Monetary Policy - Conventional and Unconventional

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Monetary Policy in the NK Model

Monetary Policy in the New Keynesian Model

- We have shown that monetary policy can have real effects in the New Keynesian model
- We also note that the New Keynesian model features distortions that lead to inefficiencies
- Ability to affect an economy featuring inefficiencies $\Rightarrow$ possible role for policy interventions
- Central banks are heavy users (and developers of) New Keynesian models
- Structural models allow policymakers to understand and plan the effects of policy

Steady state (in)efficiency in the NK model

Recall from the previous lecture:

- Steady state value of y_t^n (and y_t) was lower than in Classical model
- Related to the pricing power of monopolistically competitive firms
- Markup: $\mu \equiv \log(\mathcal{M}) \equiv \log\left(\frac{\varepsilon}{\varepsilon-1}\right)$

Natural rate of output in NK model

$$\begin{aligned} y_t^n &= \psi_{yn} + \psi_{yn,a} a_t \\ \psi_{yn} &\equiv -\frac{(1-\alpha)(\mu - \log(1-\alpha))}{\sigma(1-\alpha)+\varphi+\alpha} \end{aligned}$$

Output in Classical model

$$\begin{aligned} y_t^c &= \psi_{yc} + \psi_{yc,a} a_t \\ \psi_{yc} &\equiv \frac{(1-\alpha)\log(1-\alpha)}{\sigma(1-\alpha)+\varphi+\alpha} \end{aligned}$$

Inefficiency in the NK model

Monetary policy is not the 'right' tool to correct industrial structure inefficiencies

- Can't fix monopolistic competition
- Need to rely on supply side (e.g. tax/subsidy policies)
- In an earlier homework we showed that if producers are subsidized appropriately, we can recover the efficient level of output More detail
- We will assume such a policy holds, so the **'steady state'** value of y_t and both the steady state *and current values* of y_t^n are efficient
    - Flexible prices in the 'natural rate' world $\Rightarrow$ if we fix competitive distortions, there's nothing left to cause inefficiency, in or out of steady state

But that's not the end of the story. . .

Inefficiency in the NK Model

Additional conditions that must be satisfied by an efficient allocation are. . .

- All goods (indexed by i) should be consumed (and thus produced) in the same quantities
$$C_t(i) = C_t \ \forall i \in [0,1]$$
- All firms (each identified with a good, i) should employ the same amount of labor
$$N_t(i) = N_t \ \forall i \in [0,1]$$

An efficient benchmark

Under the flex-price equilibrium or the zero inflation steady state of the sticky price model

- All firms are producing the same amounts
  - Why? They face the same technology and prices
- Each (identical) household consumes the same amount of each good
  - Why? All goods have the same price and enter symmetrically in the concave utility function

But price stickiness prevents this from holding *outside the steady state* from period to period

An efficient benchmark

Even if the *steady state* of the NK model is efficient under the subsidy this does not mean it is efficient in any given period

- Due to price stickiness, the average markup will vary over time
  - Average marginal cost will vary with average scale of production
  - Prices do not adjust fully to reflect this
  - Even if a constant subsidy is adjust for steady state markups, it can't correct for *variations* in markups
  - Remember markups ($P \neq MC$) are associated with inefficiency
- **Due to price stickiness there will be dispersion in prices**
  - Leads to dispersion in consumption and employment across firms/goods
  - Violates optimality conditions for consumption and resource allocation
  - But this **is** something monetary policy can rectify, in theory

Optimal Allocation

Suppose we start from a steady state situation

- All firms were setting the same price in the previous period
- Price was at desired markup over (subsidy adjusted) marginal cost
- All firms operate on the same scale
- Goods are consumed in the same quantity
- Output is at its natural level

Optimal Allocation

If shocks hit the economy, how should policy respond?

- The aim is to preserve $y_t = y_t^n$ (or $\tilde{y}_t = 0$) since y_t^n is efficient
- Since this must be part of an equilibrium, the NKPC must hold
- Iterating the NKPC forwards $\Rightarrow$ if $\tilde{y}_t = 0 \ \forall t$ then $\pi_t = 0 \ \forall t$

$$
\begin{aligned}
\pi_t &= \beta E_t[\pi_{t+1}] + \kappa \tilde{y}_t \\
&= \beta E_t[\beta E_{t+1}[\pi_{t+2}] + \kappa \tilde{y}_{t+1}] + \kappa \tilde{y}_t \\
&\cdots \\
&= \kappa \sum_{j=0}^{\infty} \beta^j E_t[\tilde{y}_{t+j}]
\end{aligned}
$$

Optimal Allocation

From an alternative perspective. . .

- Assume $\pi_t = 0 \; \forall t$ and all firms are initially at their desired markup
- If policy is such that marginal cost is stabilized, then the existing price will continue to be optimal
  - Since the markup is already at desired level and the marginal cost to which the markup is applied is unchanged
- No firm (even the $1 - \theta$ who *can* reset) will want to change their price
  - Thus inflation will be zero
  - Price stickiness irrelevant (like being in flex price)
- Output is equal to natural $\Rightarrow$ constant real marginal cost
  - Thus, under zero inflation, we have constant nominal marginal cost
  - Justifies firms not changing prices

If policy achieves price stability then it also coincidentally achieves $y_t = y_t^n$

- 'Divine coincidence'
- No trade-off between price stability and goals for y_t

Optimal Allocation

Note that efficiency does not imply constant activity

- MC_t is stabilized such that the desired markup $\Rightarrow$ constant P_t
- But *output* can still vary in an efficient allocation
  - $\tilde{y}_t = 0 \Rightarrow y_t = y_t^n$
  - y_t^n depends on a_t
- This reflects one of the main insights of the RBC literature (business cycles $\not\Longrightarrow$ market failure)

Optimal Allocation

Nice quote from Galí p. 104

> *The intuition behind the desirability of zero inflation in the case of an efficient natural allocation can be conveyed as follows: if price stability is attained, then it must be the case that no firm is adjusting its price even when having the option to do so, from which it follows that the constraints on price setting are not binding and, hence, that the equilibrium allocation corresponds to that of an economy with flexible prices (which is, under the assumptions made here, efficient).*

Optimal Policy

What interest rate policy is consistent with the optimal allocation as an *equilbrium* outcome?

- $y_t = y_t^n$ combined with the DIS curve implies $r_t = r_t^n$
- Zero inflation $\forall t$ implies $i_t = r_t$ (by the Fisher equation)

Thus under optimal policy, in equilibrium,

$$i_t = r_t^n \tag{1}$$

But is this an adequate *rule* for how the interest rate should be set in all contingencies?

Optimal Policy

$i_t = r_t^n$ holds in our desired equilibrium with $\tilde{y}_t = \pi_t = 0$

- But it *also* can hold in other less desirable equilibria
- In these equilibria we do not have $\tilde{y}_t = \pi_t = 0$
- Thus we lose the desired efficiency properties
    - We can have $i_t = r_t^n$ but if $\pi_t \neq 0 \ \forall t$ then r_t will deviate from r_t^n
    - Then we cannot guarantee that $y_t = y_t^n \ \forall t$

Equation (1) derived 'assuming' optimal allocation ($\tilde{y}_t = \pi_t = 0 \ \forall t$)

- Doesn't allow for possibility of deviations from the optimal allocation
- This 'opens the door' to alternative allocations
- Needs to be augmented with response to 'off equilibrium' outcomes

Optimal Policy

Consider instead two alternative rules

- A rule that responds to realized inflation and activity

$$i_t = r_t^n + \phi_\pi \pi_t + \phi_y \tilde{y}_t$$

- A rule that responds to forecasts/expectations of inflation and activity

$$i_t = r_t^n + \phi_\pi E_t[\pi_{t+1}] + \phi_y E_t[\tilde{y}_t]$$

Let us simplify these rules further

$$\begin{aligned} i_t &= r_t^n + \phi_\pi \pi_t \\ i_t &= r_t^n + \phi_\pi E_t[\pi_{t+1}] \end{aligned}$$

Optimal Policy

Explicit adjustments to the simple ($i_t = r_t^n$) policy if π_t not as desired

- $i_t = r_t^n$ **if** $\pi_t = 0$ or $E_t[\pi_{t+1}] = 0$, respectively, but...
  - $\pi_t > 0$ or $E_t[\pi_{t+1}] > 0 \implies i_t > r_t^n$
  - $\pi_t < 0$ or $E_t[\pi_{t+1}] < 0 \implies i_t < r_t^n$

Assume that $\phi_\pi > 1$ (and, for the forecast rule, that ϕ_π is not 'too big')

- In this case the **only** equilibrium possible is the desired one
- $\tilde{y}_t = \pi_t = 0 \ \forall t$ so in equilibrium the adjustments never get made and $i_t = r_t^n$ after all!
- But the 'threat' of those adjustments eliminates other equilibria

A plan for rates should specify actions **even in contingencies that should not occur** under the plan!

Optimal Policy

Some intuition for the importance of $\phi_\pi > 1$ can be gained from the simplified forecast rule (where we ignore the response to the output gap)

$$i_t = r_t^n + \phi_\pi E_t[\pi_{t+1}]$$

Using the Fisher equation this implies that

$$r_t = r_t^n + (\phi_\pi - 1)E_t[\pi_{t+1}]$$

$\phi_\pi >$ or < 1 determines whether r_t rises or falls with $E_t[\pi_{t+1}]$

- Consider an example of an 'inflation scare' to illustrate implications of this...

Optimal Policy

If $\phi_\pi > 1$, an increase in expected inflation $\implies$ $r_t \uparrow$, all else equal

- But we know $r_t \uparrow$ is contractionary and drives inflation down, so $\pi_{t+1} \downarrow$ in expectation
- But that **contradicts** assumption of higher inflation expectations!
- $\implies$ only $\pi_t = 0 \; \forall t$ is consistent with equilibrium

If $\phi_\pi < 1$, an increase in expected inflation $\implies$ $r_t \downarrow$, all else equal

- But we know $r_t \downarrow$ is expansionary and drives inflation up, so $\pi_{t+1} \uparrow$ in expectation
- That is **consistent with** assumption of higher inflation expectations
- $\implies$ $\pi_t \neq 0$ is consistent with equilibrium

Optimal Policy

The ‘Taylor principle’ ($\phi_\pi > 1$) is desirable partly because it ensures policy responds ‘sufficiently strongly’ to inflationary pressure

- Note that $\phi_\pi > 1$ ensures zero inflation in equilibrium
- But then we recover $i_t = r_t^n$ and the expectation response term is ‘dormant’ in equilibrium
- Nevertheless, its presence is vital to eliminate other equilibria

Simple Policy Rules

One problem with specifying policy simply as $i_t = r_t^n$ is that it allows 'multiple equilibria'

- We saw a way to 'fix' this was to specify 'off equilibrium path' behavior

But all of these approaches require knowledge of r_t^n

- In practice, that's not easy (in fact, it's effectively impossible)
- See recent debates about 'r^*' (pronounced r-star)

Knowing r_t^n requires exact knowledge of

- The exact structure of the economy's 'true model'
- The values taken by all its parameters (likely changing over time)
- The realized value of all the shocks that influence r_t^n

Simple Policy Rules

The previous rules are too 'complicated' - hence people have proposed the use of 'simple' rules

- Informed by some of the same logic but...
  - Depend only on observable variables
  - Don't require deep knowledge of (all the) structural parameters and shocks
- Will not be 'optimal' but should perform 'reasonably well'
  - The rules considered earlier were optimal but infeasible
- Should be robust to a range of parameter values and sources of shocks
  - If being slightly wrong about a parameter is disastrous - then this is a bad rule!

Simple Policy Rules

We consider a simple 'Taylor rule' (inspired by Taylor (1993))

$$i_t = \rho + \phi_\pi \pi_t + \phi_y \hat{y}_t \tag{2}$$

where $\hat{y}_t \equiv y_t - y$ (log deviation from steady state - **not natural**) and ϕ_π and ϕ_y are set to ensure a unique equilibrium

Requires relatively little knowledge about the structure of the economy

- Still assumes approximate knowledge of β (ρ) and $\bar{y}$
- But see Levin *et al* (1998) and Orphanides and Williams (2002, 2006) for 'difference rules' that address this issue
- A related and very readable discussion of the role of rules is this speech by Williams (2016))

Simple Policy Rules

To assess the performance of the rule for a given parameterization we use

$$\mathcal{L} \propto \left(\sigma + \frac{\varphi + \alpha}{1 - \alpha}\right) var(\tilde{y}_t) + \frac{\varepsilon}{\lambda} var(\pi_t)$$

Welfare loss arises from $\pi_t \neq 0$ and $y_t \neq y_t^n$

- Derived via approximation to the welfare of representative household (Rotemberg and Woodford (1999))
- Weights are functions of the deep parameters
- Loss will be > 0 (unless the rule replicates optimal policy)

Caveat

Why not simply set $\phi_\pi \to \infty$?

- Sometimes called the 'inflation nutter' approach to policy
- In this simple model it essentially implements optimal policy

Beyond the scope of this course (see Ch. 5 if interested) but. . .

- We have been assuming that y_t^n is efficient
- Means that price stability is consistent with ideal 'activity' outcomes
- In richer models it may not be

There may be reasons to weight price stability against variation in some measure of output or employment (or financial imbalances?)

- Our model seems to be missing something
- No central bank thinks that focusing **purely** on price stability will achieve a desirable outcome

Summary of conventional monetary policy

- Under the assumption of a subsidy that makes our economy's *steady state* efficient, remaining inefficiencies arise from price stickiness
- This implies a role for policy to set rates such that price stability is ensured - resulting in output being equal to the natural rate in every period (which may vary over time with technology shocks)
- Under optimal policy (featuring zero inflation and output equal to natural) the nominal interest rate equals the natural real rate
- To ensure our desired equilibrium, policy should also specify how it will respond appropriately to deviations from desired outcomes
- But such policies often require an implausible degree of knowledge of the economy
- 'Simple rules' may come close to achieving the same equilibrium but are implementable in the real world

Zero lower bound and Policy responses

Zero lower bound

Shocks and long term trends can drive the r_t desired by the CB below zero

- Perhaps easiest to think about demand-side shocks/trends
- Remember our simple models where a lower interest rate was required if the desire to save was strong (i.e. current demand is relatively low)

Why might people not be able or want to borrow so much at a given r_t?

- Aging populations and longer life spans (saving for retirement)
- 'Savings glut' from Asian central banks accumulating Treasuries
- Banks tightening lending $\Rightarrow$ a given r_t has a larger spread on top
- Flight to safety and/or post crisis regulation $\Rightarrow$ demand for safe assets
- Slower growth and secular stagnation

Falling real rates

Use the intuition of an Euler equation (ignore risk) under CRRA felicity:

$$\begin{aligned} 1 &= \beta \frac{Z_{t+1}}{Z_t} R_t \frac{U_{c,t+1}}{U_{c,t}} \\ &= \beta \frac{Z_{t+1}}{Z_t} R_t \left(\frac{C_{t+1}}{C_t} \right)^{-\sigma} \end{aligned}$$

Rearrange to obtain

$$R_t = \left(\frac{C_{t+1}}{C_t} \right)^{\sigma} \frac{Z_{t+1}}{Z_t} \beta^{-1}$$

And in logs

$$r_t = \sigma \Delta c_{t+1} - \Delta z_{t+1} + \rho$$

recalling $\rho \equiv -\log \beta$ (and log of a ratio is difference of logs)

Falling real rates

What follows isn't a complete G.E. argument - a bit loose - but useful for intuition...

Falling real rates - short run

$$r_t = \sigma \Delta c_{t+1} - \Delta z_{t+1} + \rho$$

Households anticipate a future contraction driving consumption down

- $\Delta c_{t+1} \downarrow$

$$r_t = \sigma \Delta c_{t+1} - \Delta z_{t+1} + \rho$$

Households' 'confidence' $\downarrow$ and want to build up 'rainy day' fund

- Reinterpret Z_t as capturing temporary changes precaution
- $\Delta z_{t+1} \uparrow$ (from $z_t \downarrow$) like becoming relatively patient now

$$r_t^{HH} \equiv r_t + \Delta z_{t+1} = \sigma \Delta c_{t+1} + \rho$$

Households borrow at r_t *plus a spread*

- Reinterpret Z_t as capturing banks' willingness to lend (lower spread)
- $\Delta z_{t+1} \uparrow$ (from $z_t \downarrow$) reflects financial shock damaging banks

Falling real rates - long run

Suppose trend growth rate of consumption (and output) is given by γ

- 'Steady state' implies $C_{t+1} = (1+\gamma)C_t$ $(\Leftrightarrow \Delta c_{t+1} = \gamma)$
- In the long run, ignore temporary shocks and focus on general trend
- Lose Z_t and time subscripts

$$r = \sigma \Delta c + \rho = \sigma\gamma + \rho$$

Some argue that γ has $\downarrow$

- Example: Lower technological growth as effects of internet dissipate
- Intuition for how σ influence this impact?
- Unclear if lower γ is a global phenomenon

Some suggest phenomena akin to $\rho \downarrow$ $(\beta \uparrow)$

- Longer retirements
- Asian 'glut of savings'
- Regulation-induced demand for safe assets (e.g. Treasuries)

Real rates have declined to historically low levels

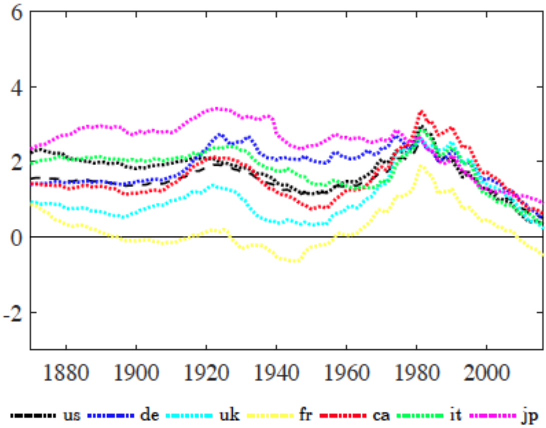


Figure 1: Substantial declines in 'long run value' of *real* rates in recent times, across many countries, Source: NY Fed

Real rates have declined to historically low levels

The debate over falling real rates often refers to the long run ‘neutral’ rate as r^* or ‘r star’

- From the reading list
  - Laubach and Williams (2015),
  - Williams (2018)
- Also see here, here and here

Connected to the broader debate on ‘secular stagnation’

- Some argue US GDP trend growth $\downarrow$ from 3.5% to 1.9%
- Collection of essays here (if you’re interested)

Falling nominal rates

Recall Fisher equation $i_t = r_t + E_t[\pi_{t+1}]$

- If inflation expectations are stable (or falling), i_t will fall with r_t

A shock (say, negative innovation to Z_t) may require r_t to be lowered as part of optimal policy

- $r^* \downarrow$ problematic if π too low for $r_t < 0$ given $i_t \geq 0$
- Arises if desired r_t (implied by a Taylor rule, perhaps) $< -E_t[\pi_{t+1}]$

Why is it typically thought $i_t \geq 0$?

- Option to hold cash, which earns a 0 net nominal return
- Zero is better than negative!

During Great Recession and afterwards, standard policy rules $\Rightarrow$ negative nominal rates were necessary

- U.S. and other countries hit the *Zero Lower Bound*

Nominal rates have declined to historically low levels

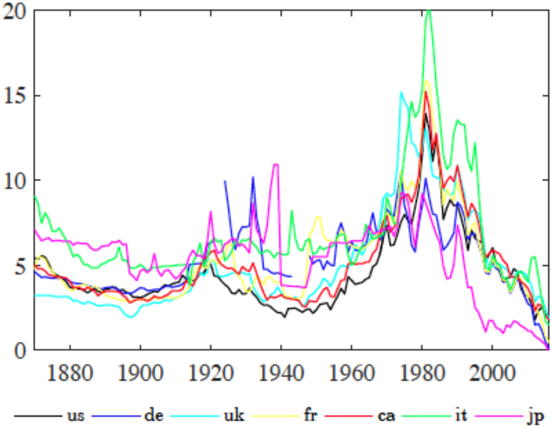


Figure 2: Substantial declines in rates in recent times, across many countries, Source: NY Fed and Jorda *et al's* Macrohistory Database

ZLB - short rates constrained

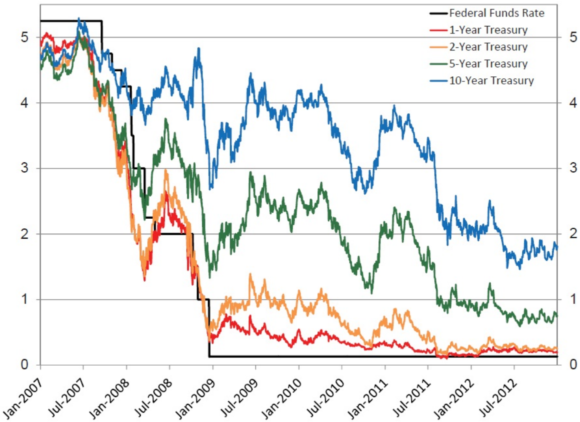


Figure 3: Fed funds rate target and 1-, 2-, 5- and 10-year zero-coupon Treasury yields. Source: Federal Reserve Board and the Gurkaynak, Sack and Wright (2007) online dataset

ZLB - inflation (and expectations?) declining

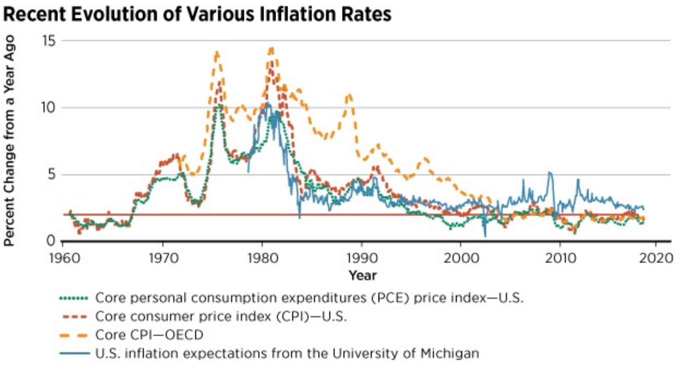


Figure 4: Declining U.S. inflation rate and expectations (red line is Fed's inflation target of 2%, Source: St. Louis Fed

ZLB - short rates constrained

To re-emphasize...

- Suppose $E_t[\pi_{t+1}] \leq \pi_{low}$
- Then real rate is constrained: $r_t \geq -\pi_{low}$ (as $i_t \geq 0$)
- Imagine $\pi_{low} = 0$ then cannot set real rate negative (which has frequently helped stimulate the economy in other recessions)

Intuitively, monetary policy remains tight when it should be loose

- CB cannot implement the responses in r_t that we discussed earlier
- Theoretical possibility of being trapped in a deflationary spiral
- Scary - scan sections of Krugman reading (up to and including 'Adding the liquidity trap')

Useful readings for this topic

- Kiley and Roberts (2017) - Some of this too difficult but read the early sections - it contains nice overviews
- Bernanke (2017, 'How big a problem...)'

Is there anything we can do?

- Yes, maybe
    - Ask the Japanese how hard it is, and the current Fed and ECB policymakers how they feel about the situation right now. . .
    - A lot of discussion of *possible* new operating frameworks for Fed (e.g. price level targeting)
    - See Bernanke (2017, 'Mon. pol. in a new era') and Yellen (2018)
- Various possibilities - a few are. . .
    - Forward guidance
    - QE
    - Fiscal expansion
    - Raise inflation target
    - Introduce price-level targeting

Forward guidance

Setting ZLB aside, recall our DIS equation from the NK lecture

$$
\begin{aligned}
\tilde{y}_t &= E_t\left[\tilde{y}_{t+1}\right] - \frac{1}{\sigma}\left(i_t - E_t\left[\pi_{t+1}\right] - r_t^n\right) \\
&= -\frac{1}{\sigma}\sum_{k=0}^{\infty} E_t[r_{t+k} - r_{t+k}^n] \\
&= -\frac{1}{\sigma}\sum_{k=0}^{\infty} E_t[i_{t+k} - (r_{t+k}^n + \pi_{t+k+1})]
\end{aligned}
$$

where we used the Fisher equation and $E_t[E_{t+k}[\pi_{t+k+1}]] = E_t[\pi_{t+k+1}]$

Current output gap reflects current and expected values of i_t, π_t r_t^n

- Assume, as *in our simple NK model*, y_t^n is independent of v_t and z_t
- If the C.B. sets *or is expected* to set i_t in a particular way then it may influence the output gap - also may be able to influence $E_t[\pi_{t+k}]$

Williams and Swanson 2013 - Long rate sensitivity to news

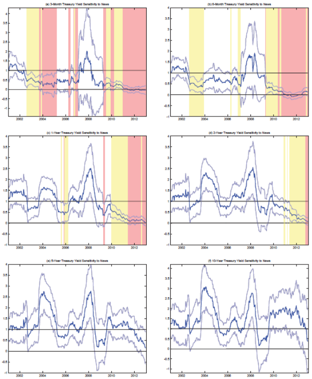


Figure 5: Sensitivity of Treasury yields to news (3-Mo, 6-Mo, 1-Y, 2-Y, 5-Y, 10-Y), Red and yellow indicate periods of insensitivitiy. Source: Swanson and Williams (2014)

Forward guidance

$$\tilde{y}_t = -\frac{1}{\sigma}\sum_{k=0}^{\infty} E_t[i_{t+k} - (r^n_{t+k} + \pi_{t+k+1})]$$

- Guidance about how rates will behave after period of ZLB can be influential if it is **credible**
- If CB can affect expectations of i_{t+j} and π_{t+j} *in the future* then can influence economy even if currently at ZLB
  - See *introductions* of papers on reading list and this classic
  - Also see here, here and here
- Some channels:
  - Many borrowing rates (e.g. mortgages) are at longer maturities and perhaps can be influenced
  - Might enhance confidence
  - Could induce depreciation in exchange rate - stimulating exports (and maybe raising inflation)
- But. . . theory is subtle/debatable

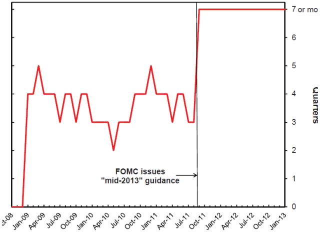


Figure 6: Effect of explicit date-based forward guidance (implemented in mid 201) on expected number of quarters until 'lift-off' from ZLB, Source: Blue Chip and Swanson and Williams (2014)

- In 2011, economic conditions, *'likely to warrant exceptionally low levels for the federal funds rate at least through mid-2013'*
- Compare with, less explicit, 'indications that rates were likely to stay low *'for some time'*

Raising (or stabilizing?) inflation expectations

Some people have suggested revisiting the Fed's interpretation of the 'price stability' aspect of its 'dual mandate'

- Fed pursues a 2% inflation target, which was asserted before people fully grasped the scale of $r^* \downarrow$
- Some people think the decline has been from 3.5% to approx $0,5\%$
- Thus, in 'steady state' the nominal rate probably now sits around $2.5\% - 3.0\%$, rather than 5.5% as previously
- Means that there is less room to cut in a recession (before hitting ZLB)

See Bernanke and Mishkin (1997) on reading list or here for more on inflation targeting

- Recall also our conventional monetary policy price stability discussion
- Due to quality improvements etc. 2.0% rather than literally 0% is interpreted as price stability

Raising (or stabilizing?) inflation expectations

One option discussed is to raise the inflation target (see chapter 1 here)

- What seems increasingly to be proposed instead is 'price level targeting'
- See Svensson (1999), Bernanke (2017) (easier) and Investopedia (easiest)

Main difference between price level and inflation targeting is that price level targeting implies a promise to adjust for past inflation misses

- Under inflation targeting: If you suffer a few periods of sub-target inflation, that doesn't change the aim to hit target inflation from today onwards
- Under price-level targeting: If you suffer a few periods of sub-target inflation, you aim for higher than target inflation until you're back on the initial price path

Raising (or stabilizing?) inflation expectations

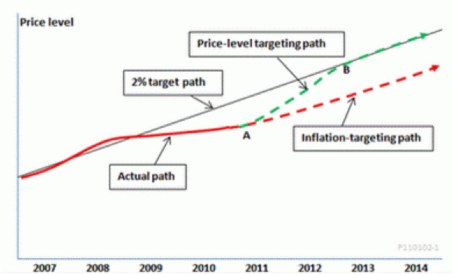


Figure 7: Price and inflation behavior under inflation targeting and price level targeting, Source: Econfix

- So? Because of ZLB we are particularly concerned with the level of inflation and even downward drift in inflation expectations
- PLT 'could' be a credible way of promising higher inflation in the near term, helping to lower real rates now, thus stimulating the economy

Quantitative Easing

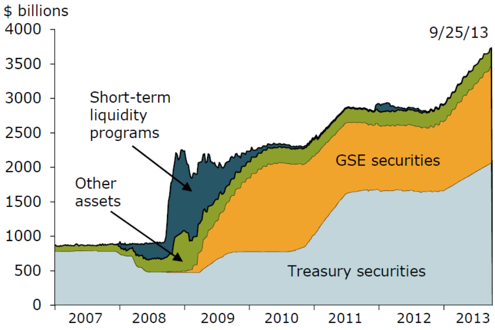


Figure 8: Federal Reserve asset holdings, Source: Federal Reserve Board.

Fed massively expanded its balance sheets to purchase assets

- Initially some liquidity programs - but most importantly QE
- Nice readable review here with good bibliography if you're interested

Quantitative Easing

QE1 (December 2008)

- \$600*bn* of agency MBS and debt - initially sterilized
- Later \$750*bn* more + \$300*bn* Treasuries - not sterilized (QE up and running)

QE2 (November 2010)

- \$600*bn* of long-dated Treasuries ($BS \uparrow$)

Quantitative Easing

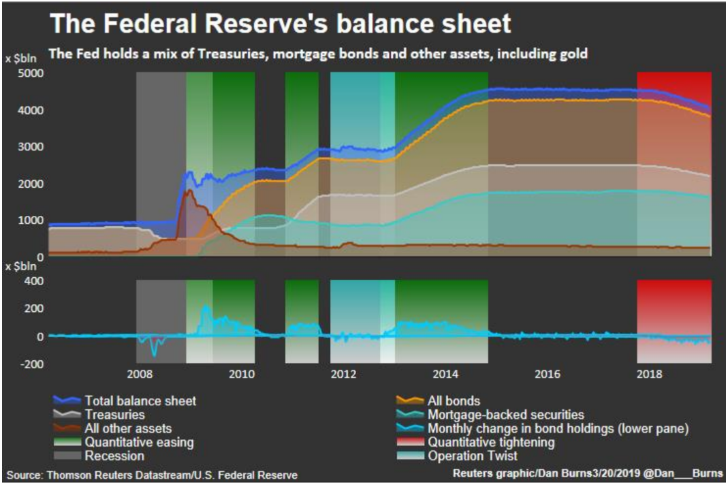
Operation Twist (2011)

- Purchase \$400*bn* bonds with maturities 6 to 30 years, using proceeds from selling bonds with maturities less than 3 years
- Limited impact on size of balance sheet - changing composition
- Lengthened average maturity and ‘removed duration’ from market
- Later extended with further \$267*bn*
- Eventually ran out of short dated to sell

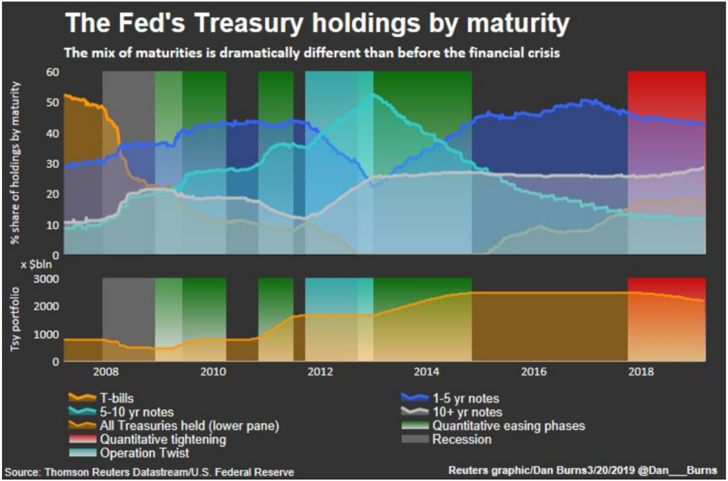
QE3 (2012)

- Open ended commitment to purchase \$40*bn* agency MBS until labor market improved
- Later added up \$45*bn* long dated Treasury purchases per month

Balance sheet decomposition - asset class



Balance sheet decomposition - maturity



Channels

Main intended channels

- Drive down long rates (similar aim to FG) - paper here if interested
- Induce substitution into other - riskier - assets (e.g. mortgages, C&I)
- Stimulate stock market (aiding wealth and confidence)
- See Gagnon papers,, D'Amico and Carpenter, plus this nice overview

Theoretical basis somewhat unclear (still)

- But empirically, rates did seem to drop - at least around impact
- VAR analysis and other approaches also suggest effect on economy

Possible additional channels

- Conveying commitment or signaling future i_t^e policy - see here
- Weakening exchange rate (though not primary aim)
- Solidifying bank balance sheets (from rising asset prices)

Stimulating risk assets? Dow Jones

Fiscal policy?

Big increase in 'G' can 'shift' the IS curve far to the 'right'

- Effectively a large demand shock that raises the r_t that should be sought by the CB
- Blasts the economy out of the ZLB

Is it that easy?

- Not necessarily
- Ricardian equivalence and expectations of future taxes (if spending is deficit financed)
- May mean a loss of confidence or leave expected effect on permanent income $\approx$ zero
- Countries already in a bad fiscal position (esp. if they've bailed out banks) may not be 'allowed' by the markets to borrow to fund spending - and raising taxes is difficult in recession

Escape Slides

An efficient benchmark

Loosely speaking, efficiency $\Rightarrow$ MRS = MRT which in this case implies

$$-\frac{U_{n,t}}{U_{c,t}} = MPN_t$$

But we know in the flex price equilibrium

$$-\frac{U_{n,t}}{U_{c,t}} \overset{HHOLD}{=} \frac{W_t}{P_t} \overset{FIRM}{=} \frac{MPN_t}{\mathcal{M}} < MPN_t$$

An efficient benchmark

Employment subsidy at rate $\tau \Rightarrow$ effective wage paid by firms is $(1-\tau)W_t$

- Then firm optimality implies

$$\frac{W_t(1-\tau)}{P_t} = \frac{MPN_t}{\mathcal{M}}$$

- So that, if τ is set to be $= \varepsilon^{-1}$ we recover

$$\frac{W_t}{P_t} = MPN_t$$

Refer back to problem set 2 where essentially the same issue was discussed thoroughly

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