Managing Monetary Policy Normalization

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Motivation

- In the aftermath of the 2008 financial crisis and COVID-19 shock, central banks around the world have significantly expanded their balance sheets through quantitative easing (QE) programs, thereby increasing their liabilities (reserves), to overcome the constraint of the policy rate at the zero-lower bound.
- Normalization might require significant unwinding of such policies with a consequent reduction in reserves: quantitative tightening (QT).
- Not much is known on the pace and timing of QT in combination with the zero-lower bound and liftoff of the policy rate.
- This paper studies an economy in a liquidity trap, in which reserves are a relevant tool of policy, to characterize the managing of QE and QT together with interest-rate policies.

Results

- Under optimal policy, reserves should increase lately in a liquidity trap, pick up before the liftoff of the policy rate and then be withdrawn at a slow pace.
- Higher spreads in money markets justify a larger QE stimulus.
- More concern for output stabilization asks for a larger QE and a faster QT.

A general framework for monetary policy analysis

- Neo-Wicksellian New-Keynesian framework: central bank can control inflation and output by just using one tool – the policy rate (interest rate on reserves) $\Longrightarrow$ Reserves are irrelevant for inflation and output.
- The more general framework of this paper, which nests the Neo-Wicksellian paradigm, gives an independent role to reserves as a tool for controlling inflation and output.
- Key features of the transmission mechanism:
  1. Consumption/saving choices depend on the **interest rate on illiquid assets**
  2. Household's **demand of liquid assets** depends on the **liquidity spread** between **interest rate on liquid and illiquid securities.**
  3. **Supply of liquid assets** by intermediaries is backed by **reserves** and determines **the interest rate on liquid asset** together with the **interest rate on reserves**.
  4. The central bank controls **interest rate on reserves** and **quantity of reserves**.

Transmission mechanism

- Consumption/saving choices are directly influenced by the "natural nominal rate of interest" i_t^B:

$$U_c(C_t) = \beta \frac{(1 + i_t^B)}{\Pi_{t+1}} U_c(C_{t+1}).$$

- Demand of liquid securities depends on liquidity premium

$$V_q\left(\frac{Q_t}{P_t}\right) = \frac{i_t^B - i_t^D}{1 + i_t^B}$$

- Banking model implies that the deposit rate is a weighted average of natural nominal rate of interest and policy rate:

$$(1 + i_t^D) = (1 - \rho)(1 + i_t^B) + \rho(1 + i_t^R).$$

- Natural nominal rate of interest can be controlled by supply of liquidity and interest rate on reserves

$$(1 + i_t^B) = \frac{\rho}{\rho - V_q\left(Q_t/P_t\right)}(1 + i_t^R).$$

Literature review

- Canzoneri et al. (2008, 2017) discuss the disconnection between the policy rate and the rate influencing consumption/saving choices.
- Benigno and Nistico (2017), Piazzesi and Schneider (2020), Diba and Loisel (2020, 2021) are models discussing the possible relevance of two tools: interest rate on reserves and quantity of reserves.
- Literature nesting banking models into NK framework (e.g. Curdia and Woodford, 2010, 2011).
- Literature on optimal monetary and fiscal policy in a liquidity trap (Eggertsson and Woodford (2003,2004), Werning (2011))

Banking model

- Intermediaries live for two periods and are subject to limited liabilities.
- Balance sheet at time t :

$$R_t + A_t = D_t + N_t,$$

and collateral/regulatory requirement

$$R_t \geq \rho D_t, \qquad \text{with } 0 \leq \rho \leq 1.$$

- Profits at time $t + 1$

$$\Psi_{t+1} = (1 + i_t^B)A_t + (1 + i_t^R)R_t - (1 + i_t^D)D_t.$$

- Subject to limited liability constraint

$$\Psi_{t+1} \geq 0.$$

Banking Model

- Intermediaries maximize rents $E_t(R_{t,t+1}\Psi_{t+1}) - N_t$, subject to $\Psi_{t+1} \geq 0$ and $R_t \geq \rho D_t$. Optimality conditions imply:
- Money-market rates:

$$(1 + i_t^D) = \rho(1 + i_t^R) + (1 - \rho)(1 + i_t^B).$$

- Demand of equity:

$$N_t \geq 0.$$

- Neo-Wicksellian framework nested when:
  1. $R_t > \rho D_t$, $i_t^B = i_t^R = i_t^D$;
  2. $\rho = 0$, $i_t^B = i_t^D$ and $i_t^B = i_t^R$ if $R_t > 0$;
  3. not nested when $\rho = 1$, $i_t^D = i_t^R$ but $i_t^R < i_t^B$.

- They get utility from consumption and **liquidity services**: B_t^h, treasury's notes, D_t, deposit, at rate i_t^D. Can borrow/lend in illiquid private securities: B_t at the rate i_t^B.
- Optimality conditions:

$$\frac{1}{1+i_t^B} = E_t\left\{\beta \frac{U_c(C_{t+1})}{U_c(C_t)} \frac{P_t}{P_{t+1}}\right\},$$

$$\frac{V_q\left(\frac{D_t+B_t^h}{P_t}\right)}{U_c(C_t)} = \frac{i_t^B - i_t^D}{1+i_t^B}.$$

- They supply labor.

Firms and governments

- Firms produce output goods using labor and are subject to price rigidities as in the Calvo's model.
- Treasury and central bank issue treasury's notes and reserves through an integrated budget constraint

$$B_t^h + R_t = (1 + i_{t-1}^D)B_{t-1}^h + (1 + i_{t-1}^R)R_{t-1} - T_t.$$

- Tax/debt policy is critical **both** for price determination and for the relevance of reserve policies.

Model

- AS equation as in the NK model

$$\pi_t - \pi = \kappa\left(\hat{Y}_t - \tilde{Y}_t\right) + \beta E_t(\pi_{t+1} - \pi).$$

- AD block given by:

$$\hat{Y}_t = E_t\hat{Y}_{t+1} - \sigma(\hat{\imath}_t^B - E_t(\pi_{t+1} - \pi) - r_t^n),$$

$$\hat{q}_t = q_y\hat{Y}_t - q_i(\hat{\imath}_t^B - \hat{\imath}_t^D).$$

$$\hat{\imath}_t^B = \hat{\imath}_t^R + \frac{1-\nu}{\rho-\nu}(\hat{\imath}_t^B - \hat{\imath}_t^D),$$

- Note $v = 0$, full satiation of liquidity $\hat{\imath}_t^B = \hat{\imath}_t^D = \hat{\imath}_t^R$.
- AD block implies

$$\hat{Y}_t = (1-\rho^{-1}v)E_t\hat{Y}_{t+1} - \sigma(1-\rho^{-1}v)(\hat{\imath}_t^R - E_t(\pi_{t+1}-\pi) - r_t^n) + q_y^{-1}\rho^{-1}v\hat{q}_t.$$

- When $v > 0$, aggregate liquidity ($\hat{q}_t$) matters.

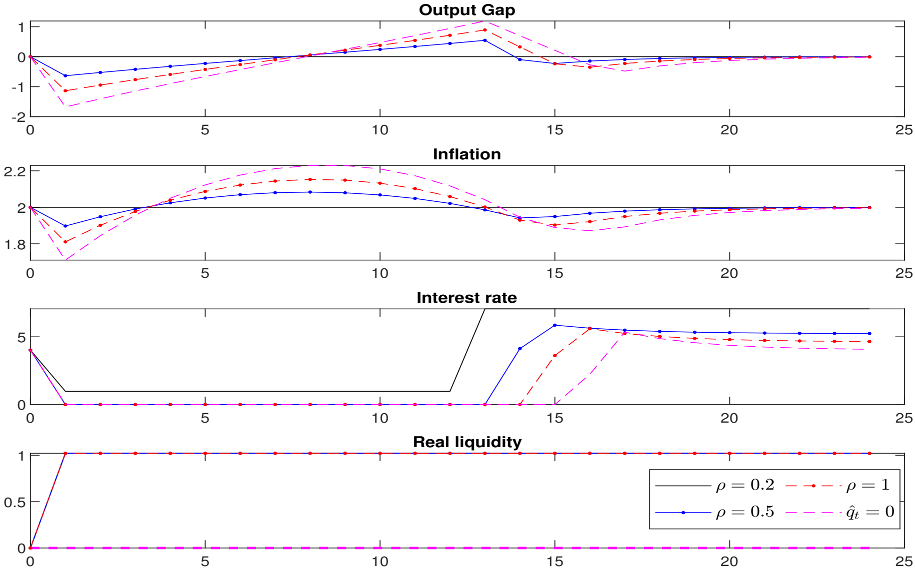
Optimal monetary policy when lump-sum taxes available

- The approximated quadratic loss function is:

$$E_{t_0}\left\{\sum_{t=t_0}^{+\infty}\beta^{t-t_0}\left[\frac{1}{2}\hat{Y}_t^2+\frac{1}{2}\frac{\theta}{\kappa}(\pi_t-\pi)^2+\frac{1}{2}\mu\left(\hat{q}_t-q^*\right)^2\right]\right\}, \tag{1}$$

- Approximation is around a steady-state in which liquidity is close to the full, optimal, satiation level. Therefore, when $\hat{q}_t = q^*$ satiation is reached.
- There is no trade-off: optimal liquidity policy is to reach satiation independently of the zero-lower bound, $\hat{q}_t = q^*$.
- Therefore, optimal policy in a liquidity trap does not change with respect to NK model unless liquidity is not set optimally, in which case an increase in liquidity lowers the stay at the zero lower bound. (caveat: separable utility between consumption and liquidity).

Optimal monetary and liquidity policy with lump-sum taxes



Optimal policy with distortionary taxation

- Assumption: $\rho = 1$ implying $D_t \leq R_t$, reserves fully backed by deposits, $i_t^R = i_t^D$.
- Intertemporal resource constraint of the economy implies that

$$\frac{(1 + i_{t-1}^R)}{\Pi_t} q_{t-1} = E_t \sum_{T=t}^{\infty} R_{t,T} \left[(\tau_T Y_T - Tr_T) + \frac{i_T^B - i_T^R}{1 + i_T^B} q_T \right], \quad (2)$$

in which $q_t = (R_t + B_t^h)/P_t$ includes treasury's debt and central bank's reserves.

- Optimal steady-state liquidity policy does not imply full satiation:

$$V_q(q) = -\frac{\phi_q}{1 + \phi_q} (V_{qq}(q) q) \quad (3)$$

in which ϕ_q is a non-negative Lagrange multiplier associated to the constraint (2) and $V(q)$ is the utility from liquidity services.

Optimal policy with distortionary taxation

Minimize loss function:

$$L_{t_0} = E_{t_0} \sum_{t=t_0}^{\infty} \beta^{t-t_0} \left\{ \frac{1}{2}\lambda_y y_t^2 + \frac{1}{2}\lambda_\pi(\pi_t - \pi)^2 + \frac{1}{2}\lambda_q \hat{q}_t^2 \right\}$$

$$(\pi_t - \pi) = \kappa[y_t + \psi(\tilde{\tau}_t - \tilde{\tau}_t^*)] + \beta E_t(\pi_{t+1} - \pi), \tag{4}$$

$$y_t = (1 - v)E_t y_{t+1} - \sigma(1 - v)(\hat{\imath}_t^R - E_t(\pi_{t+1} - \pi) - r_t^n) + \sigma\sigma_q^{-1} v \hat{q}_t, \tag{5}$$

$$\hat{q}_{t-1} - (\pi_t - \pi) - \sigma^{-1} y_t + (\hat{\imath}_{t-1}^R - r_{t-1}^n) = -f_t + E_t \sum_{T=t}^{\infty} \beta^{T-t}[b_y y_t + b_\tau(\tilde{\tau}_t - \tilde{\tau}_t^*) + b_q \hat{q}_t]. \tag{6}$$

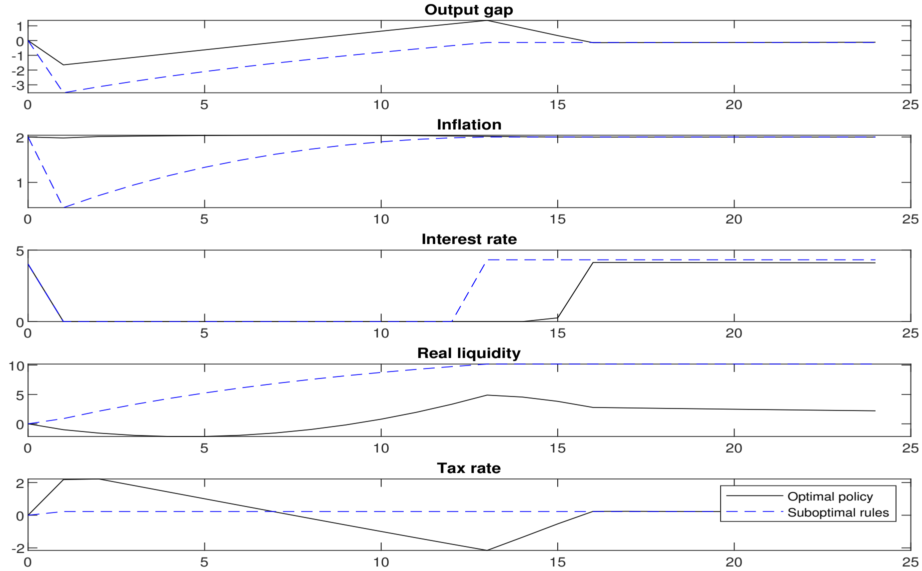
- f captures the “fiscal stress,” : full stabilization of output, inflation and liquidity at their targets is not compatible with the IBCG.

Optimal policy with distortionary taxation

Comparison with sub-optimal policy in which:

1. the central bank sets inflation at the target, i.e. $\pi_t = \pi$, whenever it is feasible, otherwise it sets the policy rate to zero and
2. the fiscal authority keeps the tax gap $\tilde{\tau}_t - \tilde{\tau}_t^*$ at a level that it expects to maintain indefinitely without violating the intertemporal government budget constraint; that is, an expected path of the tax gap such that $E_t(\tilde{\tau}_T - \tilde{\tau}_T^*) = \tilde{\tau}_t - \tilde{\tau}_t^*$ for all $T \geq t$ is consistent with IBCG.

Benchmark calibration



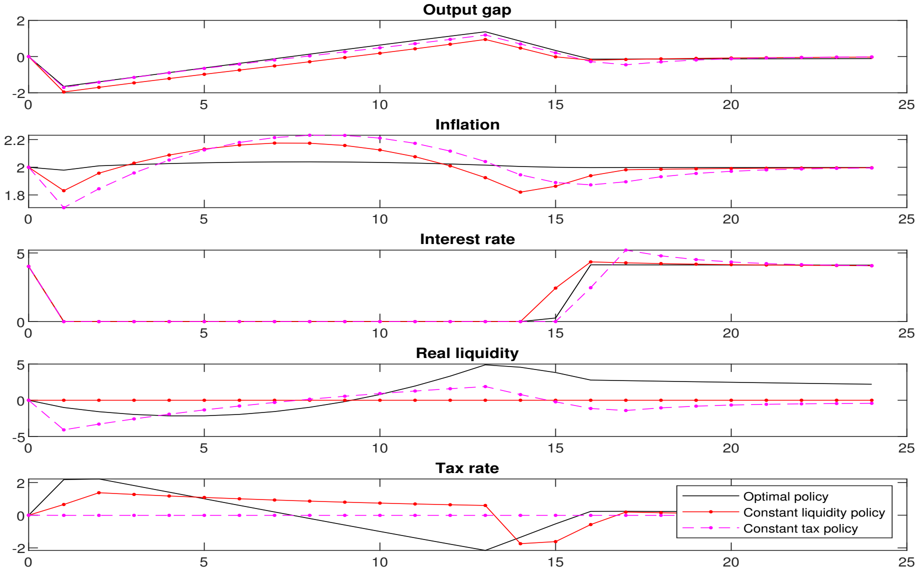
The role of liquidity and tax policy

Comparison with:

- Constant tax policy:
  1. the fiscal authority moves the tax gap $\tilde{\tau}_t - \tilde{\tau}_t^*$ in a way that it expects to maintain it in the future, i.e. $E_t(\tilde{\tau}_T - \tilde{\tau}_T^*) = \tilde{\tau}_t - \tilde{\tau}_t^*$ for all $T \geq t$ and consistently with the intertemporal budget constraint (6).
  2. the monetary authority minimize the loss function taking as given the tax policy.

- Constant liquidity policy:
  1. fiscal policy moves the tax gap to fully stabilize liquidity at the steady state
  2. the monetary authority minimizes the loss function (15) under the same constraints as in the general optimal policy problem, but considering as given the path of the fiscal variables $\tilde{\tau} - \tilde{\tau}^*$ and the fact that the intertemporal solvency of the government is ensured by the tax policy.

The role of liquidity and tax policy

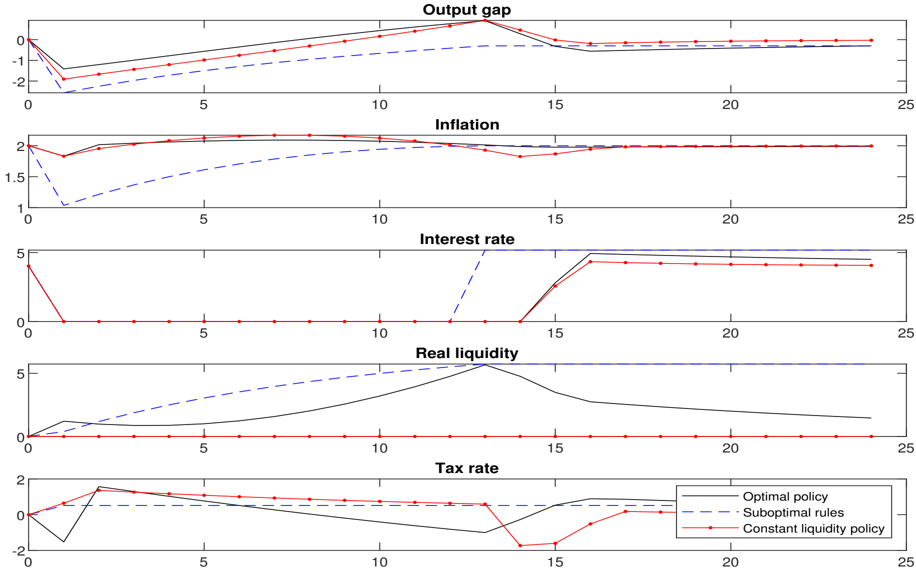


Larger money-market spread

$$y_t = (1 - v)E_t y_{t+1} - \sigma(1 - v)(\hat{\imath}_t^R - E_t(\pi_{t+1} - \pi) - r_t^n) + \sigma\sigma_q^{-1} v \hat{q}_t, \quad (7)$$

- a one-percent once-and-for-all increase in liquidity raises output, everything else being equal, by $\sigma\sigma_q^{-1} v$ percentage points. Since $\sigma = 0.5$, $\sigma_q = 0.2$ and $v = 0.0015$, it corresponds to an increase of output of just 0.00375 percentage points.
- we consider now a 4% spread, more in line with what observed at the onset of the 2007-2008 financial crisis through several indicators in money markets.

Larger money-market spread

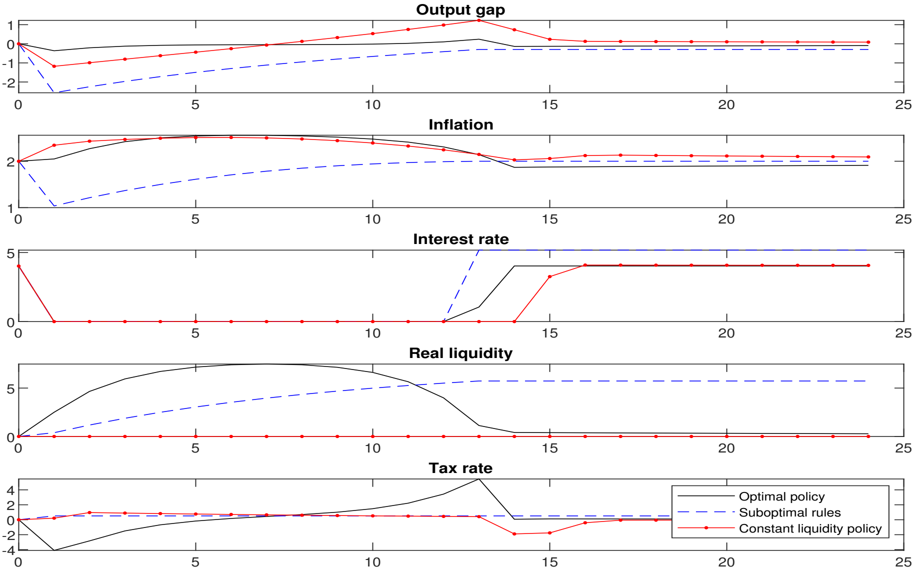


Higher weight on output-gap stabilization

- Our calibration implies a high costs of inflation stabilization with the ratio λ_y/λ_π taking a value of 0.0021. Indeed, in all Figures optimal policy is geared towards stabilizing inflation at the target rather than closing the output gap.

- Consider now an extreme case in which the ratio λ_q/λ_π is fifty times higher than the one calibrated in Figure 21, maintaining a higher value for v.

Higher weight on output-gap stabilization



Conclusions

- General framework to understand the effectiveness of reserves as an additional tool for monetary policymaking. Neo-Wicksellian framework is nested under special conditions.
- Interest rate, reserves and tax policy interact to determine inflation and output.
- It provides some direction to understand the size, pace and timing of QE and QT during liquidity traps.