

Lecture notes on risk management, public policy, and the financial system

The Federal Reserve response to the global financial crisis

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Overview of the Fed's crisis response

The economics of unconventional monetary policy

The debate on unconventional monetary policy

Normalization of monetary policy

Overview of the Fed's crisis response

Chronology of the Fed's crisis response

Conflicts in the Fed's crisis response

Growth of the Fed's balance sheet

The economics of unconventional monetary policy

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Overlapping stages of Federal Reserve action

Traditional tools and communication beginning Aug. 10, 2007

- Rate cuts beginning 18Sep2008, by 50 bps to 4.75 percent
- Communication:
 - 16Dec2008: “exceptionally low levels...for some time”
 - 18Mar2009: “for an extended period”

Emergency lending programs to support systemically-important intermediaries, infrastructures

- Balance sheet does not expand initially
- But composition change→nontraditional assets (credit policy)

Unconventional monetary policy from late 2008

Interest on reserves (IOR) paid to banks from 06Oct2008

Zero interest-rate policy (ZIRP): zero bound reached 16Dec2008

- Target funds rate 0–25 bps

Large-Scale Asset Purchases (LSAPs) from early 2009

- Expansion of balance sheet

Earliest Federal Reserve actions

Unusual press release does not announce any actual change:

Release Date: August 10, 2007

For immediate release

The Federal Reserve is providing liquidity to facilitate the orderly functioning of financial markets.

The Federal Reserve will provide reserves as necessary through open market operations to promote trading in the federal funds market at rates close to the Federal Open Market Committee's target rate of 5-1/4 percent. In current circumstances, depository institutions may experience unusual funding needs because of dislocations in money and credit markets. As always, the discount window is available as a source of funding.

OMOs unusual in several respects:

- Multiple times of day, at nonstandard times, including an afternoon operation
- Accepted collateral included MBS but not Treasuries
- Large total amount accepted in the course of the day

Deal Date	Op Type	Auction Method	Settlement	Op Close	MBS-Submit	MBS-Accept	MBS-Stop-Out	MBS-Wght Avg	MBS-High	MBS-Low
8/10/2007	RP	Multiple Price	Same Day	1:50 PM	11	3	5.1	5.127	5.25	3.5
8/10/2007	RP	Multiple Price	Same Day	10:55 AM	40.95	16	5.25	5.266	5.35	4.5
8/10/2007	RP	Multiple Price	Same Day	8:25 AM	31.2	19	5.15	5.236	5.35	4

Federal Reserve emergency programs

Term Auction Facility (TAF) 12Dec2007: banks' funding liquidity problems

Currency swap lines 12Dec2007: foreign banks' dollar funding liquidity

Term Securities Lending Facility (TSLF) 11Mar2008: shortages of good collateral

Primary Dealer Credit Facility (PDCF) 16Mar2008: discount window for primary dealers

Maiden Lane 24Mar2008: financing of Morgan acquisition of Bear

Maiden Lane II and III 16Sep2008: rescue of AIG

ABCP Money Market Mutual Fund Liquidity Facility (AMLF) 22Sep2008: run on ABCP

Commercial Paper Funding Facility (CPFF) 07Oct2008: CP liquidity

Money Market Investor Funding Facility (MMIFF) 21Oct2008: run on MMMFs

Term Asset-Backed Securities Lending Facility (TALF) 25Nov2008: sudden stop in securitization

Emergency liquidity versus monetary policy

- Initial response to crisis in capacity of lender of last resort
- Focus on dislocations in money markets, e.g.
 - Difficulty sourcing high-quality collateral → fails, repo rates → 0
 - Reluctance of commercial banks to lend to one another → spikes in interbank rates and term spreads
- Fed addresses liquidity via variants on normal operations
 - E.g., TSLF: primary dealers can swap agency debt, agency and AAA non-agency MBS for “best collateral,” Treasury securities
 - Provision of liquidity to market, not individual firms
 - Bear Stearns: first program supporting individual firm
- How drastically loosen liquidity policy without loosening monetary policy?
 - ↔ How keep bank reserves constant while supporting liquidity?
- Reserves and balance sheet initially (Dec07–Sep08) constant
 - Fed changes composition of *assets* on its balance sheet
 - Sells T-bills, then bonds to offset emergency lending

Controlling reserves with a large balance sheet

- Once balance sheet grows, Fed endeavors to retain control over target rate and monetary base
 - Fed strenuously avoiding expansionary monetary policy until late 2008
- Change composition of *liabilities* on its balance sheet (**sterilization**)
 - Replace monetary with nonmonetary assets, i.e. reduce monetary base
- **Supplementary Financing Program** (SFP) 17Sep2008: drain reserves via T-bill issue, proceeds placed with Fed
 - Fed sells T-bills, then bonds to offset emergency lending on asset side of balance sheet
 - SFP limited by fiscal constraints, e.g. debt ceiling
 - May require more explicit cooperation with fiscal authorities(→fiscal theory of money)
- **Interest on required and excess reserves** (IOR) 06Oct2008
- Some central banks issue bonds, e.g. to offset foreign-exchange reserve accumulation
 - But not contemplated by Fed

Did the Fed follow Bagehot's Rule?

- Fed authority in Section 13(3) of Federal Reserve Act
 - Adopted 1932, amended 1935, 1991
 - "In unusual and exigent circumstances," secured lending permitted to any market participant
 - Limited by Dodd-Frank to "facility with broad-based eligibility"
- Critiques of Fed as lender of last resort:
 - Following no rules or implicit rules (→TBTF, moral hazard)
 - Lending to insolvent intermediaries a Treasury function
 - Indirect taxpayer funding of bank recapitalization via IOR, reduces Treasury remittances
- Profits on Maiden Lanes ⇒ emergency credits liquidity, not credit provision or solvency relief; long-term value was there
- **Credit policy:** Fed purchases of credit-risky assets
 - Distorts markets, favors specific sectors (**credit allocation**)
 - E.g. MBS in LSAPs: supports key sector of economy, but also subsidizes housing
 - Even if collateralized, loans to banks reduce funds available to insured depositors in event of failure

Evolution of the LSAPs

LSAP1 announced 25Nov2008, ended Mar. 2010 (“QE1”)

- 05Jan2009: purchases of agency and MBS commence
- 18Mar2009: increase in size and expansion to Treasuries
- 10Aug2010: reinvestment of MBS prepayments in Treasuries

LSAP2 announced 03Nov2010, ended Dec. 2012 (“QE2”)

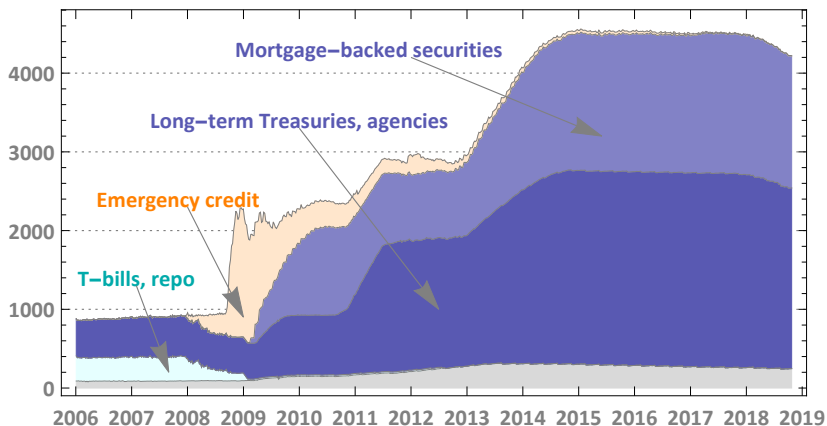
Maturity Extension Program (MEP) or “Operation Twist”

- 21Sep2011: purchase long-, sell short-term Treasuries
- reinvestment of MBS prepayments in MBS
- 20Jun2012: extended through end-2012

Flow-based asset purchases: no total amount or termination date specified (LSAP3, “QE3” or “QE ∞ ”)

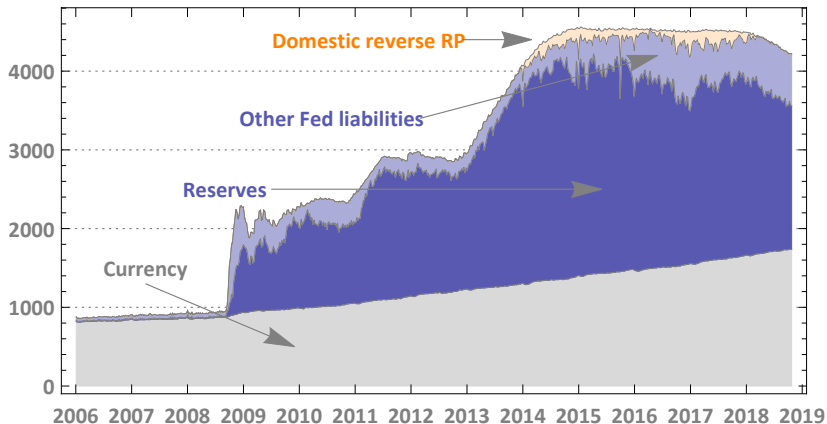
- 13Sep2012: \$40 bill. MBS/mo.
- 12Dec2012: addition of \$45 bill. Treasuries/mo.
- 18Dec2013: **tapering** announcement, purchases gradually reduced from Jan. 2014
- Oct. 2014: end of program (but reinvestment continues)

Federal Reserve assets 2006–18



Assets of Federal Reserve System, \$ bil., weekly (Wednesdays) *Source:* Federal Reserve Board, H.4.1 release.

Federal Reserve liabilities 2006–18



Assets of Federal Reserve System, \$ bil., weekly (Wednesdays) *Source:* Federal Reserve Board, H.4.1 release.

Overview of the Fed's crisis response

The economics of unconventional monetary policy

- Monetary policy at the zero bound

- Forward guidance

The debate on unconventional monetary policy

Normalization of monetary policy

Zero bound: the rationale for unconventional policy

- The overarching policy dilemma:
 - Supporting the real economy and reducing unemployment
 - While gradually and safely deleveraging the financial system
- But: once conventional tools lower current short rate to near zero...
- ...long-term interest rates stay stubbornly high
 - Short-term assets near-perfect substitutes
 - Normal monetary operations (e.g. purchase bills against reserves) ineffective
- New tools introduced by Federal Reserve:
 - LSAPs:** lower long-term rates via direct purchases
 - Forward guidance:** lower expected path of future short-term rates
 - Interest on excess reserves:** maintain control of funds rate

Background: drivers of the long-term interest rate

- Long-term real rates crucial for recovery of real economy
 - Drive cost of funding for fixed investment (plants, equipment, residential investment) and stock market
 - Reduce loan-to-value (LTV) in commercial real-estate loans
 - **Equilibrium** or **natural real interest rate** low or negative during severe recession
 - But with inflation expectations low because of weak economy, actual real interest rate positive and possibly even rising

- Nominal long-term rates can be decomposed two ways:

Path of short-term rates: long-term rate the sum of

- Market expectations of the average future short-term rate
- A risk or **term premium**: sum of premiums on several types of risk, may be negative

Fisher equation: Any interest rate the sum of

- The real rate
- Expected future inflation
- A risk premium

How could LSAPs affect the real economy?

- Primary putative effect: via lower real yield curve
- To lower long-term real rate, *lower* expected path of short rates and term premium, and/or *raise* expected inflation:

Expected short rates may fall via **signaling effect**

- LSAPs enhance credibility of commitment to hold rates low
 - Since Fed suffers balance-sheet losses if rates rise rapidly
- Fed suffers balance-sheet losses if rates rise rapidly
- Weak evidence of announcement-date effects
- But volatility of effective-target funds deviations falls sharply

Expected inflation may rise, reducing the real rate

- Post-2007: avert deflation or greater disinflation

Term premium may fall via **portfolio-balance channel**

- Change composition of assets in private-sector hands
- Create “shortage” of safer assets → riskier assets, e.g. equities, more attractive
- Yields on risk-free bonds decline, asset prices buoyed, private net worth, balance sheets improve

Channels of influence of LSAPs on term premium

Preferred-habitat or portfolio-balance channel:

- Some investors desire bonds with specific characteristics
- Limits arbitrage → LSAPs reduce those bonds' risk premiums
- Induces substitution into bond types not purchased directly (e.g. corporate, MBS) as investors rebalance portfolios
- Analogous to “classical” channel of monetary policy: changing stock of money balances drives spending decisions
- MBS purchases focus on **mortgage rate** via **mortgage spread**, gap between MBS and Treasury yield

Duration channel: LSAPs lower duration risk premium → lower yields/higher prices of all long-term bonds, possibly equities

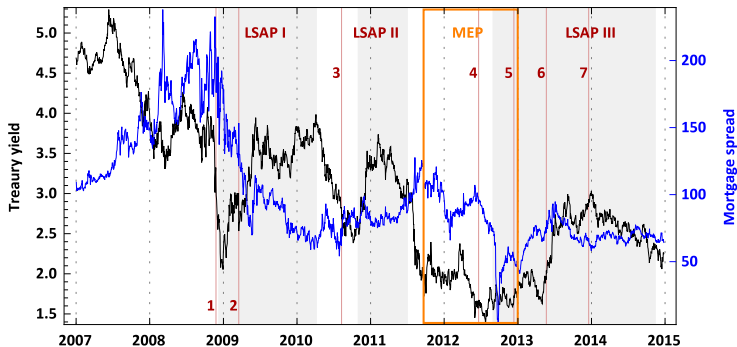
Safety channel: Treasury bonds risk-free, used as collateral

- LSAPs may *widen* credit, mortgage spreads

What was the channel?

- Evidence that it was signaling, impact on expected inflation, not portfolio balance
 - Impact on long-term rates of the programs not persistent, has a “half-life”
- Implications: less impact of LSAPs, effectiveness of this form of monetary policy more limited
 - But makes it possible to contemplate exit with large balance sheet
- Central banks experimenting with alternatives, e.g. negative rates
- Effectiveness of QE impaired by paying interest on reserves
 - Substitution of one form of government debt for another

Impact of LSAPs on interest rates



Black plot (left axis), U.S. generic 10-year yield (USGG10YR Index, percent). Blue plot (right axis), current coupon FNMA 30-year mortgage rate (MTGEFNCL Index) spread over USGG10YR (bps). *Source:* Bloomberg LP. Shading: active periods of LSAPs. Grid lines:

- | | |
|---|---------------------------------------|
| 1 LSAP I announcement | 5 Expansion of LSAP III to Treasuries |
| 2 Expansion of LSAP I to Treasuries | 6 Joint Economic Committee testimony |
| 3 Reinvestment of MBS principal in Treasuries | 7 Tapering announcement |
| 4 MEP extension through 2012 | |

New elements of communication

- Communication as an easing tool ↔ tool to align expectations with balance-sheet and rates policies
 - Persuade public that accommodation to remain even after normal policy would have tightened
 - If successful, expected path of short-term rates lower ↔ lower long-term rates than otherwise
- **Summary of Economic Projections** (SEP) of key variables since 27Apr2011
- **Forward guidance**: communication about future monetary policy
 - Typically, commitment to keep target funds rate low in the future
 - Also to maintain asset purchases, size of central bank balance sheet
 - E.g. Draghi 26Jul2012: “ready to do whatever it takes”
- Quarterly press conference

Types of forward guidance

Qualitative: the pre-crisis norm

- General statements of intention contingent on future market conditions (“data-dependent”)
- Reintroduced 19Mar2014 (“for a considerable time after...”) and modified 17Dec2014 (“can be patient...”)
- Can be consistent with discretionary or rules-based policy

Calendar-based: introduced 09Aug2011 (“at least through mid-2013”)

- Extended 25Jan2012 (“at least through late 2014”)
- And again 13Sep2012 (“at least through mid-2015”)

Threshold-based or **state-contingent:** introduced 12Dec2012 (“at least as long as the unemployment rate remains above 6-1/2 percent”)

- Modified 12Dec2013 (“well past the time... unemployment rate...below 6-1/2 percent”)
- Return to qualitative 19Mar2014

Overview of the Fed's crisis response

The economics of unconventional monetary policy

The debate on unconventional monetary policy

- Effectiveness and risks of unconventional monetary policy

- Alternative forms of unconventional monetary policy

- Risks of unconventional monetary policy

- Inflation risks of unconventional monetary policy

Normalization of monetary policy

Effectiveness of unconventional monetary policy

- Several debates on LSAP effectiveness
 - Impact on long-term rates: via which channels does it work?
 - Impact on employment, real economy, realized and expected inflation: slow and low-growth recovery
- Taylor rule no longer provides guidance
 - Use estimated response of long-term nominal rate to the amount of bonds extracted from private investors by LSAPs
 - Tells you how close you are getting to the “shadow” negative short-term rate needed to achieve mandate
- Critique: LSAPs weaken growth
 - Banks and capital markets generally seek long-term assets to replace “lost” duration
 - Gravitate away from short-term lending (distinct from short-term lending in collateral markets)
 - Weak investment: large firms improve balance sheets, small business can't borrow

Stein critique of LSAPs

- LSAPs may increase leverage rather than stimulate real economic risk-taking and growth
- Investment decisions depend on path of future rates, not long-term rate
- \Rightarrow LSAPs must lower path of short-term rates to influence capital-spending decisions
- Lower term premium
 - Cannot stimulate additional real capital investment
 - Can only induce substitution of long- for short-term debt financing

Effective lower bound “traps”

Several anomalies theoretically possible with interest rates near zero:

Liquidity trap: infinite interest-rate elasticity of money demand

Safety trap: safe-asset shortage at very low rates induces recession

- Demand for safe assets exceeds supply with (nominal and real) safe-asset yields near zero (→rising spreads and safety channel)
- Real output declines, reducing demand for safe assets via wealth effect, to re-equilibrate safe-asset supply and demand

Secular stagnation: weak demand contributes to low real rate

- Monetary policy cannot attain low real rate at effective lower bound with low inflation target
- Convergence to equilibrium has been achieved through *both* decline in potential output and unsustainably easy financial conditions
- Weak demand→feedback on potential output, lowering real rate

Neo-Fisherian trap: low real rates force expected inflation below target

- Fisher equation as identity: low nominal and real rate⇒low expected inflation

Effectiveness of forward guidance

- Two interpretations of forward guidance (“Delphic” and “Odyssean”)
 - As a change in reaction function towards more accommodation (“no more than a $\frac{1}{2}$ percentage point above”) → time consistency problem
 - As a change to a more adverse forecast of economic conditions → negative effect on market expectations
- Tapering a communication challenge
 - Tapering slowed pace of *adding* accommodation, was not *removal* of accommodation
- Forward guidance and LSAPs are distinct tools, latter can be dialed down while extending former

Negative interest rates

- Negative rates *policy* rates implemented by central banks of Switzerland, Sweden, euro zone, Denmark, Japan
 - Includes several smaller countries defending against currency appreciation
- Not currently under consideration by Federal Reserve
- Negative *market* rates: U.S. T-bills (sporadically), JGBs, Bunds
- Where is the **effective lower bound** on rates? Current low levels extremely exceptional historically
 - Short-term rates never this negative, longer-term rates never negative
- Limitations of negative policy rates:
 - **Demurrage**: cost of holding currency may be high, but finite
 - Bank depositor resistance inhibits banks from passing through costs of central bank reserves
 - Floating-rate contracts often bounded at zero
 - Impact on market functioning
- Policy mechanisms to reduce effective lower bound:
 - Time-stamped money, Silvio Gesell, Townsend Plan
 - Replace paper currency by electronic transactions

Helicopter money

- Idea introduced by Friedman (1960): money-financed fiscal policy
 - Proposed as a more-stimulative alternative to QE
 - Also called **overt monetary finance** (OMF)
- Central bank creates high-powered money, places it in hands of public
 - Permanent and irreversible, and expected by public to be so; money is nonredeemable
 - Increases government budget deficit
- Proceeds can be used to buy goods and services (i.e. spending) or for transfers (“helicopter drop”)
- Problematic impact on central-bank independence
 - Offsetting central-bank asset: perpetual nonredeemable public debt
 - Transfer of any interest to Treasury
 - Fiscal policy: equivalent to QE plus a permanent tax cut
- Incompatible with interest-rate targeting framework
- Challenge of inflation expectations
 - Credible central bank: difficult to convince public of permanence
 - Less-credible central bank may increase expected inflation more than desired

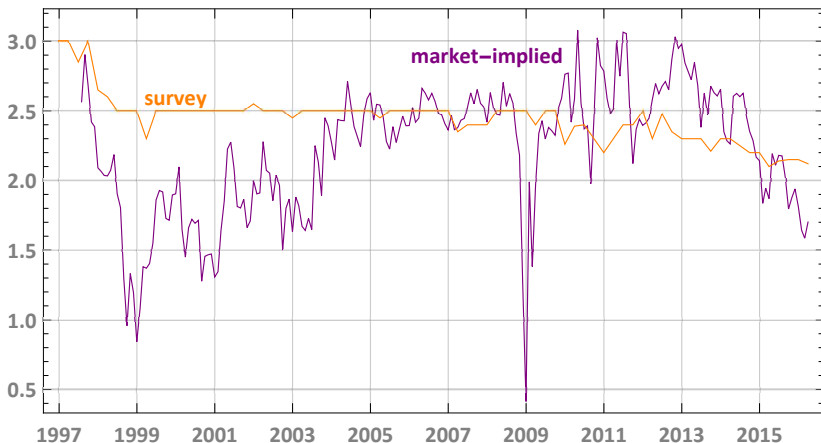
Risks of unconventional monetary policy

- Increase in monetary base→inflation risk
- Little historical experience with unconventional tools
- Distortive effects of effect of “low for long”
 - **Reaching for yield** and excessive risk-taking
 - Long-term investors, e.g. pension funds and insurance companies, under pressure
 - Reluctance to lend, esp. banks
- Difficulty of exit→exit strategy
- Credit policy and credit allocation
- Possibility of losses to Federal Reserve if growth surprise or inflation scare
 - Negative cash flow if rapid rise in short-term rates requires increase in IOER with large quantity of low-coupon assets
 - Mark-to-market losses on portfolio
 - Realized losses if (→)exit strategy amended to include sales of low-coupon bonds in rising-rate environment
- Losses→suspension of remittances to Treasury, creation of deferred asset, not reduction of capital

Unconventional monetary policy and inflation

- Widespread warnings of inflation risk as unconventional policy initiated (late 2008–09)
 - Inflation risk a key concern from mid-2008: rising oil, commodity prices
 - ECB deposit rate increased July 2008
- Why has there been no resurgence of inflation?
- Look to behavior of inflation expectations, money supply
- Expected inflation low and falling
 - Survey expectations stable through 2008, then declining
 - Market-implied expected inflation more volatile, but declining from 2013
 - Sharp decline late 2008 due to flight to safety and liquidity, market shuns less-liquid TIPS

Market-implied and survey inflation 2007–2015

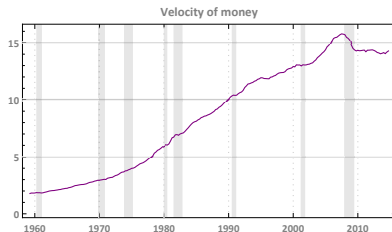
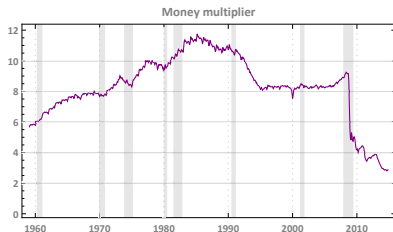


Purple plot: 5-year 5-year forward breakeven inflation; **Orange** plot: Survey of Professional Forecasters median 10-year-ahead annual average inflation forecast, quarterly. Forward breakeven inflation is the inflation rate over some future interval implied by yields on nominal and inflation-adjusted bonds of two different terms to maturity. *Source:* Bloomberg LP, Federal Reserve Bank of Philadelphia.

Behavior of money supply and unconventional policy

- Quantitative easing leads to large increase in *monetary base*, but slower increase in *money supply*
- Monetary base increases with key component—reserves—on liability side of Fed balance sheet
 - Increase consists almost entirely of excess, not required reserves
 - From commercial banks' standpoint, reflects modest deposit creation compared to reserve requirements
- Sharp decline in **money multiplier**: ratio of money supply to monetary base
 - Money multiplier typically slow-moving, governed by reserve requirements
 - Stable money multiplier historically reflects near-zero excess reserves
 - Decline in multiplier in crisis \Leftrightarrow massive increase in excess reserves
- Also observed: modest decrease in **velocity of money**: ratio of money supply to income (GDP)
 - Lower velocity \Leftrightarrow fewer transactions effected by given money stock
 - Corresponds to modest increase in money balances held by market participants
 - Increase in liquidity preference a typical crisis phenomenon

Monetary velocity and money multiplier 1959–2014

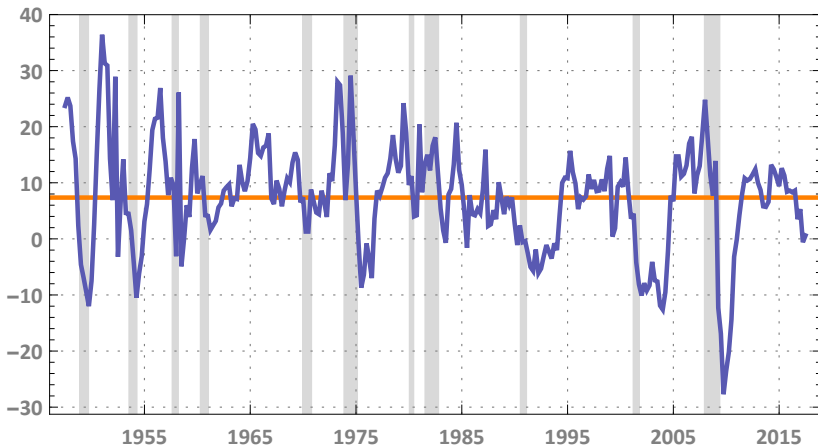


Left: money multiplier, monthly, measured as ratio of money supply to monetary base (total reserve balances maintained at Federal Reserve plus currency in circulation, month-end, nsa). Right: velocity of money, quarterly, measured as ratio of nominal GDP (gross domestic product in billions current dollars, saar) to money supply (M2 money stock, quarter-end, nsa). Vertical shading represents dates of NBER business cycles. *Sources:* U.S. Bureau of Economic Analysis; Board of Governors of the Federal Reserve System, H.3 release, Table 2 (monetary base) and H.6 release, Table 1 (M2).

Bank lending and the money supply

- Bank lending *is* deposit creation for commercial banks *collectively*
 - Excess reserves/low money growth corresponds to weak bank lending
- Demand for interest-earning assets: weak demand by banks for commercial loans as assets
- Supply of interest-earning assets: IEOR keeps money supply from rising by inducing banks to hold excess reserves in place of alternative liquid assets, loan expansion
- Low inflation \Leftrightarrow low bank lending \Leftrightarrow low money growth

Growth in U.S. bank lending 1959–2014



Annualized growth rate of loans and leases of all commercial banks, seasonally adjusted, percent, quarterly through Q2 2014. Vertically shaded intervals denote NBER recessions. *Source:* Federal Reserve Board, H.8 data release.

Implicit Federal Reserve inflation targeting

- Closely related to developments in communication
 - Publication of medium-term forecasts in *Monetary Policy Report*
 - Inflation forecasts included in SEP
- 24Jan2012 principles (long-term goal of 2 percent)
 - No primacy of price stability within dual mandate
 - But longer-term goal for inflation more specific than for employment
 - And “maximum level of employment is largely determined by nonmonetary factors”
- But no formal rule or target: “constrained discretion”
 - Asymmetry of risks: high inflation presumed more damaging, but...
 - Rosengren 16Apr2015: higher target “brings with it a lower chance of hitting the zero lower bound”

Controlling inflation with a large balance sheet

- What tools available to central bank to keep money supply from rising without selling assets?
 - Increase reserve requirements
 - Increase IOR/IOER to keep reserves locked up
 - Change composition of liabilities away from reserves→exit tools
- Limitations on use of reserve requirements
 - And reminiscent of bad 1937 experience
- Public-debt burden currently very low, would rise with higher rates
- Inflation may increase with or without change in Fed goal
- Inflation expectations, well-anchored over 3 decades, key in either case

Possible inflation scenarios

- Inflation risk scenarios if recovery takes hold, output gap diminishes
 - Bank lending recovering, can increase massively, Fed control weak
 - Would change excess into required reserves
 - Could be inhibited with sharp but disruptive increase in IOER
 - Surprise acceleration of inflation resulting from wage increase
 - → Unanchoring of inflation expectations
 - Fed runs economy “hot” to increase participation, reduce long-term unemployed and part-time share
 - → More gradual but possibly more persistent unanchoring of inflation expectations
 - Both scenarios → Need to tighten more sharply than desirable, potential trigger for renewed recession
- Unlikely but possible if weak recovery: higher Fed long-term inflation goal
- Slightly less unlikely but possible: higher Fed short-term inflation goal: ⇔ nominal GDP target
 - Bank of England tolerating transitory foreign-exchange induced inflation > 2 percent post-Brexit (04Aug2016)

Overview of the Fed's crisis response

The economics of unconventional monetary policy

The debate on unconventional monetary policy

Normalization of monetary policy

- Exit strategy

- Mechanics of exit

- Behavior of money markets since the crisis

- Risks of exit

Exit from extraordinary accommodation

- Exit: remove accommodation and normalize rates
 - Raise target and short-term market rates away from zero
 - Reduce size of Fed balance sheet
- As recovery sets in, what is best *sequencing* of exit steps?
 - Back to open market operations? Requires vast reduction in reserves via bond sales to recreate reserve tightness
 - Would raise long-term rates and reverse salutary effects of LSAPs
- → Do it the hard way: *rates first, then balance sheet*
 - Initiate rate hikes while maintaining large balance sheet
 - Recalls dilemmas of late 2008, but in reverse: support asset markets while controlling volume of reserves
- Exit underway since 2014
 - Balance sheet: “tapering,” slowing of pace of purchases, from Jan. 2014
 - Fed funds target rate increases beginning Dec. 2015
 - Reduction of reinvestment of principal payments from Oct. 2017

Exit strategy: key challenges

- Money market conditions: awash in liquidity
 - Pre-crisis approach to overnight rate control not possible
- Communication challenges: gap between market, policymaker views
- Asymmetrical risks of error near zero bound
 - Lift-off too slow: subsequent tightening more aggressive (but Fed knows how to combat inflation)
 - Lift-off too fast: high cost to real economy, need to ease again, attendant political and communication nightmare
- Market volatility: potential decline in stock market, “risk-off”
- International impact of rising rates and strong USD
- Mark-to-market or realized losses on Fed balance sheet as rates rise
- Political challenges of raising IOER

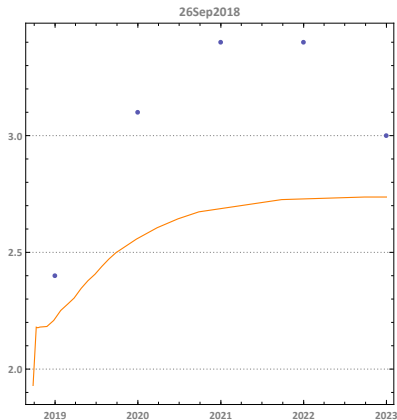
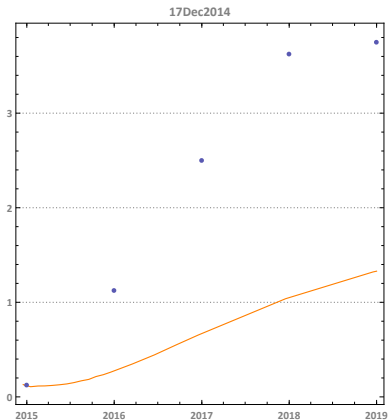
Central bank liabilities during exit

- Large volume of liabilities corresponding to asset purchases
 - Reduce volume via asset sales or run-off
 - Sterilize, i.e. exchange for non-monetary liabilities
 - Keep money multiplier low via IOR
- Banks have large amounts of excess reserves, corresponding to large Fed balance sheet
 - Banks have ample liquidity, no need to borrow in funds market
 - → Diminished activity in fed funds market
 - → Harder to control funds rate through normal operations
- Some central banks issue bonds, e.g. to offset foreign-exchange reserve accumulation
 - But not contemplated by Fed

Communication challenges: forward guidance and the “dots”

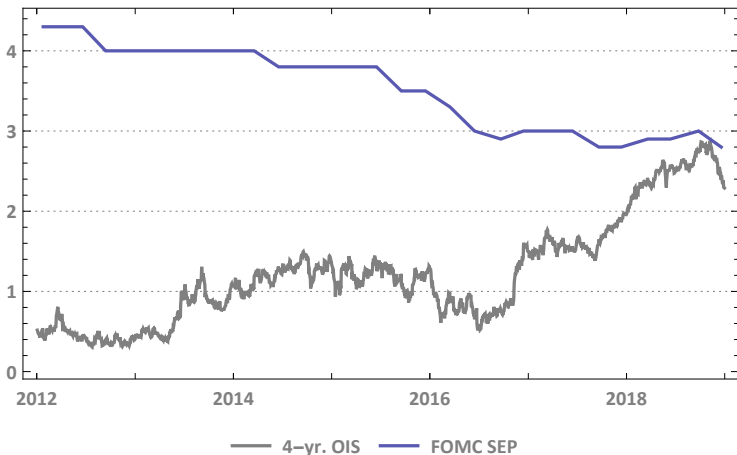
- Forward guidance a key tool in central bank accommodation since 2011
 - Pre-crisis approach to overnight rate control not possible
- Communication challenges: gap between market, policymaker views
 - Gap may represent greater pessimism in market than on FOMC
- SEP since 2012 includes projections of fed funds rate over next 4-5 years
- “Dots plot” shows gap between market and FOMC projections of funds rate at different horizons
- Gap has narrowed considerably: 4- and 5-year OIS swap rates now 2.7 percent, close to median longer-run funds rate projection

“Dots plot”



Purple markers: median of FOMC participants' projections of future Fed funds rate from 26Sep2018 Summary of Economic Projections (SEP). Medians computed by Bloomberg XLTP function, SEP data available at <http://www.federalreserve.gov/monetarypolicy/fomccalendars.htm>. Orange plot: forward overnight rates (OIS curves) on the date of the plot.

Convergence of market and FOMC expectations



Purple plot: median of FOMC participants' projections of longer run Fed funds rate from quarterly Summary of Economic Projections (SEP); *source*: FRED, series FEDTARMDLR. **Gray** plot: fixed rates on 4-year OIS swaps (4-year forward overnight rates); *source*: Bloomberg LP.

Evolution of exit strategy

- Initially set out in testimony Feb. 10, 2010, minutes June 2011 (“Exit Strategy Principles”)
 1. Reduce pace of asset purchases (tapering)
 2. “cease reinvesting some or all payments of principal”
 3. “modify...forward guidance...and...initiate temporary reserve-draining operations”
 4. Gradually sell MBS
- Runoff without MBS sales mooted: June 2013 press conference
- Asset purchases to end well before rate hikes Mar. 2014
- Formal announcement of revised approach to sequencing 16Sep2014 (“Policy Normalization Principles and Plans”)
 1. Tapering near done, so no discussion of pace of purchases
 2. Cease reinvestment at indeterminate future date, but no sales
 3. Desire to shift Fed assets to Treasuries as MBS pay down
 4. Funds rate remains intermediate target; range, not a point
 5. IOER as key tool to control funds rate, limited use of ON RRP
- Addendum of 13Jun2017: more detail on runoff plan
 - Gradual start, then acceleration up to certain caps

Normalization: new tools to control target rate

Reverse repos (ON RRP): test exercises since Sep. 2013

- Offered to wide audience, including MMMFs, GSEs
- Constitutes borrowing from public, thus provision of an asset
- Put high-quality collateral into market → firming of repo market
- Fixed amount or full allotment at fixed award rate (5–10bps)

Term Deposit Facility (TDF), 7 or 28 days

- Banks only
- Can be used to satisfy regulatory liquidity requirements
- Cannot be used for clearing

IEOR introduced in 2008, plays different role during exit

- Can be paid only to banks, not GSEs
- Then: keep rates in 1–25 bps range, rather than dropping to zero
- Now: keep rates from falling below funds rate as target is lifted

Floor system for funds rate during exit

- IOER *floor*, ON RRP “sub-floor” on effective fed funds rate
 - Technically still a corridor system, as discount rate still set, though barely used
 - IOER as primary tool to set rates near target
 - Wide ON RRP-IOER spread → active funds trading
- Fed funds rate remains target, supported by system of administered rates until normalization
- Keep effective funds rate close to 25 bps upper limit of target range
- Actual fed funds rate should get closer to IOER as reserves drained
 - Draining can however be temporary e.g. ON RRP, TDF
 - Switch liabilities, reducing reserves, but not balance sheet size

The shrunken money market

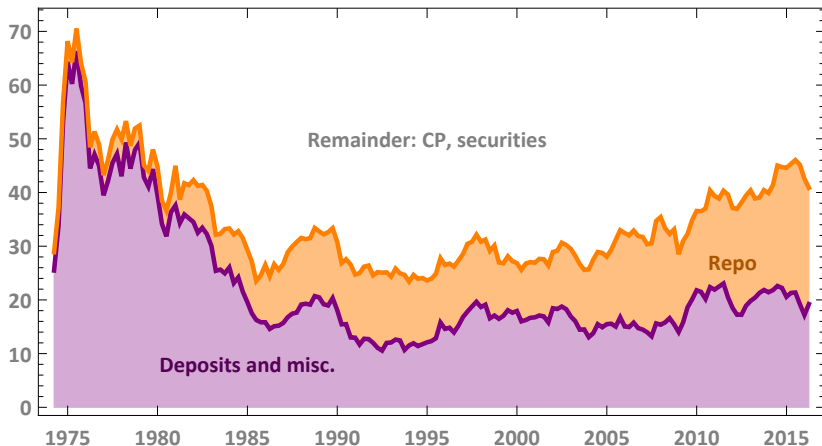
- Trading and issuance volumes much lower
- Segments of money market track each other less closely, i.e. lower correlation of daily changes
- Shifts in participants
 - Greater MMMF role in short-term intermediation, e.g. eurodollars
- Short-term borrowing less attractive to banks

The dormant fed funds market

- Trading volume much lower than pre-crisis
- Three sets of participants:
 - U.S. commercial banks
 - GSEs, esp. FHLBs: bulk of lending in shrunken funds market
 - U.S. offices and branches of foreign banks (FBOs) now nearly half the borrowing
- Dominated by FBOs borrowing from GSEs to earn IOER
- Market soggy, hence target rate expressed as 25 bps range
- Normal monetary operations ineffective, since based on structural deficiency of reserves

	Mean	Std. dev.
03Jan2000–10Aug2007	0.7	9.9
13Aug2007–18Mar2009	-11.7	28.0
19Mar2009–05Jan2016	-12.3	4.2

Holdings of money market mutual funds 1974–2016



Share of total by type of asset, percent, quarterly. *Source:* Federal Reserve Board, Financial Accounts of the United States (Z.1), Table L.121.

A new operating framework?

- No reference in exit strategy to permanent changes in framework
- Apart from laconic references to
 - Holding “ primarily Treasury securities, thereby minimizing the effect...on the allocation of credit.”
 - “[R]educing...reserve balances...to a level appreciably below that seen in recent years but larger than before the financial crisis.”
- But indications in Federal Reserve public statements that some elements of “exit strategy” may be part of new framework
 - E.g. ON RRP, IOR
- Discussion of potential alternatives to fed funds effective rate as target
 - But likely with attention paid to a broader set of money market rates than pre-crisis
- No decision as yet regarding future size of balance sheet
 - Possible return to LSAPs if ZIRP required in future

Alternative target rates

Overnight bank funding rate (OBFR): similar to effective fed funds rate

- Index of unsecured rates
- Includes fed funds transactions
- But also interbank overnight borrowing in Eurodollar market

Treasury repo reference rate: esp. (→) **Secured Overnight Financing Rate** (SOFR) index of overnight repo rates

Administered rate: e.g. ON RRP, IOR

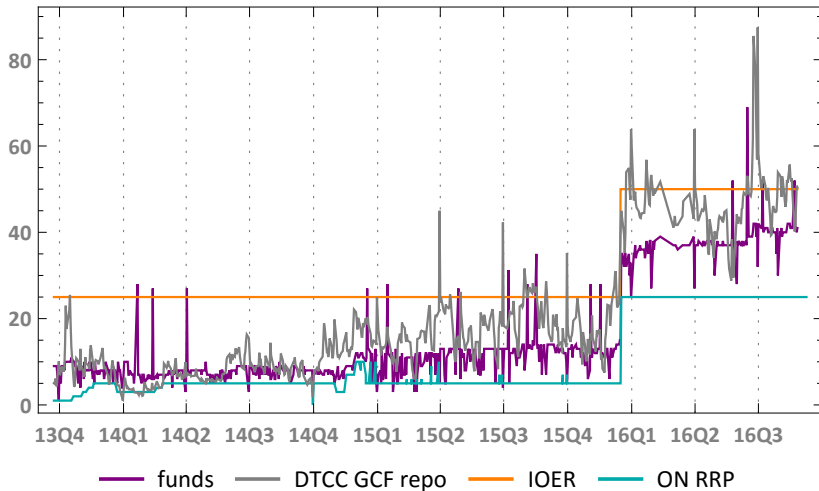
Why so hard to raise rates?

- IOER a leaky floor due to *incomplete arbitrage in money markets*
 - But note it is to be a ceiling and a magnet during normalization
- GSEs cannot receive IOR from Fed
 - But as government entities, eligible to hold deposits at Fed
 - FHLBs receive large and lumpy interest payments from mortgage borrowers
 - →Willing suppliers of o/n funds below IOR rate
- →Arbitrage opportunity for commercial banks
 - Banks could borrow from GSEs, lend to Fed until funds rate=IOER
- But: DIs face regulatory costs
 - Liquidity regulation, e.g. **Liquidity Coverage Ratio** (LCR)
 - U.S. capital charges, e.g. **Supplementary Leverage Ratio** (SLR), **GSIB Surcharge**
 - FDIC deposit insurance assessment base: assets minus capital rather than deposits
- FBOs not subject to SLR, FDIC assessment
 - →disproportionately large borrowers of Fed balances, carry out much of existing IOER arbitrage

Potential for “accidents” during exit

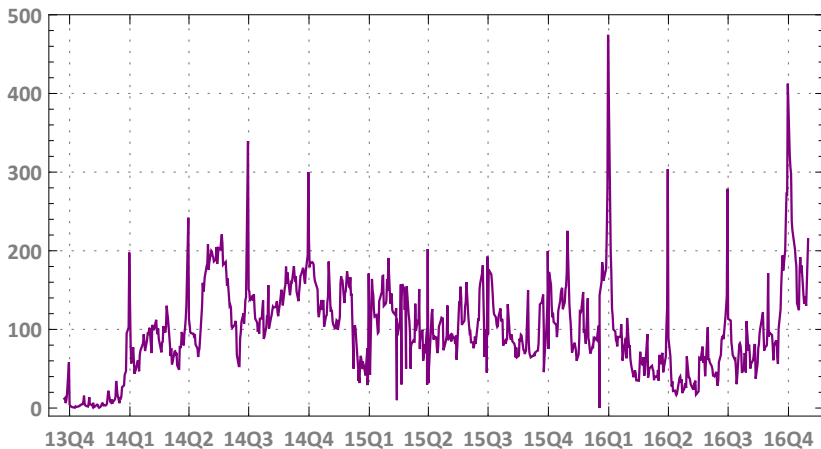
- How tightly can Fed control rates during exit?
 - Money market rates consistently below IOER, IOER doesn't act as floor
- Availability of ON RRP may make system more run-prone
 - ON RRP as safe-haven asset
- Market volatility (e.g., taper tantrums) may help or hinder exit
 - Volatility aids exit by tightening financial conditions
 - Low volatility may ordain more aggressive tightening (“Yellen collar,” risk-on increases likelihood of further tightening)

U.S. money market rates 2013–16



All rates in basis points, daily. *Sources:* Bloomberg LP, Federal Reserve Bank of New York.

Overnight reverse repo facility use 2013–16



Accepted bids, \$bill., daily. *Source:* Federal Reserve Bank of New York.