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Targets and lags in a two-equation model of US stabilization

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ABSTRACT

A simple model of activist macroeconomic policy derives a reaction function by assuming that rational governments have performance objectives, but are constrained by the Phillips curve. Although not formally modeled, governments apply a variety of instruments to influence inflation and output, in addition to monetary policy these include fiscal policy, bailouts and exchange rates. Our econometric results are generally consistent with US economic history. One qualification is that governments appear more likely to target growth rates than output gaps. Another inference is that inflation expectations are more likely to be backward than forward looking; a variety of rational expectation models fit the data less well than do simple inertial expectations. We also find that annual data series are more appropriate than quarterly ones for studying these issues.

1. Introduction

Central to the Keynesian conception of stabilization policy is the assumption that governments actively lean against the macroeconomic wind. This can be thought of as rational behavior for a government constrained by a Phillips curve.[2] A number of alternative specifications are consistent with this theme. One of these relates to the functional form of the government's objective function. Starting with a quadratic form involving an inflation target, we highlight the differences implied by substituting an output growth target for the conventional output gap target.

Another modeling issue concerns how agents and governments make inflation forecasts; we explore several possibilities. We assume that governments are rational throughout, but for agents we begin with simple backward-looking expectations, and develop extensions to forward-looking ones, including rational and new Keynesian expectations. Forward-looking expectations are appealing because they cohere with the notion of well-informed agents. We find, however, that none of our rational expectation specifications improve over the simple inertial model as judged by posterior model probabilities.

A third modeling issue is the timing of policy reactions: how quickly can policy makers respond to nominal and real shocks? A one period is a common lag assumption, but is that lag a quarter or a year? An alternative suggested by Svensson (1997) is a double lag, one for real output and two lags for inflation. We report estimates to distinguish among these possibilities.

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[2] The original insight for this literature dates to Kalecki (1943). Modern versions begin with those of Kydland and Prescott (1977) who introduced the logic of rational expectations and Barro and Gordon (1983) who further develop this logic.

2. Endogenous stabilization

The monetary policy literature invariably invokes an augmented Phillips curve as a structural constraint on policy makers. Conventionally this is an inverse relation between the unexpected inflation and the gap between actual and natural unemployment. Since the potential output Y_t^* is conceptually related to the equilibrium or natural rate of unemployment, the output gap can be substituted for the unemployment gap as the measure of macroeconomic disequilibrium,

$$\pi_t = E_{t-1}^a \pi_t + \psi x_t + \varepsilon_t, \tag{1}$$

where π_t is the inflation rate, $x_t \equiv \ln(Y_t) - \ln(Y_t^*)$ is the output gap, Y_t is real output and ε_t an inflation shock. Expected inflation $E_{t-1}^a \pi_t$ is often interpreted as the forecast of a typical agent based on information available in the previous year. Assuming that expectations are fulfilled in the long run, (1) rules out any long-run deviation from $x = 0$. However, as long as economic agents do not fully anticipate fiscal, monetary and other policies, governments are able to temporarily increase output at the cost of higher inflation.

Beginning with Fischer (1977) a number of explanations of the Phillips relationship have been offered, including overlapping nominal wage contracts, stochastic price resetting, costly price adjustment and stochastic updating of information. Calvo's (1983) "sticky price" model assumes that only a fraction of all firms are able to adjust its price in the each period. A notable result is that the new Keynesian curve is forward-looking expectations, as contrasted to the backward-looking interpretation typical in textbooks. This paper explores this issue empirically.

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Another essential element is an assumption about political objectives. A simple possibility supposes that the government's goals are given as a quadratic function of the output gap and inflation,

$$U = -\left(x^2 + \left(\pi - \pi^T\right)^2\right)$$

where π^T is the inflation target, not necessarily the announced target. Social welfare is often defined as some aggregation of individual preferences. Governmental targets may reflect a weighted average of citizen preferences. Woodford (2003) establishes microfoundations for several close relatives of this function form as an approximation to the utility of a representative consumer–worker. Objectives might also include the discounted value of expected future outcomes.[3] Our approach accounts only for the period in which current policy initially affects outcomes, ignoring other periods as second order.

Quadratic forms are tractable because they result in linear solutions.[4] Within the quadratic family a variety of alternatives are plausible. Ours has circular indifference curves, but these can be made elliptical by adding a parameter to reflect the relative weight of inflation versus output goals. Some studies consider parabolic indifference curves.[5] Differing targets for inflation could account for ideological differences. Often the output target exceeds zero.[6] Kiefer (2008) estimates several different quadratic forms. He finds that it is not possible to statistically separate goal weights from inflation and output targets.[7] Thus, the inflation-target parameter may be interpreted as a composite measure of weights and targets.

Government has limited options in this model. Although it may be able to exploit information advantages to lean against the macroeconomic wind, nevertheless its goals ($x = 0$ and $\pi = \pi^T$) are usually unattainable in the short run. Initially we assume that policymaking is only effective after a one-period delay. Carlin and Soskice (2005) explain this delay with a lag in the *IS* relation between the interest rate and output gap.[8] Recognizing that governments have more tools than just the interest rate, we assume that this lag also applies to other instruments. Accordingly, we add an expectation operator and date the objective as

$$E_t^g U = -E_t^g\left(x_{t+1}^2 + \left(\pi_{t+1} - \pi^T\right)^2\right), \tag{2}$$

which defines the government's expectation of next period's welfare. Subject to the Phillips curve constraint, the government's preferred inflation is

$$\pi_{t+1}^* = \frac{E_t^a \pi_{t+1} + \psi^2 \pi^T + E_t^g \varepsilon_{t+1}}{1 + \psi^2}.$$

To the extent that agents are rational and well informed they would expect this inflation rate (then this solution reduces to $\pi_{t+1}^* = \pi^T$), however if actual forecasts are inertial, then the government has an informational advantage.

Assuming that the government cannot forecast the inflation shock, $E_t^g \varepsilon_{t+1} = 0$, lagging one period, and adding two unexpected shocks, ε_t and ξ_t, we obtain the solution for inflation and the output gap.

$$\begin{aligned} \pi_t &= \frac{E_{t-1}^a \pi_t + \psi^2 \pi^T}{1 + \psi^2} + \varepsilon_t \\ x_t &= \frac{-\psi\left(E_{t-1}^a \pi_t - \pi^T\right)}{1 + \psi^2} + \xi. \end{aligned} \tag{3}$$

The output gap solution follows from substituting the inflation solution back into Eq. (1). Initially we take the shocks to be exogenous, independent and unpredictable. Following Carlin and Soskice we take the period of analysis to be one year, although we also investigate a shorter period of one quarter.

Rational agents come to understand that a policy of $\pi^T = 0$ implies inflation. In the absence of shocks, the time-consistent equilibrium inflation rate should occur where inflation is just high enough so that the government is not tempted to spring a policy surprise. This equilibrium occurs at zero output gap and the inflation target, $x = 0$ and $\pi = \pi^T$. Eq. (3) are reduced forms determined by $E_{t-1}^a \pi_t$, ξ_t and ε_t; they are linear in the variables, but nonlinear in coefficients.

We assume that the government implements a policy through a variety of instruments (monetary policy, unemployment insurance, tax rebates, infrastructure spending, bailouts, etc.) and that the various agencies pursue this common policy. We assume that policy can be parameterized as a fixed inflation target. Our model can be seen to be the first two equations of Carlin and Soskice's three-equation model, ignoring the *IS* equation. We would need several equations to directly model the government's instruments; we would need to assume that these all can be separated from the underlying reaction functions as the *IS* curve can, and initially that all display the same one period lag structure.

In comparison to the literature on monetary policy econometrics this is a small and stylized specification. Recent research reports much more complicated dynamic stochastic general equilibrium models (DSGE); see Christiano et al. (2005) or Smets and Wouters (2003). For example, Smets and Wouters specify 4 structural parameters without estimation and estimate 32 additional parameters in a 9-equation model. Their approach includes habit formation in consumption, technology and preference shocks, capital adjustment costs and less than full capacity utilization; it also accounts for sticky prices and wages, along with markups deriving from market power. Our 2-equation model follows the DSGE approach by applying Bayesian estimation methods, but it estimates only 2 parameters.[9] We propose that a traditional Phillips curve can approximate the more complicated equilibrium resulting from sticky prices and from technology and preference shocks. Although the DSGE literature includes detailed descriptions of consumer and firm objectives and behavior, it often models government behavior without an objective function as an agnostic stochastic process, or as a Taylor rule.[10] Our approach focuses on government goals. Although we do not elaborate microfoundations for the rest of the economy, our 2-equation model is dynamic and does have an equilibrium.

3. Growth targets

We also consider a related objective function specified on growth rates, rather than output gaps. Thus, we rewrite output in terms of the growth rate as

$$E_t^g U = -E_t^g\left(\left(g_{t+1} - g_{t+1}^*\right)^2, +, \left(\pi_{t+1} - \pi^T\right)^2\right).$$

[3] The government might plan for its current term of office only, or it might plan to be in office for several terms, discounting the future according to the probability of holding office. Alternatively, it might weigh pre-election years more heavily. These ideas are pursued in the study of Kiefer (2000) who finds little evidence that governments have long-term stabilization goals.
See Svensson (1997) for an elaboration of monetary policy based on multi-period objective functions. See Carlin and Soskice (2005) for a discussion of the single-period simplification.

[4] Ruge-Murcia (2003) questions the conventional linearity assumption. He develops an alternative where the government's inflation preferences are asymmetrical around its target.

[5] See, for example, Alesina et al. (1997).

[6] Barro and Gordon (1983) assume a zero inflation target and an unemployment target below the natural rate.

[7] Also see Ireland (1999).

[8] Although plausible, such policy lags conflict with conventional consumer choice derivations of the *IS* curve which do not show any lag; for example see Gali (2008).

[9] For a discussion of the appropriateness of this estimation method, see Fernandez-Villaverde and Rubio-Ramirez (2004).

[10] Although Adolfson et al. (2011) specify a quadratic objective function more general than ours, they discard it in favor of an ad hoc Taylor-type rule for interest rates.