

# Lecture 3

## Unconventional monetary policy

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Spring, 2024

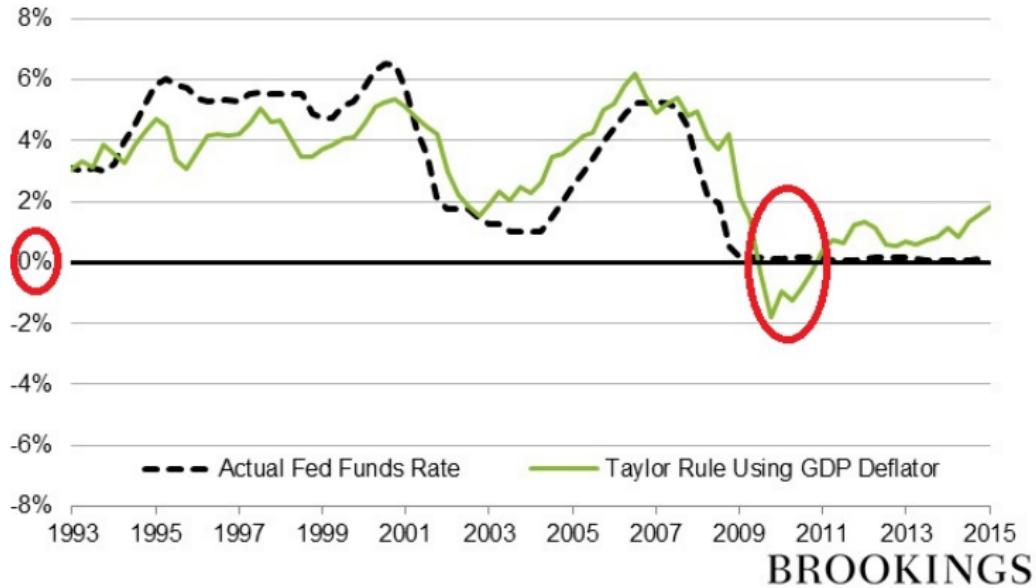
# Disclaimer

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# Unconventional policy

# Unconventional Policy

- Policy options at ZLB
- Reducing long rates
- Forward Guidance
- Quantitative Easing



Target Fed Funds Rate (including crisis). Source: Brookings

**How can CBs influence the economy when they are constrained by  $i_t \geq 0$ ?**

*The problem with QE is it works in practice but it doesn't work in theory*

- Ben Bernanke, January 2014, Brookings

# Reducing long rates

*If* there is an organizing theoretical principle to unconventional policy it is to **reduce longer term rates** - directly or as a by-product of credible indications of future policy actions

# Reducing long rates

$$i_t^k = \underbrace{\mathcal{E}_t^k}_{\text{Expected policy}} + \underbrace{\mathcal{P}_t^k}_{\text{Term premium}}$$

- $i_t^k$ : rate on a  $k$ -maturity bond
- $\mathcal{E}_t^k$ : expected average short rate over the coming  $k$  periods
- $\mathcal{P}_t^k$ : adjustment for risk, liquidity (among other things)

**See the accompanying ‘primitives’ document**

# Reducing long rates

We will discuss a few channels but the main two are:

- **Forward guidance** ('Open mouth operations')
  - Mainly influences  $\mathcal{E}_t^k$
- **Large scale asset purchases** (QE)
  - Mainly influences  $\mathcal{P}_t^k$
  - But arguably also significant effect on  $\mathcal{E}_t^k$

# Reducing long rates

Question:

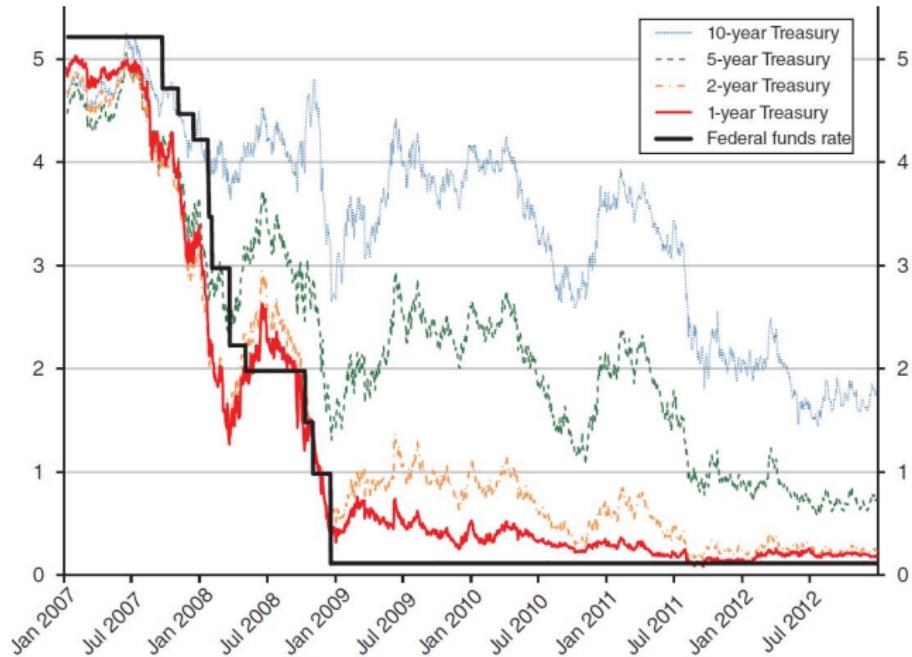
- Why focus on long rates?

# Reducing long rates

Short rates are at zero but...

- ZLB isn't expected to prevail *forever*
  - $\mathcal{E}_t^k > 0$  for big enough  $k$
- There tends to be an upward sloping term premium
  - $\mathcal{P}_t^k > 0$  for medium/large  $k$ ,  $\uparrow$  with  $k$

Thus, longer maturity rates  $i_t^k$  are typically not 'at the zero lower bound'



Fed funds target rate and zero-coupon US Treasury yields. Source: Swanson and Williams, AER 2014

*According to standard macroeconomic models, the zero lower bound greatly reduces the effectiveness of monetary policy and increases the efficacy of fiscal policy. However, private-sector decisions depend on the entire path of expected future short-term interest rates, not just the current short-term rate. Put differently, longer-term yields matter.*

- Swanson and Williams, AER 2014

▶ Euler

# Reducing long rates

Various important borrowing rates move very closely with long maturity government debt

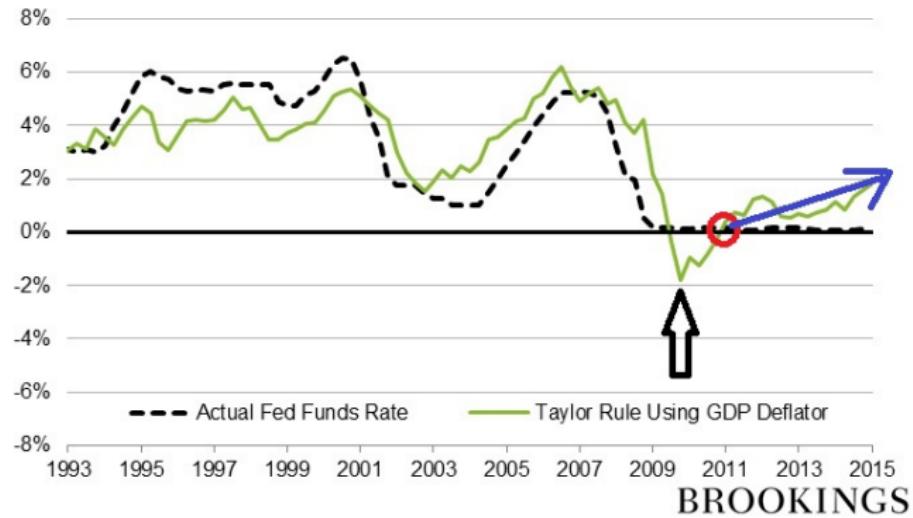
- Indeed some products are explicitly priced in relation to them
- Discount rates relevant for pricing equities too

► Private Rates

# Forward guidance

Suppose the central bank finds itself at the ZLB and...

- The *private sector's* presumption is that they follow a Taylor rule and, given that,...
- The CB will raise rates above zero ('lift off') in  $J_L$  periods and,...
- Raise rates fairly rapidly thereafter



Target Fed Funds Rate based on Taylor rule - early liftoff. Source: Brookings

# Forward guidance

Questions:

- Why might a CB not want to follow TR 'near' the ZLB?
- What sort of deviation from the rule might be suitable?
- Why might this reduce long rates?

# Forward guidance

Following such a rule (or simply allowing the private sector to believe it 'may' be followed with some probability) can lead to undesirably high  $\mathcal{E}_t^k$  and even  $\mathcal{P}_t^k$

# Forward guidance

Precaution (asymmetric risks?) in the vicinity of ZLB may necessitate a deviation from Taylor

- Delay of liftoff
- ‘Lower for longer’ after liftoff

Commitment to being ‘irresponsible’

- Raising  $\pi$  expectations can reduce real rates, for given  $i_t$  path
- Convey that  $i_t$  will be kept low for longer than they might otherwise be, to ‘juice’ the economy and drive up inflation
- $\approx$  a promise to overheat the economy **in the future** - to get it going **now**

If the CB can credibly commit - then it can influence  $\mathcal{E}_t^k$  (and the implied longer term real rates that influence real activity)

# Forward guidance

*This means that the central bank must make a credible commitment to engage in what would in other contexts be regarded as irresponsible monetary policy - that is, convince the private sector that it will not reverse its current monetary expansion when prices begin to rise!*

- Krugman (1988) - discussing Japan's predicament

# Forward guidance

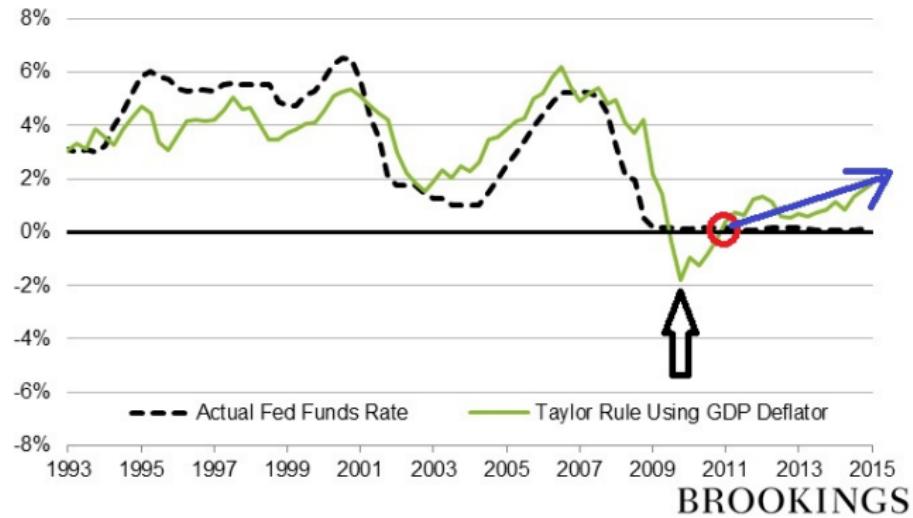
Options for forward guidance...

- Later liftoff
- Reducing predicted pace of interest rate increases *after* liftoff
- Higher inflation in future periods

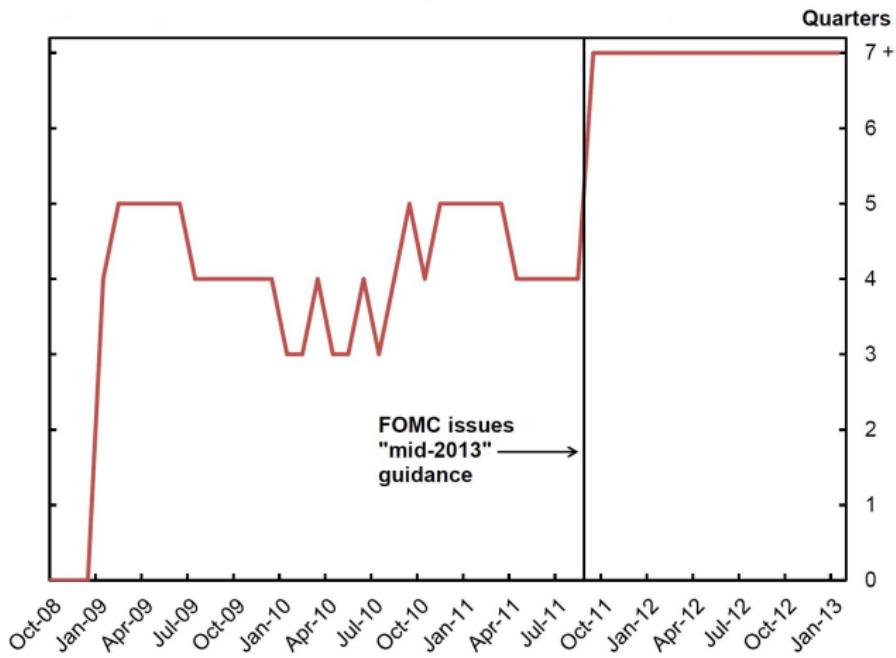
Policymakers *can* also increase the impact of forward guidance if they articulate it unambiguously

► Censored Uncertainty

- But *should* they?



Target Fed Funds Rate based on Taylor rule - early liftoff. Source: Brookings



Date-based forward guidance: Number of quarters until FFR expected to rise above 37.5bps (Blue Chip). Source: [John Williams, Discussion, 2016](#)

	Treasury Yield Maturity					
	3-month	6-month	1-year	2-year	5-year	10-year
FOMC drops "considerable period" language on Jan. 28, 2004						
Jan. 27, 2004	0.89	0.96	1.17	1.69	3.08	4.39
Jan. 28, 2004	0.92	0.98	1.30	1.86	3.22	4.49
change (bp)	3.0	2.0	12.5	16.6	13.9	10.3
FOMC projects near-zero funds rate "at least through mid-2013"						
Aug. 8, 2011	0.05	0.07	0.17	0.27	1.13	2.59
Aug. 9, 2011	0.03	0.06	0.13	0.17	0.93	2.36
change (bp)	-2.0	-1.0	-4.3	-9.9	-20.4	-22.8

Date-based forward guidance: Differential impact on Treasury yields - 'considerable period' vs 'at least through mid-2013'.

Source: John Williams, Discussion, 2016

# Forward guidance

There are dangers to forward (especially 'date-based') guidance

- Can frequently be interpreted (perhaps unfairly) as a 'commitment'
- While forward guidance is still (has always been) important - date based guidance is used as a 'last resort'

Speaking confidently - even with caveats - about the future is a dangerous game...

# Is Carney an unreliable boyfriend - or just sensitive?

Kamal Ahmed  
Economics editor  
@bbckamal

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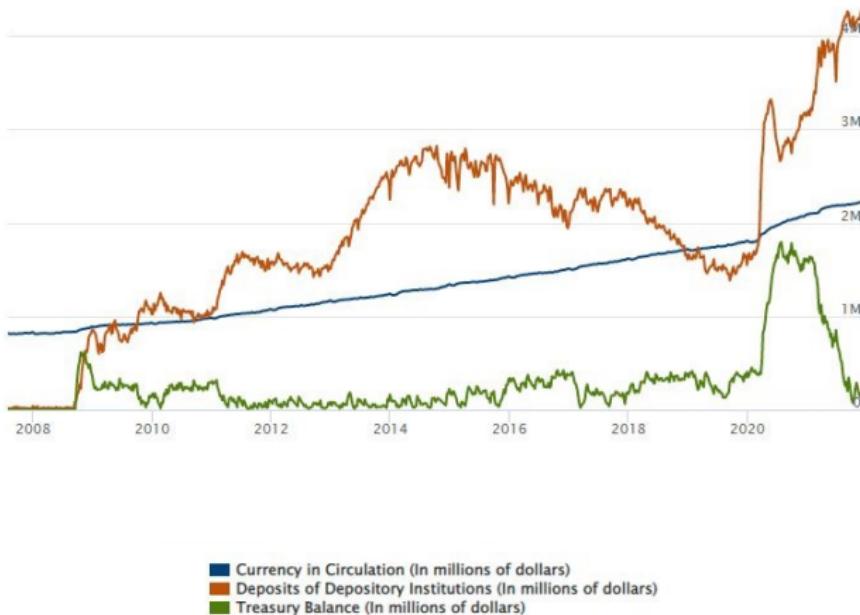
# Quantitative easing

Beyond using forward guidance, CBs engaged in large scale asset purchases

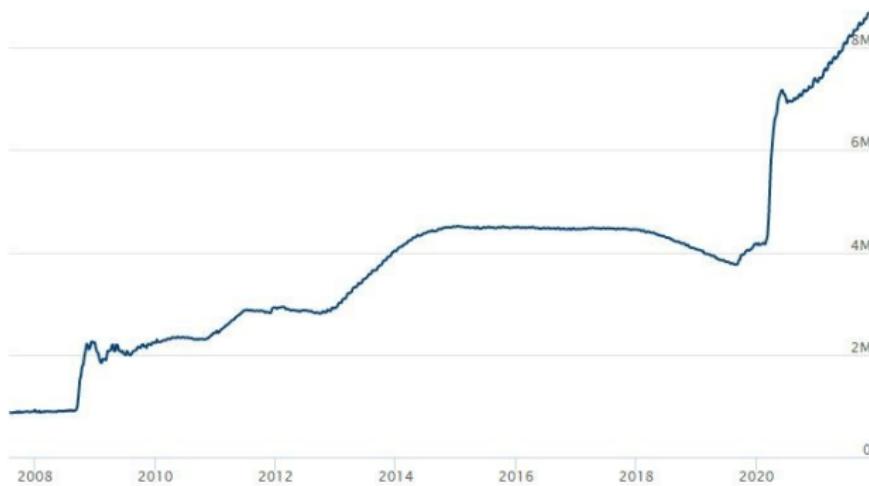
- Typically regarded as a monetary operation (QE)
- Also initially had a big ‘financial stability’ / ‘market functioning’ motivation (Bernanke calls this ‘**credit easing**’)

The purchases were funded by enormous reserve creation...

- Fed bought assets from ‘banks’ using reserves it created
- Credited the banks with ‘money’ in their accounts at the CB

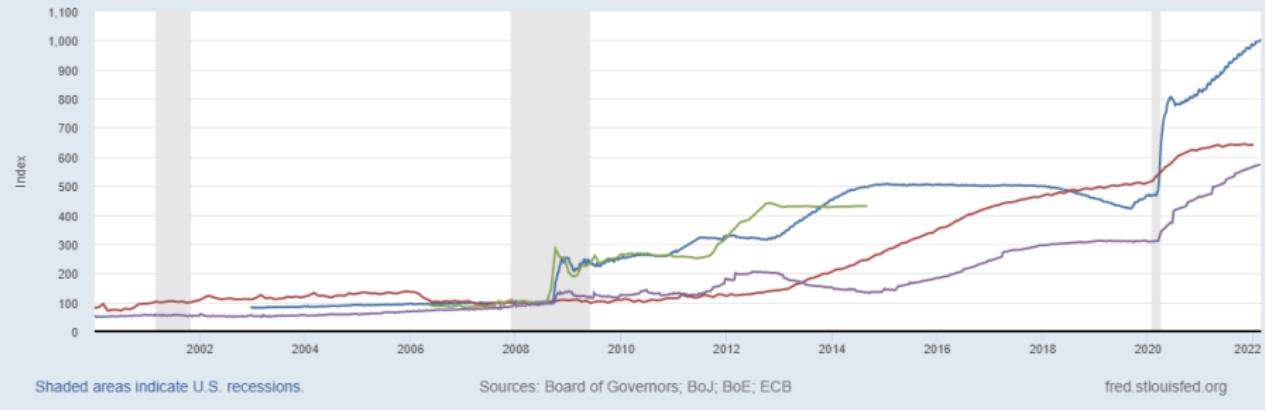


Liabilities of the Federal Reserve. Source: BoG - Recent balance sheet trends



Total assets of the Federal Reserve. Source: BoG - Recent balance sheet trends

- Assets: Total Assets: Total Assets (Less Eliminations from Consolidation): Wednesday Level, 2008-01-01=100
- Bank of Japan: Total Assets for Japan, Jan 2008=100
- Total Central Bank Assets for United Kingdom (DISCONTINUED), Jan 2008=100
- Central Bank Assets for Euro Area (11-19 Countries), 2008-01-01=100

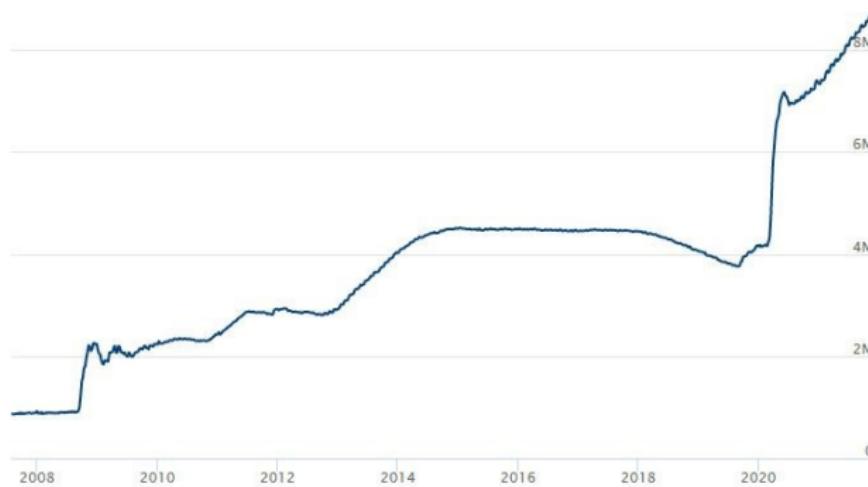


Total assets of various central banks. Source: FRED

# Quantitative easing

Question:

- Is it just a question of the *value* of purchases?



Total assets of the Federal Reserve. Source: BoG - Recent balance sheet trends

# Quantitative easing

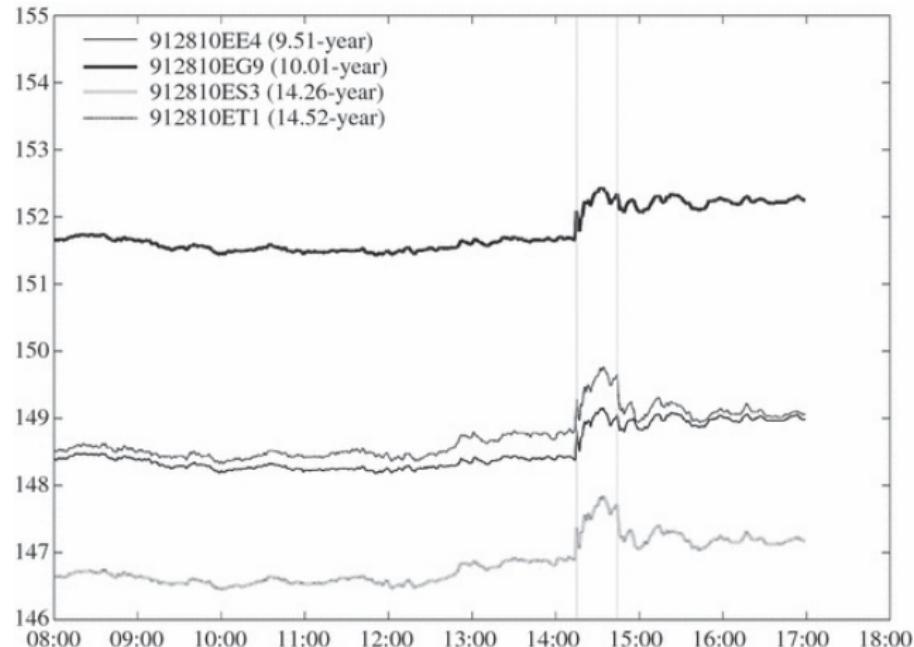
Question:

- How would you check if QE worked?

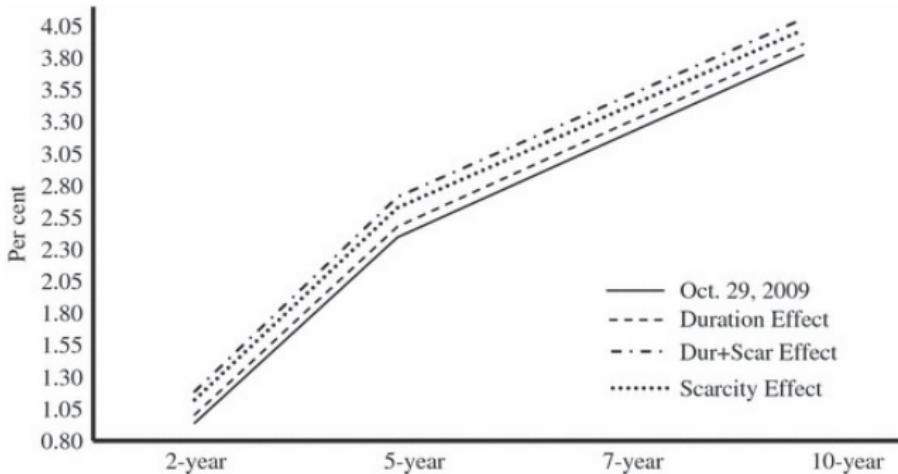
# Quantitative easing

Did the actions affect rates?

- Consensus is yes

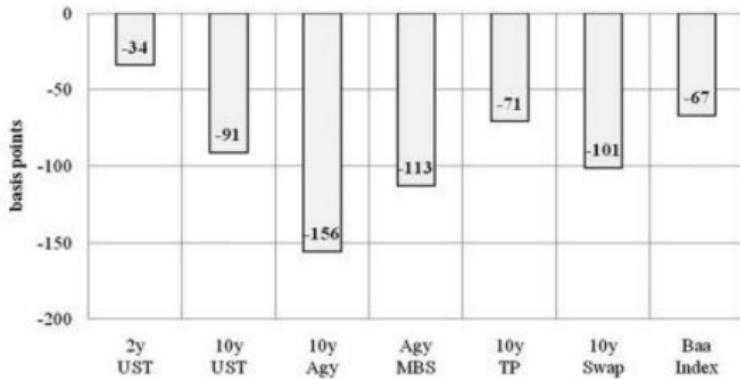


Effect of LSAPs: Intraday bond price movements, August 10, 2010. Source D'Amico et al, EJ, 2012



Counterfactual yield curves. Source D'Amico *et al*, EJ, 2012

► Duration removal



Effect of LSAPs: Broader market rates. Source [Gagnon et al, IJCB, 2011](#)

# Quantitative easing

What about the effects on the *broader* economy?

- Surprisingly limited work on this (short samples, fewer events, lower reporting frequency of data?)
- Much of the focus is on the effect on market rates/asset prices

There are some impacts that have been plausibly estimated - here are some (UK focused) examples:

- Kapatenios *et al* (EJ 2012): GDP, inflation
- Baumeister and Benati (IJCB 2013): GDP, inflation
- Boneva *et al* (IJCB 2016): Wage and price expectations
- Weale and Wieladek (JME 2016): GDP, unemployment

# Quantitative easing

Question:

- *Why did the policies ‘work’?*
  - **Disclaimer:** Depends on whom you ask and when you ask them...

# Quantitative easing

Various theories have been proffered:

- ① **Scarcity + preferred habitat investors:** Some important (and large) investors are active in only a small subset of maturities and removing *those* maturities from the market requires higher prices (lower yields) to clear demands that aren't (perfectly) substituted with demands for *other* maturities
- ② **Removal of duration risk:** CBs removed assets from private holdings that had particularly long duration (exhibited 'duration risk'), implying less of a premium for holding the remaining risk was necessary to clear the market
- ③ **Search for yield:** Lower returns on assets saw investors driven into riskier financial (and real) assets

(so-called 'portfolio balance' effects)

# Quantitative easing

- ④ **Conveying credibility:** ‘*Signaling channel*’ whereby QE enhanced credibility of *forward guidance* so not only  $\mathcal{P}_t^k$  affected but  $\mathcal{E}_t^k$  also
- ⑤ **Repairing market liquidity/confidence:** Often offered as an explanation of evidence that early rounds of expansion were most effective

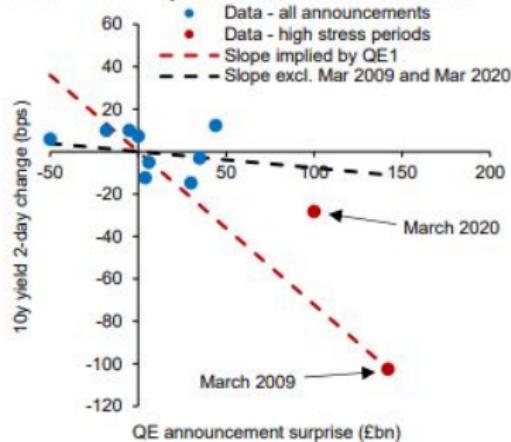
... and many more (**more on this, later in the course.**)

# Quantitative easing

*Whether you think QE works mainly via a persistent portfolio balance effect that reduces risk premia, or – as I do – mainly by lowering future rate expectations and raising inflation expectations back to target, with a powerful temporary liquidity effect in dysfunctional markets, in either case the persistent effect of QE works by lowering long term yields*

- Gertjan Vlieghe, Speech, July 2021

**Chart 5: Yield impact of QE announcements**



### **Chart 6: Measures of market liquidity**



Impact of QE and market context. Source Vlieghe (2021)

# Current and future policy

# Roadmap

- Flexible average inflation targeting (FAIT)
- Floor system for policy rate outside ZLB
- Large balance sheets - here to stay? (if we have time)

Why might forward guidance be difficult at the zero lower bound, in a weak economy?

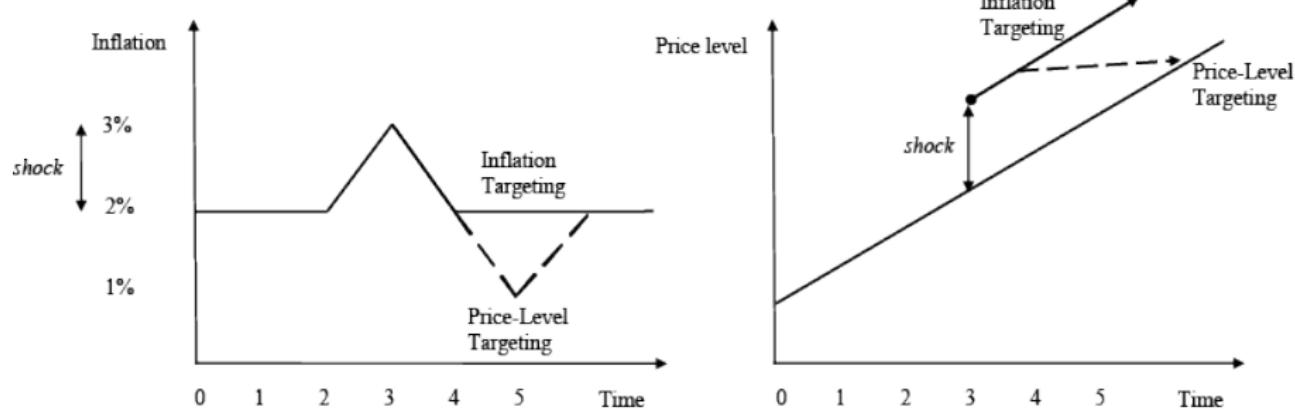
- Has inflation targeting become 'too credible'
- To reduce (long) real rates, there is an argument to allow inflation to run above 'target' for some time
- But (some) people think once inflation gets back to target, the CB will hit the brakes

Promising to be 'irresponsible' is tricky - especially given the '**short memory**' of inflation targeters

► Short Memory

Question:

- In what way does an inflation targeter have a 'short memory'?



Inflation and price-level targeting compared (here for the case of unexpectedly high inflation). Source: [Hatcher and Minford \(2014\)](#)

# FAIT

See week 1 for discussion of PLT and its close cousin, FAIT

- Won't repeat here...

# Floor system

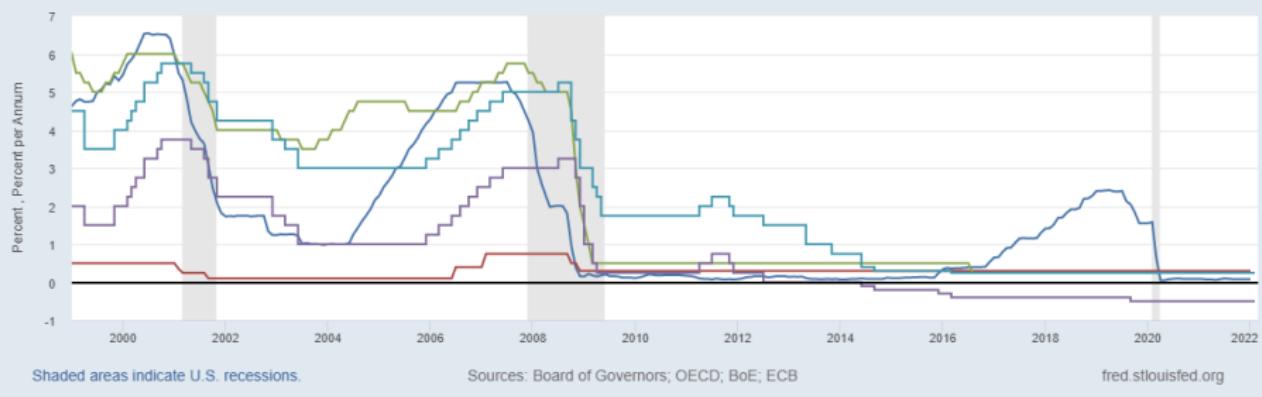
As economies emerged from the (long) aftermath of the GR, policymakers wanted to use  $i_t > 0$  again

- Better understood than LSAPs by policymakers and public
- Even with 'lower for longer' concerns, optimal policy  $\Rightarrow i_t > 0$

COVID caused a return to ZLB and reactivation of some unconventional policies

- But similar reasons now for normalization
- Plus inflation is running hot!

- Federal Funds Effective Rate
- Immediate Rates: Less than 24 Hours: Central Bank Rates for Japan
- Bank of England Policy Rate in the United Kingdom
- ECB Deposit Facility Rate for Euro Area
- ECB Marginal Lending Facility Rate for Euro Area



Policy rates for various central banks. Source: FRED

# Floor system

But how do you raise rates in a context of 'abundant reserves'?

- Recall the 'corridor' system
- There the supply of reserves was such that 'markets cleared' at a positive interest rate
- Now (flipside of LSAPs) the system is flooded with reserves

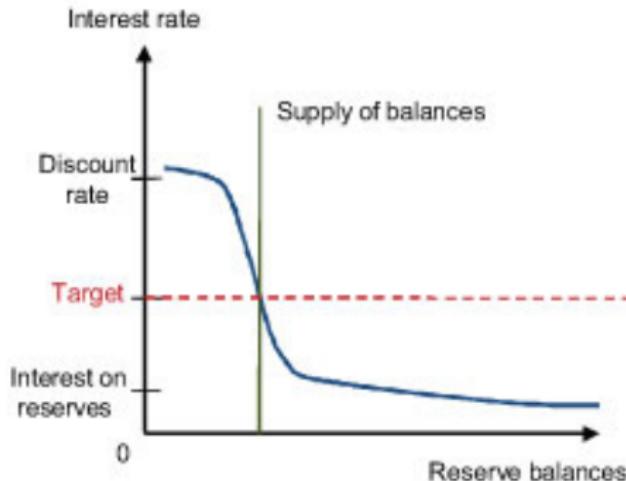
Recall our 'fat fingered' friend on Liberty Street...

# Floor system

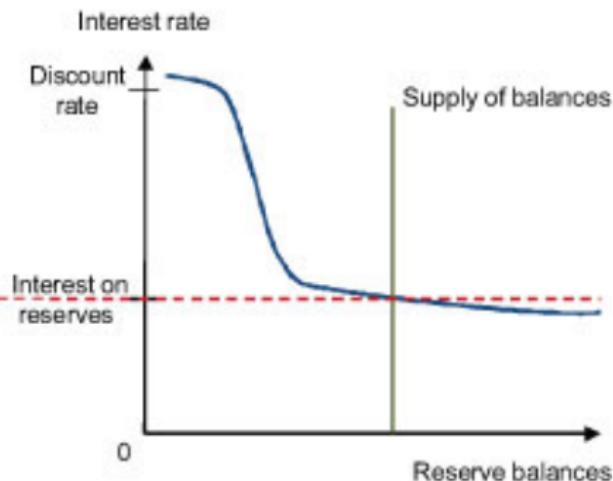
If enough reserves are supplied, banks' demands will be 'satiated'

- Rates will be driven down to the floor
  - Reserves are abundant (not 'scarce')
  - Interest rate is then pinned by arbitrage vs rate available at CB
  - CB is 'borrower of first resort'
- Old days:
  - Fed paid zero IOER
  - BoE paid  $> 0$  but only a 'stress reliever' for individual banks who messed up their liquidity management!
  - OMOs used to keep rates  $\approx$  **policy rate**, well **above** floor

## A Corridor System



## A Floor System



Corridor vs. Floor. Source: NY Fed Liberty Street Blog, Todd Keister (2012)

# Floor system

Question:

- How are the 'interpretation and role' of the 'floor' now different?

# Floor system

Previously - the floor did not...

- 'Determine' market rates for other short term riskless lending (and by the '**transmission mechanism**' ripple through other rates and the economy more broadly)
- Convey the stance of policy

**Now it (ideally) does both those things**

- So we can use interest rates again (yay?)

# Floor system

Typically CBs implement floors through, essentially, making themselves 'borrower of first resort'

- If you (or a competitive intermediary you can give your funds to) can 'lend to the fed' at the floor rate, why would you lend to anyone else?
  - Note this is the same intuition as when we first discussed the floor (in the corridor context)
- The actual implementation varies across central banks but typically it involves some combination of...
  - Interest on reserves for financial institutions with reserve accounts and/or...
  - A 'reverse repo' scheme for a (typically broader) set of institutions
- For example, the Fed has **IOER and Reverse-Repo**

# Floor system

Question:

- But what about the balance sheet effects (remember  $\mathcal{P}_t^k$ ) - how can the short rate be capturing policy?

# Floor system

CBs don't like to talk about this much

- *If* they do, they assert that the balance sheet is on 'auto-pilot' or words to that effect ('gradual', '**predictable**',...)

**Joumanna Bercetche:** *Many people see this potential reduction in reserves in the future as a substitute for rate hikes, in other words that the bank is essentially saying that there's going to be some resistance to hiking beyond zero point five percent. . .*

- Monetary Policy Report Press Conference, August 2021

**Andrew Bailey:** [L]et me start by just repeating . . . that we see interest rate movements, bank rate movements, as the primary active tool of monetary policy. . . So just to push back on the suggestion that we're using this reduction on the balance sheet as a substitute for what might be viewed as an unpopular use of interest rates. Not at all. We view interest rates as the active tool.

#### - Monetary Policy Report Press Conference, August 2021

**Andrew Bailey's 'internal monologue': *I want to talk about interest rates.***

- Monetary Policy Report Press Conference, August 2021

(maybe)

**Andrew Bailey (cont.):** However, we also think it's appropriate to have, in a sense, a predictable path for managing the stock of reserves, and for reducing the size of the balance sheet. And the reason that we've emphasised, sort of, in a sense, the first port of call in this policy as being the, if you like, put it on *autopilot*, no re-investment approach, is that that is a *gradual and entirely predictable* path. You know, it'll be perfectly easy to work out what the path of no re-investment is, because we're transparent about what we hold and when it matures.

- Monetary Policy Report Press Conference, August 2021

**Andrew Bailey's 'internal monologue':** *I want to talk about interest rates. You can go away and calculate when all these bonds mature, yourself. But focus on what I say about interest rates.*

- Monetary Policy Report Press Conference, August 2021

(maybe)

# Floor system

Note the subtlety

- He's not (necessarily) saying that the balance sheet *size* doesn't matter
- It probably does influence the amount of stimulus
  - Debate about 'stock' vs. 'flow' effects of QE
- **But**, if CB ties its hands (makes BS path predictable), *changes* in interest rates convey *changes* in policy

Effects of *predictable* balance sheet movements (e.g. runoffs or pre-announced pace of sales) should already be 'priced in' by private sector

- This is partly why the Fed and other central banks document their bond holdings right down to the *CUSIP level* ► CUSIPs

**Vital to avoid** unpredictable and arbitrary moves of the two different tools

- At that point, what is the stance of policy?
- One combination of interest rate and balance sheet policy may be 'equivalent' to another
- Nightmare communication problem

Hence excruciatingly careful description of sequence

- **Here** and, in the BoE case...

*The MPC judges that there are benefits to reducing the stock of purchased assets by initially ceasing to reinvest maturing assets.*

The MPC judges that there are advantages to reducing the stock of purchased assets initially by stopping the reinvestment of maturing assets that the Bank's Asset Purchase Facility already holds. This would have the benefit of providing a predictable and gradual path for the reduction in the stock. It would also be operationally straightforward. For illustration, over 2022 and 2023, just over £70 billion of government bonds held by the Asset Purchase Facility will mature, and over 2024 and 2025, around a further £130 billion will mature. At some point, the MPC could actively sell assets it has previously bought. Any such active asset sales would also be conducted in a predictable manner over a period of time, with the pace dependent on conditions at the time.

#### **The MPC's current approach to the sequencing of monetary policy tools**

*Weighing the above factors together, the MPC intends to begin to reduce the stock of purchased assets, by ceasing to reinvest maturing assets, when Bank Rate has risen to 0.5% and if appropriate given the economic circumstances.*

Taking the above factors together, the MPC intends to begin to reduce the stock of purchased assets when Bank Rate has reached 0.5%, if appropriate given the economic circumstances. The MPC judges that the reduction in the stock of purchased assets should initially occur through ceasing the reinvestment of maturing assets, to allow the reduction to occur at a gradual and predictable pace.

*That level of Bank Rate is lower than was previously assessed...*

That level of Bank Rate is lower than the MPC's previous assessment of the threshold for reducing the stock of purchased assets: in June 2018, the MPC had stated that it intended not to reduce the stock of purchased assets until Bank Rate reached around 1.5%.<sup>[2]</sup>

*...in part reflecting the MPC's judgement that setting a negative Bank Rate is now part of its monetary policy toolkit...*

Previously, the MPC had judged that the ELB for Bank Rate was close to, but a little above, zero. In February 2021, the MPC decided to add a negative Bank Rate to the monetary policy toolkit.<sup>[3]</sup> At its August 2021 meeting, the MPC had been briefed that technical preparations internally and by PRA-regulated firms had progressed sufficiently that a negative Bank Rate could be implemented by the system as a whole, with or without tiered reserve account remuneration, if warranted.

*...as well as its view that the impact on monetary conditions of reducing the stock of purchased assets is likely to be smaller than that of asset purchases on average over the past.*

An additional motivation for starting the reduction in the stock of purchased assets at a lower level of Bank Rate than previously announced is the MPC's judgement that the impact on monetary conditions of a reduction in the stock of purchased assets, when conducted in a gradual and predictable manner and when markets are functioning normally, is likely to be smaller than that of asset purchases on average over the past.

# Large balance sheets - here to stay?

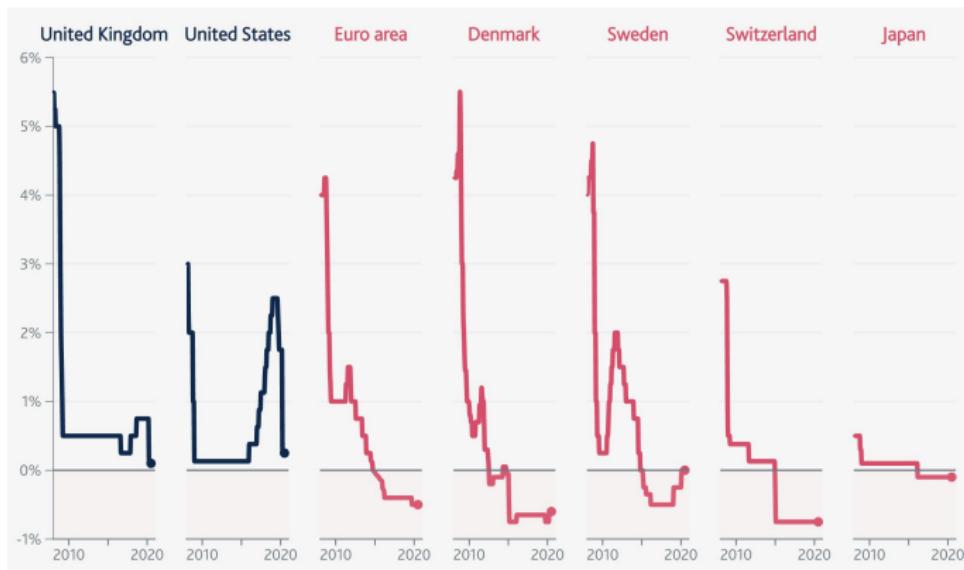
Why might large (larger than pre-crisis) balance sheets persist?

- Regulatory reforms reward banks for holding large amounts of 'high quality liquid assets' (⇒ greater demand for reserves)
  - Possibly reduced liquidity in markets and willingness of dealers to provide liquidity
  - Unexpected market **disruption** in Autumn 2019 gives some credence to this
- Alternative supply of liquidity to private-sector sources
  - Short term debt (deposits, short maturity repo) satisfies demand for liquidity... but at a cost (bank runs, '**run on repo**')
  - If CB provides a substitute (reserves, reverse-repo, CBDC?) then possibly **financial stability risks** are reduced
  - Krishnamurthy and Vissing-Jorgensen (2012, 2015)
- Reverse repo / floor schemes may ultimately allow more precise influence over market rates
  - Though **concerns** that banks are forgetting how to manage liquidity

# Large balance sheets - here to stay?

What are the arguments for balance sheet reduction?

- To the extent they provide stimulus, economic recovery and increasing inflation suggest they should be pared back
  - But recall the delicate issue of coordination/sequencing with interest rate policy
- Delicate 'political' issues arising from portfolio choice
  - 'Favoring' certain assets/asset classes
  - **Accusations** of funding - and thus encouraging - fiscal profligacy, through government bond purchases
- Increasingly, some central banks are implementing, or becoming more favorable towards, **negative interest rates**
  - Would remove one of the main reasons for unconventional (LSAP) policy - the ZLB



Negative interest rates already implemented in various countries. Source: BoE

# Large balance sheets - here to stay?

What are the arguments for balance sheet reduction?

- Large balance sheet ⇒ greater risk of CB making a loss
  - Revaluation of legacy assets ⇒ capital losses (discuss next week)
  - Negative term premium and continued funding of purchases of long maturity assets with short maturity liabilities (reserves) ⇒ drain on net income
  - Given 'consolidated balance sheet' of government, not *per se* problematic, but possible political risk (see, also, [here](#))
- Reverse-repo schemes could, without care, cause disintermediation and loss of (commercial) bank funding
  - Unless designed carefully, could compete with deposit accounts (esp. in crises - easier to run to CB than to hoard cash)
  - This is one reason why RR rates set 'somewhat' below IOER by Fed when first introduced
  - These concerns apply also, to some degree, to CBDC... but that is for another day...

# Appendix

The term federal funds rate refers to the target interest rate set by the Federal Open Market Committee (FOMC). This target is the rate at which commercial banks borrow and lend their excess reserves to each other overnight.

Be careful in distinguishing FFR from **Target** FFR.

▶ Back

## Outright purchases (sales simply the reverse)

- Banks hold Gilts/Treasuries
- CB buys them - crediting reserves to the account of the bank, in exchange
- Gilts are now owned by the CB and there is no 'automatic' reversal of the position
- Both sides of the CB balance sheet increase (unless some offsetting asset sale is made)
- Increases the narrow money supply (in the form of reserves) to be at the level where it is expected to cut the demand curve at a rate near the policy rate

## Repo ('repurchase agreement')

- Banks hold Gilts/Treasuries
- Bank sells them to the CB *with the agreement to repurchase them at a given price after k days*
- As in the outright purchase case, the CB credits reserves to the account of the bank *at the start of the 'repo'*, and acquires the Gilt in exchange
- Essentially a collateralized loan from the CB to the bank (interest rate defined by the repurchase price vs initial price)
- Unlike in the outright purchase case, the operation will be 'automatically' reversed in  $k$  days' time (so change in size of balance sheet is temporary)
- Suitable for offsetting shorter term fluctuations in reserve demand - to keep cutting the demand curve at a rate near the policy rate

## Reverse repo

- CB holds Gilts/Treasuries
- CB can repo them out to banks *with the agreement to repurchase them at a given price after k days*
- As in the outright sales case, the CB debits the bank's reserve account *at the start of the 'repo'*, and gives the bank the Gilt in exchange
- Essentially a collateralized loan from the bank to the CB (interest rate defined by the repurchase price vs initial price)
- Unlike in the outright purchase case, the operation will be 'automatically' reversed in  $k$  days' time (so change in size of balance sheet is temporary)
- Suitable for offsetting shorter term fluctuations in reserve demand - to keep cutting the demand curve at a rate near the policy rate

▶ Back

- Market Yield on U.S. Treasury Securities at 10-Year Constant Maturity
- ICE BofA BBB US Corporate Index Effective Yield
- ICE BofA AAA US Corporate Index Effective Yield
- Bank Prime Loan Rate
- 30-Year Fixed Rate Mortgage Average in the United States



Shaded areas indicate U.S. recessions.

Sources: Board of Governors; FHLMC; Ice Data Indices, LLC

[fred.stlouisfed.org](http://fred.stlouisfed.org)

Yields on TSY10 and on various private borrowing rates. Source: FRED

▶ Back

# Reducing long rates

Recall a basic (deterministic) consumption-savings problem implies an 'Euler equation' (see auxiliary notes)

$$u'(c_t) = r_t + u'(c_{t+1}) + o.t.$$

Using the Fisher equation

$$u'(c_t) = i_t - \pi_{t+1} + u'(c_{t+1}) + o.t.$$

Iterating, we obtain

$$u'(c_t) = \sum_{j=0}^J i_{t+j} - \sum_{j=0}^J \pi_{t+j+1} + u'(c_{t+J+1}) + o.t.$$

Take  $J$  large so that the economy has returned to 'steady state'

$$u'(c_t) = \sum_{j=0}^J i_{t+j} - \sum_{j=0}^J \pi_{t+j+1} + o.t.$$

## Reducing long rates

Assuming a sensible period utility function (so can invert  $u'$ ):

$$c_t = \mathcal{F} \left( \underbrace{\sum_{j=0}^J i_{t+j}}_{-}, \underbrace{\sum_{j=0}^J \pi_{t+j+1}}_{+} \right)$$

Although this analysis is simplified (we are ignoring risk and '**the forward guidance puzzle**' encoded in this) it gets across the main thrust of Swanson-Williams' point

- **Whether we are at the ZLB or not**, real activity is informed by relative prices of consumption in future periods (and contingencies)

# Forward guidance

Consider...

$$\sum_{j=0}^J i_{t+j} - \sum_{j=0}^J \pi_{t+j+1} \equiv \sum_{j=J_L}^J i_{t+j} - \sum_{j=0}^J \pi_{t+j+1}$$

where we assume liftoff occurs in  $t + J_L$  ( $i_{t+j} = 0 \forall j < J_L$ )

Options for forward guidance...

- Later liftoff ( $J_L \uparrow$ )
- Shallowing the slope of  $i_{t+j}$  for  $j \geq J_L$  ( $\sum_{j=J_L}^J i_{t+j} \downarrow$ )
- Higher inflation in the coming periods ( $\sum_{j=0}^J \pi_{t+j+1} \uparrow$ )

▶ Back

# Forward guidance

Uncertainty about future short rate *censored by ZLB* increases its expectation (and thus  $\mathcal{E}_t^k$ )

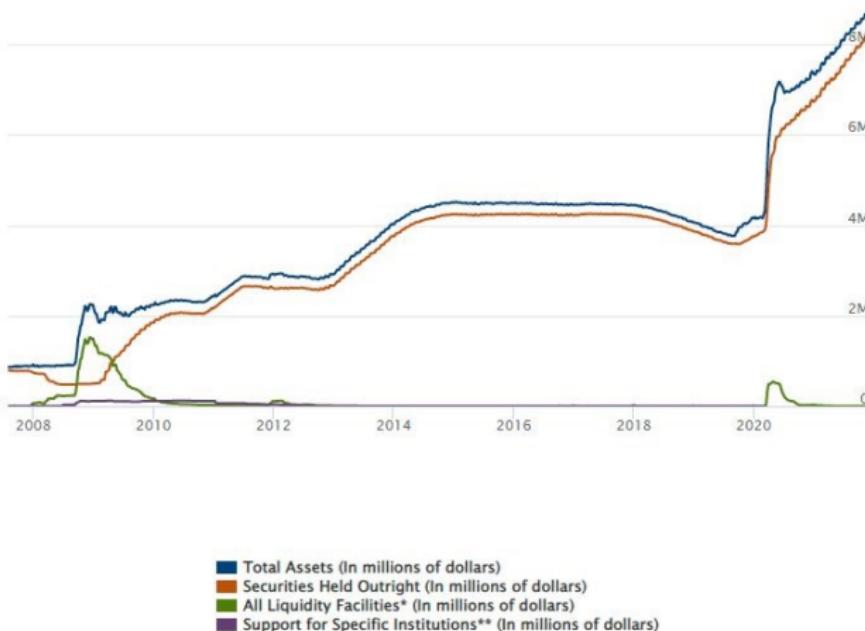
- Less obvious, but consider a  $N(0,1)$  distributed random variable,  $Z$
- Suppose we increase its variance - what happens to the mean?  
**Nothing**
- Now suppose we create  $\tilde{Z} = \min(0, Z)$
- Suppose we increase the variance of  $Z$  - then the mean of  $\tilde{Z}$  **will increase**

Some of the aforementioned risk may be priced

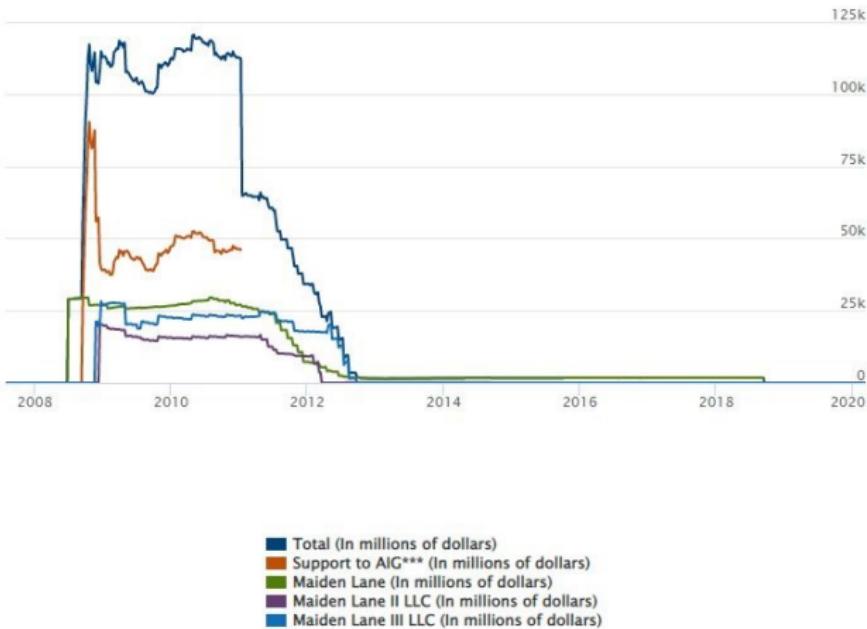
- Uncertainty could increase  $\mathcal{P}_t^k$  too

▶ Back

# Further detail on Fed's balance sheet

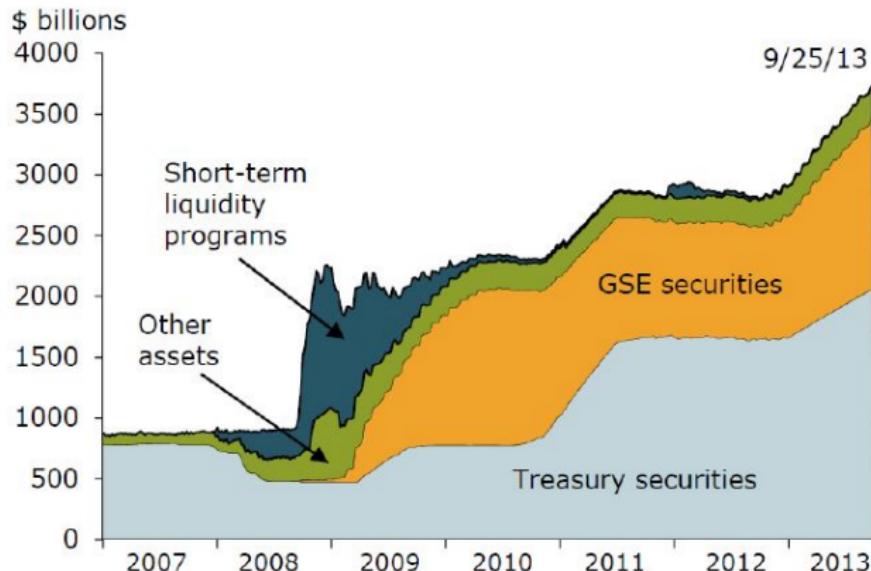


Decomposition showing temporary role of liquidity facilities. Source BoG - Recent balance sheet trends



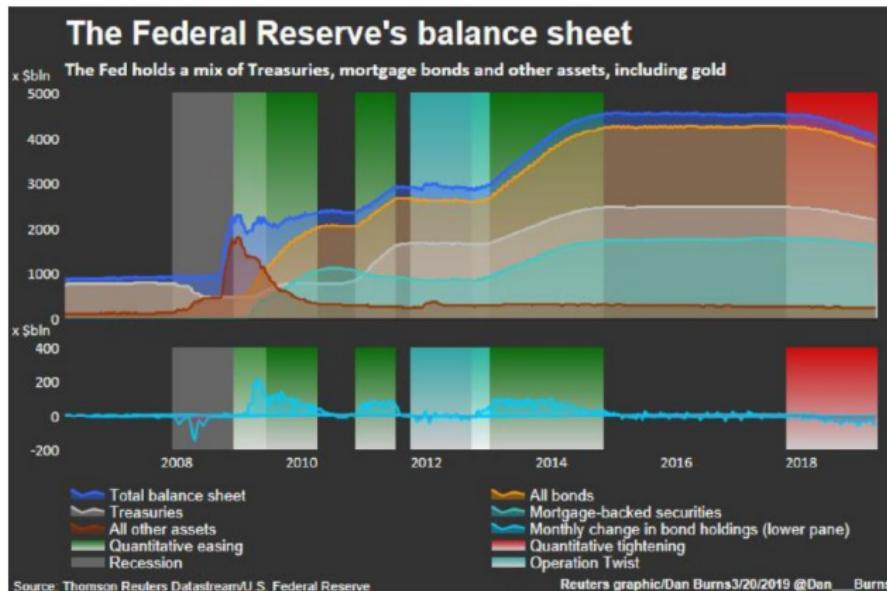
Decomposition showing temporary role of liquidity facilities for specific institutions. Source BoG - Recent balance sheet trends

## Further detail on Fed's balance sheet



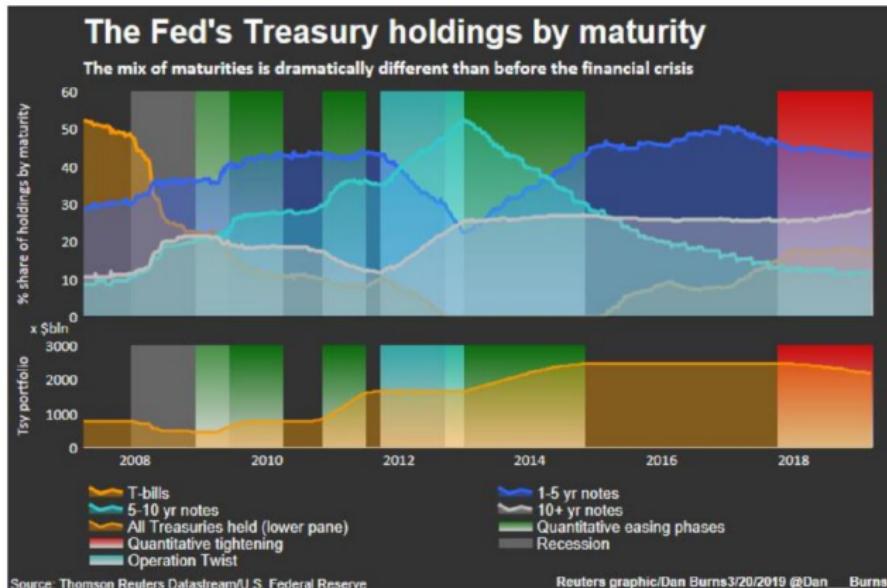
Decomposition showing diversity of holdings beyond Treasuries.

# Further detail on Fed's balance sheet



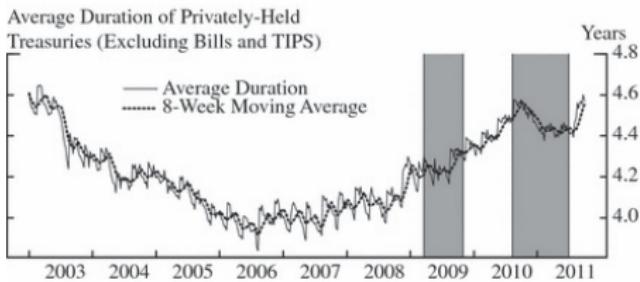
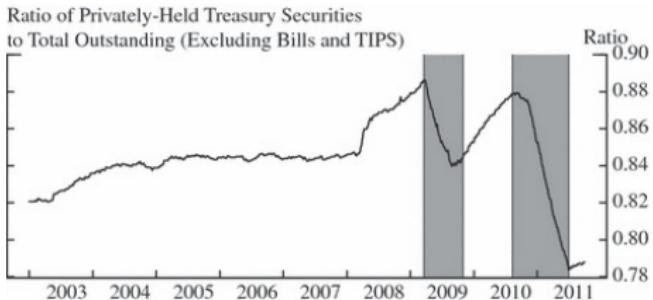
Decomposition of Fed asset holdings - and flow of purchases.

# Further detail on Fed's balance sheet



Decomposition of Treasury holdings by maturity - illustrating operation twist through 2012.

▶ Back



Scarcity of Treasuries and duration removal. Source D'Amico et al, EJ, 2012

▶ Back

Domestic Security Holdings as of  
 ◀ Previous **February 23, 2022**   
Posted February 24, 2022 at 4:30 PM

**SUMMARY** **T-BILLS** **T-NOTES AND T-BONDS** FRNS TIPS AGENCY DEBTS MBS CMBS

MATURITY DATE	CUSIP	COUPON (%)	PAR VALUE (\$Thousands)	TOTAL OUTSTANDING (%)	CHANGE IN PAR FROM PRIOR WEEK <sup>1</sup>	CHANGE IN PAR FROM PRIOR YEAR <sup>1</sup>
02/28/2022	912828ZA1	1.125	11,470,401.1	24.91%		297,000.0
02/28/2022	912828J43	1.750	3,943,000.0	13.60%		1,895,000.0
02/28/2022	912828W55	1.875	15,937,359.7	41.17%		3,193,000.0
03/15/2022	9128286H8	2.375	17,138,000.0	45.10%		586,000.0
03/31/2022	912828ZG8	0.375	11,463,828.4	25.26%		776,000.0
03/31/2022	912828J76	1.750	5,177,000.0	17.85%		2,183,000.0
03/31/2022	912828WB9	1.875	16,496,233.7	43.28%		1,432,000.0
04/15/2022	9128286M7	2.250	12,270,280.0	32.29%		3,241,000.0
04/30/2022	912828ZM5	0.125	9,916,458.3	21.72%		3,022,000.0
04/30/2022	912828WZ9	1.750	2,528,083.4	8.69%		828,000.0
04/30/2022	912828X47	1.875	10,740,491.3	27.80%		908,000.0

Granular detail on securities held on CB balance sheet. Source: [NY Fed SOMA Holdings site](#)

▶ Back