Woodford's *Imperfect Common Knowledge & the Effects of Monetary Policy*

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Last Week: Morris and Shin (MS, 2002) showed economic outcomes can be excessively sensitive to public information because, when a coordination motive exists (*strategic complementarity*), agents use it to predict others' actions.

Woodford's paper can be viewed as a specific example of the MS result.

Woodford's (2002) Goal: To use imperfect information to explain the persistent real effects of monetary shocks.

Background: Lucas' (1972) model did this: Firms partially attribute unanticipated ↑ nominal aggregate demand to an ↑ in relative demand for their good.
⇒↑ Production after monetary injection.

But, two criticisms:

1. If beliefs update accordingly, real effects don't persist.
2. Why don't agents make use of public info?

Woodford's Claim: Imperfect information can explain the persistent real effects of monetary shocks – if modeled in a manner similar to MS.

Approach: Extend Lucas (1972) in two ways to address both criticisms:

1. Add a strategic complementarity in firms' pricing decisions through monopolistic competition. (≈ MS coordination motive)
2. Agents can't process all available public info.
   (Sims' *rational inattention*, enters model as MS noisy public signal)

Result: Strategic complementarity + imperfect info ⇒ Higher-order expectations adjust slowly, so monetary shocks have real persistent effects. Persistence increases when private info is less precise, and when the strategic complementarity is stronger.

Comparison with other papers:

MS: $a_i = (1-r)\sum_{k=0}^{\infty} r^k E_i(E^k(\theta))$ (14)

Woodford: $y_t = \xi \sum_{k=0}^{\infty}(1-\xi)^k[q_t - E_i(E^k(q_t))]$ (2.9)

Lucas: $y_t = b[q_t - E_i(\bar{q})]$ where $\bar{q}$= average price.

In this application: a_i is a pricing decision; $r = (1-\xi)$, the strategic complementarity, is how much demand for my good falls as my price deviates from (is above) the price charged by others; θ is the state of aggregate nominal GDP.

Continuing the analogy: In Woodford's model, agents receive a noisy private signal ($z_t(i)$, demand for their good) and we can think of the monetary policy shock, u_t, as a noisy public signal.

Agents' optimal choice will have two components:

1. The true state (*i.e.* nominal aggregate demand, or AD); and
2. Others' actions (*i.e.* the prices they set). The prices others set depend on their expectations of AD and their expectation of the price I will set (which, in turn, depends on my expectation of AD and on my expectation of the price they set, and so on ...)

Intuition: A given firm may understand that the shock is aggregate rather than relative, but they may be unsure that others know that. Therefore, they produce more because they expect that if others produce more that they will be shut out of the market. Since $C_y > 0$ and firms start with a constant mark-up over cost, both output and inflation rise simultaneously. And since higher-order expectations adjust slowly, the impact is more persistent.

Future Work: Combine this model with Calvo's (1983) sticky prices.

An Alternative Interpretation: Focusing on nominal GDP ignores the monetary transmission mechanism as a potential explanation for real monetary effects.

In reality, policy sets short-term r, updating at predetermined intervals:

1. $\Delta r \Rightarrow \Delta$ relative prices, *i.e.* other interest rates & the exchange rate

   $\Rightarrow \Delta$ cost of: borrowing; consuming today vs. tomorrow; imports vs. exports. *i.e.* Firm's cost function and demand for its good may change. Hence, real decisions impacted (likely with some lag to adjust).

2. What are these exogenous monetary shocks in the first place? Monetary policy decisions are: a) endogenous; b) explicitly directed at influencing expectations; and c) highly persistent (tightening/easing cycles, see the attached Figure).

So observing that monetary policy has persistent real effects in the short run in the data is to be expected- indeed it would be surprising if it did not!

Fed Funds Rate, 1996-2005