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**Irrational expectations and econometric practice:  
discussion of Orphanides and Williams, "Inflation scares  
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## **Irrational Expectations and Econometric Practice Discussion of Orphanides and Williams, "Inflation Scares and Forecast-Based Monetary Policy"**

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**Abstract:** Athanasios Orphanides and John C. Williams' excellent conference paper, "Inflation Scares and Forecast-Based Monetary Policy," contributes importantly to the new and rapidly growing branch of the literature on bounded rationality and learning in macroeconomics. Their paper, like many others, derives interesting and useful theoretical results that show how the introduction of bounded rationality and learning impacts on the effects of monetary policy shocks and the characteristics of optimal monetary policy rules. This note suggests that some additional empirical work—some "irrational expectations econometrics," if you will—might serve to make these purely theoretical results seem more relevant and convincing.

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Discussant's comments on Athanasios Orphanides and John C. Williams' "Inflation Scares and Forecast-Based Monetary Policy" were presented at the Monetary Policy and Learning Conference sponsored by the Federal Reserve Bank of Atlanta in March 2003. The views expressed here are the author and not necessarily those of the Federal Reserve Bank of Atlanta or the Federal Reserve System. Any remaining errors are the author's responsibility.

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# **Irrational Expectations and Econometric Practice Discussion of Orphanides and Williams, “Inflation Scares And Forecast-Based Monetary Policy”**

## **1 Irrational Expectations ...**

Athanasios Orphanides and John C. Williams’ excellent conference paper, “Inflation Scares and Forecast-Based Monetary Policy,” takes as one of its starting points the observation that many central banks around the world devote considerable resources towards producing their own, internal macroeconomic forecasts and towards monitoring private, external macroeconomic forecasts. And, moreover, monetary policy actions taken by central banks around the world often appear to be driven, at least in part, by changing internal and private macroeconomic forecasts. Within the Federal Reserve System, for example, the Greenbook—which presents the macroeconomic forecasts generated by the Federal Reserve Board staff—serves as one of the principal documents guiding the policy deliberations at each meeting of the Federal Open Market Committee.

Orphanides and Williams’ paper takes its second starting point another observation: that most contemporary models of the monetary business cycle attach no special importance to macroeconomic forecasts in the design of monetary policy rules. To see where this result comes from, and why it holds true so generally, consider a very simple model in which, for some reason, the central bank decides to set its policy instrument, the short-term nominal interest rate  $r_t$  at time  $t$ , as a linear function of expected or forecasted output  $y_{t+1}^e$  and inflation  $\pi_{t+1}^e$  at time  $t + 1$ , according to the policy rule

$$r_t = \alpha_y y_{t+1}^e + \alpha_\pi \pi_{t+1}^e, \tag{1}$$

where  $\alpha_y$  and  $\alpha_\pi$  are coefficients chosen by the central bank that measure the sensitivity of the interest rate response to movements in expected output and inflation. Next, suppose that the structure of this simple model implies that the forecasts  $y_{t+1}^e$  and  $\pi_{t+1}^e$  of output

and inflation at time  $t + 1$  are optimally constructed as linear functions of the actual levels of output and inflation at time  $t$ , so that

$$y_{t+1}^e = \beta_y y_t + \beta_\pi \pi_t \quad (2)$$

and

$$\pi_{t+1}^e = \delta_y y_t + \delta_\pi \pi_t, \quad (3)$$

where the reduced-form parameters  $\beta_y$ ,  $\beta_\pi$ ,  $\delta_y$ , and  $\delta_\pi$  may depend in potentially complicated ways on the model's underlying structural parameters describing private agents' tastes and technologies as well as on the parameters of the monetary policy rule (1). Optimal forecasting rules take the linear form exhibited by (2) and (3) not just in this simple model but in *any* member of the broad class of linear or linearized rational expectations models that have been developed and used in the literature on monetary economics over the past quarter century. In more complicated models, additional lags of output and inflation as well as additional lags of other endogenous variables besides output and inflation may appear in the optimal forecasting rules. But the linear form of (2) and (3) will always be preserved by the linearity of the structural model itself, together with the rational expectations assumption, which implies that all agents know and use the linear structural model in constructing their forecasts.

Now, simply substitute the optimal forecasting rules (2) and (3) into the policy rule (1) to confirm that the forecast-based policy rule (1) adopted by the central bank is fully equivalent to the outcome-based rule

$$r_t = \gamma_y y_t + \gamma_\pi \pi_t, \quad (4)$$

with  $\gamma_y = \alpha_y \beta_y + \alpha_\pi \delta_y$  and  $\gamma_\pi = \alpha_y \beta_\pi + \alpha_\pi \delta_\pi$ , which makes no explicit reference to forecasts

and instead just calls for the interest rate  $r_t$  at time  $t$  to be adjusted based on movements in actual output  $y_t$  and inflation  $\pi_t$  at time  $t$ . The exact equivalence of (1) and (4) implies, for instance, that if optimal resource allocations are supported by the forecast-based rule (1), then those same optimal allocations are also supported by the outcome-based rule (4). In this simple model, as in virtually all of the others used by monetary economists today, there may be no harm in assigning a role to forecasts in the policymaking process, but at the same time, there is no special reason to do so: rules that ignore forecasts and depend only on observed outcomes work just as well. A disconnect therefore appears between central banking in practice, where forecasts seem to play a very important role, and central banking in theory, where they do not.

In their paper, Orphanides and Williams skillfully highlight one major source of this disconnect: the assumption, maintained throughout virtually all of the literature from the past 25 years, that agents have full knowledge of the economy's true structure and form their forecasts rationally and optimally based on that complete knowledge. More specifically, Orphanides and Williams begin by constructing a linear rational expectations model of the monetary business cycle that shares the same basic features possessed by most other popular specifications that are used today. However, they subsequently depart from this benchmark by assuming that private agents lack the ability to use optimal forecasting rules like (2) and (3) from above. Instead of having rational expectations, the agents in Orphanides and Williams' framework generate forecasts using a simple econometric model—an econometric model that is, moreover, misspecified in that it is designed to reflect the agents' belief that the coefficients of the true model drift randomly over time, even though this parameter drift never actually occurs.

Through a variety of numerical exercises, Orphanides and Williams show how, in this

economy without rational expectations, the equivalence between forecast-based and outcome-based policy rules illustrated by the comparison of (1) and (4) from above breaks down. These exercises reveal that in this model of bounded rationality and learning—that is, in this model of irrational expectations—the central bank finds considerable value in adjusting its policy instrument in response to changes in *both* forecasts and outcomes, just as, evidently, central banks in the real world find it desirable to monitor and respond to changes in both forecasts and outcomes.

To be sure, these results are interesting and important. My first comment, therefore, is just to say that I like the paper very much, learned a lot from reading it, and would recommend it highly to anyone with an interest in monetary economics. My second comment is to call for some empirical work that might usefully serve to complement the purely theoretical results that are presented in this paper—and throughout the branch of the literature on bounded rationality and learning in macroeconomics to which this paper contributes.

## **2 ... and Econometric Practice**

Orphanides and Williams' paper presents an interesting and important theoretical result: that a special role for forecast-based monetary policy rules—a role that is absent in most conventional, rational expectations models—emerges in an environment in which private agents are boundedly rational and perpetually trying to learn about the true structure of the economy. Orphanides and Williams' paper, like most of the others presented at this conference, thereby contributes to an already large, but still rapidly growing, branch of the literature in macroeconomics that explores, theoretically, how the introduction of bounded rationality and learning impacts on the effects of monetary policy shocks and the characteristics of optimal monetary policy rules. Once again, to be sure, this branch of the literature

has produced many useful results and insights. What is sorely missing from this branch of the literature, however, is any empirical or econometric work that might serve to make the purely theoretical results obtained so far seem more relevant and convincing.

One very nice feature of Orphanides and Williams' model is that it nests the conventional rational expectations specification as the special case in which the constant gain parameter  $\kappa$  used by private agents in their recursive least squares learning and estimation procedure converges to zero. Another very nice feature of Orphanides and Williams' model is that it implies that different settings for this parameter  $\kappa$  lead to very different implications for the volatility and persistence of movements in output and inflation. Why not build on these theoretical results, and attempt to estimate the parameters of this model, including the key parameter  $\kappa$ , using actual time-series data on output and inflation from the postwar US economy together with formal econometric methods? The results of such an exercise could then be used to assess how allowing  $\kappa$  to differ from zero—that is, how allowing for a departure from rational expectations—helps improve the model's fit.

In the field of agricultural economics, two absolutely fascinating studies by Baak (1999) and Chavas (2000) successfully perform econometric exercises of exactly this nature. Both of these studies start by outlining a dynamic, stochastic model of the US cattle market in which private agents are assumed to have fully rational expectations. Both of these studies then go on to perturb the rational expectations benchmark in ways that allow, but do not require, some agents to be boundedly rational instead. Baak (1999) estimates his model via maximum likelihood and finds that the best fit is provided by a variant in which approximately one-third of all agents are boundedly rational; he finds, also, that a likelihood ratio test rejects the constrained version of the model in which all agents have rational expectations. Chavas (2000), meanwhile, uses a generalized method of moments estimation



procedure instead; his results, too, strongly support the hypothesis that the introduction of boundedly rational agents works to improve the model's ability to track movements in the data. These studies serve to demonstrate that "irrational expectations econometrics" can yield results that are sharp, useful, and convincing. In macroeconomics, however, Sargent's (1999) volume represents the only published attempt that I am aware of to actually estimate and test a model with boundedly rational agents.

Years ago, Hansen and Sargent (1980) famously declared that "cross-equation restrictions" are the "hallmark of rational expectations models." But please look again at Orphanides and Williams' results, which reveal, first, that the dynamic behavior of output and inflation in their model is strongly influenced by the learning process used by private agents and, second, that the learning process used by private agents is itself influenced, in turn, by the characteristics of the monetary policy rule chosen by the central bank. These results suggest, therefore, that cross-equation restrictions are imposed not just by rational expectations models, but by many other models like Orphanides and Williams' in which the process through which agents form their expectations is described carefully and completely. Just as they do in rational expectations models, the cross-equation restrictions that emerge out of models with boundedly rationality and learning provide potentially powerful channels through which key parameters can be econometrically identified and through which key hypotheses can be econometrically tested.

That famous paper by Hansen and Sargent (1980), by the way, also appears in an edited volume titled *Rational Expectations and Econometric Practice* (Lucas and Sargent 1981) that collects some of the most important studies produced during the early stages of the rational expectations revolution. As Orphanides and Williams' paper and many of the other papers presented at this conference reveal, macroeconomists have become increasingly willing to

depart from the rational expectations hypothesis—today, it seems that we may be witnessing the early stages of an “irrational expectations revolution.” What this new revolution needs to succeed, I suggest, is some “econometric practice” to go along with the theoretical work that we’ve already seen.

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