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Monetary Stabilization Policy in a Low-Interest-Rate World

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 - the target for which was further decided on a **meeting-by-meeting basis**, with no commitment in advance

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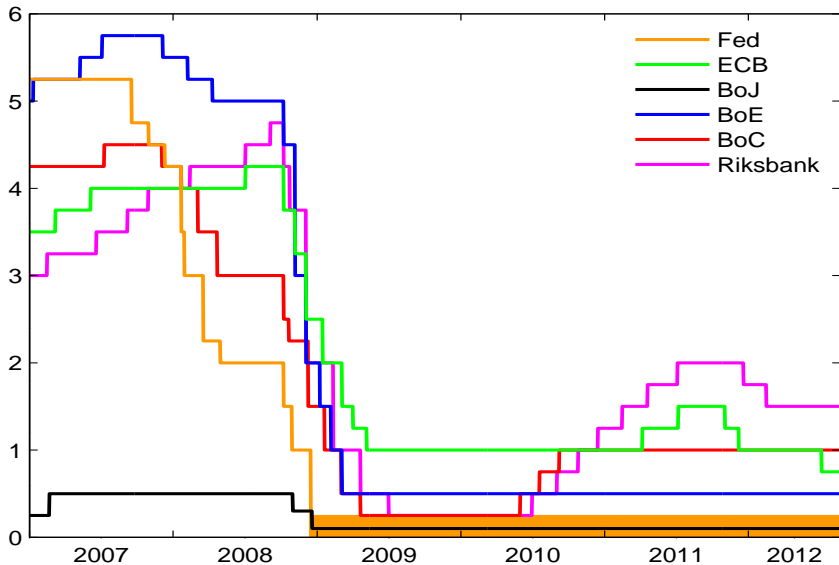
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- Discussions of **strategy** to be followed in the future were instead couched in terms of targets for **inflation**, and perhaps stabilization goals for certain real variables as well [“**flexible inflation targeting**”]
— but not interest rates or other financial conditions
- Consequences for CB **balance sheet** treated as details of implementation that need not even be discussed at policy meetings, let alone specified in advance

A New World for Monetary Policy?

- Instead, following the crisis, interest-rate policy of many CBs was constrained by a [to some extent self-imposed] **effective lower bound** on policy rates

Central-Bank Policy Rates



A New World for Monetary Policy?

- This has meant, not that policy committees had nothing to do, but that focus shifted largely to **other measures**, notably
 - balance-sheet expansion, even when not in order to implement a different interest-rate target [“quantitative easing”]
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 - balance-sheet expansion, even when not in order to implement a different interest-rate target [“**quantitative easing**”]
 - statements about future interest rates, even when current operating target unchanged [“**forward guidance**”]
- To what extent does this mean that the entire **conceptual framework** of monetary stabilization policy needs to be reconsidered, for a world in which ELB might well continue periodically to bind?

A Theory of Optimal Policy

- The general framework for the conduct of policy by many central banks before the crisis — **“flexible inflation targeting”** (Svensson and Woodford, 2005; Woodford, 2012a) — can be given a normative justification (Woodford, 2003, 2011) as optimal policy for an economy in which only important sources of inefficiency are
 - market power and tax distortions
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 - market power and tax distortions
 - distortions resulting from fact that wages and/or prices are not adjusted instantaneously in response to changing conditions
- Role of monetary policy is conceived to be the **mitigation of the distortions resulting from nominal rigidities**, by maintaining an environment in which carefully tracking constantly changing nominal aggregate demand is not necessary

A Theory of Optimal Policy

- Policy prescription at the **policy targets level**:
 - solve Ramsey policy problem, optimizing over **allocations and price paths** consistent with Calvo-style staggered price setting, and tax distortions

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 - log-linearize FOCs around optimal steady state \Rightarrow optimal **target criterion** (Benigno and Woodford, 2005):

$$\pi_t + \phi(x_t - x_{t-1}) = \bar{\pi}$$

where π_t is the inflation rate [**Dixit-Stiglitz index**], $x_t \equiv \log(Y_t/Y_t^*)$ is the “output gap,” Y_t is aggregate output [**Dixit-Stiglitz index**], Y_t^* is a welfare-theoretic concept of potential output [**function of exogenous real disturbances**], and $\bar{\pi}$ is the optimal steady-state inflation rate

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- a form of “flexible inflation target”

A Theory of Optimal Policy

- Policy prescription at the **operating target level**:
 - model-implied stochastic pricing kernel for financial assets

$$m_{t+1} = \beta \frac{\lambda(Y_{t+1}; \zeta_{t+1})}{\lambda(Y_t; \zeta_t)} \frac{P_t}{P_{t+1}}$$

determined by above solution to Ramsey problem

- determines financial conditions consistent with the Ramsey allocation; in particular, state-contingent evolution of **short-term nominal interest rate** i_t [identified with policy rate]

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- relation can be used to determine adjustments of M_t and/or i_t^{CB} needed to implement desired state-contingent evolution of i_t

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- Yet as long as the solution to the Ramsey problem above implies a nominal interest-rate process satisfying $i_t \geq \underline{i}$ at all times [as will necessarily be true with **small enough shocks**], then
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 - the question of how interest-rate target will be implemented can be ignored in choice of operating target at each policy meeting

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 - the question of how interest-rate target will be implemented can be ignored in choice of operating target at each policy meeting
- However, experience since 2008 shows that we cannot assume this!

Optimal Policy When the ELB Binds

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- Can again log-linearize these FOCs; and once again, can show that satisfaction of a **target criterion** — that involves only the price level and the output gap — is necessary and sufficient for a non-explosive solution to represent the optimal allocation

Optimal Policy When the ELB Binds

- Optimal target criterion (Eggertsson and Woodford, 2003):
 - ① the “**output-gap-adjusted price level**”

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- ③ the target level should be adjusted according to the rule

$$p_{t+1}^* - p_t^* = \bar{\pi} + \psi_1 \Delta_{t-1} - \psi_2 \Delta_{t-2}$$

where $\Delta_t \equiv p_t^* - \tilde{p}_t \geq 0$ is the **target shortfall**, and the coefficients $\psi_1 > \psi_2 > 0$ depend on model parameters.

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Optimal Policy When the ELB Binds

- However, an important difference from prescription when ELB assumed never to bind: optimal target criterion no longer can be verified simply by looking at current projections for **inflation** and **output growth**, in a history-independent way
- When the ELB temporarily binds, this fact should change the **outlook for subsequent policy** [even conditional on future fundamentals]:
 - the fact that gap-adjusted price-level target is **not allowed to decline** in response to persistent target undershoots requires that subsequent policy will target a **higher rate of nominal growth** than would otherwise be the case
 - in order to create **expectations** of looser conditions later, stimulating aggregate demand despite ELB constraint

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- When the crisis of 2008 arrived, however, and ELB was reached, there was **no reason** for the private sector to expect that, based on previous explanations of CB policy commitments
 - and simply behaving that way **later** would accomplish nothing, if it could not be **anticipated** while policy is still constrained by ELB

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- Was there anything CBs could do?

“Quantitative Easing”?

- One popular answer: a CB that finds that cutting its policy rate all the way to the ELB is still insufficient monetary stimulus should **continue to expand the monetary base** through open-market purchases, to extent necessary to achieve desired volume of aggregate nominal spending [**“quantitative easing” as a substitute for interest-rate reduction**]

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 - a policy urged upon Japan by many Western economists, when ELB reached in late 1990s
 - in its classic formulation [e.g., **Milton Friedman**], the point is increase in **monetary liabilities** of CB, not the particular type of assets acquired

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- Idea may appeal as one that allows stimulative measures to be taken **immediately** (when evident that they are needed), with no need to make commitments to do anything in **future** that may not seem desirable then

“Quantitative Easing”?

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“Quantitative Easing”?

- However, while further increases in base money are definitely **feasible** even after the supply of reserves has driven the overnight interest rate down to the rate of interest paid on reserves, there is no reason for further increases in reserve supply beyond that point to **stimulate spending**
 - once this point is reached, private-sector willingness to hold increased reserves should become **infinitely elastic**
 - increased volume of private transactions is no longer necessary in order for larger quantity of base money to be held

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- Leads to a **demand function for base money** of the form

$$\frac{M_t}{P_t} \geq L \left(Y_t, \frac{1 + i_t}{1 + i_t^{CB}} \right), \quad i_t \geq i_t^{CB}$$

where i_t^{CB} is the interest rate on central-bank balances, and at least one relation must hold with equality at any point in time

— but the first inequality **need not** be an equality, once $i_t = i_t^{CB}$

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- Remaining equations that determine equilibrium paths for $\{P_t, Y_t, i_t\}$ **also** unchanged by a change in the path of $\{M_t\}$, assuming **no change** in the reaction function that determines **interest-rate target** i_t as function of evolution of $\{P_t, Y_t\}$

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 - their result depends on assumption that monetary base is **permanently increased**
 - which implies a different interest-rate policy after ELB ceases to bind

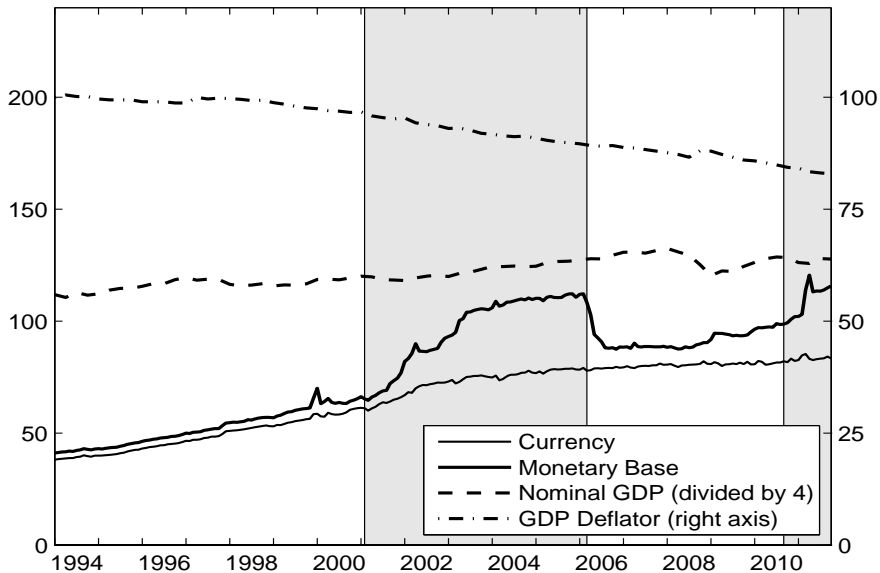
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 - their result depends on assumption that monetary base is **permanently increased**
 - which implies a different interest-rate policy after ELB ceases to bind
- In fact, the “OMO” is mathematically equivalent (in their model) to commitment to a (higher) **nominal GDP level target**

A Signalling Justification for QE?

- In practice, no reason to think that a central bank that greatly increases the supply of reserves (and hence of base money) because constrained by the ELB is intending to **permanently increase** the supply of reserves

Japan: The Original QE Experiment



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- Moreover, in the Auerbach-Obstfeld model, a permanent increase in the monetary base only amounts to a commitment to raise the implicit long-run target for nominal GDP **because zero interest is paid on CB balances**
 - if instead, the interest rate paid on reserves is increased once the ELB ceases to bind, a permanently larger supply of reserves **need not** imply any long-run stimulus to nominal demand
 - this seems to be the current intention of the Fed (Logan, 2018)

“Forward Guidance”?

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 - an approach used by the Fed, among others, in the aftermath of global financial crisis
 - statements advising that interest rates were **unlikely to be increased** above lower bound, as quickly as might otherwise have been expected

“Forward Guidance”?

- What if instead, when CB finds itself constrained by the ELB, it makes an **ad hoc announcement** about the outlook for future policy — perhaps extending years into the future — in light of the unusual circumstances? [**“forward guidance”**]
- Each such statement offered as a one-off response to a **particular situation**, rather than a commitment to any **general rule** to be followed from then on
 - nonetheless, if announcement were taken to be a **credible commitment**, and its consequences were **correctly understood**, RE analysis would imply same equilibrium response as in the RE equilibrium with a systematic history-dependent policy of kind advocated by Eggertsson-Woodford

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- Actual experiments with forward guidance have been rather different from a commitment to a price-level targeting regime (Woodford, 2012b, 2013):
 - in practice, CBs reluctant to **commit** to future policy different than would seem desirable at that time
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 - in practice, CBs reluctant to **commit** to future policy different than would seem desirable at that time
 - only offer view about what they currently anticipate that future conditions will warrant
 - date-based, rather than outcome-dependent, statements about future policy
 - this has limited CBs’ willingness to continue to be specific once change in target is near

How Much Can We Rely on People's Foresight?

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 - which one may doubt, especially in the case of a **novel** policy experiment
- We know from experimental game theory (Crawford *et al.*, 2013) that when people have to play a game for **the first time**, their ability to reason their way to Nash equilibrium play is limited, despite being told precisely what the possible actions and payoffs of all players are
 - though convergence to equilibrium play **through experience** is more reliable

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- And RE predictions depend critically on assuming that people not only believe the policy commitment, but **correctly anticipate** its future equilibrium effects
 - which one may doubt, especially in the case of a **novel** policy experiment
- We also know from experiments that people's ability to solve dynamic optimization problems through **explicit forward planning** is limited (Keramati *et al.*, 2016)
 - though again, learning from experience is possible in case of sufficiently repetitive situations

Forward Guidance in More Realistic Models

- Woodford (2018) shows how it is possible to analyze the effects of an ad hoc policy commitment while assuming that people (and firms) engage in **forward planning** only a **finite distance into the future**
 - boundedly rational strategizing of the kind used by programs to play chess or go

Forward Guidance in More Realistic Models

- Woodford (2018) shows how it is possible to analyze the effects of an ad hoc policy commitment while assuming that people (and firms) engage in **forward planning** only a **finite distance into the future**
 - boundedly rational strategizing of the kind used by programs to play chess or go
- García-Schmidt and Woodford (2015) instead assume people form complete optimal plans for **themselves**, but do not model **others** as taking into account implications of the new policy, or model others as modeling others, and so on forever
 - as in models of “level- k reasoning” in experimental game theory

Implications of Bounded Forward Planning

- In these models, a commitment to maintain looser policy in the future [understood as commitment to different policy for unchanged fundamentals, not a forecast of worse fundamentals] should still increase both output and inflation when announced — but by **less** than under the RE analysis, especially in the case of a **long-lasting** commitment [relative to the length of planning horizons]

Implications of Bounded Forward Planning

- This reason for doubting the strength of effects expected from **ad hoc forward guidance** doesn't mean that consistently conforming to a **price level targeting** regime couldn't have benefits in an ELB episode, that depend on **anticipation** of subsequent return to price-level target path

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 - effectiveness of ad hoc FG depends on people's being able to **deduce** the future effects of a newly announced (but unfamiliar) policy — an ability that may be limited
 - effectiveness of the PLT regime instead could be based on **learning from experience** that departures from PL target path are eventually corrected — likely more reliable, as long as pattern to be learned is not complex

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 - effectiveness of the PLT regime instead could be based on **learning from experience** that departures from PL target path are eventually corrected — likely more reliable, as long as pattern to be learned is not complex
 - RE analysis treats the two policies as **equivalent** — but in practice they are unlikely to be

Preparing for Future ELB Episodes

- Lesson of these analyses: should expect **ad hoc** measures adopted only after the ELB binds [**whether balance-sheet expansion or forward guidance regarding interest-rate policy**] to be of limited effectiveness

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- Lesson of these analyses: should expect **ad hoc** measures adopted only after the ELB binds [**whether balance-sheet expansion or forward guidance regarding interest-rate policy**] to be of limited effectiveness
- Adoption of a **nominal level target** during the period **before** the next ELB episode would instead make it possible for people to come to understand — through **experience** rather than **deduction** — the implications of the CB's commitment to such a regime

— and hence have expectations of a stabilizing character when the ELB again becomes a binding constraint on interest-rate policy

References

Auerbach, Alan J., and Maurice Obstfeld, “The Case for Open-Market Purchases in a Liquidity Trap,” *American Economic Review* 95: 110-137 (2005).

Benigno, Pierpaolo, and Michael Woodford, “Inflation Stabilization and Welfare: The Case of a Distorted Steady State,” *Journal of the European Economic Association* 3: 1185-1236 (2005).

Crawford, Vincent P., *et al.*, “Structural Models of Non-equilibrium Strategic Thinking: Theory, Evidence, and Applications,” *Journal of Economic Literature* 51: 5-62 (2013).

Eggertsson, Gauti B., and Michael Woodford, “The Zero Bound on Interest Rates and Optimal Monetary Policy,” *Brookings Papers on Economic Activity* 2003(1): 139-211.

References

García-Schmidt, Mariana, and Michael Woodford, “Are Low Interest Rates Deflationary? A Paradox of Perfect-Foresight Analysis,” NBER Working Paper no. 21614, October 2015.

Keramati, Mehdi, *et al.*, “Adaptive Integration of Habits into Depth-Limited Planning Defines a Habitual-Goal-Directed Spectrum,” *PNAS* 113: 12868-73 (2016).

Logan, Lorie K., “Operational Perspectives on Monetary Policy Implementation,” remarks at the Policy Conference on Currencies, Capital, and Central Bank Balances, Hoover Institution, May 4, 2018.

Svensson, Lars E.O., and Michael Woodford, “Implementing Optimal Policy Through Inflation-Forecast Targeting,” in Bernanke and Woodford, eds., *The Inflation Targeting Debate*, 2005.

References

Woodford, Michael, *Interest and Prices: Foundations of a Theory of Monetary Policy*, Princeton University Press, 2003.

Woodford, Michael, “Optimal Monetary Stabilization Policy,” in B.M. Friedman and M. Woodford, eds., *Handbook of Monetary Economics*, vol. 3B, Elsevier, 2011.

Woodford, Michael, “Forecast Targeting as a Monetary Policy Strategy: Policy Rules in Practice,” in E.F. Koenig, R. Leeson, and J.B. Taylor, eds., *The Taylor Rule and the Transformation of Monetary Policy*, Hoover Institution Press, 2012a.

Woodford, Michael, “Methods of Policy Accommodation at the Interest-Rate Lower Bound,” in *The Changing Policy Landscape*, Federal Reserve Bank of Kansas City, 2012b.

References

Woodford, Michael, “Forward Guidance by Inflation-Targeting Central Banks,” Sveriges Riksbank *Economic Review* 2013:3, pp. 81-120.

Woodford, Michael, “Monetary Analysis when Planning Horizons are Finite,” paper presented at NBER Macroeconomics Annual Conference 2018.