Discussion of "Central Bank Balance Sheet Policies without Rational Expectations" by Iovino and Sergeyev

Alessandro Dovis
U Penn and NBER

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Context

- General idea:
  Monetary policy operates by affecting (or reacting to) risk
  - Atkeson-Kehoe NBER macro-annual, Alvarez-Atkeson-Kehoe JPE, RESTUD

- Standard model:
  Monetary policy operates by affecting inter-temporal substitution

- Few (but growing) theoretical papers analyze link between monetary policy and risk
  - Segmented markets/limited participation
  - Liquidity provision

- This paper: "bounded rationality'

My discussion

- 2 period model to review mechanism
- Compare to dinky limited participation model
- Comments
  - Lack of learning and novel vs. usual policy tools
  - Transmission channel + objective separate?

Example Economy

- $t = 0, 1$
- State in period 1 is $s \in S$ distributed according to $p(\cdot)$
- Endowment:
  - $t = 1$: y
  - $t = 2$: $y(s) = y + \theta(s)$
- Measure one of agents with preferences

$$u(c_1) + \beta \sum_s p(s) u(c_2(s))$$

where u increasing and strictly concave

Assets and policies

- Two assets:
  - Claims to risky component of output in period 2: $\theta(s)$
  - Risk free debt
  - y is labor income

- QE-like policy:
  - In period 0: buy shares of risky assets, ω^{gov}, and issue risk free debt, B, backed by lump sum taxes in period 1, $T(s)$
  - Policy$\pi = (\omega^{gov}, B, T(s))$
  - Policy can be indexed by ω^{gov}

Equilibrium

Given ω^{gov} , an equilibrium is hh's allocation, policy π, and asset prices (r, q) such that

- hh's allocation solves

$$\max u(c_1) + \beta \sum_s p(s)\, u(c_2(s))$$

subject to

$$c_1 + \omega q + \frac{b}{1+r} \leqslant q + y$$
$$c_2(s) \leqslant y + \omega\theta(s) + b - T(s)$$

- gov't budget constraints

$$\frac{B}{1+r} = \omega^{gov} q$$
$$T(s) = B - \omega^{gov}\theta(s)$$

- market clearing

$$B = b$$
$$\omega^{gov} + \omega = 1$$

Wallace irrelevance result in example

- For all feasible π:

$$q = \frac{\beta \sum_s p(s) u'(y + \omega\theta(s) + b - T(s)) \theta(s)}{u'(y + (1-\omega) q - b/(1+r))}$$

$$\frac{1}{1+r} = \frac{\beta \sum_s p(s) u'(y + \omega\theta(s) + b - T(s)) \theta(s)}{u'(y + (1-\omega) q - b/(1+r))}$$

- Using gov't budget constraints and market clearing:

$$q = \frac{\beta \sum_s p(s) u'(y + \theta(s)) \theta(s)}{u'(y)}$$

$$\frac{1}{1+r} = \frac{\beta \sum_s p(s) u'(y + \theta(s))}{u'(y)}$$

$\Rightarrow \omega^{gov}$ does not affect asset prices

Deviation from rational expectations

- There is one way to be rational, many ways to be "irrational"
  - Need to choose how to deviate
- hh's problem

$$\max u(c_1) + \beta \sum_s \tilde{p}(s) u(c_2(s))$$

subject to

$$c_1 + \omega q + \frac{b}{1+r} \leqslant q + y$$

$$c_2(s) \leqslant y + \omega\theta(s) + b - \tilde{T}(s)$$

- Household needs to know::
  - $\tilde{p}(s)$: distribution of s
    - not really pertinent to think about changes in policy
  - $\tilde{T}(s)$: taxes next period in each state
    - focus of the paper

Level-1 agents

- Suppose we start the economy with $\omega^{\text{gov}} = 0$
  $\Rightarrow T(s) = 0$ for all s

- Change in policy: gov't buys some risk asset $\omega^{\text{gov}} = \Delta > 0$

- Agents' expectations:
  - know physical probabilities $\tilde{p}(s) = p(s)$ and $\theta(s)$
  - do not expect changes in taxes tomorrow so $\tilde{T}(s) = 0$

Equilibrium with level-1 agents

Given $\tilde{T}(s) = 0$, an equilibrium is hh's allocation, policy and asset prices (r, q) such that

- hh's allocation solves

$$\max u(c_1) + \beta \sum_s p(s)\, u(c_2(s))$$

subject to

$$c_1 + \omega q + \frac{b}{1+r} \leqslant q + y$$

$$c_2(s) \leqslant y + \omega\theta(s) + b - \tilde{T}(s)$$

- gov't budget constraint

$$\frac{B}{1+r} = \omega^{gov} q$$

$$T(s) = -\omega^{gov}\theta(s) + B$$

- market clearing

$$B = b$$

$$\omega^{gov} + \omega = 1$$

SDF with level-1 agents

- The sdf is

$$m_1(s) = \frac{\beta p(s) u'\left(y + \omega\theta(s) + b(1+r) - \tilde{T}(s)\right)}{u'(y + (1-\omega)q - b)}$$

Imposing market clearing

$$B = b, \quad \Delta + \omega = 1$$

so

$$m_1(s) = \frac{\beta p(s) u'\left(y + (1-\Delta)\theta(s) + B(1+r) - \tilde{T}(s)\right)}{u'(y + \Delta q - B)}$$

from current gov't budget constraint in period 1, $B = \Delta q$ so

$$m_1(s) = \frac{\beta p(s) u'\left(y + (1-\Delta)\theta(s) + \Delta q(1+r) - \tilde{T}(s)\right)}{u'(y)}$$

$$= \frac{\beta p(s) u'(y + (1-\Delta)\theta(s) + \Delta q(1+r))}{u'(y)}$$

Prices with level-1 agent

- So $(q, 1+r)(\Delta)$ solve

$$q = \sum_s \frac{\beta p(s) u'(y + (1-\Delta)\theta(s) + \Delta q(1+r))\theta(s)}{u'(y)}$$

$$\frac{1}{1+r} = \sum_s \frac{\beta p(s) u'(y + (1-\Delta)\theta(s) + \Delta q(1+r))}{u'(y)}$$

- Higher Δ reduces risk premium
  - Say $\Delta = 1$

$$\frac{1}{1+r} = \sum_s \frac{\beta p(s) u'(y + \mathbb{E}\theta)}{u'(y)} = \frac{\beta u'(y + \mathbb{E}\theta)}{u'(y)}$$

$$q = \frac{1}{1+r} \sum_s p(s)\theta(s) = \frac{\mathbb{E}\theta}{1+r}$$

so there is no risk premium

Level-k agents

Level-2:

- Agents expect others to be level-1 agents so level-2 agents belief taxes are going to be equal to

$$\tilde{T}(s) = T_1(s) = -\Delta\left(\theta(s) - \frac{1+r_1}{q_1}\right)$$

Level-k:

- Agents expect others to be level-(k-1) agents

Alternatives

- Other form of deviations from RE
  - robustness
  - learning
- Segmented markets/limited participation
- Liquidity role of debt
  - it may depend from overall portfolios of risky assets
  - Are taxes short position of an asset? if so no changes

Dinky model of limited participation

- Suppose two types of agents
  - traders: can trade risky asset and gov't bond, endowed with claims to risky asset, fraction μ
  - non-traders: cannot trade assets, hand-to-mouth, fraction $1 - \mu$

- Government can also trade in asset markets
  - issue bond B to finance purchases ω^{gov} of the risky asset
  - tax *all* agents to balance budget in period 2

  $\Rightarrow$ QE like policy effectively shares risk circumventing limited market participation (fixed costs ...)

Compare asset prices

- Limited participation:

$$q = \sum_s p(s) \frac{\beta u'\left(y + \frac{1-(1-\mu)\Delta}{\mu}\theta(s) - \Delta q(1+r)\right)\theta(s)}{u'(y)}$$

$$\frac{1}{1+r} = \sum_s p(s) \frac{\beta u'\left(y + \frac{1-(1-\mu)\Delta}{\mu}\theta(s) - \Delta q(1+r)\right)}{u'(y)}$$

- Level-1:

$$q = \sum_s p(s) \frac{\beta u'(y + (1-\Delta)\theta(s) + \Delta q(1+r))\theta(s)}{u'(y)}$$

$$\frac{1}{1+r} = \sum_s p(s) \frac{\beta u'(y + (1-\Delta)\theta(s) + \Delta q(1+r))}{u'(y)}$$

How to distinguish?

- Look at expectations?
  - in model with heterogeneity: is there a way to look at joint behavior of expectations and trades?

- How to distinguish from other forms of deviation from RE
  - like robustness?

Learning: Novel vs. normal policy tools

- No notion of learning from observations
  - "Learning how to play": increase level from k to $\mathsf{k}+\mathsf{h}$
  - Observation of past experiences does not affect expectations

- If QE-like policies are business as usual
  - if agents are "econometrician" will eventually learn $\mathsf{T}(\mathsf{s}|\Delta_{-})$
  - but it can exploit it first time it uses it

- Can see if systematic expectation errors there there for new policy but not for regular policy?

Monetary policy in normal times?

- General theme: monetary policy works by affecting risk premia
- Want to think of all open market operations as QE-like policy?
- To analyze effects of given policy starting point is $\mathsf{T}(s)$ at staus quo policy
  - Reasonable for one unexpected deviation from "normal" policy or novel policy tool
  - what about stochastic environment with instruments often used?

Transmission channel + policy objective

- Government wants to affect asset prices because of ...
  - increase net worth of financial intermediaries/constrained agents
  - reducing risk premia to foster investment
  - devalue currency to improve competitiveness
  - ...
- Should we think of transmission channel + objective separately?
- Or transmission mechanism may be related to objective
  - change in asset prices is manifestation that policy achieves its objective