Monetary Policy Frameworks and Real Equilibrium Determinacy

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- Sargent and Wallace (1975): Interest rate pegs cause price-level indeterminacy under rational expectations
- Huge subsequent body of research on how to design (interest rate) policy to secure determinacy (to avoid sunspot fluctuations)
- Evident in recent strand of literature within the "New Neo-Classical Synthesis" (Goodfriend and King, 1997) models

- These models feature:
  - Micro-founded, optimizing private sector behavior
  - Sticky prices
- Issue typical one of attaining *real* determinacy (unique, fundamental-based, "anchored" outcomes for, e.g., inflation and output)
- How to achieve this?
  - How do one model monetary policymaking?
- Essentially two frameworks proposed/analyzed in literature:
  - "Targeting rules" (an optimizing central bank)
  - "Instrument rules" (a bank following a fixed decision scheme)

- Purpose of paper: Examination of these frameworks in terms of their stability properties within simple model in "synthesis" paradigm
- Main result:
  - Targeting rules do well in terms of securing determinacy
  - Instrument rules must be restricted (well known)
- Main intuition: Targeting rules circumvent a problem with instrument rules:
  - They are vulnerable to a "reverse Lucas critique"
  - ....while targeting rules are not
- By-product of analysis: Estimated interest rate functions may tell little about stability properties

Agenda of talk

1. The simple model
2. An on-going dispute about proper modelling of monetary policy frameworks: Targeting rules versus Instrument rules
3. Indeterminacy problems when the nominal interest rate is the policy instrument — economic outcomes may not be "anchored" under instrument rules
4. Determinacy under targeting rules — economic outcomes are "anchored"
5. Estimations of interest rate rules when the central bank operates under a targeting rule: Do they say anything (about determinacy)?
6. Conclusions

1. The simple model

- Micro-founded behavioral equations (e.g., consumption decisions, investment decisions, pricing decisions, made by clever, forward-looking and optimizing individuals)

=> Some immunity against Lucas critique

- Simplest version of "synthesis model"

$$x_t = \mathrm{E}_t x_{t+1} - \sigma\left(i_t - \mathrm{E}_t \pi_{t+1}\right) + \mu_t, \quad \sigma > 0, \qquad \text{("IS curve")}$$

$$\pi_t = \mathrm{E}_t \pi_{t+1} + \kappa x_t + \varepsilon_t, \quad \kappa > 0. \qquad \text{("Phillips curve")}$$

- Nominal interest rate (i_t) $\rightarrow$ demand and output $\rightarrow$ inflation

- "Welfare" represented by loss function:

$$L = \mathrm{E}_0 \sum_{t=1}^{\infty} \beta^{t-1} \left[\lambda x_t^2 + \pi_t^2\right], \quad \lambda > 0,$$

(optimal levels of inflation and output gap normalized to zero).

2. Targeting rules versus Instrument rules

- Two different approaches to modelling monetary policymaking in terms of how it is/was conducted (descriptive) or how it should be conducted (prescriptive)
- "Targeting rules" (see Rogoff 1985, Svensson 1999, 2001b, Walsh 1998)
  - The central bank minimizes some loss function, i.e., it optimizes (like the rest of the people in the economy)
  - In simple example this is modelled as: Minimize L
    subject to (IS curve) and (Phillips curve)
  - Resulting RE solution follows from model equations and optimality condition(s); a TRE (**T**argeting **R**ule **E**quilibrium)

- "Instrument rules" (Taylor, 1993; McCallum, 1999; Woodford, 1999)
  - The central bank follows a fixed rule that defines the response of the policy instrument (i_t) to various variables
  - In this model, it could be a Taylor rule:

$$i_t = b\pi_t + ax_t, \quad b > 0, \quad a > 0,$$

  - or a forward-looking Taylor rule:

$$i_t = b\mathrm{E}_t\pi_{t+1} + ax_t,$$

  - Resulting RE solution follows from model equations and the adopted instrument rule; an IRE (**I**nstrument **R**ule **E**quilibrium)
- Pros and cons with both approaches (see Svensson, 2001b)
- Here: What are the stability properties of either approach?

3. Indeterminacy problems when the nominal interest rate is the policy instrument

- In this model, consider simple instrument rule: $i_t = \bar{i}$.
  => Indeterminacy. Why?
  - For some reason (a sunspot is observed at Palomar Observatory), assume inflation expectations go up
  - The real interest rate will fall, stimulating demand (thus the output gap) and actual inflation (by *more* than the increase in inflation exp.)
  - Demand and inflation return over time to long-run equilibrium
  - "Well behaved" scenario with self-fulfilling expectations leading to *inefficient* increases in inflation and output gap
  - ...just because they were expected to increase...

- Determinacy *can* be attained with instrument rules:
- In example with simple forward-looking Taylor rule, $i_t = b\mathrm{E}_t\pi_{t+1}$ by proper design of b:
  - Coefficient on expected inflation should be larger than one, i.e., $b > 1$ — reflecting the "Taylor principle"
  - Assume inflation expectations go up
  - With $b > 1$ nominal rate increases by more => real rate goes up
  - Output and inflation goes down, invalidating the self-fulfilling non-fundamental expectations
- I.e., restrictions on instrument rules to secure determinacy....
  ....but "good" rules in this sense not necessarily optimal

- Preamble to analysis of targeting rules/optimizing central bank behavior
- Something odd about indeterminacy story under $i_t = \bar{i}$ (and other instrument rules)
- When private sector behavior changes, the bank "keeps on $i_t = \bar{i}$"
- This situation is subject to a "reverse Lucas critique":
  - Bank is passively following a non-optimizing decision rule, irrespective of what the private sector does
  - A type of behavior the literature has abandoned regarding private sector behavior a long time ago! (cf. Svensson, 2001b)
- What would happen if the bank, as the last remaining non-optimizing entity, actually started to optimize?

4. Determinacy under targeting rules

- First, targeting rules under discretion (period-by-period optimization)
- Let targeting rule be "minimize L"
- Optimality condition

$$\lambda x_t + \kappa \pi_t = 0.$$

  - Inflation increases are held "in check" by contractive policy, $x_t < 0$
  - Preliminary intuition for determinacy under targeting rule: The sunspot solutions with increases in both π_t and x_t are *incompatible* with optimal central bank behavior

- The wrong argument for determinacy:
  - *In* equilibrium, one can express the nominal interest rate as function of expected inflation,
    and $\partial i_t / \partial \mathrm{E}_t \pi_{t+1} > 1$. This conforms with Taylor principle!
  - ....*but* one can also express the nominal interest rate as function of expected output gap,
    and $\partial i_t / \partial \mathrm{E}_t x_{t+1} < 0$. No Taylor principle there!
  - Indeed, infinitely many equilibrium representations of the interest rate as function of endogenous variables.....
    .....some would appear to yield determinacy, some would not
- So, empirical analyses of interest rate response functions could say little about determinacy

- Why does the targeting rule then yield determinacy?
  - The optimality condition implies an interest rate *reaction function* in terms of *any* expectations:

$$i_t = \Omega_\pi \pi^e_{t+1} + \frac{1}{\sigma} x^e_{t+1} + i\,(\text{shocks})\,, \quad \Omega_\pi > 1$$

  - "Kills" off non-fundamental increases in output gap expectations
  - Contractive response to non-fundamental increases in expected inflation
  - Effect on actual inflation is reduced
  - Current inflation will increase by less than expected inflation

    => *Not* a well-behaved rational expectations solution

- I.e., the targeting rule circumvents the "reverse Lucas" critique through the implicit reaction function!

- Expression for reaction function mathematically equivalent to recent instrument rule proposed by Evans and Honkapohja (2001). Quite different interpretations:
  - They consider it as a normative (instrument) rule; I consider it an implication of optimal central bank behavior
  - When performing determinacy analysis, they disentangle the optimality condition from the interest rate equations it yields
  - They highlight the instrument rule as one addressing out-of-equilibrium behavior; I highlight that this is already addressed through the targeting rule (in a much simpler manner)
- Also, Svensson and Woodford (1999) advocate instrument rules addressing out-of-equilibrium behavior
  - I posit: Unnecessary; already addressed through the targeting rule

- Now, targeting rules under commitment (requires credibility of CB; sets a policy path for all future)
- Optimality condition (under "timeless perspective", Woodford, 1999):

$$\pi_t = -\frac{\lambda}{\kappa}\left(x_t - x_{t-1}\right).$$

  - Commitment policy involves "history dependence"
  - E.g., a prolonged contraction reduces inflation expectations and helps stabilize current inflation against inflation shocks
  - The central bank induces the economy to do some of the stabilization

- Again, preliminary intuition for determinacy:
  The sunspot solutions with increases in both π_t and x_t are *incompatible* with optimal behavior

- The "wrong argument" for determinacy now dies completely:
  - *In* equilibrium, one can express the nominal interest rate as a function of expected inflation, and under commitment: $\partial i_t / \partial \mathrm{E}_t \pi_{t+1} < 1$. No Taylor principle!
  - Even $\partial i_t / \partial \mathrm{E}_t \pi_{t+1} < 0$ is possible in equilibrium!
    - Positive, temporary inflation shock arrives
    - Nominal interest rate is raised, but policy is expected to continue to be contractive
    - $\mathrm{E}_t \pi_{t+1}$ goes down implying a negative correlation between i_t and $\mathrm{E}_t \pi_{t+1}$

- Why then determinacy?
- As under discretion: The implied reaction function to *any* expectations "kills" non-fundamental expectations
- Note: Estimations of forward-looking Taylor rules would say nothing about determinacy
- Could as well be that violation of the Taylor principle reflects commitment behavior in an economy exhibiting determinacy

5. Estimations of interest rate rules when the central bank operates under a targeting rule: Do they say anything (about determinacy)?

- Realistic extension of simple model:
  - Introduction of inflation and output inertia
  - Introduction of lags in the transmission mechanism
- Model is calibrated and simulated under assumptions of either discretionary or commitment policies.
- Determinate equilibria identified and high quality data is extracted to the econometrician

- Estimations of interest rate functions with "discretionary data" reveal a Taylor-type relationship (but sometimes the coefficient on inflation is too low to satisfy the Taylor principle)
- Estimations of interest rate functions with "commitment data" reveal no Taylor-type rule (and negative coefficients on inflation). But equilibrium is determinate and lowest possible social loss is attained
- Instructing a reversal to a Taylor-type rule — from unwarranted fear of indeterminacy — would increase social loss

6. Conclusions

- Setting up clear targets and let the central bank optimize, i.e., do the best it can => determinacy in conventional model framework due to the flexibility it induces in policy conduct
- An instrument rule as a guideline for policy: Suboptimal, rigid, and determinacy secured only under certain restrictions
- Nothing can be learned about economy's stability properties induced by monetary policy from interest rate estimations
  - A Taylor rule may appear, but the bank does not follow it
  - The Taylor principle may be absent even though the bank is doing the best of all policies and equilibrium is determinate
  - (and response coefficients tell nothing about the bank's goals)

- Results are in favor of analyzing monetary policy conduct in terms of targeting rules (in contrast with main bulk of current research focusing on performance of instrument rules)
- Often, real-world monetary institutions are often characterized by clear defined mandates for attaining various goals
- This suggests — to me — that it is appropriate to model monetary policy conduct (both from a descriptive and prescriptive view) through targeting rules
- Paper aims at highlighting one potential beneficial, and tangible, aspect of targeting rules: their stabilizing properties for the economy
- Future research: Implications of optimizing policy authorities in other monetary models with indeterminacy prevailing under a non-optimizing policymaker