

Unconventional Monetary Policy

@econcortex

What central banks did when the policy rate hit zero: forward guidance, asset purchases, negative rates, yield curve control, and the long exit. Eight lessons with the evidence, the mechanics of the balance sheet, and flashcards.

The effective lower bound

Why the policy rate cannot fall much below zero, why that matters more when the natural rate is low, and what a liquidity trap does to the usual policy logic.

Every tool in this course exists because of one constraint: the short-term nominal interest rate cannot be pushed far below zero. Cash pays zero, so a deposit rate much below zero would send savers to the vault. Central banks call the level at which this bites the **effective lower bound** (ELB); it is somewhat below zero once the costs of storing and insuring cash are counted, as Negative interest rates shows, but it exists.

Why the bound is a problem

Conventional policy stabilises the economy by moving the real interest rate around the natural rate r^* . When a recession pushes the natural rate below zero, and expected inflation is low, the real rate the central bank can deliver,

$$r_t = i_t - \pi_t^e \geq \underline{i} - \pi_t^e, \quad (1)$$

has a floor above the level the economy needs. Policy is then *too tight by default*, not by choice. The gap between the required and the deliverable real rate is what the tools in the following lessons try to close.

Krugman brought the problem back into macroeconomics with Japan in the 1990s: a central bank at zero that cannot lower rates further, an economy that needs a negative real rate, and a public that does not believe the central bank will tolerate the inflation that would deliver it (Krugman, 1998). His proposed cure, a credible promise to be “irresponsible” later, is the intellectual origin of Forward guidance.

Two ways to lose at the bound

Definition 1 (Liquidity trap). A situation in which the short-term nominal rate is at its lower bound and additional base money is held rather than spent, so that conventional open-market operations no longer change anything. Demand is short of potential and the central bank cannot stimulate it through the policy rate.

The first way to lose is the **deflation spiral**. Falling prices raise the real rate in (1) even though the nominal rate is fixed. Higher real rates depress demand, which lowers prices further. The dynamics are unstable in the direction the central bank least wants.

The second is **anchoring at the wrong level**. If the public comes to expect low inflation permanently, the nominal rates consistent with that expectation are low too, which leaves less room above the bound in the next recession. Japan after 1995 and the euro area after 2013 are the two clearest examples.

Why it matters more now than in 1990

The bound is not new; what changed is how often it binds. The natural rate of interest fell by several percentage points across advanced economies between the 1980s and the 2010s. With r^* near 1 percent and a 2 percent target, the neutral nominal rate is around 3 percent, which gives a central bank about three points of cutting room before it hits zero. Typical recessions in the United States saw cuts of five points or more. The arithmetic is why the ELB moved from a Japanese curiosity to the central problem of monetary policy in a decade.

Eggertsson and Woodford formalised the optimal response inside the New Keynesian model: when the bound binds, the best the central bank can do is to commit to keeping rates low *after* the constraint has stopped binding, accepting a period of above-target inflation and output, because the expectation of that future stimulus lowers long real rates today (Eggertsson & Woodford, 2003). Everything in Forward guidance is an attempt to make that commitment credible.

What the tools are

The rest of the course covers the instruments in the order central banks reached for them.

Tool	What it changes	Lessons
Forward guidance	Expected future short rates	2
Asset purchases	Term premia, risk premia, signalling	3, 4
Negative policy rates	The bound itself	5
Balance sheet as an instrument	Reserves, remittances, fiscal exposure	6
Yield curve control, exit	Direct control of long rates; normalisation	7

Bernanke's presidential address to the American Economic Association is the best single overview of how these tools performed in the United States and what they can be expected to deliver in the next downturn (Bernanke, 2020).

Forward guidance

Delphic versus Odyssean guidance, the Fed's calendar and threshold promises, and the puzzle that models predict effects far larger than the data show.

When the short rate cannot fall, the central bank can still move the *expected path* of short rates, and long rates with it. Forward guidance is communication about future policy used as an instrument in its own right. It had existed informally for decades; at the lower bound it became explicit, dated, and sometimes conditional on numbers.

Two kinds of guidance

Campbell, Evans, Fisher and Justiniano introduced a distinction that every later discussion uses (Campbell et al., 2012).

Definition 2 (Delphic and Odyssean guidance). **Delphic** guidance is a forecast: the central bank shares its view of the outlook and of how it will react, without binding itself. **Odyssean** guidance is a commitment: the central bank ties itself to a future path, as Odysseus tied himself to the mast, so that it will not re-optimize once the bound stops binding.

Only Odyssean guidance implements the Eggertsson–Woodford prescription from The effective lower bound. Delphic guidance can even be contractionary: if the announcement of low rates for longer is read as news

that the outlook is worse than thought, expectations of income fall and spending with them. Distinguishing the two in the data is the central difficulty of the empirical literature.

The Federal Reserve’s sequence

The Fed’s statements after 2008 show the escalation from vague to precise.

- **Qualitative (December 2008):** rates would stay exceptionally low “for some time”, later “for an extended period”.
- **Calendar-based (August 2011):** exceptionally low rates “at least through mid-2013”, pushed to late 2014 in January 2012 and mid-2015 in September 2012.
- **Threshold-based (December 2012):** rates would stay near zero at least as long as unemployment remained above 6.5 percent and projected inflation stayed below 2.5 percent. This is guidance conditioned on the state of the economy rather than on a date, which is closer to a rule.

Calendar guidance has an obvious flaw: it does not say whether the date reflects a bad outlook (Delphic) or a promise (Odyssean). Threshold guidance is more informative, but thresholds are not triggers, a point the Fed had to explain repeatedly as unemployment approached 6.5 percent in 2014.

Does it work? The forward guidance puzzle

In the standard New Keynesian model of The Taylor principle and determinacy, guidance is extraordinarily powerful. The IS curve iterated forward makes today’s output gap depend on the *sum* of all expected future real rate gaps:

$$x_t = -\frac{1}{\sigma} \sum_{k=0}^{\infty} \mathbb{E}_t (i_{t+k} - \pi_{t+k+1} - r_{t+k}^n). \quad (2)$$

A promise to hold the rate 25 basis points lower for one quarter ten years from now has the same effect on x_t as the same cut today, and the Phillips curve compounds the inflation response. Del Negro, Giannoni and Patterson named this the **forward guidance puzzle**: the model implies effects of announcements far larger than anything observed (Del Negro et al., 2023).

Two families of explanations followed. McKay, Nakamura and Steinsson showed that with incomplete markets and precautionary saving, households discount future income more heavily, which breaks the equal weighting in (2) and cuts the power of distant promises sharply (McKay et al., 2016). The other family relaxes rational expectations: if only part of the public pays attention to central bank statements, or if agents have bounded horizons, distant guidance is heavily discounted as well.

Measured effects

Swanson separated forward guidance from asset purchases in Fed announcements by their distinct signatures across the yield curve and found that guidance moved short- and medium-term yields with effects comparable to conventional rate changes, while purchases moved longer maturities (Swanson, 2021). Guidance is therefore a real instrument, with effects in the observed range rather than the model’s, and it fades when the horizon exceeds a few years.

Practical lessons

- Guidance is only as credible as the central bank’s willingness to deliver it later, which is why state-contingent language beats dates.
- It works best in combination with Asset purchases: channels, which signal the same commitment through actions.
- The ECB’s “lower for longer” language from 2013 and the SNB’s conditional inflation forecast are Delphic by construction; both banks avoided Odyssean commitments, which limits what guidance can do for them.

Asset purchases: channels

How buying bonds with reserves can lower long rates: portfolio balance, signalling, liquidity, and what the programmes of the Fed, ECB and Bank of Japan looked like.

Large-scale asset purchases, usually called quantitative easing, are the second tool. The central bank buys long-dated government bonds or other securities from the private sector and pays with newly created reserves. Why that should lower long-term interest rates is less obvious than it looks, and the answer determines what to expect from the tool.

The irrelevance benchmark

Start from the case where purchases do nothing. If investors can hold any portfolio without cost, price assets by their expected payoffs, and treat the consolidated government's liabilities as one pool, then swapping long bonds for reserves changes the *composition* of what the public holds but not its total wealth or the fundamentals that price the bonds. Long rates are the expected average of future short rates plus a term premium, and neither moves. Something has to break for purchases to work.

Three things that break

Portfolio balance. Tobin's original insight is that assets are imperfect substitutes (Tobin, 1969). When the central bank removes duration from the market, investors who wanted that duration bid up the price of what remains, lowering the term premium. Vayanos and Vila made this precise with *preferred-habitat* investors who want specific maturities and risk-averse arbitrageurs who connect the segments; purchases in one maturity lower yields there and, through the arbitrageurs, along the curve (Vayanos & Vila, 2021). This channel operates through the *stock* of bonds held, so its effect persists as long as the holdings do.

Signalling. A central bank that has bought trillions of long bonds would lose money if it raised rates early. Purchases therefore make the low-rate promise of Forward guidance more credible, and part of the fall in long yields is a fall in expected short rates rather than in the term premium. Bauer and Rudebusch found this channel accounts for a large share of the yield response to the first Fed programme (Bauer & Rudebusch, 2014).

Liquidity and scarcity. In stressed markets the central bank's willingness to buy restores trading and compresses liquidity premia; this mattered in mortgage-backed securities in 2009 and in Treasuries in March 2020. In calm markets purchases can instead make specific securities scarce, which lowers their yields for reasons unrelated to policy.

The decomposition matters because the channels have different implications. A term-premium effect lowers long rates without changing the expected policy path; a signalling effect works through the same expectations as guidance, and it unwinds if the central bank contradicts the signal. Asset purchases: evidence shows how these were separated.

What the programmes looked like

Programme	Announced	Size and design
Fed QE1	Nov 2008, expanded Mar 2009	About 1.75 trillion dollars: 1.25 trillion agency MBS, 300 billion Treasuries, agency debt
Fed QE2	Nov 2010	600 billion dollars of Treasuries over eight months
Fed maturity extension ("Twist")	Sept 2011	Sell short, buy long; no change in balance sheet size
Fed QE3	Sept and Dec 2012	Open-ended, 85 billion a month; tapered through 2014

Programme	Announced	Size and design
Fed pandemic purchases	Mar 2020	Unlimited at first, then 120 billion a month; tapered from Nov 2021, ended Mar 2022
ECB asset purchase programme	Jan 2015	Public and private securities, 60 billion euro a month at the start; net purchases ended June 2022
ECB pandemic emergency programme	Mar 2020	Envelope raised to 1.85 trillion euro; flexible across countries
Bank of Japan QQE	Apr 2013	Doubling the monetary base in two years; from 2016 combined with Yield curve control and the exit

Two design choices recur. *Flow* purchases at a monthly pace signal continuing commitment and are easy to taper; *stock* announcements of a total front-load the portfolio-balance effect. Purchases of *private* assets (MBS, corporate bonds) work partly through credit spreads and carry credit risk that government bonds do not.

The mechanics, briefly

On the central bank’s balance sheet the purchase adds bonds to assets and reserves to liabilities. On a commercial bank’s balance sheet reserves replace bonds (or, if the seller was a fund, the bank gains reserves and a deposit). No money reaches households directly; the “printing money” description is right about reserves and wrong about spending. The central bank balance sheet takes this further, including what happens to the central bank’s profit when rates rise.

Asset purchases: evidence

Event studies, term-premium decompositions, macro estimates, and why central bank researchers find larger effects than academics.

The channels in Asset purchases: channels are theory. Whether purchases lowered rates, and whether lower rates raised output and inflation, are empirical questions with a large literature and a narrower range of answers than the debate suggests.

Event studies of yields

The first evidence came from announcement effects. Gagnon, Raskin, Remache and Sack summed the changes in yields over the days on which the Fed announced or signalled its first programme and found the ten-year Treasury yield fell by somewhere between 30 and 100 basis points depending on the event set, with most of the fall in the term premium (Gagnon et al., 2011). Krishnamurthy and Vissing-Jorgensen used the same method across asset classes and found that the effects differed by asset in ways that pointed to several channels at once: a safety premium on Treasuries, prepayment risk in mortgage-backed securities, signalling about future rates (Krishnamurthy & Vissing-Jorgensen, 2011).

Definition 3 (Event-study identification). Measure the change in asset prices in a narrow window (a day, or thirty minutes) around an announcement and attribute it to the announcement, on the argument that nothing else systematic happens in the window. It identifies the *financial* effect well and the *macroeconomic* effect not at all, because the latter unfolds over quarters.

The method has known limits. Effects measured in windows may reverse within weeks; later programmes were increasingly anticipated, so the announcement window captures only the surprise; and the first programme was launched into a market crisis, which inflates the liquidity component. The estimates for QE2 and QE3 were smaller, in the range of 10 to 30 basis points on ten-year yields for programmes of comparable size.

Separating guidance from purchases

Swanson’s decomposition, introduced in Forward guidance, uses the fact that guidance and purchases load differently across maturities and asset classes: guidance moves two- to five-year yields, purchases move ten-year yields and mortgage rates (Swanson, 2021). Both survive as distinct instruments in the data, and the purchase effect is concentrated in the term premium. This is the strongest evidence that the portfolio-balance channel is real rather than a relabelled expectations effect.

From yields to the economy

Estimating what lower long rates did to output and inflation requires a model. Weale and Wieladek used a vector autoregression with purchase announcements as the shock and found that purchases of one percent of GDP raised real GDP by a fraction of a percent and CPI by a similar order in both the United States and the United Kingdom (Weale & Wieladek, 2016). Structural models that feed the estimated yield changes through conventional transmission give effects of the same sign and broad magnitude. Bhattarai and Neely surveyed the international evidence and concluded that purchases lowered yields and supported activity in every major economy, with the caveat that the effects were larger in stressed markets and at the start of programmes (Bhattarai & Neely, 2022).

Who finds what

Fabo, Jančoková, Kempf and Pástor compared over fifty studies and found that papers written by central bank economists report larger and more significant effects of purchases on output and inflation than papers by academics, and that central bank authors who report larger effects have better subsequent careers at their institutions (Fabo et al., 2021). The finding does not say who is right; it says that the literature’s centre of gravity is not a neutral estimate, and that a reader should weight the source.

A summary a policymaker could use

Question	Answer the evidence supports
Did purchases lower long yields?	Yes, by tens of basis points per programme, more in crises
Through which channel?	Term premium mainly, signalling substantially, liquidity in stressed markets
Did they raise output and inflation?	Yes, modestly; magnitudes are model-dependent
Were later programmes as effective?	Less so, because they were anticipated and markets were calm
Who reports the largest effects?	Central bank researchers

Bernanke’s own assessment, that the combination of purchases and guidance can deliver roughly three percentage points of additional easing when the policy rate is at the bound, sits at the optimistic end of this range and is the best statement of the case that the tools work (Bernanke, 2020).

Negative interest rates

Who went below zero, how far, why banks are the crux, the reversal rate, and what the evidence from the euro area and Switzerland says.

The lower bound in The effective lower bound is not exactly zero. Holding cash costs money: vaults, insurance, transport. A deposit rate slightly below zero does not trigger a flight to banknotes, so several central banks tested how far below zero they could go.

Who and how far

Central bank	First negative rate	Trough	Exit
Danmarks Nationalbank	2012	about minus 0.75 percent	2022
European Central Bank	June 2014, deposit rate minus 0.10	minus 0.50 (September 2019)	July 2022
Swiss National Bank	January 2015	minus 0.75	September 2022
Sveriges Riksbank	February 2015	minus 0.50	2019
Bank of Japan	January 2016	minus 0.10 on part of reserves	March 2024

Nobody went much below minus one percent, and every bank that went negative built in exemptions: the ECB's two-tier system from October 2019 exempted a multiple of minimum reserves, the SNB exempted balances up to a threshold set as a multiple of minimum reserves, the Bank of Japan applied the negative rate only to a marginal tier. The exemptions are the point: the negative rate is meant to be a *marginal* price that moves market rates, not a tax on the whole banking system.

Why banks are the crux

The transmission of a rate cut from zero to minus 0.5 is the same as from 1 to 0.5, with one exception: banks did not pass negative rates to most retail depositors, because households can hold cash. The bank's funding cost stays at zero while its lending rates and the return on its liquid assets fall. Net interest margins compress.

Brunnermeier and Koby formalised the consequence as the **reversal interest rate**: the level below which further cuts *reduce* lending, because the hit to bank capital from lower margins outweighs the stimulus from cheaper credit (Brunnermeier & Koby, 2018). The reversal rate depends on how much of banks' funding is retail deposits, on how much of their assets reprice, and on how long the policy lasts; it rises over time as fixed-rate assets roll over into low yields.

Definition 4 (Reversal interest rate). The policy rate below which a further cut is contractionary, because the loss of bank profitability and capital lowers lending by more than the lower rate raises credit demand. It is not a constant: it moves with bank balance-sheet structure and with the duration of the low-rate period.

Eggertsson, Juelsrud, Summers and Wold documented the mechanism with Swedish bank-level data: once the policy rate went negative, deposit rates stopped falling, and lending rates for the affected banks stopped falling too, so the cuts below zero had little of the intended effect (Eggertsson et al., 2024).

Evidence that it worked anyway

The euro-area evidence is more favourable. Altavilla, Burlon, Giannetti and Holton showed that healthy banks did pass negative rates to corporate depositors, and that firms facing negative deposit rates shifted out of cash into investment, so that the transmission ran through the *asset* side of firms rather than through bank lending alone (Altavilla et al., 2022). Their reading: for sound banks with corporate depositors there was no zero lower bound in the sense that matters.

The two findings are less contradictory than they look. The Swedish result concerns retail-funded banks and the lending channel; the euro-area result concerns corporate deposits and the portfolio channel. Which dominates depends on the banking system.

The Swiss case

The SNB's negative rate was aimed less at domestic demand than at the exchange rate. After the minimum exchange rate was abandoned in January 2015, minus 0.75 percent, combined with foreign-exchange purchases, was meant to make franc deposits unattractive relative to euro deposits and lean against appreciation. Banks

passed the rate to large and institutional depositors, later to wealthy retail clients above thresholds, and raised mortgage margins to compensate, which is the margin compression channel in reverse. Mortgage rates in Switzerland fell less than the policy rate, and the mortgage market stayed profitable, which is one reason the SNB could hold the rate for seven years.

What the episode settled

- The bound is below zero, by roughly half to one percentage point in practice.
- Tiering is essential; without it the policy is a tax on banks rather than a change in marginal rates.
- The effect depends on bank funding structures, so the same rate can be stimulative in one country and near-useless in another.
- Duration matters: the longer the rate stays negative, the closer the reversal rate creeps to the policy rate.

The next lesson, The central bank balance sheet, follows the reserves that negative rates were charged on.

The central bank balance sheet

Reserves, floor versus corridor systems, why central banks lost money after 2022, and when a balance sheet needs fiscal support.

Every tool so far shows up on the central bank’s balance sheet. Purchases add bonds to the asset side and reserves to the liability side; negative rates are a charge on those reserves; the exit in Yield curve control and the exit is the balance sheet shrinking. This lesson explains the accounting and its consequences, because after 2022 the consequences became political.

A stylised balance sheet

Assets	Liabilities
Government bonds and other securities	Banknotes
Loans to banks (refinancing operations)	Bank reserves (deposits of commercial banks)
Foreign reserves (large for the SNB)	Government deposits
	Equity and provisions

Reserves are the central bank’s own money, held only by banks. Purchases create them; when the central bank pays interest on reserves, that interest is its main expense; when it charges a negative rate, it is income.

Corridor and floor

Before 2008 most central banks kept reserves scarce and steered the overnight rate inside a **corridor** between a lending rate above and a deposit rate below, with the market rate near the middle. Large purchases flood the system with reserves, so the overnight rate falls to the deposit rate, the bottom of the corridor. That is a **floor system**: the policy rate is the rate paid on reserves, and the quantity of reserves no longer matters for the rate. The Fed formalised this in January 2019 as its “ample reserves” framework, in which the policy rate is implemented through interest on reserves and the balance sheet stays large (Federal Open Market Committee, 2019).

Definition 5 (Floor system). An implementation framework in which reserves are abundant, the overnight market rate sits at (or just below) the rate the central bank pays on reserves, and rate changes are made by changing that administered rate rather than by adjusting the quantity of reserves.

A floor system has a consequence that was easy to miss while rates were zero: the central bank’s interest expense moves one for one with the policy rate, while the income on its bonds is fixed for years. Raising rates with a large balance sheet is expensive.

Where the losses came from

Between 2022 and 2024 the Federal Reserve, the Bundesbank, the Dutch, Swedish and Swiss central banks and the Bank of England all reported losses or stopped remitting profits to their treasuries. The mechanism is the same everywhere and follows from the previous paragraph.

- The asset side earns the yields at which bonds were bought: for bonds bought in 2015–2021, close to zero and sometimes negative.
- The liability side pays the current policy rate on reserves: 4 to 5 percent in the United States from 2023, 4 percent in the euro area.
- The difference, multiplied by trillions of reserves, is a running loss. The Fed records it as a “deferred asset”: future profits will be retained until the loss is recouped, and remittances to the Treasury stop in the meantime.

The Swiss case adds a second channel. The SNB’s assets are mostly foreign currency, so a stronger franc produces valuation losses regardless of interest rates; its 2022 loss of about 132 billion francs was overwhelmingly a valuation loss and led to cancelled distributions to the Confederation and cantons.

Whether a loss “matters” is a question about the consolidated government. Reis argued that a central bank’s balance sheet is best read together with the treasury’s: a central bank loss is a fiscal cost that would otherwise have appeared as higher government borrowing costs, and the mystique around central bank equity obscures this (Reis, 2013). Del Negro and Sims made the limits precise: a central bank can operate with negative equity indefinitely as long as the public expects the treasury to back it if needed, but without that backing a sufficiently large loss can force the central bank to inflate to restore its solvency (Del Negro & Sims, 2015). Fiscal support is therefore not a technicality; it is what makes the balance sheet a safe tool.

Reserves are not lending

A widespread misreading of purchases is that banks “sit on” reserves instead of lending them out. Reserves cannot leave the banking system: a bank that lends creates a deposit, and reserves move between banks as payments clear, but the total is set by the central bank. High reserves are a consequence of purchases, not evidence that banks refused to lend. The relevant question is whether lower long rates and higher asset prices raised the demand for credit, which is the subject of Asset purchases: evidence.

Size

The Fed’s balance sheet peaked near 9 trillion dollars in 2022, about a third of GDP; the Eurosystem’s near 9 trillion euro, about two-thirds of euro-area GDP; the Bank of Japan’s exceeds Japan’s GDP; the SNB’s is close to Swiss GDP for the foreign-reserve reason above. None of these ratios has a theoretical ceiling; what limits them is the exit, next.

Yield curve control and the exit

Japan’s cap on the ten-year yield, Australia’s failed three-year target, quantitative tightening, and what the 2019 repo spike taught about how far balance sheets can shrink.

Two questions close the toolkit. Can a central bank target long rates directly instead of buying a quantity and hoping? And how does it get out once the emergency is over?

Yield curve control

In September 2016 the Bank of Japan announced that it would hold the ten-year government bond yield at “around zero percent”, buying whatever quantity was needed, alongside a short rate of minus 0.1 percent (Bank of Japan, 2016). This is **yield curve control**: a price target rather than a quantity target.

Definition 6 (Yield curve control). A commitment to buy (or sell) government bonds in whatever amount keeps a chosen maturity’s yield at or within a band around a target level. The instrument is the price; the balance sheet becomes an outcome.

The appeal is that a credible target requires *fewer* purchases: if markets believe the cap, they price the bond at the cap and the central bank rarely has to buy. The Bank of Japan's purchases indeed slowed after 2016. The risks are the mirror image. A cap that markets stop believing has to be defended with unlimited purchases; a cap on one maturity distorts the curve around it; and the exit requires either an announcement that moves the yield in a jump or a slow widening of the band during which the central bank is visibly fighting the market.

Japan chose the slow route. The band was widened in December 2022 to plus or minus 0.5 percent, loosened further in 2023, and the framework, together with the negative short rate, ended in March 2024. The transition was orderly, and the ten-year yield rose gradually to around 1 percent.

Australia's counter-example

The Reserve Bank of Australia targeted the three-year yield from March 2020, first at 0.25 and then at 0.10 percent, tied to a statement that the cash rate was not expected to rise before 2024. In late October 2021, as inflation data surprised upward, the three-year yield broke above the target and the bank did not defend it; the target was formally abandoned on 2 November 2021. The bank's own review concluded that the exit had been disorderly, that the target had become inconsistent with the outlook well before it was dropped, and that the reputational damage was real (Reserve Bank of Australia, 2022). The lesson: a yield target is a promise, and its credibility is the whole instrument. Choosing a maturity short enough to be consistent with plausible policy paths, and a clear exit condition, would have avoided most of the damage.

Quantitative tightening

Shrinking the balance sheet is called quantitative tightening (QT). The Fed did it twice: from October 2017 to September 2019 with monthly caps on maturing securities not reinvested, and from June 2022 with caps of 60 billion dollars of Treasuries and 35 billion of mortgage-backed securities a month, slowed in 2024 and 2025 and concluded in December 2025. The ECB stopped reinvesting maturing bonds from its main programme in mid-2023 and from the pandemic programme by the end of 2024.

Three features of QT differ from QE in reverse.

- **It is passive.** Letting bonds mature avoids the announcement effects of sales, so its yield effect is smaller per unit than QE's; central banks describe it as running "in the background".
- **The constraint is reserves, not bonds.** QT drains reserves. At some level banks' demand for reserves, driven by liquidity regulation and payment needs, is no longer satisfied, and money-market rates jump.
- **The floor can crack.** On 17 September 2019 the US overnight repo rate spiked to several times the policy rate as reserves, drained by two years of QT and by a corporate tax date, proved insufficient. The Fed restarted bill purchases within weeks. The episode set a practical lower limit on reserves and is why the second QT was slowed as reserves approached what the Fed judged "ample" rather than scarce.

Sequencing the exit

The consensus sequence that emerged from 2015–2019 and again after 2021: end net purchases, then raise the policy rate, then start passive QT, with the balance sheet as the last and slowest lever. The order reflects the tools' precision: the policy rate is a well-understood instrument, the balance sheet is not, so it is moved last and slowly. The 2022 exit compressed the sequence, ending purchases and beginning rate rises within the same quarter, because inflation left no room for the leisurely version.

The next lesson, Lessons and open questions, asks whether the exit shows that the tools were used for too long.

Lessons and open questions

What the toolkit can deliver, its side effects, the argument that it stayed on too long after 2021, how the frameworks changed, and an exercise on balance sheet data.

Fifteen years of unconventional policy produced a toolkit that central banks now consider permanent. This lesson takes stock.

What the tools can deliver

The evidence in Asset purchases: evidence and Forward guidance supports a modest, positive answer. At the lower bound, the combination of guidance and purchases lowers long real rates by an amount comparable to a few percentage points of conventional easing, and that easing raises output and inflation with the usual lags. Bernanke's estimate that the new tools add roughly three points of equivalent policy space is the optimistic end; the mid-range of the literature is somewhat lower (Bernanke, 2020; Bhattarai & Neely, 2022). Negative rates add perhaps half a point before the reversal rate of Negative interest rates bites. Together, that is enough for a normal recession and not enough for a severe one, which is why fiscal policy carried more of the load in 2020 than in 2009.

Side effects that are established

- **Asset prices and distribution.** Purchases work through raising asset prices; holders of assets gain first. The effect on wealth inequality is real in the short run; the effect on income inequality runs the other way, through lower unemployment. The net is contested and depends on the horizon.
- **Financial stability.** Long periods of low rates encourage duration risk and leverage. The 2023 failures of US regional banks holding long bonds bought at 2021 yields, and the UK pension-fund episode of September 2022, are consequences of the same duration that made The central bank balance sheet expensive.
- **Fiscal entanglement.** Central bank losses, deferred remittances, and the size of holdings of government debt have made central bank independence a live political question in the euro area, the United Kingdom and Switzerland.
- **Market functioning.** Bond markets in which the central bank holds half the stock trade differently; Japan is the extreme case.

The 2021–2023 question

Purchases continued in the United States until March 2022 and in the euro area until mid-2022, while inflation had risen above 5 percent in late 2021. Critics argue the tools were state-dependent instruments used as if they were unconditional, and that the guidance frameworks of 2020, designed for a world of too-low inflation, delayed the response by two to three quarters. Defenders argue that the supply shocks of 2021–2022 would have produced most of the inflation regardless and that the exit, once begun, was fast. The honest summary: the tools proved harder to stop than to start, because stopping them was read as tightening at a time when the outlook was uncertain, and because guidance had promised otherwise. Odyssean commitments have a cost when the state changes.

How the frameworks responded

The Fed's 2020 framework, with its emphasis on inflation shortfalls, was revised in August 2025 toward a flexible inflation-targeting formulation, as Rules in practice: Fed, ECB and SNB describes. The ECB's 2021 strategy kept a symmetric 2 percent target and stated that unconventional tools would remain part of the toolkit, to be used with proportionality (European Central Bank, 2021). Both banks now treat the lower-bound tools as part of the standard kit rather than emergency measures, with the important qualification that purchases are to be *state-contingent*: for market dysfunction or for the bound, not as a general-purpose stimulus.

An exercise

Plot the Fed's balance sheet relative to GDP and mark the programmes from Asset purchases: channels. The series are on FRED; the code needs `pandas` and `pandas-datareader`.

```
import pandas as pd
from pandas_datareader import data as pdr

assets = pdr.DataReader("WALCL", "fred", "2007-01-01")           # total assets, weekly,
    ↪ millions
gdp = pdr.DataReader("GDP", "fred", "2007-01-01")               # nominal GDP, quarterly,
    ↪ billions
ratio = (assets["WALCL"].resample("QE").last() / 1000) / gdp["GDP"].resample("QE").last()
events = {"2008-11-25": "QE1", "2010-11-03": "QE2", "2012-09-13": "QE3", "2017-10-01":
    ↪ "QT1",
        "2020-03-15": "pandemic", "2022-06-01": "QT2"}
print(ratio.dropna().round(3).tail(12))
for date, label in events.items():
    q = pd.Timestamp(date).to_period("Q").to_timestamp("Q")
    print(label, date, f"{ratio.get(q, float('nan')):.2f}")
```

Two things to check: the ratio at the 2022 peak, and how much of the post-2022 decline came from QT versus from nominal GDP growing under high inflation. The second is larger than most people expect, and it is the clearest illustration of why inflation reduces the real burden of a balance sheet just as it reduces the real burden of debt.

Open questions

1. Is there a size of balance sheet beyond which purchases stop working, or start harming market functioning?
2. Can guidance be made state-contingent enough to avoid the 2021 problem without losing its power?
3. Should the central bank pay interest on all reserves at the policy rate, given the fiscal cost, or tier remuneration as the ECB and SNB did for negative rates?
4. How much of the toolkit is transferable to small open economies like Switzerland, where the exchange rate does much of the work?

None of these has a settled answer. That is the state of the field, and the reason the course ends here rather than with a conclusion.

Altavilla, C., Burlon, L., Giannetti, M., & Holton, S. (2022). Is there a zero lower bound? The effects of negative policy rates on banks and firms. *Journal of Financial Economics*, 144(3), 885–907. <https://doi.org/10.1016/j.jfineco.2021.06.032>

Bank of Japan. (2016). *New framework for strengthening monetary easing: “Quantitative and qualitative monetary easing with yield curve control”*. Statement on monetary policy, 21 September. https://www.boj.or.jp/en/mopo/mpmdeci/mpr_2016/k160921a.pdf

Bauer, M. D., & Rudebusch, G. D. (2014). The signaling channel for Federal Reserve bond purchases. *International Journal of Central Banking*, 10(3), 233–289.

Bernanke, B. S. (2020). The new tools of monetary policy. *American Economic Review*, 110(4), 943–983. <https://doi.org/10.1257/aer.110.4.943>

Bhattarai, S., & Neely, C. J. (2022). An analysis of the literature on international unconventional monetary policy. *Journal of Economic Literature*, 60(2), 527–597. <https://doi.org/10.1257/jel.20201493>

Brunnermeier, M. K., & Koby, Y. (2018). *The reversal interest rate* (NBER Working Paper 25406). National Bureau of Economic Research. <https://doi.org/10.3386/w25406>

Campbell, J. R., Evans, C. L., Fisher, J. D. M., & Justiniano, A. (2012). Macroeconomic effects of Federal Reserve forward guidance. *Brookings Papers on Economic Activity*, 2012(1), 1–80. <https://doi.org/10.1353/eca.2012.0004>

- Del Negro, M., Giannoni, M. P., & Patterson, C. (2023). The forward guidance puzzle. *Journal of Political Economy Macroeconomics*, 1(1), 43–79. <https://doi.org/10.1086/722734>
- Del Negro, M., & Sims, C. A. (2015). When does a central bank’s balance sheet require fiscal support? *Journal of Monetary Economics*, 73, 1–19. <https://doi.org/10.1016/j.jmoneco.2015.05.001>
- Eggertsson, G. B., Juelsrud, R. E., Summers, L. H., & Wold, E. G. (2024). Negative nominal interest rates and the bank lending channel. *Review of Economic Studies*, 91(4), 2201–2275. <https://doi.org/10.1093/restud/rdad085>
- Eggertsson, G. B., & Woodford, M. (2003). The zero bound on interest rates and optimal monetary policy. *Brookings Papers on Economic Activity*, 2003(1), 139–233. <https://doi.org/10.1353/eca.2003.0010>
- European Central Bank. (2021). *The ECB’s monetary policy strategy statement*. Press release, 8 July. https://www.ecb.europa.eu/home/search/review/html/ecb.strategyreview_monpol_strategy_stateme nt.en.html
- Fabo, B., Jančoková, M., Kempf, E., & Pástor, L. (2021). Fifty shades of QE: Comparing findings of central bankers and academics. *Journal of Monetary Economics*, 120, 1–20. <https://doi.org/10.1016/j.jmoneco.2021.04.001>
- Federal Open Market Committee. (2019). *Statement regarding monetary policy implementation and balance sheet normalization*. Press release, 30 January. <https://www.federalreserve.gov/newsevents/pressrelease s/monetary20190130c.htm>
- Gagnon, J., Raskin, M., Remache, J., & Sack, B. (2011). The financial market effects of the Federal Reserve’s large-scale asset purchases. *International Journal of Central Banking*, 7(1), 3–43.
- Krishnamurthy, A., & Vissing-Jorgensen, A. (2011). The effects of quantitative easing on interest rates: Channels and implications for policy. *Brookings Papers on Economic Activity*, 2011(2), 215–287. <https://doi.org/10.1353/eca.2011.0019>
- Krugman, P. R. (1998). It’s baaack: Japan’s slump and the return of the liquidity trap. *Brookings Papers on Economic Activity*, 1998(2), 137–205. <https://doi.org/10.2307/2534694>
- McKay, A., Nakamura, E., & Steinsson, J. (2016). The power of forward guidance revisited. *American Economic Review*, 106(10), 3133–3158. <https://doi.org/10.1257/aer.20150063>
- Reis, R. (2013). The mystique surrounding the central bank’s balance sheet, applied to the European crisis. *American Economic Review*, 103(3), 135–140. <https://doi.org/10.1257/aer.103.3.135>
- Reserve Bank of Australia. (2022). *Review of the yield target*. Reserve Bank of Australia. <https://www.rba.gov.au/monetary-policy/reviews/yield-target/>
- Swanson, E. T. (2021). Measuring the effects of Federal Reserve forward guidance and asset purchases on financial markets. *Journal of Monetary Economics*, 118, 32–53. <https://doi.org/10.1016/j.jmoneco.2020.09.003>
- Tobin, J. (1969). A general equilibrium approach to monetary theory. *Journal of Money, Credit and Banking*, 1(1), 15–29. <https://doi.org/10.2307/1991374>
- Vayanos, D., & Vila, J.-L. (2021). A preferred-habitat model of the term structure of interest rates. *Econometrica*, 89(1), 77–112. <https://doi.org/10.3982/ECTA17440>
- Weale, M., & Wieladek, T. (2016). What are the macroeconomic effects of asset purchases? *Journal of Monetary Economics*, 79, 81–93. <https://doi.org/10.1016/j.jmoneco.2016.03.010>