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Abstract: The design of interest rate rules for conducting monetary policy have recently been examined for two key concerns. The first issue is determinacy of equilibria. Indeterminacy (multiplicity of stationary rational expectations equilibria) is a concern in models of monopolistic competition and price stickiness are currently a popular framework for the study of monetary policy. The second issue is stability of equilibria under adaptive learning. Some interest rate rules do not perform well when the expectations of the agents get out of equilibrium, e.g. as a result of structural shifts.

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Discussion of Preston, "Learning about Monetary Policy Rules when Long-Horizon Expectations Matter"

1 Background

The design of interest rate rules for conducting monetary policy have recently been examined for two key concerns. The first issue is determinacy of equilibria. Indeterminacy (multiplicity of stationary rational expectations equilibria) is a concern in models of monopolistic competition and price stickiness are currently a popular framework for the study of monetary policy. The second issue is stability of equilibria under adaptive learning. Some interest rate rules do not perform well when the expectations of the agents get out of equilibrium, e.g. as a result of structural shifts.

Both determinacy and learning stability can be seen criteria for good monetary policy.[1] The recent literature has shown that the form of the interest rate rule is important in facilitating the learning process of the private agents. In adaptive learning economic agents are assumed to use an econometric model to forecast the future and they update their forecast functions as new data becomes available. In any period, the forecasts are input to

[1] See (Evans and Honkapohja 2002a) for a review of the recent literature.

agents' behavioral rules. The decisions of the agents are obtained by combining the forecasts and the behavioral rules and these decisions lead to a temporary equilibrium, i.e. an equilibrium in the current period given the forecasts and the agent's decisions.

The formulation of agents' behavioral rules outside equilibrium is a major issue in the learning approach. Much of the literature has assumed that Euler equations under subjective expectations, which are a key part of individual first-order optimality conditions, provide the behavioral rules of the agents. The behavioral rules based on Euler equations are forward-looking but they look forward only one period ahead. Nevertheless, these rules have often been used even if the horizon of the agents is in principle infinite.[2] One-step forward-looking behavioral rules are a relatively crude way for representing individual behavior under the changing circumstances in adaptive learning. The one-period ahead margin is a key margin of optimality but one can envisage that longer horizons can also matter.

2 Preston's Contribution

The central contribution of (Preston 2003) is the reformulation of individual behavioral rules for standard models of monetary policy in a way that gives a role to long-horizon forecasting. This is a useful contribution even if earlier papers have done the same in other contexts (see footnote 2 above).Let me briefly outline Preston's methodology using a simple permanent-income model for illustration.[3]

There are two parts to the description of the agent's behavior. The agent's current decisions in terms of forecasts is logically the first part. Preston's approach consists of the following steps.

1. Formulate the household decision problem over the infinite future and derive the standard optimality conditions, i.e. the Euler equation and the intertemporal budget constraint.

[2] Behavioral rules with an infinite or a long finite horizon have appeared in earlier literature. See the iterated Euler equation in (Sargent 1993) pp.122-145, the zero profit condition in (Evans, Honkapohja, and Romer 1998) and the asset holding functions in (Bullard and Duffy 2001).

[3] For formal details see Section 2 of (Honkapohja, Mitra, and Evans 2002).

2. Linearize the Euler equation and the intertemporal budget constraint at a nonstochastic steady state.

3. Iterate the linearized Euler equation and compute planned consumption for each future period s as a function of current consumption and anticipated interest rates in periods up to $s-1$.

4. Substitute the iterated Euler equations into the linearized intertemporal budget constraint and solve for current consumption.

These steps yield a behavioral rule for current consumption decisions in terms of the infinite horizon sequence of variables that are exogenous to the agent.

The second part to agent's behavior is the description how forecasts are made. In any period the agent has an estimated linear econometric model for the variables that he needs to forecast and its parameters have been estimated from past data. Given knowledge of some exogenous variables the agent computes the required forecasts using the estimated model. For the longer horizon forecasts the agent is assumed to iterate the econometric model forward using the current estimated values of the parameters.

These two parts give the decisions of the agents for the current period. Market clearing then yields the temporary equilibrium. The equilibrium provides a new data point for the agents in the economy and they re-estimate the parameters of the econometric model and the learning process continues. The story about temporary equilibrium and parameter updating is exactly the same as in the other literature on adaptive learning, see e.g. (Evans and Honkapohja 2001).

Formulation of Infinite-horizon behavior rules is clearly going to be important for some applications, though it may perhaps be less central in other situations. Let me first make a remark about extending it. I will then make some comments on the current paper.

Linearization is a major limitation in Preston's model. It means restricting attention to dynamics in a small neighborhood of the nonstochastic steady state and, in particular, it must be assumed that shocks to the economy are small for otherwise nonlinearities can be important. One could try to avoid the linearization. In some cases assuming a parametric form, say, for the utility function can make possible the derivation of a full consumption function in terms of perceived wealth and its different components. If this is successfully done, adding specific assumptions about the stochastic process for the interest rate and other relevant future variables would allow the study of more global aspects of learning dynamics for economic policy. Doing all this could provide interesting perspectives, especially when wealth variations and changing perceptions about the components of wealth are important.

3 Discussion

Preston studies the implications of assuming that agents have infinite-horizon behavioral rules in an economy operating under an given instrument rule for setting of the interest rate. He considers both rules which respond only to exogenous shocks and Taylor rules that respond to inflation and the output gap. Preston finds that the Taylor principle is necessary and sufficient for stability under learning and that rules responding only to shocks lead to instability. These results are exactly the same that (Bullard and Mitra 2002) derived for the same model, except that in (Bullard and Mitra 2002) the agents' behavioral rules were based Euler equations, i.e. agents had only short horizons. Let me call the two approaches infinite horizon (IH) and Euler equation (EE) learning.

Preston's results are a useful robustness check of the (Bullard and Mitra 2002) recommendation that the interest rate instrument rule should respect the Taylor principle.[4] This is a worth while undertaking since we know relatively little about the behavioral rules that individual agents might have outside a full intertemporal equilibrium. I do not find the result very surprising as the paper just considers local learning stability of equilibrium in an unchanging environment.

I do not have a full understanding of the connections between EE and IH learning. Let me just offer some tentative comments about the EE and IH approaches and suggest that some of Preston's discussion is misleading.

My first point is that both approaches represent plausible models of boundedly rational behavior. IH learning is based on more elaborate individual optimization reasoning than EE learning, but it is still not optimal behavior. It is assumed that the agents ignore the fact that during the learn-

[4] In a companion paper (Preston 2002) considers optimal interest rate setting under IH learning, which was studied by (Evans and Honkapohja 2002b) under EE learning. He finds that learning stability obtains when the interest rate rule is derived from the correctly specified model, including agents' behavioral rules, and taking the values of private forecasts as given. The latter key principle was first suggested in (Evans and Honkapohja 2003).

ing dynamics the estimates of the forecast function parameters will change over time. If the agents are sophisticated about planning over the infinite horizon,.they might well have anticipations about future parameter change and e.g. estimate separate forecast functions over the longer horizons.

Second, EE learning and IH learning are not inconsistent. Indeed, it is possible to derive the equations of the model with EE learning under plausible assumptions from Preston's basic behavioral rules (5) and (11) under the simple assumption that agents have identical subjective expectations.[5] Preston mistakenly claims that obtaining the EE learning framework in this application, shown in his equations (28)-(29), requires use of "knowledge that other agents' consumption decisions satisfy a subjective Euler equation" (p.2). In fact, all that is required is that (1) agents have identical expectations, which Preston also assumes, and (2) $C_t^i = Y_t = x_t + Y_t^n$ for all i and t. Concerning the latter, it should be noted that, with identical preferences and technology we have $C_t^i = Y_t$ in temporary equilibria as a result of market clearing. Since this equality has held in the past, it is natural for the agents to make the forecast $\hat{E}_t^i C_{t+1}^i = \hat{E}_t^i x_{t+1} + Y_{t+1}^n$, where $Y_t = x_t + Y_t^n$ is just a definition.

Third, while IH learning makes elaborate use of the consumers' subjective intertemporal budget constraint and EE learning does not use it at all, this does not imply that EE learning is necessarily inconsistent with this budget constraint. The consumer formulates current demand behavior by looking only at the (subjective) optimality margin one period ahead. Nothing is assumed about the further future. Moreover, if the economy converges to the rational expectations equilibrium, then the transversality condition must hold ex post in this kind of model also under EE learning. This is simply a matter of iterating forward and aggregating the flow budget constraints and making use of market clearing.

Fourth, let me take up Preston's argument that EE learning ignores the wealth term (see Section 6 of the paper). This is misleading since also EE learning would take any wealth variation into consideration if the forecasting required it for the EE behavioral rule. See e.g. the analysis of the Ramsey model in Section 4.4 of (Evans and Honkapohja 2001).

These comments show that EE and IH learning are both possible approaches to study the learning behavior of the economy under a Taylor in-

[5] Details are given in Section 3 of (Honkapohja, Mitra, and Evans 2002), where an earlier version of Preston's equation (5) was used. It did not have the wealth variable ϖ_t^i, but see the remarks below.

terest rate rule satisfying the Taylor principle (to achieve convergence). The difference between EE and IH learning lies in the ultimately empirical question of the nature of individual behavioral rules outside equilibrium. I do not have strong views on the behavioral rules that are appropriate. Let me just suggest that the behavioral rules are likely to depend on the nature of outside-equilibrium situations that the agents encounter. If the economy is in a constant stable regime, one might expect that agents use simple rules of thumb and do not consider what happens at long horizons. They do not have strong reasons to look at long horizons.

On the other hand, it is easy to envisage situations where boundedly rational agents would have a clear interest in considering long horizons. Consider a model with government spending, taxes, debt, money and infinitely lived agents. Suppose that the government announces that it will do a major tax cut in the future for a fixed number of periods, finance this by issuing debt and return to balanced budgets after the fixed number of periods with deficits. This announcement would give a strong reason for a boundedly rational agent to consider long horizons. The IH learning approach or its nonlinear generalization would be a natural tool to study the resulting learning dynamics.

References

Bullard, J., and J. Duffy (2001): "Learning and Excess Volatility," *Macroeconomic Dynamics*, 5, 272–302.

Bullard, J., and K. Mitra (2002): "Learning About Monetary Policy Rules," *Journal of Monetary Economics*, 49, 1105–1129.

Evans, G. W., and S. Honkapohja (2001): *Learning and Expectations in Macroeconomics*. Princeton University Press, Princeton, New Jersey.

——— (2002a): "Adaptive Learning and Monetary Policy Design," Journal of money, credit and banking conference paper, www.valt.helsinki.fi/RAKA/seppo.hmtl and http://darkwing.uoregon.edu//∼gevans/.

——— (2002b): "Monetary Policy, Expectations and Commitment," mimeo, www.valt.helsinki.fi/RAKA/seppo.hmtl, and http://darkwing.uoregon.edu/∼gevans/.

——— (2003): "Expectations and the Stability Problem for Optimal Monetary Policies," *Review of Economic Studies, forthcoming.*

Evans, G. W., S. Honkapohja, and P. Romer (1998): "Growth Cycles," *American Economic Review*, 88, 495–515.

Honkapohja, S., K. Mitra, and G. W. Evans (2002): "Notes on Agents' Behavioral Rules Under Adaptive Learning and Recent Studies of Monetary Policy," manuscript, www.valt.helsinki.fi/RAKA/seppo.hmtl, and http://darkwing.uoregon.edu/∼gevans.

Preston, B. (2002): "Adaptive Learning and the Use of Forecasts in Monetary Policy," mimeo, Princeton University.

——— (2003): "Learning about Monetary Policy Rules when Long-Horizon Forecasts Matter," mimeo, Princeton University.

Sargent, T. J. (1993): *Bounded Rationality in Macroeconomics*. Oxford University Press, Oxford.