DEPARTMENT OF ECONOMICS WORKING PAPER SERIES

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Working Paper No: 2013-14

November 2013

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Abstract

A standard model of activist macroeconomic policy derives a monetary reaction rule by assuming that governments have performance objectives, but are constrained by an augmented Phillips curve. In addition to monetary policy governments apply a variety of instruments to influence inflation and output, including fiscal policy, bailouts and exchange rates. Solving the Phillips curve and reaction rule for a reduced form, we study this model with a panel of OECD countries. A textbook version of the activist model leads to implausible results. The econometric results are much enhanced by accounting for serial correlation among output shocks. Our results suggest that governments do lean against inflation shocks, but not output shocks, although the flatness of the Phillips curve limits policy makers' ability to effective lean against the wind. Furthermore, the activist model fits the data only slightly better than a flat-Phillips-curve benchmark. Some results are unexpected, like the estimated slope of the Phillips curves and the implied stabilization behavior of Finland, Japan and US policy makers.

JEL codes: E61, E63
Keywords: stabilization policy, inflation targets, expectations

1. Introduction

Central to the endogenous policy model is a monetary rule *MR* derived by assuming that governments have an inflation target and are constrained by a Phillips curve *PC*.[1] Carlin and Soskice (2005) label this the *IS-PC-MR* model, adding an *IS* curve to explain how policy makers pursue their goal by setting interest rates. This approach can be further extended to include a variety of other policy instruments. But, is there evidence of effective activism beyond public pronouncements and decades of Keynesian doctrine? Perhaps these instruments are ineffective, or governments do not actually attempt to lean against the wind, or perhaps the Phillips curve is horizontal. If no short-run tradeoff exists, then there is no motivation to pursue activist intervention. This paper addresses these questions with an econometric analysis of a panel of OECD countries.

To keep the methodology simple we do not formally model international trade, although we allow for linkages in the form of between-country covariances. Nor, do we formally model policy tools such as interest, tax or exchange rates, government spending or bailouts. This reduces our inferences to those that can be drawn indirectly from examining inflation and output outcomes.

Because expected inflation enters the analysis as a shift in the Phillips curve, an important modeling issue is the nature of inflation forecasts. We explore several possibilities econometrically, including a simple inertial model, its generalization as an autoregressive model, and an alternative model-consistent rational model.

The estimation of a textbook version of the activist model leads to implausible inferences about macroeconomic dynamics. The econometric results are much enhanced by accounting for serial correlation, which we find to be rather important for output shocks, but not inflation ones. We do find evidence of activist stabilization, but it not strong, nor is it entirely consistent with conventional wisdom. We find Phillips curves with the wrong slope for some countries and with unexpected reaction implications.

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[1] This model also known as the political business cycle. The original insight for this literature dates to Kalecki (1943); also see Nordhaus (1975). Modern versions begin with Kydland and Prescott (1977) who introduced the logic of rational expectations; Barro and Gordon (1983) further develop this logic.

2. Macroeconomic structure and government objectives

The policy literature usually invokes an augmented Phillips curve as a structural constraint on policy makers. This is the *PC* part of the *IS-PC-MR* model. 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 unexpected inflation shock. Expected inflation $E_{t-1}^a \pi_t$ is defined as the forecast of a typical agent based on information available in the previous ; the operator subscript dates the forecast. Given 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 policy, an activist government may be able to temporarily increase output at the cost of higher inflation.

Another essential element is an assumption about political objectives; this is the basis of the *MR* curve. A simple possibility supposes that the government's goals are given by a quadratic function of the output gap and inflation,[2]

$$U_t = -\left(x_t^2 + \left(\pi_t - \pi^T\right)^2\right) \tag{2}$$

where π^T is the inflation target. Social welfare is often defined as an aggregation of individual preferences. Governmental targets may reflect a weighted average of citizen preferences.[3] Woodford (2003) establishes microfoundations for several close relatives of this function form as an approximation to the utility of a representative consumer-worker.

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[2] For example, see Clarida et al. (1999).

[3] Objectives might also include the discounted value of expected future outcomes. 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. Here we assume that only current conditions matter. See Kiefer (2000) for empirical evidence that only current conditions matter in political macroeconometrics.

Our endogenous policy model assumes that governments maximize (2) subject to (1). Quadratic goals are tractable because they result in linear solutions.[4] Within this family a variety of alternatives are plausible. Equation (2) has circular indifference curves, but these can be made elliptical by adding a parameter to reflect the relative weight of inflation versus output goals. Often the output target exceeds its potential level.[5] Some models invoke parabolic indifference curves.[6] Kiefer (2008) estimates eight different quadratic forms. He confirms the conventional wisdom that it is not possible to statistically separate the goal weight, the inflation target and the output target.[7] Thus, the target parameter π^T may be interpreted as a composite of weights and targets.

3. Optimal policy with an inflation target

Although an activist government has limited options in this model, it may be able to lean against the macroeconomic wind.[8] Following Carlin and Soskice, we assume that policy making is only effective after a one-year delay. This one-year delay is explained as a lag in the *IS* relation between interest rate and output gap.[9] Accordingly, we re-date the government's objective to next year's outcome and add an expectations operator,

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

Subject to the Phillips curve constraint, the government's preferred inflation for next year is

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

To the extent that agents are rational and well informed they would expect this outcome so that expected output is zero. However if agent forecasts behave otherwise, the policy maker can lean against the wind.

Adding a inflation shock ε_t and lagging by one year, gives inflation as

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[4] Ruge-Murcia (2003) presents evidence that questions the conventional linearity assumption. He develops an alternative where the government's inflation preferences are asymmetrical around its target.
[5] Barro and Gordon (1983) assume a zero inflation target and an unemployment target below that natural rate.
[6] See, for example, Romer (1993) or Alesina et al. (1997).
[7] Also see Ireland (1999).
[8] Fischer (1977) is an early example in this literature.
[9] Although plausible, this policy lag conflicts with conventional consumer choice derivations of the *IS* curve which does not show any lag; for example see Gali (2008).

$$\pi_t = \frac{E^a_{t-1}\pi_t + \psi^2 \pi^T}{1+\psi^2} + \varepsilon_t \tag{3}$$

assuming that the government cannot predict the inflation shock. Using the Phillips curve and adding another unexpected shock ξ_t, the output gap is

$$x_t = -\psi \frac{E^a_{t-1}\pi_t - \pi^T}{1+\psi^2} + \xi_t \tag{4}$$

Equations (3) and (4) imply that macroeconomic outcomes depend on shocks, expectations, Phillips curve slopes and policy targets. This solution is the point where the *PC* and *MR* curve cross except for inflation and output shocks; the later are taken to be independent and identically distributed random variables.

We assume that the government implements policy through variety of instruments (monetary policy, unemployment insurance, tax rebates, infrastructure spending, bailouts, exchange rates, etc.) and that the various agencies pursue this common policy. We assume that policy goals can be measured in terms of the inflation target; below we explore allowing this target to vary among countries. Our model is two of the equations in Carlin and Soskice's three-equation model, dropping the *IS* equation. We would need several more equations to directly model the government's instruments; we would also need to assume that these all can be separated from the underlying reaction functions as the *IS* curve can, and that all display the same one-year lag. This study is limited to policy that exploits the Phillips tradeoff; governments often pursue other mechanisms to influence macroeconomic outcomes.

In the long run agents come to understand that a policy of $\pi^T > 0$ implies inflation. In the absence of shocks or uncertainty, the time-consistent equilibrium inflation rate should occur where inflation is just high enough so the government is not tempted to spring a policy surprise. This equilibrium occurs at the potential output and the inflation target, $x = 0$, $\pi = \pi^T$.

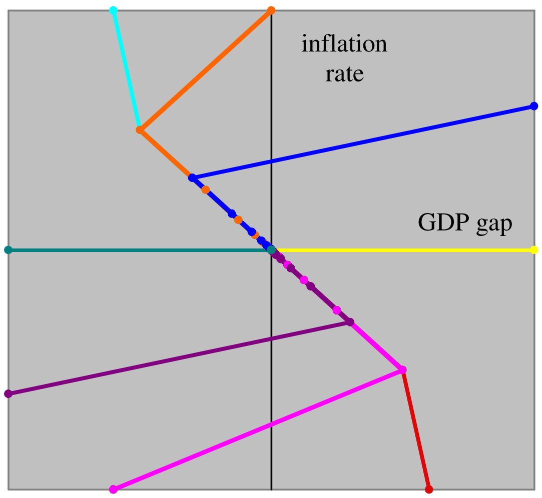
Because these equations are a reduced form, they are appropriate for econometric estimation. An alternative estimate of the Phillips curve slope could be based on the structural equation (1). The obvious objection to such a regression is that it may be affected by simultaneity bias because the output gap is endogenous, an issue that does not arise with (3) and (4).

As compared to the literature on monetary policy econometrics, this is a very small and stylized specification. Recent research reports much more complicated models; see the dynamic stochastic general equilibrium approach of Christiano et al. (2005) or Smets and Wouters (2003). The latter, for example, specifies 4 structural parameters without estimation and uses Bayesian methods to estimates 32 additional parameters in a 9-equation model. By comparison our 2-equation model has only 2 parameters. 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. Although this literature develops a detailed description of consumer and firm objectives and behavior, they often model government behavior as an agnostic stochastic process without any objective function.

4. Expected inflation

The concept of expected inflation has been much discussed. The inertial assumption, $E^a_{t-1}\pi_t = \pi_{t-1}$ is one possible model for this unobserved variable. This simple forecasting rule, common in textbooks, has the desirable property that it converges to the time-consistent equilibrium. Figure 1 illustrates this proposition with trajectories for this model. These are simulated policy responses to a variety of temporary inflation and output shocks. We do not require that these shocks fall along the contemporaneous Phillips curve, although inflation shocks have consequences for subsequent curves to the extent that they affect expectations. These paths calculated according to a unit-slope Phillips curve, a zero inflation target and inertial expectations; each dot denotes one year. These dynamics generate the negative-sloped *MR* curve. Since output shocks are often be accompanied by inflation shocks, the blue path is of interest. The model predicts that the response to any inflation shock is a recession (even one initially associated with a boom as in the blue case), and that it responds to any deflation shock with a boom. One peculiar prediction of these equations is the horizontal jump from any initial condition along the horizontal axis to the long-run equilibrium, for example the response to a positive (yellow) or negative (green) output shock. This occurs because random output shocks have no effect on the location of the Phillips curve; this curve is only shifted by an inflation shock, or last-year's inflation. This implication is a shortcoming of this standard model of activist policy.

Figure 1. Some stylized trajectories using inertial expectations



Perhaps these peculiarities are connected to the naivity of interial expectations. To the extent that agents use more than just one year's experience to make their forecasts, we might generalize expectations as an *AR* form,

$$E_{t-1}^{a}\pi_t = \alpha_0 + \sum \alpha_k \pi_{t-k} \tag{5}$$

Such a model has merit in that it increases the number of the determinants of expectations.

Many Economists may be skeptical of such backward-looking specifications. Another approach to expectations acknowledges that the typical agent ought to know the government's inflation target, she ought use this information to forecast inflation. Taking the expectation of (3) and recalling that by assumption future shocks are unpredictable, we can show that the model-consistent rational expectation is $E_{t-1}^{a}\pi_t = \pi^T$. Substituting into (3), gives the solution,

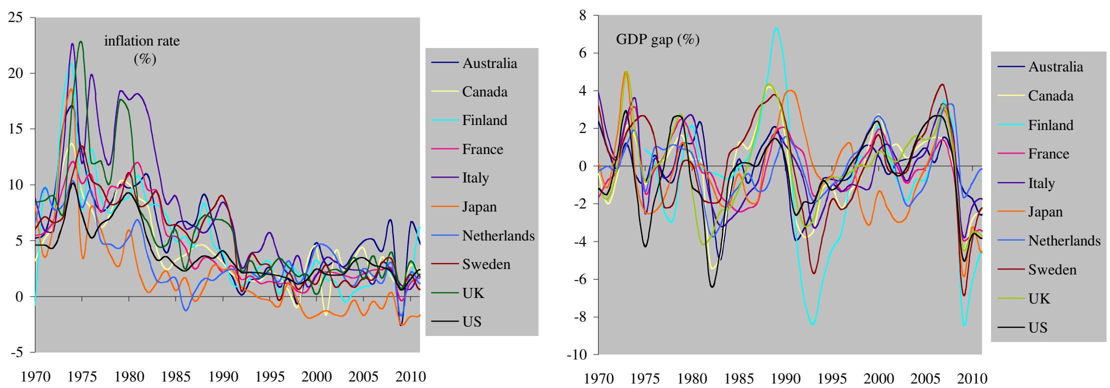
$$\begin{aligned} \pi_t &= \pi^T + \varepsilon_t \\ x_t &= \xi_t \end{aligned} \tag{6}$$

When these behavioral assumptions are valid (activist government with rational agents), the equilibrium is the inflation target and potential output. In this case we cannot estimate the slope of the Phillips curve, although the inflation target is identified.

5. A panel of OECD economies

We study a panel of countries chosen for data availability and because they are significant in the global economy, OECD (2011). Our inflation rate is percentage change in implicit GDP price deflator. GDP gap is the percentage deviation from potential GDP.[10] Figure 2 plots annual observations of these series.

Figure 2. The OECD macroeconomic data, 1970-2011



The inflation plot shows high inflation initially, moderating during the 1990s and 2000s. The gap series reveals greater cyclical behavior with across-country correlation. The global crisis of 2008 is apparent as a spike to output, but its impact can also be seen in the inflation series.

Table 1. Macroeconomic statistics, 1977-2011 averages

	GDP deflator inflation (%)	GDP gap (%)
Australia	4.70	-0.37
Canada	3.49	-0.24
Finland	3.94	-0.89
France	3.68	-0.31
Italy	6.23	-0.39
Japan	0.51	-0.59
Netherlands	2.35	-0.16
Sweden	4.31	-0.35
United Kingdom	4.79	-0.22
United States	3.28	-0.40
average	3.73	-0.39

[10] Giorno et al. (1995) discuss the OECD methodology for estimating the output gap.

Although these data are available starting in 1970 for most countries (except Finland), we limit the sample to annual averages starting in 1977 in order to work on a balanced panel. Unfortunately this excludes the 1974 oil shock, but it adds Finland's rather extreme output swings. Table 1 reports descriptive statistics.

Given that the GDP gap should be centered on zero by definition, it is a little surprising to find negative averages for all countries. This probably reflects the severity of the 2008 crisis.

Table 2 reports initial regression results. Although we do not make any modeling adjustments for openness or international trade, our estimation procedure does recognize across-country covariance.[11] We allow nonzero contemporaneous covariances between inflation and output shocks and across countries. All the estimates reported below are calculated by the seemingly unrelated regressions method; all are systems of equations with cross-equation restrictions.[12] Model (a) estimates (3) and (4), invoking the inertial assumption and requiring identical coefficients in all countries. The results are discouraging for the activist model; neither parameter is statistically significant, neither has the expected sign. Imposing the rational expectation solution (6) is an improvement. Model (b) finds an inflation target of about 1% and achieves the better fit.[13]

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[11] Justification rests on the theoretical result in Clarida et al (2001), that stabilization policy in an open economy is qualitatively the same as that of a closed economy.

[12] This method incorporates a non-diagonal across-equation-across-country covariance matrix. The reported results are obtain by iterating the generalized least squares estimate until it converges in the covariance matrix and the parameters

[13] For a system of equations the Schwartz criterion is

$$SC = T \ln\left(\left|\text{error covariance}\right|\right) + \left(\text{number of parameters}\right)\ln\left(T\right).$$

For model (b) there is only one parameter and the number of observations is 35 in the *SC*. The total number of observations is 700 since we have ten countries, two equations each.

Table 2. Initial empirical results,
uncorrelated shocks, 10 OECD countries, 1977-2011, seemingly unrelated regressions
(z-ratios in parentheses), *restrictions in italics*

	(a)	(b)	(c)	(d)
	inertial expectation	rational expectation	*AR*(3) expectation	flat Phillips curve
Phillips curve slope	-0.010		0.107	
	(-0.605)		(4.864)	
target	-1.260	0.842	2.120	*0.831*
	(-0.103)	(5.068)	(15.515)	
AR constant			*0.715*	0.189
				(1.227)
AR 1-year lag			0.132	0.417
			(4.787)	(8.343)
AR 2-year lag			0.323	0.200
			(13.62)	(4.799)
AR 3-year lag			0.208	0.156
			(9.924)	(4.414)
Schwarz criterion	315	238	123	173

Model (c) generalizes the inertial model according to (5), using an *AR*(3) to model expected inflation.[14] We restrict the long-run equilibrium *AR* equation to equal the inflation target,

$$\pi^T = \frac{\alpha_0}{1-\alpha_1-\alpha_2-\alpha_3} \tag{7}$$

With this assumption we rewrite the activist model (3) and (4) as[15]

$$\pi_t = \frac{\pi^T(1-\alpha_1-\alpha_2-\alpha_3)+\alpha_1\pi_{t-1}+\alpha_2\pi_{t-2}+\alpha_3\pi_{t-3}+\psi^2\pi^T}{1+\psi^2}+\varepsilon_t$$

$$x_t = -\psi\frac{\pi^T(1-\alpha_1-\alpha_2-\alpha_3)+\alpha_1\pi_{t-1}+\alpha_2\pi_{t-2}+\alpha_3\pi_{t-3}-\pi^T}{1+\psi^2}+\xi_t$$

The *AR* constant coefficient reported above is calculated according to restriction (7).[16] This specification results in plausible estimates for the Phillips curve and target parameter and an improved goodness-of-fit.

However, we find that an agnostic *VAR*(1) specification for the same two dependent variables (6 parameters) lowers the Schwarz statistic to 44, suggesting that none of these specifications provide an

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[14] Varying the *AR* order, three lags minimize the Schwartz criterion for this 10-equation *AR* system (restricting the α's to be the same in all countries).
[15] We impose this restriction for modeling consistency. It may not be valid if agents are unaware of the government's target, or do not make forecasts that take this logical requirement into account.
[16] In an unreported regression we find that relaxing this restriction does not improve the fit; the Schwartz increases to 127.

adequate statistical explanation. We believe, however, that a more appropriate benchmark should impose a flat Phillips curve, $\psi = 0$. Under this restriction all motivation for activism is removed. Imposing this restriction removes the tradeoff between inflation and the output; the target parameter drops out of equations (3) and (4). Now the government (even though it has activist goals) prefers the expected inflation rate, and a zero output gap.

$$\pi_t = E^a_{t-1}\pi_t + \varepsilon_t$$
$$x_t = \xi_t$$

This benchmark is estimated as model (d). We find that the activist specification does fit these data better.[17]

In Figure 3 we plot simulated policy simulates responses (one year between dots) to generic shocks for model (c) by the same method as Figure 1. These dynamics look much different; they trace out a nearly vertical *MR* curve, suggesting that potential for using the Phillips tradeoff to lean against the inflation shocks is very limited. Because of this nearly vertical *MR* curve, the trajectories do not show any overshooting along the blue and purple paths. These paths are nearly indistinguishable from those of the flat benchmark (not plotted) with its exactly vertical *MR* curve. Even though the activist specification achieves an improved fit, the lack of correspondence between these predictions and observation casts doubt on the activist model.

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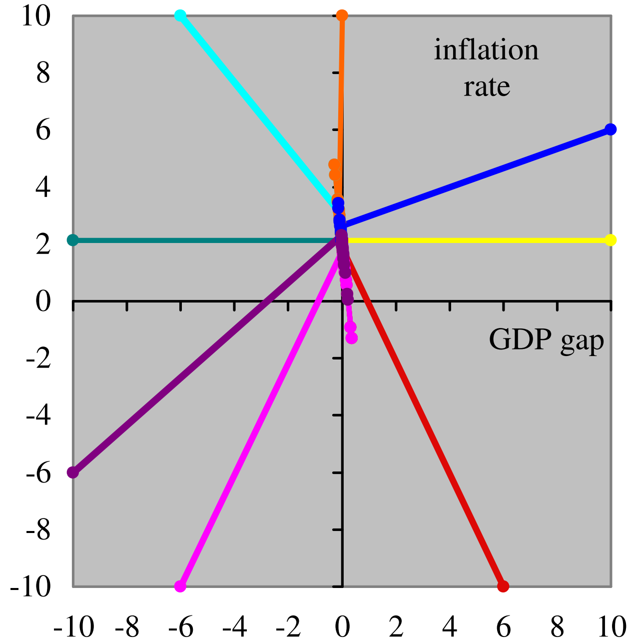
[17] We estimate (e) as a 10-equation $AR(3)$ system for inflation rates. We calculate the Schwartz statistic from the residuals from these seemingly unrelated regressions plus observations on GDP gap for the 10 countries (the flat model takes all deviations from potential outputs as residuals).

Figure 3. Simulated trajectories, model (c)



6. Autocorrelation

Another reason to doubt these results is methodological: our econometrics have assumed uncorrelated error terms, despite the frequent observation of serial correlation in macroeconomic time series. Thus, we modify the output error term to introduce first-order autocorrelation, $\xi_t = \rho_\xi \xi_{t-1} + \upsilon_t$. Table 3 repeats the specifications in Table 2 with this alternative error structure, finding improved Schwartz statistics in all cases. Again, the inertial and rational expectations specifications fit the data poorly; specification (g) gives a better fit, but only slightly better than that of the flat benchmark (h).[18] We find strong output autocorrelation implying that multiple output shocks are often strung together.

[18] In unreported regression we find that a *VAR*(1) with output autocorrelation achieves a Schwartz of –12.

Table 3. Further empirical results,
first order output autocorrelation, 10 OECD countries, 1977-2011, seemingly unrelated regressions
(z-ratios in parentheses), *restrictions in italics*

	(e)	(f)	(g)	(h)	(i)	(j)
	inertial expectation	rational expectation	*AR*(3) expectation	flat Phillips curve	new Keynesian Phillips curve	double-lag timing
Phillips curve slope	-0.102		0.147		0.165	0.126
	(-7.082)		(3.878)		(4.238)	(3.633)
target	1.096	1.000	1.505	*1.504*	1.957	1.841
	(0.386)	(11.211)	(6.073)		(12.575)	(10.763)
AR constant			*0.371*	0.378	*0.448*	*0.623*
				(5.015)		
AR 1-year lag			0.226	0.250	0.554	0.033
			(7.276)	(7.644)	(16.460)	(1.845)
AR 2-year lag			0.321	0.306	-0.180	0.335
			(13.767)	(11.643)	(-3.832)	(13.027)
AR 3-year lag			0.206	0.193	0.397	0.294
			(9.416)	(8.363)	(14.903)	(12.635)
output autocorrelation	0.739	0.558	0.686	0.697	0.669	0.631
	(25.930)	(21.345)	(25.897)	(27.105)	(26.026)	(27.797)
Schwarz criterion	107	119	-37	-36	-7	-18

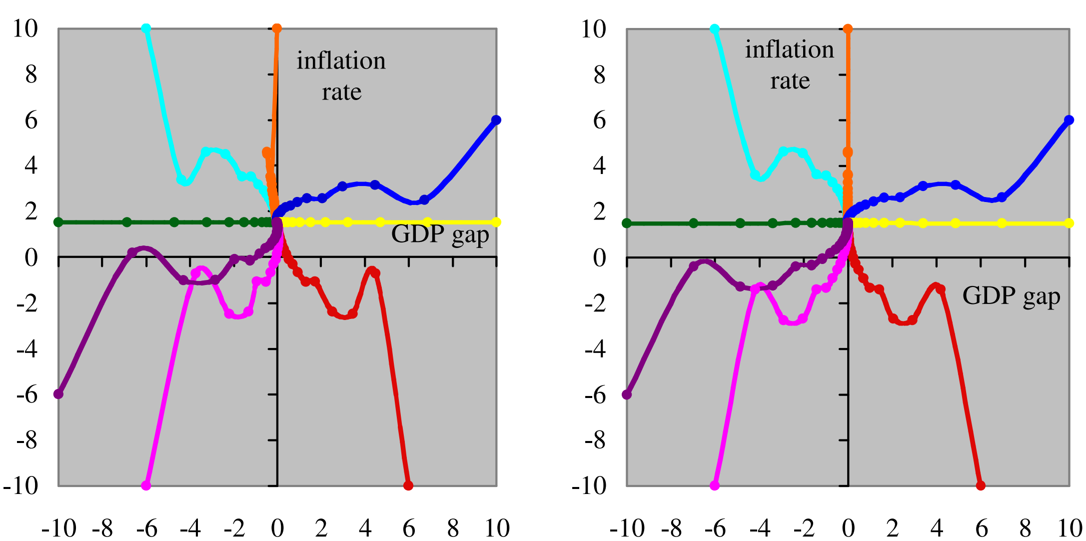
A further extension might introduce serial correlation among inflation shocks. This extension would introduce an added theoretical consideration because it implies that the shock is partially predictable. Correlated output shocks are also predictable, but according this policy model, governments do not react output shocks, only inflation ones. We explore inflation correlation at length in Appendix A. But, because we find little empirical evidence of serial correlation among inflation shocks, we see little relevance for such modeling.

Our approach contrasts with the popular methodology one that specifies the current inflation rate as its rational expectation. This frequently invoked method then constructs instruments for the endogenous variable (current inflation); usually lagged inflation rates are included among the instruments; see Gali and Gertler (1999), Smets and Wouters (2003) or Christiano et al. (2005). The first step of this two-step procedure might be the estimation of an *AR*(3), half of the equations in (h). According to this methodology, the lag-weights in (h) can be interpreted as rational, while those in (g) are behavioral. The closeness of these estimates are consistent with the hypothesis that agents are making rational forecasts, but they are also consistent with the hypothesis that government are not able to practice stabilization policy due to a flat Phillips curve.

Figure 4 compares the dynamics predicted by models (g) and (h). Gone is the immediate convergence of Figure 3. All paths converge gradually to equilibrium along plausible paths, although most of this behavior arises from autocorrelation, not activist policy. The clear similarity of these plots reflects the closeness of their Schwarz statistics. Cyclic oscillations appear in the convergence of inflation to the long run, but not for output. For the flat model (h), the response follows the vertical axis after a pure inflation shock (the orange path), consistent with a flat Phillips curve. For model (g) a pure inflation shock results in an almost straight response, again reflecting the closeness of these specifications. The prediction that pure output shocks do not have any inflation consequences remains surprising; so are those for pure inflation shocks.

Figure 4. Simulated policy trajectories, correlated shocks

activist *AR*(3) expectations (g) flat Phillips curve benchmark (h)



7. Alternative specifications

Models (i) and (j) investigate two alternative models suggested in the literature. Following Calvo's (1983) sticky-price model of the Phillips curve, expectations look forward to future inflation, and (1) is respecified as

$$\pi_t = E^a_{t-1}\pi_{t+1} + \psi x_t + \varepsilon_t$$

It is appropriate to incorporate only the information that was public at the time of the forecast. Thus, we date the expectation at t-1 because aggregate prices are not published until after the current date.[19] According to this theory, we have the same solution equations with the substitution of $E^a_{t-1}\pi_{t+1}$ for $E^a_{t-1}\pi_t$. Applying the AR(3) expectations model recursively, we write the two-year forecast based only on lagged rates as

$$E^a_{t-1}\pi_{t+1} = \alpha_0 + \alpha_1 E^a_{t-1}\pi_t + \alpha_2\pi_{t-1} + \alpha_3\pi_{t-2}$$
$$E^a_{t-1}\pi_{t+1} = \alpha_0(1+\alpha_1) + \left(\alpha_1^{\,2} + \alpha_2\right)\pi_{t-1} + (\alpha_1\alpha_2 + \alpha_3)\pi_{t-2} + \alpha_1\alpha_3\pi_{t-3}$$

Our model (i) substitutes forward-looking expectations and imposes the above restriction on the activist model. Table 3 shows that it does not fit the data as well, and it's estimates of the forecasting coefficients differ considerably from those of the best-fitting AR(3), reported as (h). If this new Keynesian Phillips curve is valid, then this specification should have improved the fit.

Another theory is a double-lag timing hypothesis: this model proposes that output impact is delayed by one year as before, but the inflation impact is delayed by two years. Svensson (1997) stipulates that output is affected by policy after one, and inflation effects are delayed an additional year due to the lagging of output gap in the Phillips curve, although he offers no theoretic foundations for these lags.[20]

$$\pi_t = E^a_{t-1}\pi_t + \psi x_{t-1} + \varepsilon_t$$

Now we rewrite the government's objective to includes only the arguments when they are initially be affected by policy,[21]

$$E^g_t U = -E^g_t\left(x^2_{t+1} + \left(\pi_{t+2} - \hat{\pi}\right)^2\right)$$

Solving by the same method, lagging appropriately and adding random shocks to both the inflation and output solution gives

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[19] Modeling expectations in terms of current inflation is also problematic because it introduces an endogenous variable into the right side of regression model.

[20] Carlin and Soskice favor the double-lag as being more realistic, and for facilitating the derivation a Taylor rule.

[21] For simplicity we do not discount the inflation term even though that it would be appropriate for this dating, especially if the current year has an election scheduled.

$$\pi_t = \frac{E_{t-2}^g\left(E_{t-1}^a \pi_t\right) + \psi^2 \hat{\pi}}{1+\psi^2} + \varepsilon_t$$

$$x_t = -\psi\left(\frac{E_{t-1}^g\left(E_t^a \pi_{t+1}\right) - \hat{\pi}}{1+\psi^2}\right) + \xi_t$$

where $E_{t-2}^g\left(E_{t-1}^a \pi_t\right)$ denotes the government's expectation in the $(t\text{-}2)^{th}$ year of the private sector's forecast to be made in the $(t\text{-}1)^{th}$ year. This double-lag timing assumption implies that inflation is affected by the government's two-year forecast of inflation. A two-year government forecast also affects growth, but here it is only one year old; in this equation policy looks ahead to influence future inflation. Of course, other timing assumptions are possible.

Assuming that both agents and governments use the same *AR*(3) forecasting model, we specify that

$$E_{t-2}^g\left(E_{t-1}^a \pi_t\right) = \alpha_0(1+\alpha_1) + \left(\alpha_1^{\,2} + \alpha_2\right)\pi_{t-2} + (\alpha_1\alpha_2 + \alpha_3)\pi_{t-3} + \alpha_1\alpha_3\pi_{t-4}$$

The activist model is then rewritten as

$$\pi_t = \frac{\pi^T(1-\alpha_1-\alpha_2-\alpha_3)(1+\alpha_1) + \left(\alpha_1^{\,2}+\alpha_2\right)\pi_{t-2} + (\alpha_1\alpha_2+\alpha_3)\pi_{t-3} + \alpha_1\alpha_3\pi_{t-4} + \psi^2\pi^T}{1+\psi^2} + \varepsilon_t$$

$$x_t = -\psi\frac{\pi^T(1-\alpha_1-\alpha_2-\alpha_3)(1+\alpha_1) + \left(\alpha_1^{\,2}+\alpha_2\right)\pi_{t-1} + (\alpha_1\alpha_2+\alpha_3)\pi_{t-2} + \alpha_1\alpha_3\pi_{t-3} - \pi^T}{1+\psi^2} + \xi_t$$

Model (j) imposes these restrictions, again finding a fit worse that than the single-lag version (g). If double-lagged timing is valid, then this restriction should have improved the fit.

8. A country-specific behavior

Perhaps the fit of (g) is disappointing because of its all-countries-identical restrictions: identical Phillips curves in all countries, all policy makers share the same target, and all economies converge to the same output-inflation point. Model (l) allows these parameters to vary among countries, reported in Table 4. Since four of these countries joined in the Eurozone in 1999 (Finland, France, Italy and Netherlands), we specify that these four countries share a common target during the Euro years, although they retain different slopes. Overall model (l) achieves our best fit (Schwartz of –51) despite the large increase in the number of parameters (25 instead of 6). The result that the Eurozone target is less than that of 3 of the 4 member countries is consistent with of casual observation that the European Central Bank is committed to a low inflation target. However, a flat version (k) with 11 different targets fits these data nearly as well; its Schwartz is –50, and its target estimates are very close to those in model (l).

Table 4. Individual country estimates, activist and structural Phillips curve models, output autocorrelation, 10 OECD countries, 1977-2011

	(k)	(l)		(m)	(n)
	flat Phillips curve, seemingly unrelated	reduced, seemingly unrelated		structural, seemingly unrelated	structural, 3SLS
	target	target	slope	slope	slope
Australia	4.554*	4.272*	0.255*	0.349*	0.466
Canada	3.212*	3.535*	0.589*	0.292*	0.256
Finland	4.283*	4.224*	-0.441*	0.031	0.015
France	3.666*	3.092*	-0.005	0.325*	0.419*
Italy	6.665*	6.399*	0.232*	0.471*	0.691*
Japan	-0.207	-0.290	-0.344*	0.244*	0.245
Netherlands	1.771*	2.201*	0.798*	0.389*	0.335
Sweden	3.464*	3.407*	0.208	0.218*	0.209
UK	3.861*	2.787*	0.070	0.469*	0.609*
US	3.194*	3.264*	-0.307*	0.303*	0.230*
Eurozone	2.220*	2.279*			
average	3.155	3.008	0.106	0.262	0.347

* statistically significant at the 5% level

Although 7 of the 10 Phillips slope estimates in model (l) are significant, three (Finland, Japan and US) have unexpected negative slopes. To further investigate this surprise, we report slopes estimated as a system of 10 structural equations, reported as model (m) in Table 4. For comparability with model (l) this (m) also incorporates $AR(3)$ expectations. These structural estimates give positive slopes for all countries, statistically significant for all except Finland. A shortcoming of (m) is the possibility of simultaneity bias arising from the endogeneity of the output gap. The conventional solution for this failure of the classical regression assumptions is instrumental variables.[22] Accordingly, we report consistent Phillips curve estimates as model (n).[23] Again all slopes are positive and their average increases, but now only 4 are statistically significant. A comparison of the activist and the structural slopes shows large differences; for example, the US slope is positive at about 0.2 for model (n), but about -0.3 in model (l). If (l) is valid, then

[22] We use three lags of inflation and two of GDP gap as instruments.

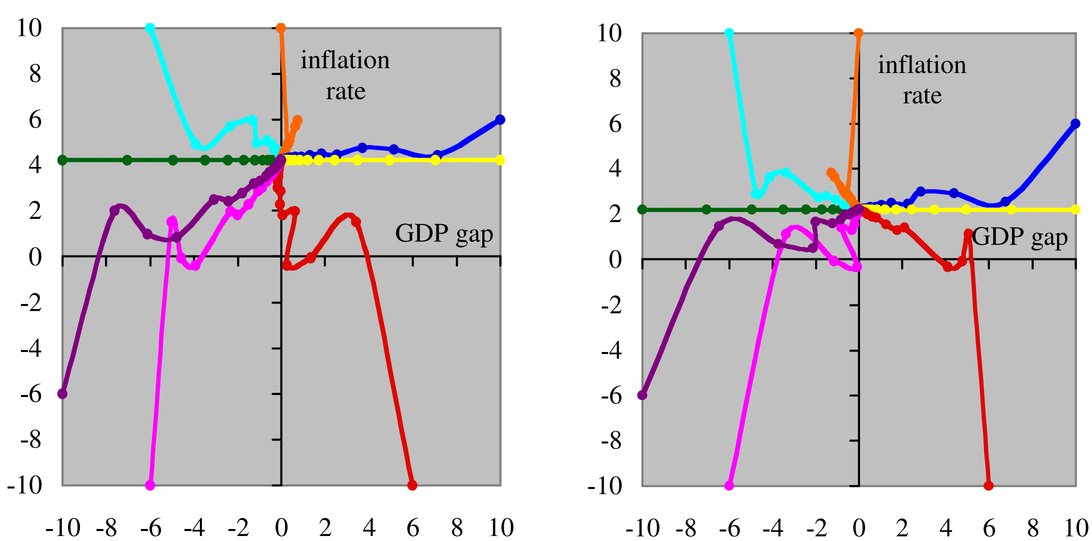
[23] The differences between (m) and (n) validate the concern about simultaneity bias. A system-wide Hausman endogeneity test supports the hypothesis that the GDP gap is endogenous: the *t*-ratio resulting from adding its reduced form residual to the ten structural equations is –2.70.

US policy makers tend to respond to above equilibrium inflation by engineering a boom, and a recession in response to below equilibrium inflation.

Although their average is positive and comparable to that estimated for the all-countries-identical model (g), we find wide variation in the country-specific estimates. Finland is an outlier with an inflation target 4% and a negative *PC* slope. Figure 5 compares the estimated dynamic responses for Finland and the Netherlands, for which we estimate a positive slope. Again, we find that a pure output shocks have no price consequences. In both cases convergence is gradual and the trajectories do not generally follow straight paths. Although there are apparent differences, there are also many similarities between these plots, and even more for countries with nearly flat Phillips curves.

Figure 5. Outlier trajectories for model (l)

Finland (pre Euro) Netherlands (pre Euro)



9. Conclusion

We develop a standard theory of activist policy, and test its relevance to recent macroeconomic history using a panel of interconnected countries. Although the simplest regression models do not fit these data well, a correction for autocorrelation brings improvement. The rational expectations version of this model is poorly supported by these data, but an *AR* generalization of the inertial model of expectations shows promise. We find a plausible, but a rather flat Phillips curve slope, an inflation target of about 2%, and plausible predictions of dynamic response. Imposing the restrictions implied by the new Keynesian

Phillips curve and the double-lag timing hypotheses are not supported by these data. However, extending the activist specification to allow for differences between countries achieves further improvement. We conclude that this Keynesian model of asymmetric information and backward-looking expectations is consistent with the data. However, we find are large differences between countries and some surprises.

Our most surprising finding is that of “wrong-sloped” Phillips curve for the US, Finland and Japan. Nowhere in the literature on the foundations of the Phillips’ tradeoff does any theory suggest a negative slope.[24] Moreover, the method used by the OECD to measure the GDP gap invokes the NAIRU concept, see Giorno et al. (1995). This method inconsistent in the case of a negative slope, which implies that inflation rate should actually decelerate in response to a decrease in unemployment (or an increase in the output gap). These doubts are not reduced by the possibility of a flat Phillips curve; a NAIRU is inconceivable if the Phillips curve is flat. One response to our surprising results is to question the data; the OECD does reports a NAIRU of over 12% for Finland in the mid-90s, but less than 4% for the Netherlands after the turn of the century.

Perhaps our results reveal real structural differences, although contemporary accounts of the Finnish and Dutch (at the opposite extreme) economies do not support this explanation, see Wikipedia (2013a, b). The economic structure and policy institutions of these countries are not very different. Although severe, the Finnish depression of the early 1990 has been described in very conventional terms as the combination of an over-liberalization of financial regulation and the output shock associated with the collapse of the Soviet Union. Perhaps the unconventional stabilization behaviors implied by our results are simply a statistical aberration.

Thus, while this study weakly validates conventional thinking about macroeconomic policy, it poses several unsolved puzzles.

[24] See Phelps (1967), Lucas (1972) and Calvo (1983)

References

Alesina, Alberto and Nouriel Roubini with Gerald Cohen (1997) *Political Cycles and the Macroeconomy*, Cambridge, MA, MIT Press.

Barro, Robert J and David B Gordon (1983) "A Positive Theory of Monetary Policy in a Natural-Rate Model," *Journal of Political Economy 91*: 598-610.

Calvo, Guillermo A (1983) "Staggered Prices in a Utility Maximizing Framework," *Journal of Monetary Economics 12*: 383-398.

Carlin, Wendy and David Soskice (2005) "The 3-Equation New Keynesian Model–a Graphical Exposition," *Contributions to Macroeconomics 5*: Issue 1, Article 13.

_____ (2006) *Macroeconomics: Imperfections, Institutions and Policies*, New York, Oxford University Press.

Christiano Lawrence J, Martin Eichenbaum and Charles L Evans (2005) "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy," Journal of Political Economy 113: 1-45.

Clarida, Richard, Jordi Gali and Mark Gertler (1999) "The Science of Monetary Policy: a New Keynesian Perspective," *American Economic Review 37*: 1661-1707.

_____ (2001) "Optimal Monetary Policy in Open versus Closed Economies: An Integrated Approach," *Journal of Economic Literature 91*: 248-252.

Fischer, Stanley (1977) "Long-Term Contracts, Rational Expectations, and the Optimal Money Supply," *Journal of Political Economy 85*: 191-205.

Gali, Jordi (2008) *Monetary Policy, Inflation and the Business Cycle,* Princeton NJ, Princeton University Press.

_____ and Mark Gertler (1999) "Inflation dynamics: A structural econometric analysis," *Journal of Monetary Economics 44*: 195-222..

Giorno, Claude, Pete Richardson, Deborah Roseveare, and Paul van den Noord (1995) "Estimating potential output, output gaps and structural budget balances." OECD Economics Working Papers, No. 152. OECD.

Ireland, Peter N (1999) "Does the Time-Consistency Problem Explain the Behavior of Inflation in the United States?" *Journal of Monetary Economics 44*: 279-292.

Kalecki, Michael (1943) "Political Aspects of Full Employment," *Political Quarterly 4*: 322-331.

Kiefer, David (2000) "Activist Macroeconomic Policy, Election Effects and Adaptive Expectations: Evidence from OECD Economies," *Economics and Politics 12*: 137-154.

_____ (2008) "Revealed Preferences for Macroeconomic Stabilization," *Journal of Applied Economics 11*: 119-143.

Kydland, Finn E., and Edward C. Prescott (1977) "Rules Rather than Discretion: The Inconsistency of Optimal Plans," *Journal of Political Economy 85*: 473-92.

Lucas, Robert E. Jr (1972) "Expectations and the Neutrality of Money," *Journal of Economic Theory 4*: 102–23.

Nordhaus, William (1975) "Political Business Cycle," *Review of Economics Studies 42*: 169-190.

OECD (2011), "OECD Economic Outlook No. 90," *OECD Economic Outlook: Statistics and Projections* (database).

Phelps Edmund S (1967) "Phillips Curves, Expectations of Inflation and Optimal Unemployment over Time," *Economica 34*: 254-281.

Romer, David (1993) "Openness and Inflation: Theory and Evidence", *Quarterly Journal of Economics 108*, 869-903.

Ruge-Murcia, Francisco (2003) "Inflation Targeting under Asymmetric Preferences," *Journal of Money, Credit and Banking*, 35: 763-785.

Smets, Frank and Raf Wouters (2003) "An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area," *Journal of the European Economic Association, 1*: 1123-1175.

Woodford, Michael (2003) *Interest and Prices*, Princeton NJ, Princeton University Press.

Wikipedia, (2013) "Economy of Finland," accessed 11/1/2013, http://en.wikipedia.org/wiki/Economy_of_Finland.

Wikipedia, (2013) "Economy of the Netherlands," accessed 11/1/2013, http://en.wikipedia.org/wiki/Economy_of_the_Netherlands.

Appendix A. Inflation autocorrelation

To further explore the consequences of serial correlation, we introduce first-order autocorrelation in both inflation and output.

$$\varepsilon_t = \rho_\varepsilon \varepsilon_{t-1} + \mu_t$$
$$\xi_t = \rho_\xi \xi_{t-1} + \upsilon_t$$

The ρ's are parameters; μ_t and υ_t are independent and identically distributed random variables.

With serial correlation between inflation shocks it is no longer true that the future shocks are unpredictable, an assumption made in (3). Supposing that rational governments know the autocorrelation parameter, then we should rewrite our inflation solution as

$$\pi_t = \frac{E^a_{t-1}\pi_t + \rho_\varepsilon \varepsilon_{t-1} + \psi^2 \pi^T}{1+\psi^2} + \varepsilon_t$$

Combining this result with the error specification gives

$$\pi_t = \frac{E^a_{t-1}\pi_t + \psi^2 \pi^T}{1+\psi^2} + \left(\frac{2+\psi^2}{1+\psi^2}\rho_\varepsilon\right)\varepsilon_{t-1} + u_t$$

The solution is essentially unchanged: the error term still takes the *AR*(1) form, but with a redefined autocorrelation parameter. This equation implies that activist policy amplifies any inherent serial correlation. For output the introduction of inflation autocorrelation rewrites (4) as

$$x_t = -\psi \frac{E^a_{t-1}\pi_t - \pi^T}{1+\psi^2} + \left(\frac{\rho_\varepsilon}{\psi(1+\psi^2)}\right)\varepsilon_{t-1} + \rho_\xi \xi_{t-1} + v_t$$

Again, the solution is unchanged except for the error term, which now involves lagged shocks to both inflation and output.

This logic raises a theoretical problem: the second term in our output equation is undefined for $\psi = 0$, although this issue dissapears when inflation autocorrelation is zero. Estimation of this specification finds that ρ_ε is indeed statisticaly insignificant and close to zero. Its fit is inferior to model (g) with a $\rho_\varepsilon = 0$ restriction which fits these data better, Schwartz of –35.

In the presence of rational agents who know both the slope of the Phillips curve and autocorrelation coefficient ρ_ε, our rational solution (6) also needs revision. Taking the expectation of the above inflation solution and solving, we get

$$E_{t-1}^{a}\pi_t = \pi^T + \frac{1+\psi^2}{\psi^2}\rho_\varepsilon \varepsilon_{t-1}$$

and this amends rational solution as

$$\pi_t = \pi^T + \left(\frac{1+\psi^2}{\psi^2}\rho_\varepsilon\right)\varepsilon_{t-1} + u_t$$

$$x_t = -\frac{\rho_\varepsilon}{\psi}\varepsilon_{t-1} + \rho_\xi \xi_{t-1} + v_t$$

which this reduces to (6) when $\rho_\varepsilon = 0$.

Appendix B. Residual analysis

Table B summarizes the estimate of the 210 elements in the covariance matrix resulting from our best-fitting model. It shows that the within-country variances of inflation and growth shocks are larger than across-country covariances. The across-country inflation and growth covariances are both substantial, consistent with the apparent synchronization of the global business cycle. We estimate the within-country output-inflation covariances to be smaller, even more so across countries.

Table B. Summary model (l) covariance estimates,
i and *j* subscripts denote countries

	averages	observations
within inflation: $\text{var}(\mu_{it}) = \sigma_{i\mu}^2$	3.730	10
within output: $\text{var}(\upsilon_{it}) = \sigma_{i\upsilon}^2$	2.803	10
within output-inflation: $\text{cov}(\mu_{it}, \upsilon_{it}) = \sigma_{ii\mu\upsilon}$	0.835	10
across inflation: $\text{cov}(\mu_{it}, \mu_{jt}) = \sigma_{ij\mu}$	1.453	45
across output: $\text{cov}(\upsilon_{it}, \upsilon_{jt}) = \sigma_{ij\upsilon}$	1.565	45
across output-inflation: $\text{cov}(\upsilon_{it}, \mu_{jt}) = \sigma_{ij\upsilon\mu}$	0.703	90

The plot of the distribution of the residuals in Figure A reinforces the conclusion that output-inflation covariance is low. A variety of macroeconomic shocks have occurred.

Figure A. Residuals for model (l)