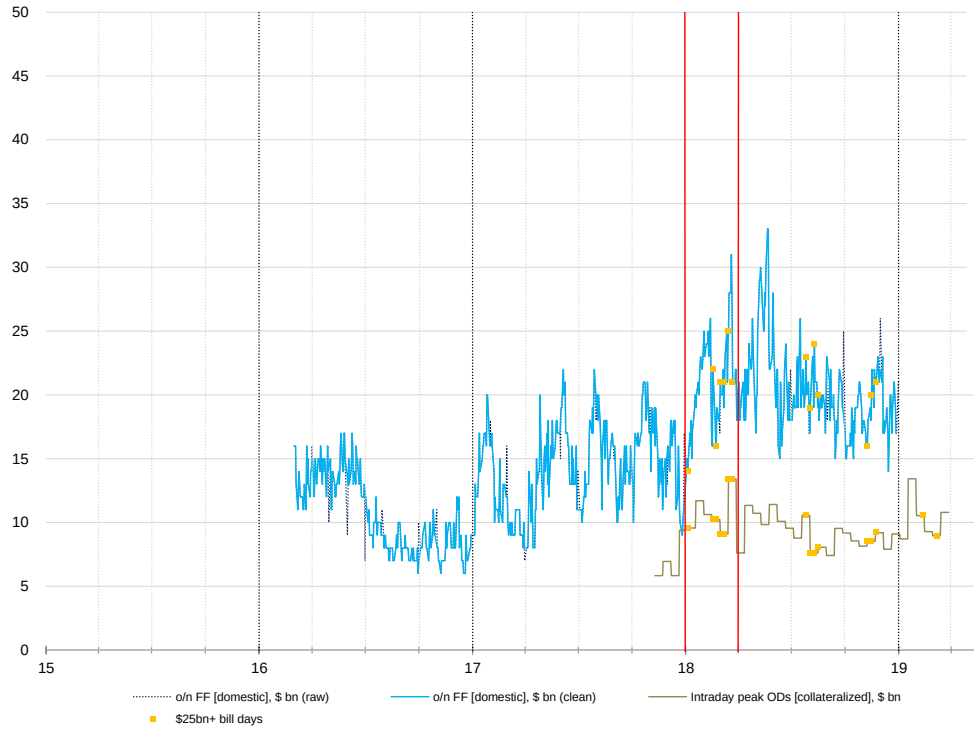
$ billions



Source: U.S. Treasury, Federal Reserve, Credit Suisse

Figure 35: Chunky Bill Days, Daylight Overdrafts and U.S. Banks' Demand for o/n FF

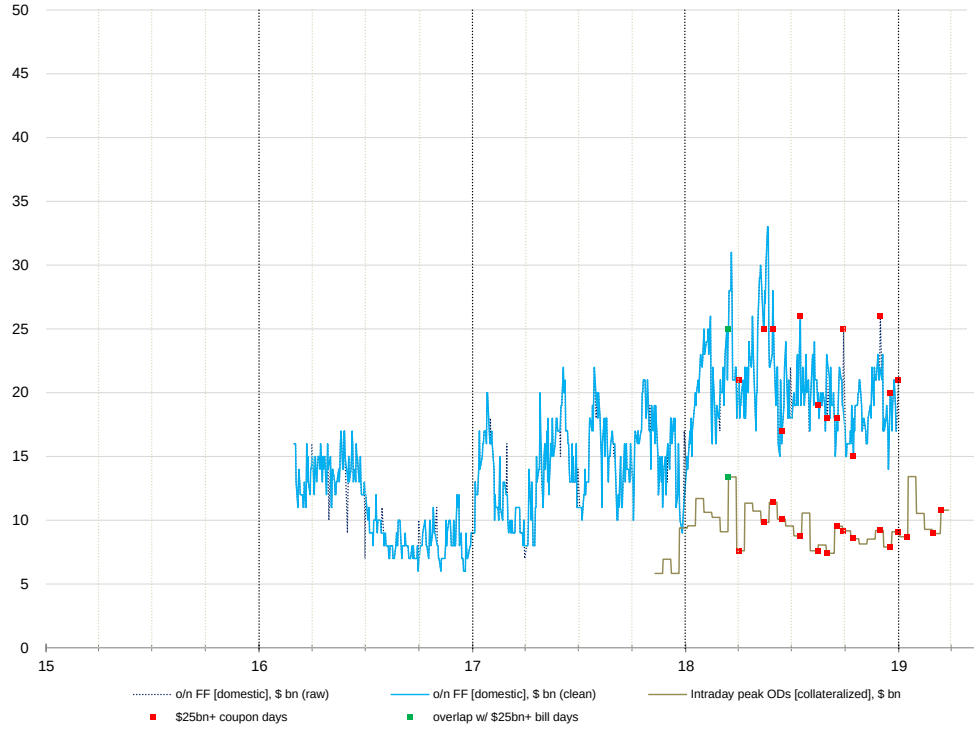
$ billions



Source: Federal Reserve, Credit Suisse

Figure 36: Chunky Coupon Days, Daylight Overdrafts and U.S. Banks' Demand for o/n FF

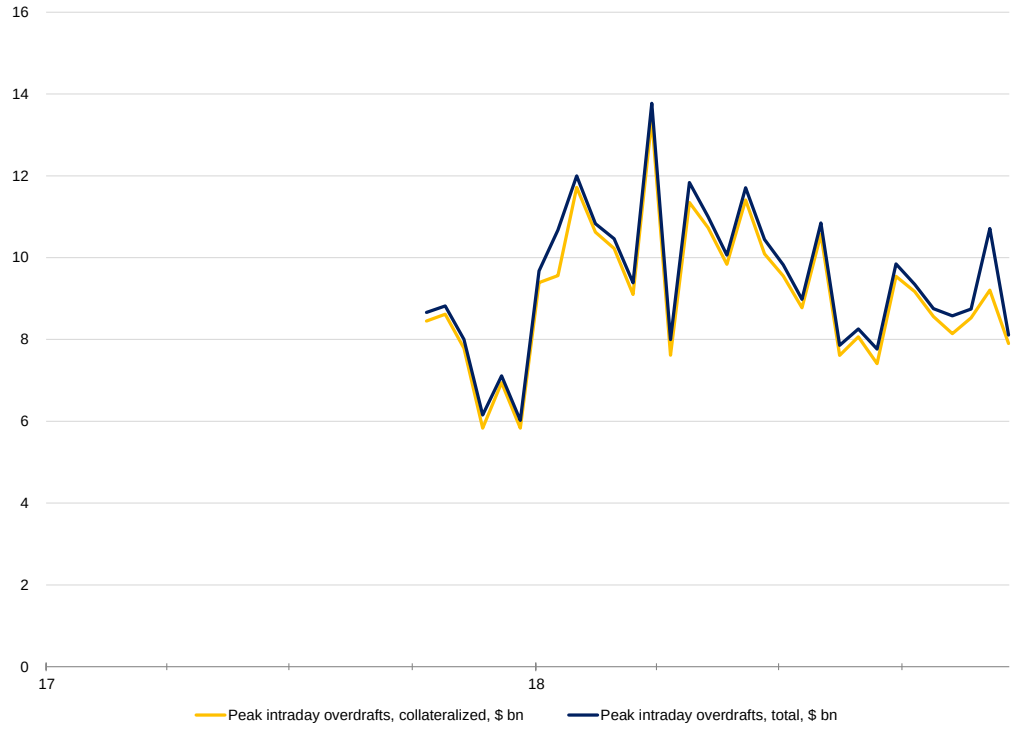
$ billions



Source: Federal Reserve, Credit Suisse

Figure 37: Daylight Overdrafts

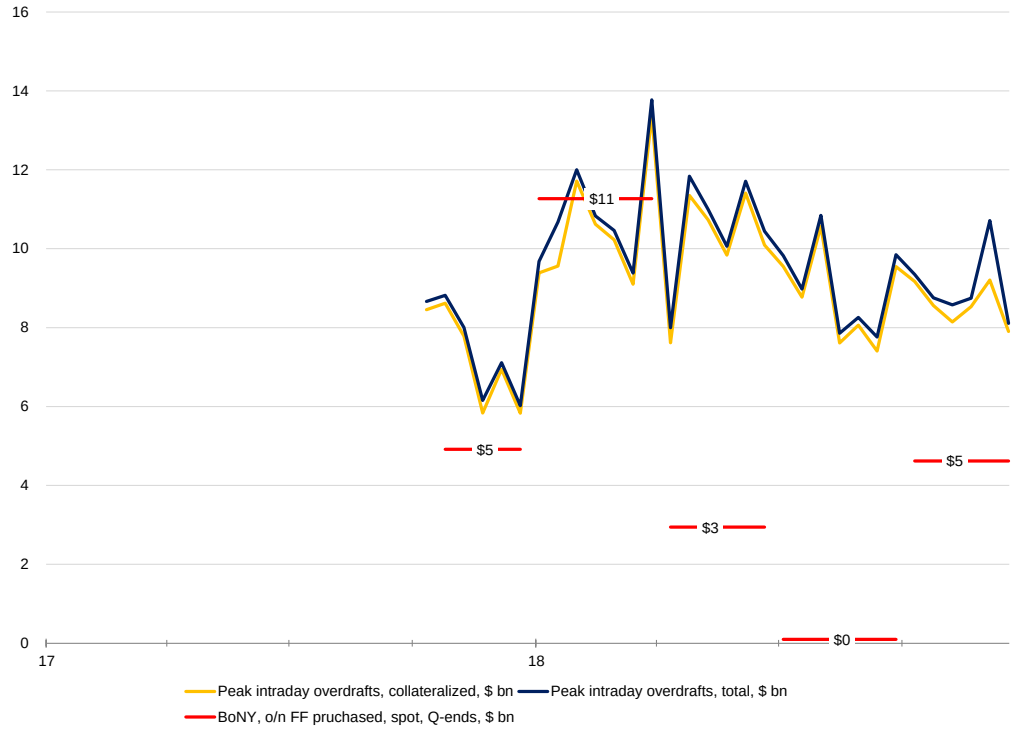
$ billions



Source: Federal Reserve, Credit Suisse

Figure 38: Daylight Overdrafts and BoNY's Presence in the o/n FF Market

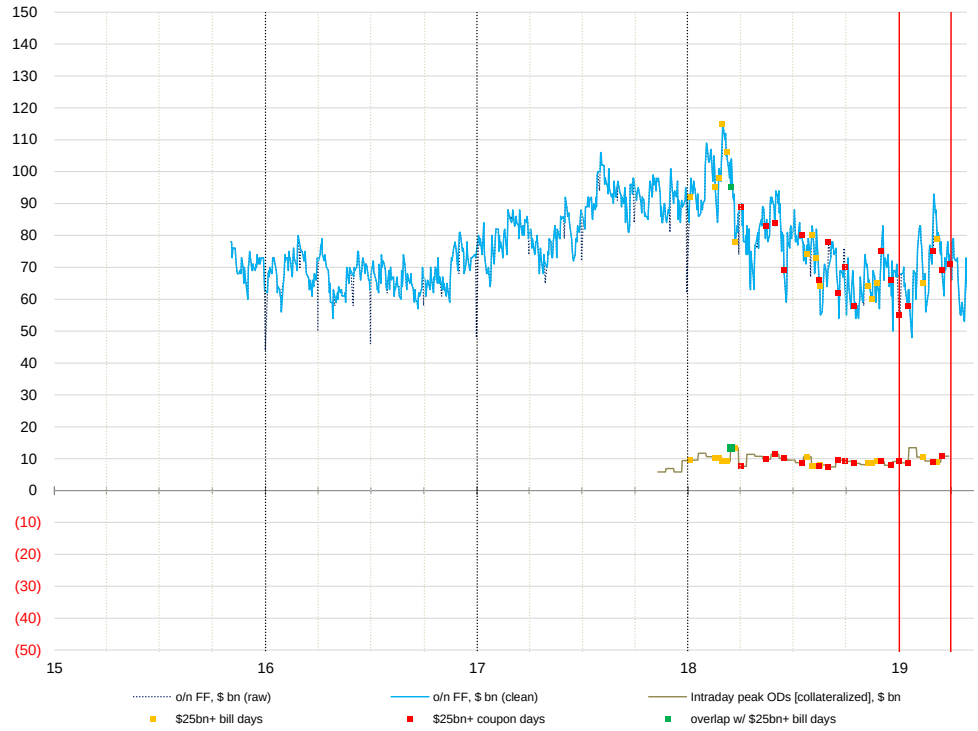
$ billions



Source: Federal Reserve, BoNY's call reports, Credit Suisse

Figure 39: "Trends *vs.* Extremes"

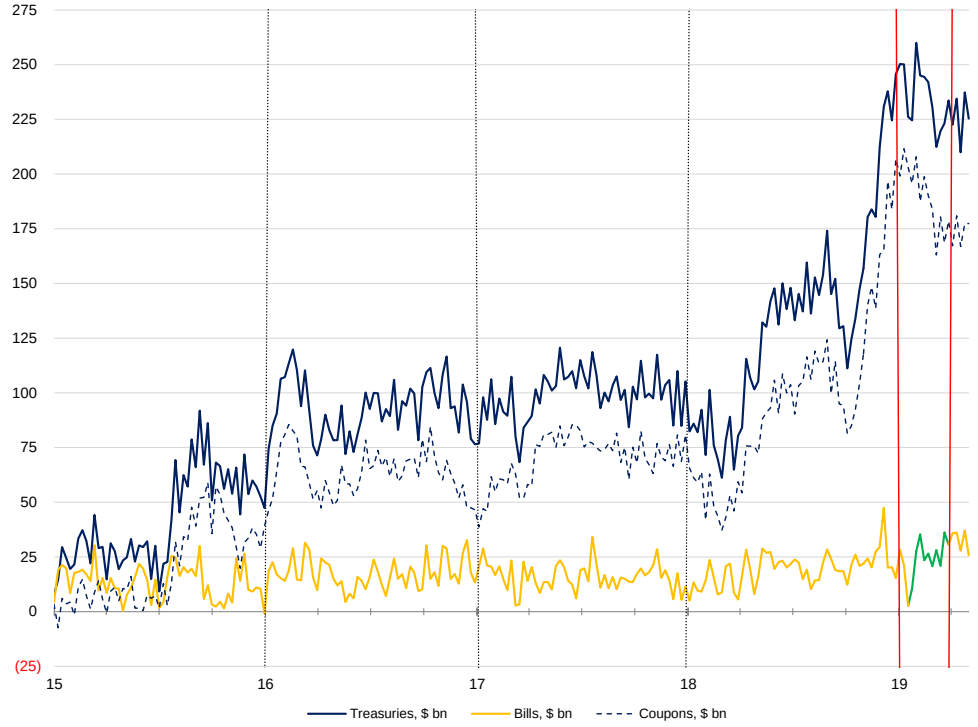
$ billions



Source: Federal Reserve, U.S. Treasury, Credit Suisse

Figure 40: Bill Inventories Drove Recent Demand for Daylight Overdrafts

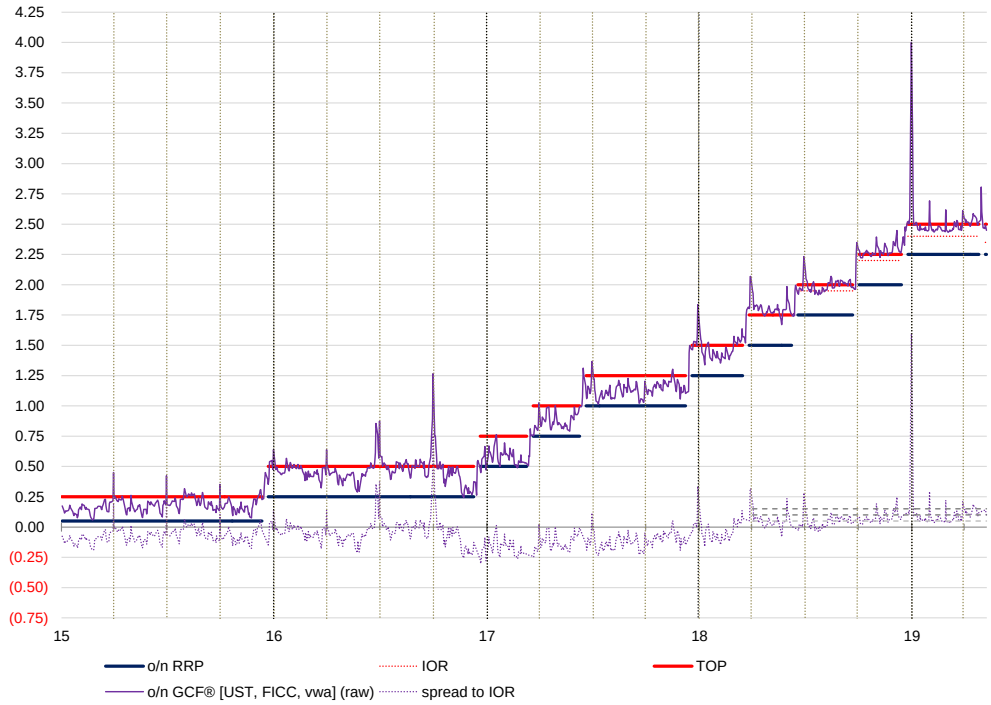
$ billions



Source: Federal Reserve, Credit Suisse

Figure 41: o/n GCF® Repo Rates

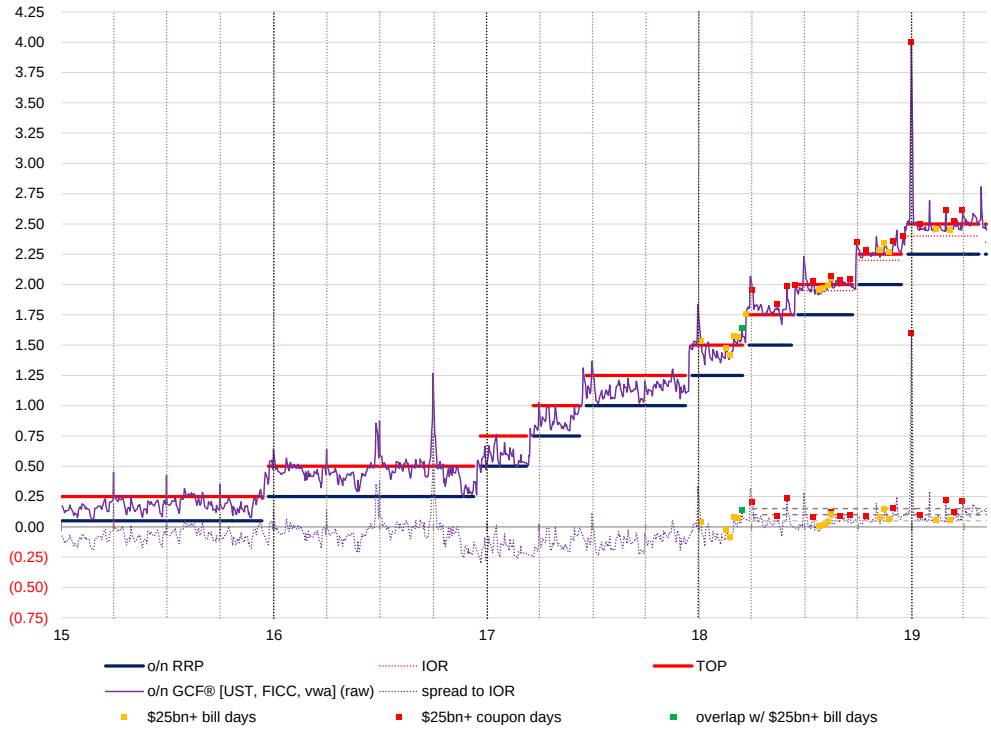
percent



Source: the BLOOMBERG PROFESSIONAL™ service, U.S. Treasury, Credit Suisse

Figure 42: o/n GCF® Repo Rates on Chunky Settlement Days

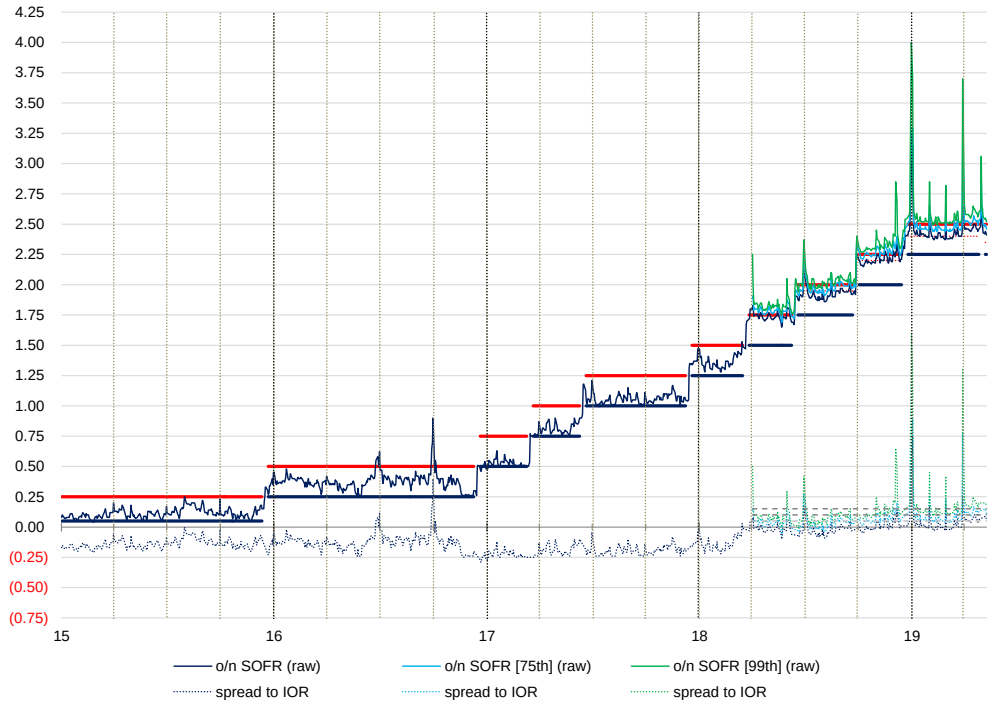
percent



Source: the BLOOMBERG PROFESSIONAL™ service, U.S. Treasury, Credit Suisse

Figure 43: Top Percentile SOFR Rates

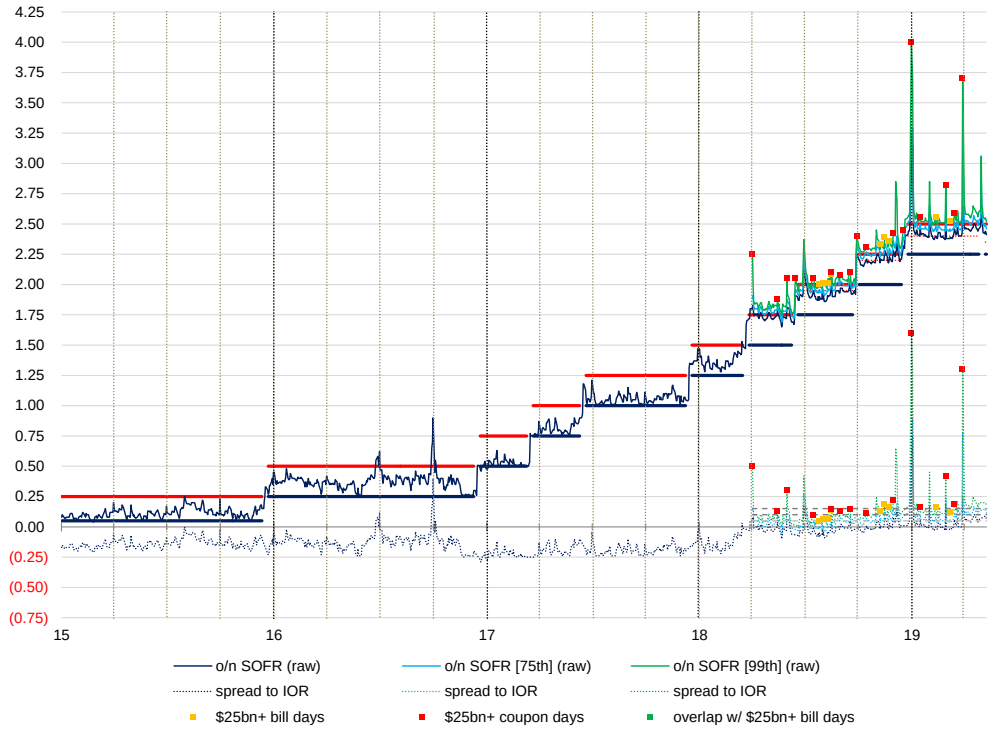
percent



Source: the BLOOMBERG PROFESSIONAL™ service, U.S. Treasury, Credit Suisse

Figure 44: Top Percentile SOFR Rates on Chunky Settlement Days

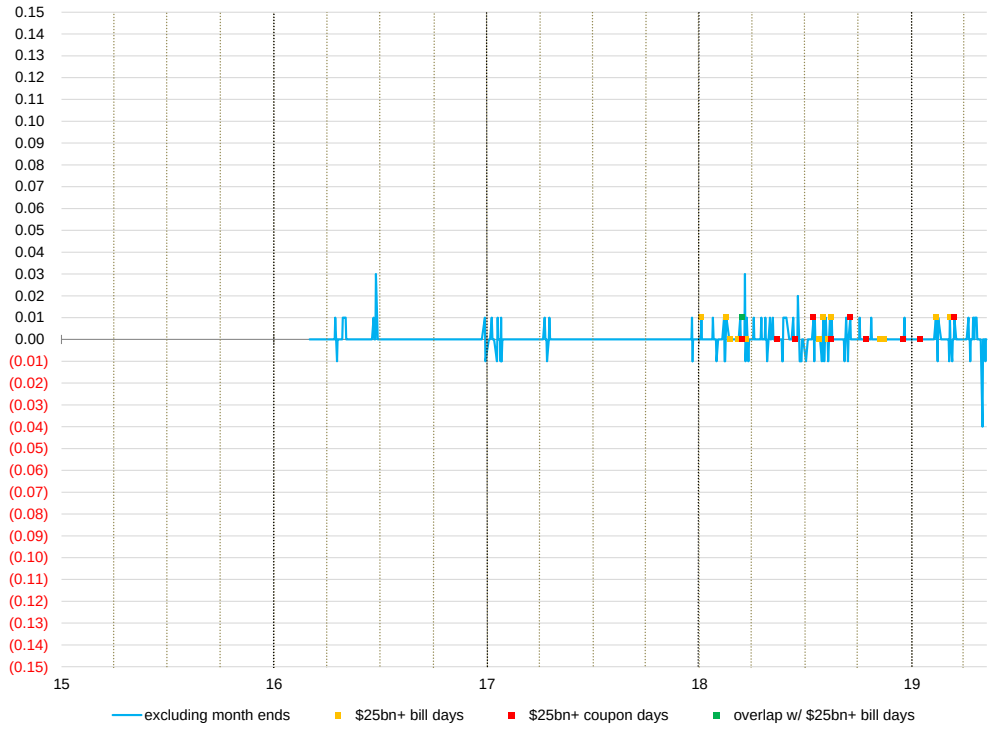
percent



Source: the BLOOMBERG PROFESSIONAL™ service, U.S. Treasury, Credit Suisse

Figure 45: Top Percentile o/n FF Rates

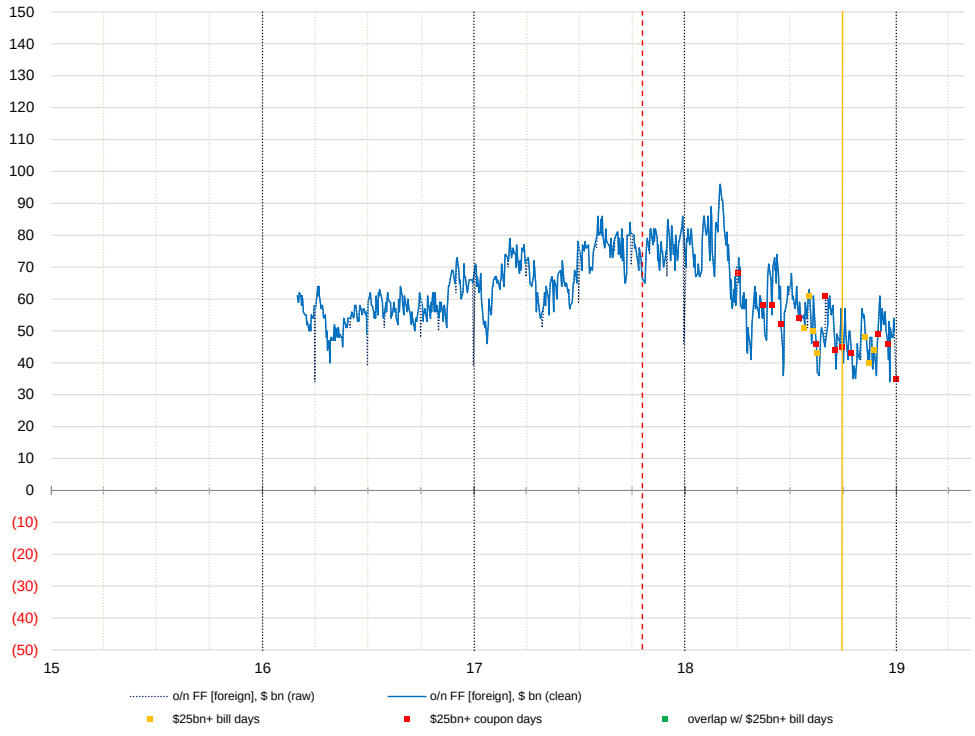
basis points



Source: the BLOOMBERG PROFESSIONAL™ service, U.S. Treasury, Credit Suisse

Figure 46: Chunky Settlement Days Drive Foreign Banks' Arbitrage-Related Demand for o/n FF

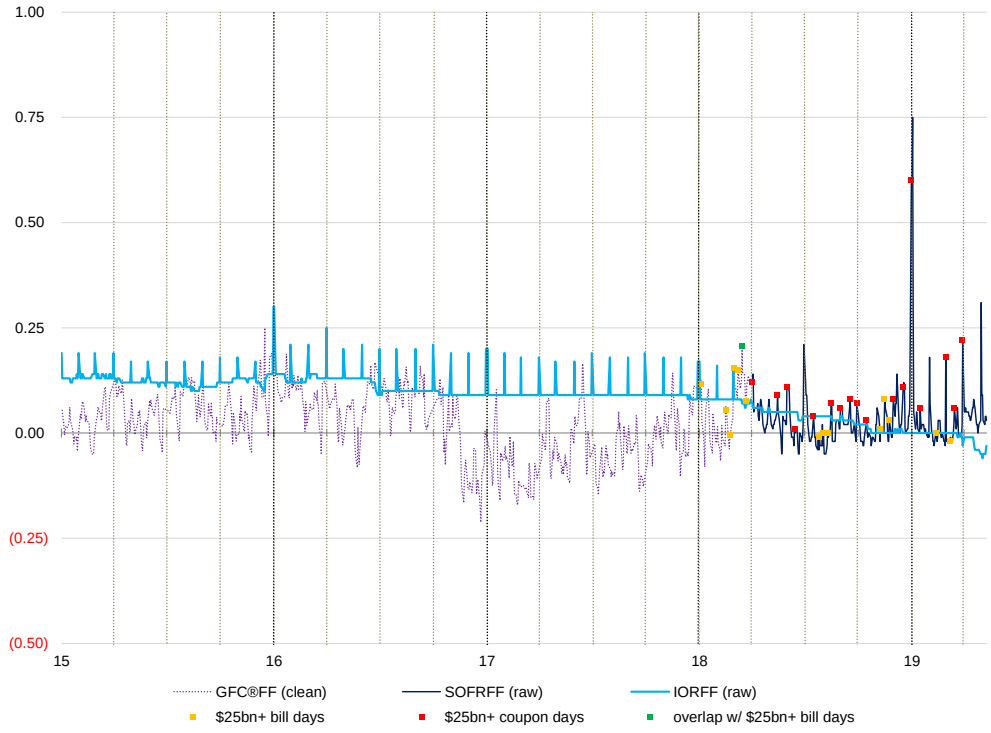
$ billion, dashed red line marks the start of taper and the orange line marks the start of the curve inversion relative to FX hedging costs



Source: Federal Reserve, U.S. Treasury, Credit Suisse

Figure 47: The Old *vs.* the New Arbitrage Trade

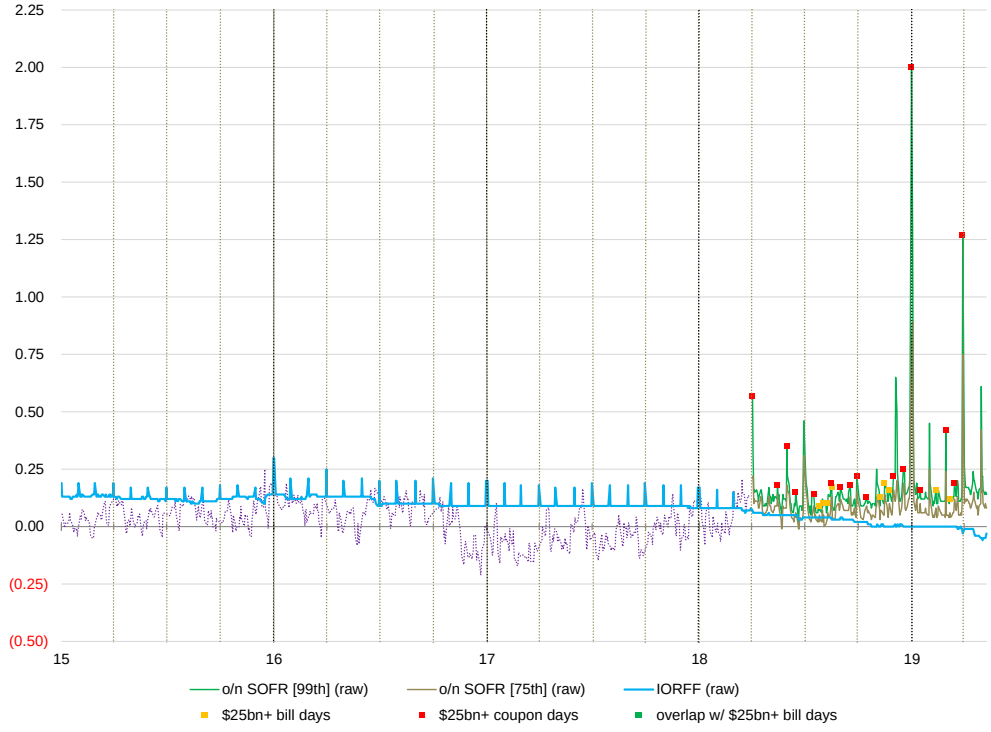
percent



Source: the BLOOMBERG PROFESSIONAL™ service, U.S. Treasury, Credit Suisse

Figure 48: The "Super" Arbitrage Trade at the Fringes

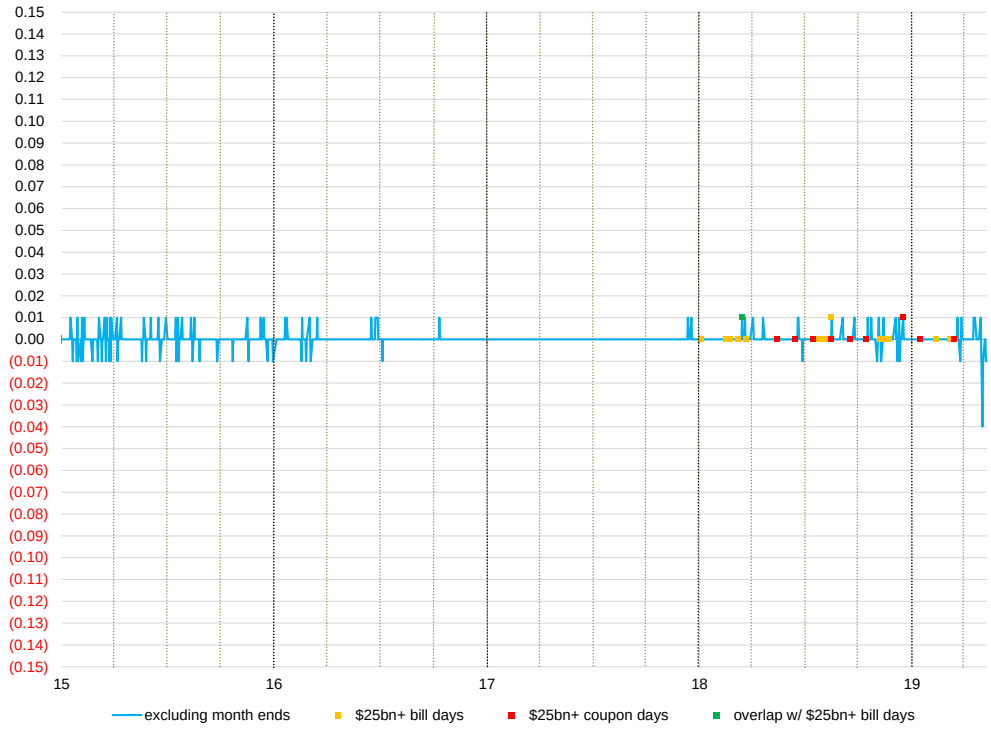
percent



Source: the BLOOMBERG PROFESSIONAL™ service, U.S. Treasury, Credit Suisse

Figure 49: The Lagging and Low-Beta Indicator of Collateral-Related Stresses

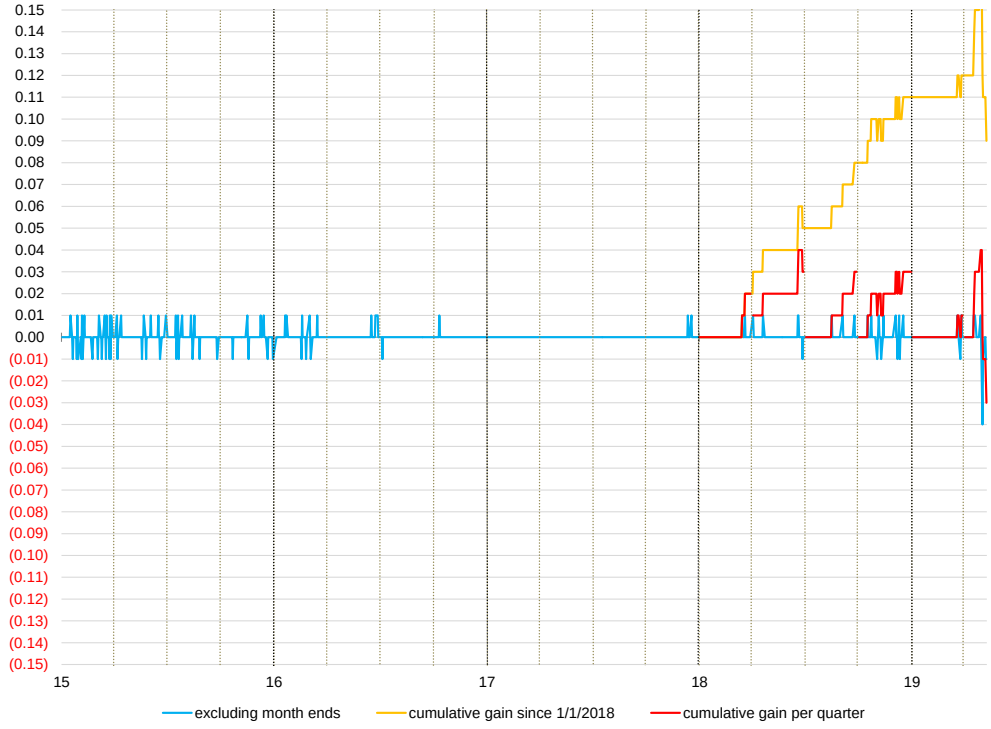
percent



Source: the BLOOMBERG PROFESSIONAL™ service, U.S. Treasury, Credit Suisse

Figure 50: "Vol is Baaack" – at Least in the o/n FF Market

percent



Source: the BLOOMBERG PROFESSIONAL™ service, U.S. Treasury, Credit Suisse

Appendix

	Federal Reserve (FRBNY)		Dealers (Credit Suisse Securities LLC)		Large U.S. Banks (Citibank, N.A.)		Non-Banks (real money, etc.)	
7:00 AM	UST	$Reserves_{BoNY}$ $Reserves_{Citi}$ $Reserves_{DNB}$ TGA	Deposits		$Reserves_{C}$	Deposits	Deposits	
9:00 AM								
9:30 AM								
3:30 PM								
Scenario, net:								
End-of-day, net:								
Intraday, normal:								
Intraday, with daylight overdrafts:								

	Treasury (Debt Management Office)		Clearing Bank (BoNY)		Foreign Banks (DNB Bank NY branch)		Federal Home Loan Banks (FHLBNY)	
7:00 AM	TGA	UST	$Reserves_{B}$	Deposits	$Reserves_{D}$	FF_{DNB}	FF_{DNB}	
9:00 AM								
9:30 AM								
3:30 PM								
Scenario, net:								
End-of-day, net:								
Intraday, normal:								
Intraday, with daylight overdrafts:								

Source: Credit Suisse

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