Monetary Economics: Macro Aspects, 26/4 2004
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Plan for today:

(first part based on last part of April 19 slides)

1. Optimal monetary policy under discretion:
   Credibility problems and "Rogoff-conservatism"
2. Optimal monetary policy under commitment: Policy inertia
3. Practical implications and extensions

Literature Clarida et al. (1999, *Journal of Economic Literature*, 1675-1707; incl. Appendix). As supplementary reading, I recommend Woodford (1999, see link on course web page)

Introductory remarks

- **Discretionary** solution in simple "New Keynesian" model is **suboptimal**
- With forward-looking variables: differences between ex ante and ex post optimal policies
- In new type of models, the commitment policies — the ex ante optimal policies — have interesting features
  - Features that confirm results from early credibility literature (Barro and Gordon)
  - Features that are new, and which requires new thinking about the optimal strategy for monetary policymaking
- "Resurrection" of the conservative central banker — for completely **new reasons**

- Finally, main implications of simple model:
  - Carries over into more realistic extensions....
  - ....and/or confirm previous findings concerning, e.g., intermediate targeting and choice of monetary policy instrument

Credibility problems and "Rogoff-conservatism"

- With forward-looking variables, credibility of monetary policy becomes important
- Immediately evident if per-period loss function takes the form:

$$-\frac{\alpha}{2}(x_t - k)^2 - \frac{1}{2}\pi_t^2, \quad k > 0$$

- I.e., the natural rate of output is not the target, but due to monopolistic competition, $z_t + k$ is target output (remember, $x_t = y_t - z_t$)
- $k > 0$ represents the output loss due to imperfect competition
- Under discretion, optimal policy will lead to

$$x_t = -\lambda \frac{1}{\lambda^2 + \alpha(1-\beta\rho)} u_t \tag{4.3'}$$

$$\pi_t = \frac{\alpha}{\lambda} k + \alpha \frac{1}{\lambda^2 + \alpha(1-\beta\rho)} u_t \tag{4.4'}$$

- I.e., **same** as previous outcomes, **but** now a Barro-Gordon-style **inflation bias** is present
- Same explanation as in standard Barro-Gordon model
- A Rogoff-conservative central banker, with utility function $\alpha^c < \alpha$, can be improvement

- Important insight highlighted by New-Keynesian literature:
  - **Even when $k = 0$, there can be gains from commitment**, and gains from appointing a conservative central banker
- Intuitive idea:
  - With forward-looking inflation expectations, a policy affecting inflation expectations appropriately, can help stabilize current inflation
  - If $u_t > 0$, a **commitment to fight future inflation**, reduces inflation expectations and therefore current inflation
  - A smaller current output contraction can then attain a higher reduction in current inflation
  - Commitment **improves the inflation-output gap trade off**
  - Hence, **conservatism** (=commitment to fight future inflation) **can improve shock stabilization**
  - Contrast with Barro-Gordon model, where conservatism *distorted* shock stabilization

Example of policy commitment

- Example to highlight the stabilization gains from commitment
- NOTE: **Not** the unrestricted optimal commitment policy
  - Instead, a commitment policy that highlights the credibility problems in a simple manner
  - ...and highlights the improvement in the inflation-output gap trade off through commitment
- Assume again for simplicity that output gap is policy instrument
- Commitment is to policy rule of form

$$x_t^c = -\omega u_t \tag{4.5}$$

(nominal interest rate will follow from IS-equation when inflation is solved for); $\omega > 0$ is to be chosen optimally

- Inflation follows from the Phillips curve:

$$\begin{aligned} \pi_t^c &= \beta \mathrm{E}_t \pi_{t+1}^c + \lambda x_t^c + u_t \\ &= \beta \mathrm{E}_t \pi_{t+1}^c - \lambda \omega u_t + u_t \end{aligned} \tag{0.1}$$

- Solving forward:

$$\begin{aligned} \pi_t^c &= \mathrm{E}_t \sum_{i=0}^{\infty} \beta^i \left[-\lambda \omega u_{t+i} + u_{t+i} \right] \\ &= \frac{1 - \lambda\omega}{1 - \beta\rho} u_t \end{aligned} \tag{4.9}$$

- The improved inflation-output gap trade-off is now evident
- Solution for inflation can be expressed as

$$\pi_t^c = \frac{\lambda}{1-\beta\rho} x_t^c + \frac{1}{1-\beta\rho} u_t$$

- Note:

$$\frac{\mathrm{d}\pi_t^c}{\mathrm{d}x_t^c} = \frac{\lambda}{1-\beta\rho}$$

- Under discretion, $\pi_t = \beta \mathrm{E}_t \pi_{t+1} + \lambda x_t + u_t$, and $\mathrm{E}_t \pi_{t+1}$ is taken as given; hence:

$$\frac{\mathrm{d}\pi_t^d}{\mathrm{d}x_t^d} = \lambda$$

- Result:

$$\frac{\mathrm{d}\pi_t^c}{\mathrm{d}x_t^c} > \frac{\mathrm{d}\pi_t^d}{\mathrm{d}x_t^d}$$

  A given change in the output gap has **larger impact on inflation under commitment**

- Implication: a given inflation reduction can be achieved at a smaller output loss
- Intuition: Under commitment, expected future inflation is affected => **larger impact on current inflation**

- What is optimal value of ω?
- Solves

$$\max_{\omega} -\mathrm{E}_t \frac{1}{2} \sum_{i=0}^{\infty} \beta^i \left[\alpha \left(x_{t+i}^c \right)^2 + \left(\pi_{t+i}^c \right)^2 \right]$$

- Since both x_{t+i}^c and π_{t+i}^c are proportional to the exogenous cost-push shock, the optimal ω solves simply

$$\max_{\omega} -\frac{1}{2} \left[\alpha \left(x_t^c \right)^2 + \left(\pi_t^c \right)^2 \right]$$

subject to

$$\pi_t^c = \frac{\lambda}{1-\beta\rho} x_t^c + \frac{1}{1-\beta\rho} u_t$$

- I.e., find

$$\max_{\omega} -\frac{1}{2} \left[\alpha \left(-\omega u_t \right)^2 + \left(\frac{1-\lambda\omega}{1-\beta\rho} u_t \right)^2 \right]$$

- First-order condition:

$$-\alpha\omega u_t^2 + \frac{1-\lambda\omega}{1-\beta\rho} u_t^2 \frac{\lambda}{1-\beta\rho} = 0$$

- Alternatively

$$\alpha x_t^c + \frac{\lambda}{1-\beta\rho} \pi_t^c = 0$$

$$-\alpha^c x_t^c = \lambda \pi_t^c, \qquad \alpha^c \equiv \alpha \left(1-\beta\rho \right) < \alpha$$

- Remember first-order condition under discretion:

$$-\alpha x_t = \lambda \pi_t$$

Precise same form, but under the commitment policy $\alpha^c < \alpha$; i.e., **Rogoff conservatism is beneficial**

- Example of benefits from commitment
- By committing to being "tough" on inflation in the future, the inflation-output gap trade-off is improved
- But will this be credible? When the "future arrives," the central bank has incentive to act according to

$$-\alpha x_t = \lambda \pi_t$$

Hence, if this is believed by the private sector, expectations will not serve a role a an inflation stabilizing mechanism

- So, the commitment policy is time-inconsistent
- Appointing a conservative central banker could be remedy to (partially) resolve credibility problems
  - Just as in Barro and Gordon model, but for **very different reasons**

- Example shows credibility issues in monetary policy, even when the target value of output is the natural rate
- No average inflation bias, but a "stabilization bias" arises under discretionary policymaking

Characterization of the full commitment solution

- Previous example considered commitment to a particular form of policy rule ($x_t = -\omega u_t$)
- Not the fully optimal commitment solution (but a "constrained optimum")
- The "unconstrained" commitment solution has very interesting features
- Problem: find sequence of output gap and inflation that maximizes utility
- Technique: Set up the Lagrange function:

$$\begin{aligned}\mathcal{L} &= -\frac{1}{2}\mathrm{E}_t\left\{\sum_{i=0}^{\infty}\beta^i\left[\alpha x_{t+i}^2 + \pi_{t+i}^2\right.\right. \\ &\quad \left.\left.+2\phi_{t+i}\left(\pi_{t+i} - \beta\pi_{t+1+i} - \lambda x_{t+i} - u_{t+i}\right)\right]\right\}\end{aligned} \qquad (4.17')$$

  where $2\phi_{t+i}$ is the multiplier on the Phillips curve (we do not need the IS-curve as the nominal interest rate can be adjusted freely)

- First-order conditions

$$\alpha x_{t+i} - \lambda\phi_{t+i} = 0$$

$$\begin{aligned}\pi_{t+i} + \phi_{t+i} - \phi_{t+i-1} &= 0, \quad i > 0 \\ \pi_t + \phi_t &= 0,\end{aligned}$$

- Combined:

$$\begin{aligned}-\alpha\left(x_{t+i} - x_{t+i-1}\right) &= \lambda\pi_{t+i}, \quad i > 0 \\ -\alpha x_t &= \lambda\pi_t\end{aligned}$$

- Central implication: Commitment policy involves (for $i > 0$)

$$\pi_{t+i} = -\frac{\alpha}{\lambda}\left(x_{t+i} - x_{t+i-1}\right) \qquad (4.18')$$

- Hence, inflation and output gap exhibit **history dependence**
- Also, known as **policy inertia**
- Again, the optimality of this arises from the fact that it will affect inflation expectations, and improve the inflation-output gap trade-off
- Intuition: Consider the case of $\rho = 0$ (only temporary inflation shocks)
  - If $u_t > 0$, inflation rises, and optimal policy is contractive
  - With **policy inertia**, **next-period policy will also be contractive**
    - => Next-period inflation is dampened
    - => Current inflation expectations are dampened
    - => Current inflation is reduced
  - Thus a **mild**, but **prolonged** contraction provides better inflation stabilization

- Generally, policy inertia improves predictability of future policy, and current variables are easier to affect by smaller current policy adjustments
- Through policy inertia, the central bank is "letting the market do some of the stabilization"

- Note again the inherent credibility problem of the commitment solution:
  - When the temporary cost-push shock has “worn out,” it is no longer optimal to contract policy
  - Typical difference between ex ante and ex post optimality (the standard time-inconsistency of commitment)
  - But if one cannot commit, one doesn’t reap the gains in terms of better stabilization performance
  - Hence, **institutional frameworks securing commitment policy** is desirable

Practical implications and extensions of simple model

- Main implications of the simple model, carry over to more richer and realistic extensions of the model

- Imperfect information about current shocks
  - Real world: Shocks g_t and u_t are not observed at the time of policy implementation
  - First-order condition for optimal policy (here discretion for simplicity) become one in expected terms:

$$-\alpha \mathrm{E}\left[x_t|\Omega_t\right] = \lambda \mathrm{E}\left[\pi_t|\Omega_t\right] \tag{5.1}$$

  - Solution the same as under perfect information, except for forecast errors
    - Note that forecast errors about g_t causes positive correlation between x_t and π_t (but fundamental-driven; not result of indeterminacy)
  - Scope for intermediate targeting, if intermediate targets exist that are
    - Readily observable
    - Correlated with goal variables

- Instrument choice problem
  - Imperfect information about shocks raises the issue about optimal operating procedure
  - Complete analogous to Poole (1970)
  - If model is extended with money market equilibrium and money demand shocks,
    - Interest targeting procedure is optimal if money demand shocks are predominant (and if money demand is rather interest rate insensitive)

- Parameter uncertainty
  - Uncertainty about the structural parameters of the economy
  - I.e., what is the true value of, e.g., φ?
  - Classic paper by Brainard (1967, *Am. Ec. Rev.*) showed that such uncertainty called for "cautious" central bank behavior
    - Arises from the central bank's risk aversion: The loss from something going "wrong" by a policy choice is higher than the gain from when it is going "good"
  - Evident to some extent by central banks' reluctance to move the nominal interest rate in large steps

- Endogenous output and inflation persistence
  - Empirically, it is hard to reject that
    - Output and consumption depend on their own past values
    - Inflation depends on its own past value
  - Controversial, how strong this endogenous output and inflation persistence is
  - Introduction of such realistic persistence, does not affect qualitatively the results found in simple model
  - Output persistence is immaterial if effects of lagged output can be neutralized by the nominal interst rate
    - If interest variability is costless, output persistence may be unimportant
  - Inflation persistence, however, plays a crucial role:
    - Induces **worse** policy trade-off (current inflation is less "controllable") (more output costs of mitigating u_t shocks)
    - The "leaning against the wind" policy, however, is still optimal
    - All things equal, the convergence towards steady state will take longer time

- Transmission lags
  - Realistically, the nominal interest rate does no affect demand and inflation "simultaneously" as in simple model
  - Consensus. Demand is affected first, but with some lag; then inflation is affected by a further lag through the Phillips curve
  - With one-period lags, this changes the optimality condition to

$$-\alpha \mathrm{E}_t x_{t+1} = \lambda \mathrm{E}_t \pi_{t+2} \qquad (6.7)$$

  - Not much is qualitatively changed by this alteration; except that one can express the equilibrium nominal interest rate as a function of current output gap and one-period ahead inflation expectations; i.e., as a forward-looking Taylor rule
  - Note that g_t shocks create a positive correlation between x_t and π_t

Plan for next lecture

Wednesday, April 28, 12-14

1. Delegation solutions to credibility problems in the "New Keynesian" model of monetary policy analysis

2. Nominal income growth targeting and other approaches

Literature: Jensen (2002, *American Economic Review*).