Inflation Targeting versus Price-Path Targeting: Looking for Improvements

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The world's central banks have undergone dramatic changes in the past fifteen years. Increases in independence and transparency have been coupled with a shift in focus. Price stability is now the paramount objective for the vast majority of modern central bankers. Combined, these changes in central bank structure and policy framework have yielded substantial benefits. Low and stable inflation has brought with it high and stable growth.

Taking recent successes as a starting point, we look at the possibility for further improvements. Could countries benefit by shifting from inflation targeting to price-path targeting? The answer depends on the structure of each country's economy—specifically, on how slowly output growth returns to its sustainable growth rate after moving away from the target. If deviations of output from its potential are relatively persistent, a country is likely to benefit from a shift to price-path targeting. As Svensson (1999b) argues, if the output gap is persistent, focusing on the price level rather than the inflation rate will contribute to reducing fluctuations in output and inflation under a discretionary rule.

Numerous authors (including some in this volume) discuss the benefits associated with implementing a pure inflation-targeting regime. Taking the seminal work of Svensson (1999b) as a starting

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point, we study the relative merits of price-level targeting versus inflation targeting. A number of authors examine this comparison and come to various conclusions. For example, Barnett and Engineer (2000) argue that eliminating price-level drift does a better job than inflation targeting in allowing relative prices to allocate resources and in reducing tax-related distortions and the unintended transfers of wealth between savers and debtors. Chadha and Nolan (2002) employ a representative-agent general equilibrium model to compare the performance of price-level versus inflation targeting for the United Kingdom. Consistent with Svensson's results, they find that the volatility of inflation, output, and interest rates is lower under a price-level target than under an inflation target. Eggertsson and Woodford (2003) and Svensson (2003) show that under certain conditions, price-level targeting contributes toward avoiding the problems associated with the zero nominal interest floor. If the economy experiences either deflation or inflation that is lower than its target for one period, then price-level targeting implies that the inflation rate must be higher in future periods, thereby assisting the economy in countering a liquidity trap.

Pure inflation targeting can create nominal indeterminacy because of its forward-looking nature. Carlstrom and Fuerst (2002) note that forward-looking private agents will sometimes set prices in anticipation of monetary policy that validates their expectations at any level of inflation. By contrast, price-level targeting has a backward-looking feature that eliminates this problem. Dittmar and Gavin (2005) employ a flexible-price real business cycle model to show that pure inflation targeting leads to multiple equilibria, whereas targeting a price-level path can eliminate this indeterminacy.

Price-path and inflation targeting are not the only choices, however. Combinations are also possible. While inflation targeting implies that the (log) price level will be a random walk, and price-path targeting means that prices will quickly revert to their target and be as close to white noise as possible, hybrid rules imply a specific level of persistence. Hybrid or average rules that combine the two extremes are, in fact, optimal in most cases, as shown by Nessén and Vestin (2005).

Our discussion in this paper focuses on these hybrids, with the goal of deriving an optimal rule for a broad set of countries. We build on the earlier work of Cecchetti and Kim (2005) as we study the horizon over which price-path or inflation targets should be evaluated. Following the intuition first provided in King (1999), we examine the equivalence between a rule with a high weight on inflation targeting that is evaluated only infrequently and one with a high weight on the price-path that is evaluated often. For each country, we are able to derive a horizon for target evaluation that would result in optimal policy.[1] The general result is that when deviations of output from its potential are less persistent, the optimal horizon for target evaluation will be shorter.

The remainder of the paper is developed in five sections. Section 1 provides the theoretical framework that is the basis for our empirical examination. Here we discuss the policymaker's problem and derive the optimal inflation/price-path hybrid targeting rule. We then show how this has implications for the horizon at which the target should be evaluated. Section 2 presents the basic empirical results of the paper. We have thirty-one years of annual data for seventy countries; for eighteen of these countries, we also have twenty-four years of quarterly data. While the larger data set provides some insights, structural changes in the 1973–2003 period lead us to focus on the quarterly results. Taken together, our results suggest little difference between developed and emerging market countries, but the methods of detrending the data matter. When we employ filtering techniques that allow for time variation in mean growth rates, we (unsurprisingly) estimate less persistence in both output and the price level. In sections 3 and 4, we look at certain aspects of the results in more detail. First, we examine time variation in the estimates. Overall, we find that output persistence has not changed much over time, but price-level persistence has fallen. Moreover, the declines are larger in countries that have adopted publicly announced inflation targets. That is, price paths are more stable in these countries. A country's monetary policy regime does matter. Finally, in section 5 we provide some concluding remarks.

1. The Theoretical Framework

We begin with a bit of theory that is based on Cecchetti and Kim (2005). Following Svensson (1999b), that paper examines the case in which society cares about the weighted average of inflation and

1. The horizon for target evaluation is in addition to the time it takes for a policy action to have an impact on the central bank's objectives, usually inflation and the output gap.

output variability. If it were possible to bind central bankers to react to shocks in specific ways—that is, to enforce a commitment to a specific reaction function—then policymakers should be held accountable for minimizing society's loss function. As Svensson shows, however, given discretion over the instrument rule, it may be better to hold policymakers accountable for minimizing a different loss function.[2] The appropriate loss function depends on the degree to which output is persistent, and Svensson concludes that if the choice is between inflation targeting and price-path targeting, then the critical cut-off occurs when the autocorrelation of output deviations from potential equals one-half.[3] Cecchetti and Kim generalize this result, noting that inflation and price-path targeting are the limiting cases of a continuum of possibilities. That is, many hybrid targeting regimes lie between these two options. The mix depends on output persistence.

Cecchetti and Kim (2005, sect. 4.1) present a model derived in two distinct steps. First, they derive the solution to the policymaker's problem (under discretion) assuming that the objective function is known. Second, given this solution, they find the targeting regime that is best from the society's point of view. To present the results, we start by assuming that the central bank minimizes the following function:

$$L^{CB} = E\left\{\sum_t \beta^t \left[\lambda (p_t - p_t^*)^2 + (1-\lambda)(y_t - y_t^*)^2\right]\right\}, \tag{1}$$

where L^{CB} is the central bank's loss function; E is the expectation operation, p is the log of the actual price level; p^* is the desired (target) price level; y is log of current output; y^* is the log of potential or desired output; and β is a discount factor. The targeting regime—whether it is inflation targeting, price-path targeting, or something in between—depends on the definition of p^*. To see this, note that inflation targeting occurs when

$$p_t^*(\text{IT}) = p_{t-1} + \pi^*, \tag{2}$$

where π^* is the inflation target. By contrast, price-path targeting is when

2. Price-level or hybrid targeting can be justified under commitment, as well. In models with forward-looking components where the social and central bank loss functions coincide, such as those described in Woodford (2003) and Giannoni and Woodford (2005), various versions of price-level and hybrid targeting are optimal. The results in the appendix to Cecchetti and Kim (2005), where inflation targeting is optimal under commitment when agents are purely backward looking, are a special case of these.

3. Dittmar and Gavin (2000) and Vestin (2006) also discuss this result.

$$p_t^* \,(\text{PPT}) = p_{t-1}^* + \pi^* . \tag{3}$$

Under inflation targeting, the current target is last period's realized level of prices plus the increment π^*, while under price-path targeting, the increment is added to last period's target. In the language of the literature on money-growth targeting, inflation targeting allows for "base drift" whereas price-path targeting does not.

It is only a small step from considering equations (2) and (3) in isolation to studying a weighted average. This is what Batini and Yates (2003) refer to as the hybrid case, in which the price level is allowed to drift somewhat after moving away from the target. We can write this as

$$\begin{aligned} p_t^* \,(\text{Hybrid}) &= \eta\,(p_{t-1} + \pi^*) + (1-\eta)(p_{t-1}^* + \pi^*) \\ &= \eta\, p_{t-1} + (1-\eta)\, p_{t-1}^* + \pi^*, \end{aligned} \tag{4}$$

where η is the relative weight placed on inflation targeting. The two extremes, $\eta = 0$ and $\eta = 1$, represent price-path and inflation targeting, respectively.

Normalizing both π^* and y^* to zero (so that both the price path and output are measured as deviation from the targets), we can now rewrite the objective function (equation 1) as

$$L^{CB} = E\left\{\sum_t \beta^t \left[\lambda\,(p_t - \eta p_{t-1})^2 + (1-\lambda)\, y_t^2\right]\right\}. \tag{5}$$

Following Svensson (1999b), Cecchetti and Kim close the model with an open economy neoclassical Phillips curve:

$$y_t = \rho y_{t-1} + \alpha\,(p_t - p_t^e) + \varphi p_t^F + \varepsilon_t\,, \tag{6}$$

where y_t is now the output gap; p_t^e is the expectation of the log price level (p) at t; p_t^F is the foreign price level denominated in domestic currency; ρ, α, and φ are constants; and ε is an independent and identically distributed shock with variance σ_ε^2 .

The role of central bank policymakers is to choose a path for the price level, p_t, that minimizes the objective function (equation 5) subject to the constraint imposed by the dynamics in equation (6). As Cecchetti and Kim show, the rational expectations solution for this problem yields expressions of the form

$$p_t = \eta p_{t-1} + b y_{t-1} + c(\varphi p_t^F + \varepsilon_t) \text{ and} \tag{7}$$

$$y_t = \rho y_{t-1} + (1 + \alpha c)(\varphi p_t^F + \varepsilon_t), \tag{8}$$

where b and c are complex functions of the structural parameters ρ and α and the preference parameters λ and β.[4]

A number of authors, including Parkin (2000), note a technical restriction for the existence of a solution to this problem. The condition is that λ has to be sufficiently large relative to ρ. In other words, if output is highly persistent and central bankers care sufficiently about output variability, then the solution will not exist.[5] Policymakers will generate infinite price-level volatility in an attempt to meet their output stabilization goals. The condition is extremely interesting, as it depends on the absolute size of the numbers. That is, it depends on the relative importance of inflation and output variability in the objective—something that has no time units—and a persistence parameter that critically depends on the frequency of the data. The lower the data frequency, the smaller ρ will presumably be, and the less likely the condition is to bind. We return to the issue of data frequency shortly.

To complete the derivation, we move to society's problem. We assume that the social loss is written in terms of output and inflation variability. If we further assume that the preference parameter λ in the central bank's objective and the one in society's are the same, the social loss function is[6]

$$L^S = \lambda \sigma_\pi^2 + (1 - \lambda)\sigma_y^2 . \tag{9}$$

4. Equations (7) and (8) are later estimated using annual data. Following Cecchetti and Kim (2005), the results for the quarterly data analysis come from estimating the following equations:

$$p_t = \eta p_{t-1} + \sum_{i=1}^{4} b_i y_{t-i} + \phi_p p_t^F + e_{1t} \text{ and} \tag{7'}$$

$$y_t = \rho y_{t-1} + \sum_{i=1}^{4} \gamma_i \Delta y_{t-i} + \phi_y p_t^F + e_{2t} . \tag{8'}$$

5. See Cecchetti and Kim (2005, p. 179) for the complex formulas.

6. The two lambdas do not need to match. Following Rogoff (1985), the central banker's weight on output and inflation stabilization could deviate from that of society. Cecchetti and Kim (2005) examine this possibility, showing when it might be reasonable for society to find an inflation-averse central banker. They show that as ρ increases for a fixed social level of λ, there is reason to find a central banker with an increasingly high value for λ.

Cecchetti and Kim show that the value of η that minimizes equation (9)—which constitutes the optimal hybrid—satisfies the following condition:

$$\eta^* = \frac{1-\rho}{2\rho}\,. \tag{10}$$

As output becomes more persistent (ρ increases toward one), η^* goes to zero, and the optimal hybrid targeting regime thus approaches pure price-path targeting.

In his discussion of Cecchetti and Kim, Mankiw (2005) notes a problem that arises when taking this model to the data. What, Mankiw asks, should the frequency of the data be? Cecchetti and Kim focus on quarterly data. Is this appropriate? Mankiw suggests pinning down the answer to the question by looking at the frequency over which expectations are formed and wages are set. Since the crucial parameter in the model is the persistence of the output gap (ρ), and the output gap results from expectation errors, Mankiw reasons that this is where to determine whether quarterly data are appropriate. He concludes that the answer is no, and that the model should be applied to annual data.

Mankiw comes to this conclusion by focusing on wages. The answer might be different if we instead direct our attention to prices. The rationale for including prices (or inflation) in the social and central bank loss functions is that nominal price changes are inefficient. We would like nominal prices to stay fixed for as long as possible. The sooner prices return to their target, the better. The implication is that the data frequency should match the frequency of price changes.[7]

The most recent evidence indicates that the median duration of price spells (at the retail level) is 10.6 months in the euro area and 4.6 months in the United States (see Dhyne and others, 2005). The distribution of price spells is positively skewed, so the mean is substantially higher than the median. For the euro area, the mean exceeds a year, and it is over six months for the United States. This leads us to conclude that the appropriate frequency is somewhere between one quarter and one year.

We come to a more informative answer if we pose the problem somewhat differently. Instead of asking what the data frequency should be for the computation of the optimal hybrid targeting rule,

7. We thank Gauti Eggertsson for clarifying this argument.

we can look for a joint estimate of η and the horizon over which the central bank is trying to achieve this goal. Both are then measured in the units of the data. For example, if we use annual data, then we have the optimal hybrid rule at an annual frequency, and it is to be evaluated over the horizon computed from annual data.

Here is how it works. First, the ρ and η in equations (7) and (8) have no natural time units; nor does the η in the central bank's objective (equation 5). Equation (8), however, shows that if ρ is measured over quarterly data—call this ρ(quarterly)—then the corresponding annual persistence estimate is approximately $\rho(\text{annual}) = \rho(\text{quarterly})^4$, because the system in equations (7) and (8) is recursive. That is, the annual ρ is the quarterly ρ raised to the fourth power. Equation (7) reveals that the behavior of η is exactly analogous: $\eta(\text{annual}) = \eta(\text{quarterly})^4$.

We now turn to the solution for the optimal hybrid, where η is a function of ρ. For values of η and ρ, we can compute the implied horizon, *h,* from the following expression:

$$\eta^h = \frac{1-\rho^h}{2\rho^h}\,. \tag{11}$$

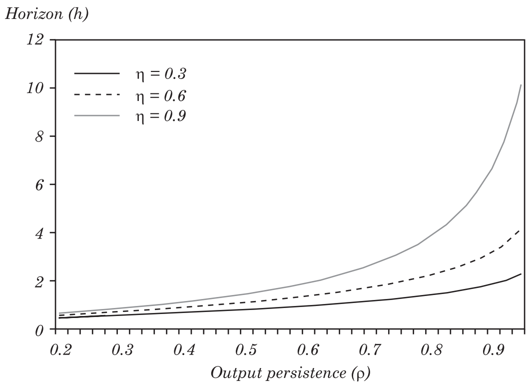
For a given persistence in the price level and the output gap, equation (11) provides an estimate of the horizon at which a central bank that is behaving optimally evaluates its hybrid target. As a practical matter, the *h* that solves equation (11) has to be added to the lag that it takes for policy actions to influence the central bank's objectives.

Figure 1 provides a sense of the relationship between output gap persistence (ρ), price-level persistence (η), and the implied horizon (h).[8] As either η or ρ increases, so does h. That is, more persistence in either the price level or the output gap implies a longer interval between target evaluations. For example, if $\eta = 0.6$, then as ρ rises from 0.7 to 0.8, h increases from 1.7 to 2.2.

The properties of *h* are related to the conclusions in King (1999) and Nessén and Vestin (2005): as the evaluation horizon lengthens, the practical difference between inflation and price-path targeting disappears. Politicians are likely to hold an inflation-targeting central bank accountable for meeting inflation targets over horizons that are sufficiently long to make the regime behave similarly to targeting a

8. The natural time units of *h* are the same as those used to measure the persistence parameters.

Figure 1. Relation between the Optimal Horizon, Price-Level Persistence, and Output Persistence[a]



Source: Own computations based on IFS and OECD Economic Outlook data.
a. The relation is based on equation (11) in the text. The optimal horizon is denoted by h, price-level persistence by η, and output persistence by ρ.

price path. The lower the price-level persistence (η) and the implied horizon (h), the closer the economy is to pure price-path targeting. In a sense, a low (η, h) pair is equivalent to a high one—that is, they can both yield the same value of η^h. For example, (η, h) = (0.4, 1.5) is equivalent to (η, h) = (0.8, 6.1); in both cases $\eta^h = 0.253$. As King's logic implies, short-horizon price-path targeting is equivalent to long-horizon inflation targeting.[9]

2. Empirical Results

Our objective is to estimate the hybrid rule and the implied horizon for the policy regime in as broad a cross-section of countries as possible. To that end, we have assembled annual data on gross domestic product (GDP), the aggregate price level, and import prices for seventy countries. Moreover, we also have quarterly data for eighteen of the

9. A second way to approach this problem is to look for the approximate horizon over which inflation targeting yields the same variability of the price-level gap. Under the hybrid, the variance is proportional to $(1 - \eta^2) - 1$. Alternatively if the inflation target is reset every T periods, then the variance over those intervals is proportional to T. Setting these two equal, and given that our estimates of η are in the range of 0.7 to 0.9, we estimate the horizon T to lie between two and five (in the same time units as the data).

OECD countries in the larger sample. (See the data appendix for a list of sources.) A full set of results for the annual data are shown in table A1 in the appendix. Table 1 provides a summary.

The estimates are somewhat sensitive to the manner in which we estimate the output and price-path gaps. We present two sets of results: one based on assuming a simple linear trend and a send that uses a Hodrick-Prescott (HP) filter with the parameter set to 400. Based on the results for the full sample of seventy countries estimated over the 1973–2003 period, the average estimated horizon, h, equals 3.65 years when we use linear detrending and only 2.35 years when we apply the HP filter. We interpret these horizon estimates as being in addition to the time that it normally takes for monetary policy actions to have an impact on inflation and the output gap. That is, h is the horizon in addition to the policy lag, which is 1.5 to 2.0 years in industrialized countries.

Table 1 reports estimates for four groups of countries: the full sample of seventy countries, forty-five non-OECD countries, twenty-five OECD countries, and twelve euro-area countries. Overall, the groupings are not all that different. They all show some range in the estimates, and the persistence and implied horizon estimates all fall when we use the HP filter. The reason for the drop in the estimated horizon is straightforward. The HP filter essentially removes a time-varying mean from the growth rate—in other words, it allows for a linear trend that is moving around. As many authors note, allowing for time variation in the mean of data reduces estimates of persistence.[10] For example, if the mean of a time series shifts once and for all on a specific date, the mean shift is, by assumption, very persistent. If one were to estimate an autoregressive parameter like ρ or η in equations (7) and (8) ignoring the mean shift, the estimates would be high. Explicitly accounting for the shift unambiguously lowers the estimate of persistence. Now consider what happens to the estimate of h if we reduce both ρ and η. For example, if $\rho = 0.8$ and $\eta = 0.8$, then h is roughly 3.0. If ρ and η both fall to 0.7, this reduces the estimate of h to 2.0. The estimate of h will also drop if the estimate of ρ falls, but η does not.

Fortunately, the qualitative picture painted by the data is not all that different when we shift between the two methods of detrending. For the annual data, horizons for policy evaluation after the effect on inflation and output are two to three years, with estimates of η

10. See, for example, Cecchetti and Debelle (2006).

Table 1. Estimates of Hybrid Inflation Target, Annual Data, 1973–2003[a]

	All 70 countries		*45 non-OECD countries*		*25 OECD countries*		*12 euro area countries*	
Hybrid rule and horizon	η	h	η	h	η	h	η	h
Linear trend								
Mean	0.80	3.65	0.80	3.85	0.81	3.31	0.86	4.20
75^{th} percentile	0.90	4.14	0.92	4.45	0.90	3.85	0.90	3.88
Median	0.84	3.00	0.82	3.18	0.85	2.52	0.85	2.77
25^{th} percentile	0.71	1.83	0.69	1.89	0.74	1.51	0.80	1.51
HP filter								
Mean	0.75	2.35	0.72	2.23	0.81	2.54	0.84	2.79
75^{th} percentile	0.88	2.66	0.87	2.47	0.91	2.97	0.92	3.39
Median	0.78	2.00	0.73	1.86	0.84	2.49	0.86	2.34
25^{th} percentile	0.64	1.31	0.60	1.27	0.68	1.49	0.60	1.06

Source: Summary of estimates reported in table A1.
a. Horizon h is measured in years.

in excess of 0.7 for more than fifty countries. These countries are behaving as if they were near pure inflation targeting. Based on the quarterly data, estimates of the horizon (after the full effect of policy) are substantially shorter at one-half to one year, but again the economies are close to targeting inflation, presenting estimates of η between 0.6 and 0.8. (To facilitate comparison, we quote all estimates of h in years, regardless of the frequency of the data from which they are computed.)

In the end, we find the analysis of annual data unsatisfactory. It seems wrong to assume that economies have been stable over the turbulent decades of the 1970s, 1980s, and 1990s. We therefore turn to the smaller set of eighteen countries for which we have quarterly data beginning in 1980. Again, we present two sets of results: one based on linear detrending and the second using the HP filter (with a smoothing parameter of 1,600). Tables 2 and 3 report the complete results, while table 4 contains a brief summary. Each table includes results for two time periods: 1980–91 and 1992–2003. They also report bootstrap standard errors.[11]

For the period from 1980 to 1991, linear detrending yields an average estimated implied horizon of 1.35 years, while the HP-filtered estimates are half that, at 0.68 years. For the more recent sample, from 1992 to 2003, the average estimate of the horizon obtained using HP-filtered data is half what we get from linear detrended data. The quarterly estimates are uniformly lower than the ones we obtain using annual data. That is, we find both lower price-persistence and a smaller implied horizon for target evaluation. This almost surely reflects the sample period we are studying. The annual data includes the much more turbulent 1970s—a period in which inflation was generally higher and more variable than in recent years, while growth tended to be lower and more volatile. All in all, this leads us to be more confident in the higher-frequency estimates.

With regard to the precision of the estimates, we note two things. First, using the 1980–91 data, the estimates of the implied horizon

11. The parametric recursive bootstrap (Freedman and Peters, 1984) used here assumes that the estimated model for each country in equations (7′) and (8′) is correctly specified, and that the corresponding error terms are independent but not identically distributed. We resample with replacement from the matrix consisting of both estimated residuals from both equations. This allows us to generate 1,000 "pseudo"-samples for each country, which are then used to compute replications of the estimate of the horizon. The reported standard errors are obtained from computing the standard deviation of these replications.

Table 2. Quarterly Data Estimates: Linear Trend[a]

	1980–91			1992–2003		
Country	ρ	η	h	ρ	η	h
Australia	0.88	0.98	1.89	0.86	0.97	1.71
	(0.09)	(0.07)	(1.63)	(0.10)	(0.08)	(1.82)
Belgium	0.88	0.69	0.88	0.73	0.60	0.46
	(0.06)	(0.07)	(0.31)	(0.13)	(0.11)	(0.16)
Canada	0.88	1.07	3.94	0.88	0.83	1.20
	(0.07)	(0.08)	(7.17)	(0.07)	(0.11)	(0.56)
Denmark	0.82	0.94	1.16	0.76	0.69	0.57
	(0.10)	(0.08)	(0.51)	(0.10)	(0.13)	(0.16)
Finland	0.71	0.82	0.59	0.90	0.96	2.12
	(0.08)	(0.07)	(0.09)	(0.07)	(0.07)	(0.94)
France	0.90	0.92	1.73	0.91	0.77	1.22
	(0.05)	(0.09)	(0.71)	(0.05)	(0.12)	(0.43)
Germany	0.95	0.78	1.64	0.78	0.91	0.90
	(0.10)	(0.11)	(0.65)	(0.13)	(0.06)	(0.46)
Italy	0.77	0.93	0.90	0.72	0.92	0.71
	(0.10)	(0.05)	(0.37)	(0.12)	(0.03)	(0.40)
Japan	0.86	0.69	0.79	0.72	0.79	0.58
	(0.07)	(0.11)	(0.35)	(0.16)	(0.09)	(0.26)
Korea, Rep. (S)	0.41	0.99	0.31	0.80	0.72	0.68
	(0.14)	(0.05)	(0.17)	(0.06)	(0.06)	(0.13)
Netherlands	0.80	0.89	0.95	0.97	0.89	2.99
	(0.09)	(0.05)	(0.33)	(0.06)	(0.09)	(2.26)
New Zealand	0.54	1.05	0.47	0.62	0.81	0.45
	(0.15)	(0.06)	(0.29)	(0.14)	(0.09)	(0.17)
Norway	0.85	1.01	1.73	0.81	0.54	0.53
	(0.07)	(0.07)	(1.16)	(0.09)	(0.16)	(0.16)
Portugal	0.83	0.74	0.77	0.89	0.75	1.04
	(0.06)	(0.10)	(0.22)	(0.06)	(0.11)	(0.29)
Spain	0.76	1.07	1.20	0.83	0.81	0.90
	(0.11)	(0.11)	(0.59)	(0.06)	(0.12)	(0.28)
Sweden	0.80	0.84	0.83	0.90	0.70	0.94
	(0.13)	(0.08)	(0.34)	(0.06)	(0.08)	(0.24)
United Kingdom	0.97	0.88	3.04	0.81	0.57	0.56
	(0.07)	(0.11)	(1.97)	(0.09)	(0.14)	(0.21)
United States	0.83	1.01	1.49	0.82	0.74	0.75
	(0.06)	(0.06)	(0.58)	(0.07)	(0.09)	(0.27)

Source: Own computations based on IFS and OECD Economic Outlook data.
a. Horizon is measured in years. Standard deviations are in parentheses.

Table 3. Quarterly Data Estimates: HP Filter[a]

	1980–91			1992–2003		
Country	ρ	η	h	ρ	η	h
Australia	0.82	0.87	0.97	0.65	0.88	0.54
	(0.11)	(0.07)	(0.65)	(0.13)	(0.07)	(0.46)
Belgium	0.81	0.78	0.78	0.59	0.46	0.29
	(0.12)	(0.06)	(0.43)	(0.15)	(0.12)	(0.24)
Canada	0.81	1.07	1.70	0.80	0.71	0.67
	(0.09)	(0.08)	(2.42)	(0.08)	(0.14)	(0.20)
Denmark	0.55	0.49	0.27	0.64	0.28	0.25
	(0.15)	(0.14)	(0.13)	(0.13)	(0.16)	(0.07)
Finland	0.80	0.80	0.78	0.84	0.74	0.79
	(0.06)	(0.11)	(0.29)	(0.07)	(0.12)	(0.63)
France	0.87	0.79	1.04	0.82	0.47	0.49
	(0.09)	(0.07)	(0.61)	(0.09)	(0.14)	(0.23)
Germany	0.65	0.56	0.36	0.64	0.74	0.43
	(0.15)	(0.16)	(0.17)	(0.11)	(0.10)	(0.45)
Italy	0.77	0.86	0.79	0.65	0.85	0.52
	(0.12)	(0.07)	(0.50)	(0.12)	(0.06)	(0.25)
Japan	0.67	0.62	0.41	0.45	0.57	0.24
	(0.12)	(0.12)	(0.15)	(0.17)	(0.14)	(0.14)
Korea, Rep. (S)	0.36	0.91	0.25	0.74	0.37	0.34
	(0.15)	(0.06)	(0.14)	(0.06)	(0.15)	(0.11)
Netherlands	0.61	0.84	0.46	0.89	0.80	1.17
	(0.14)	(0.07)	(0.26)	(0.09)	(0.10)	(1.54)
New Zealand	0.28	1.10	0.23	0.58	0.73	0.37
	(0.17)	(0.08)	(0.55)	(0.12)	(0.07)	(0.20)
Norway	0.70	0.87	0.62	0.32	0.38	0.16
	(0.10)	(0.11)	(0.26)	(0.15)	(0.17)	(0.08)
Portugal	0.84	0.79	0.89	0.81	0.74	0.72
	(0.10)	(0.08)	(0.71)	(0.09)	(0.13)	(0.39)
Spain	0.60	0.75	0.41	0.77	0.70	0.59
	(0.14)	(0.12)	(0.15)	(0.09)	(0.14)	(0.28)
Sweden	0.63	0.92	0.53	0.82	0.45	0.47
	(0.13)	(0.07)	(0.37)	(0.05)	(0.11)	(0.24)
United Kingdom	0.87	0.83	1.15	0.78	0.40	0.39
	(0.08)	(0.09)	(0.55)	(0.07)	(0.14)	(0.11)
United States	0.71	0.89	0.66	0.80	0.70	0.66
	(0.07)	(0.07)	(0.19)	(0.10)	(0.09)	(0.22)

Source: Own computations based on IFS and OECD Economic Outlook data.
a. Horizon is measured in years. Standard deviations are in parentheses.

Table 4. Estimates of Hybrid Inflation Target, Quarterly Data[a]

	Linear trend				*HP filter*			
	Mean		*Median*		*Mean*		*Median*	
Period and sample	η	h	η	h	η	h	η	h
1980–91								
18 OECD countries	0.91	1.35	0.92	1.05	0.82	0.68	0.84	0.64
8 euro area countries	0.85	1.08	0.85	0.92	0.77	0.69	0.79	0.78
1992–2003								
18 OECD countries	0.78	1.01	0.78	0.82	0.61	0.50	0.70	0.48
8 euro area countries	0.83	1.29	0.86	1.27	0.69	0.62	0.74	0.55

Source: Own computations based on IFS and OECD Economic Outlook data.
a. Horizon h is measured in years.

are not only high, but also imprecise. We see many fewer estimates above four in 1992–2003, using the linear trend. Second, allowing for a time-varying mean has a dramatic effect: our estimates of persistence and the implied horizon both fall substantially, and precision is increased (see table 3).

A complete analysis would build uncertainty directly into the optimization problem. In the setup we use here, the important source of uncertainty is the imprecision in the model parameter estimates—that is, the uncertainty about η and ρ. In the elementary framework described by Brainard (1967), policymakers should act cautiously when they are unsure of something like the elasticity of their inflation or output objective with respect to their interest rate instrument; in particular, they should not react strongly to observed shocks.[12] More recently, Onatski and Stock (2002) describe circumstances under which uncertainty can lead to bigger, not smaller, reactions. Theirs is a risk-management result: policymakers need to avoid very bad outcomes. If, for example, inflation might be a random walk, then a policymaker who cares about inflation variability should react more aggressively to any possibility of inflation changing. Balancing these two results—one advocating smaller reactions and the other larger—is a daunting task for policymakers.

Returning to our results, we note that uncertainty about persistence in both output and price-path gaps fell in the last decade. This clearly makes life easier for policymakers.

3. Time Variation

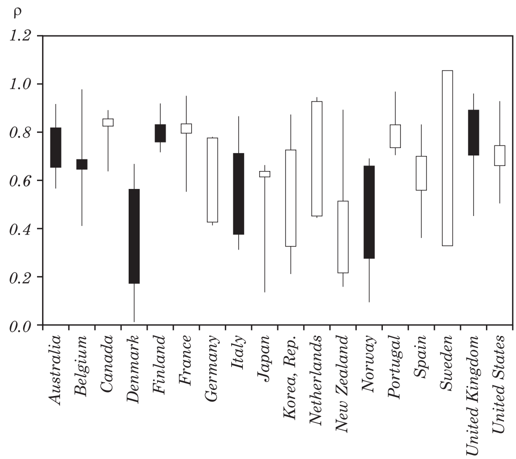
While interesting, the estimates of the previous section are clearly unsatisfactory. Substantial evidence indicates that persistence in output and prices varies over time.[13] This, combined with the known changes in monetary policy regime, suggests that both η and h may undergo important changes during our sample. Unfortunately, thirty years of annual data—the size of the sample for our large cross-section of seventy countries—is insufficient to study time variation. Instead, we focus on the twenty-four years of quarterly data covering eighteen countries.

12. Data uncertainty—that is, imprecise estimates of the state of the economy—does not influence the problem in the same way, as recently proved by Svensson and Woodford (2003).

13. For an examination of time variation in output persistence, see Cecchetti, Flores-Lagunes, and Krause (2005); for inflation persistence, see Cecchetti and Debelle (2006).

We have split the sample in half, creating subperiods for 1980 to 1991 and 1992 to 2003. The results using linear detrending are in table 2, while those using the HP filtered data are in table 3. With regard to output persistence, our estimate of ρ falls in nine of the eighteen countries when we use constant linear detrending, and in eleven when we allow for time variation in mean growth. To provide a closer look at the second case, figure 2 plots the range of estimates of ρ obtained using a five-year moving window. The general pattern is that output persistence increased between the early to mid-1980s and the eight years ending in 2003. Persistence also tends to be higher in the early 1990s than either before or after, although this is not evident in the figure. For all but two countries (Denmark and New Zealand), the output persistence estimates tend to lie primarily above one-half.

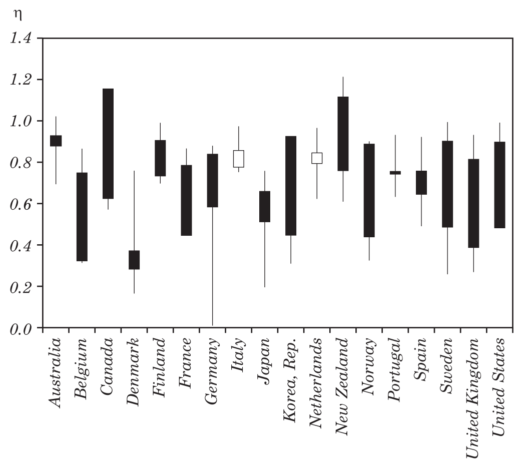
Figure 2. Range of Output Persistence for Eighteen OECD Countries[a]



Source: Own computations based on IFS and OECD Economic Outlook data.
a. For each country, the thin vertical line represents the overall range of the estimates, while the top and bottom of the bar is the estimate at the beginning and the end of the sample period. A solid bar indicates that estimated persistence fell between the early to mid-1980s and the 1996–2003 period, while a white bar represents an increase.

The persistence in the deviation of prices from trend has tended to decline substantially over time. When we use linear detrending, persistence falls in thirteen of the eighteen countries; applying an HP filter results in estimated declines in sixteen countries (see table 2). This shift toward price-path targeting is confirmed by the more flexible time-variation estimates reported in figure 3. Comparing the early 1980s with the most recent five-year period reveals that the estimated degree of price-level persistence declined in sixteen of the eighteen countries. Moreover, the increases were very modest in the two countries where the estimates rise (Italy and the Netherlands).

Figure 3. Range of Price Persistence for Eighteen OECD Countries[a]

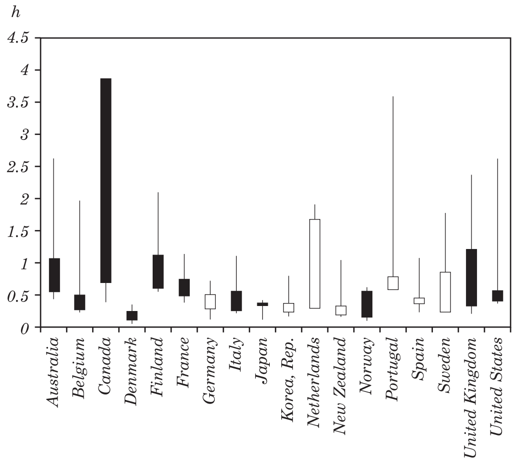


Source: Own computations based on IFS and OECD Economic Outlook data.
a. For each country, the thin vertical line represents the overall range of the estimates, while the top and bottom of the bar is the estimate at the beginning and the end of the sample period. A solid bar indicates that estimated persistence fell between the early to mid-1980s and the 1996–2003 period, while a white bar represents an increase.

Estimates of the implied horizon for target evaluation show less of a tendency to vary (see figure 4). When we use linearly detrended data, five countries show an increase in h; the number rises to seven with HP filtering. Most of the increases are relatively small, however, at one-quarter or less. By contrast, where we estimate reductions, they are large.

The horizon h is the value that equates price-level persistence with optimal price level persistence. It thus equates the optimal convex combination of inflation and price-path targeting with that in the data. This means that the horizon, plus the lag with which policy affects inflation and the output gap, is an indicator of the timeframe policymakers should have in mind in order to achieve the minimum loss.

Figure 4. Range of Horizon Estimates for Eighteen OECD Countries[a]



Source: Own computations based on IFS and OECD Economic Outlook data.

a. For each country, the thin vertical line represents the overall range of the estimates, while the top and bottom of the bar is the estimate at the beginning and the end of the sample period. A solid bar represents a decrease in the optimal horizon between the first and last period; a white bar represents an increase in the horizon. *h* is measured in years.

4. Inflation Targeters versus Nontargeters

The data in tables 2 and 3 provide the basis for exploring whether there are any systematic differences between countries that publicly state that they target inflation and those that do not. For this comparison, we run a fixed-effects regression to establish whether countries that adopted inflation targeting in the 1990s experienced a significantly different behavior of output and price persistence (ρ and η) or the implied horizon for target evaluation (h) than nontargeters.

The regressions are of the following form:

$$y_{i,t} = a_i + b\text{Target}_{i,t} + u_{i,t}\,, \tag{12}$$

where $y_{i,t}$ is ρ, η, or h for country i in period t; $\text{Target}_{i,t}$ is a dummy variable that takes the value of one if country i is targeting inflation in period t; and a_i is a country-specific fixed effect. For each country we take the difference in equation (12) across the two subperiods of our quarterly data. We report estimates of b, the impact of publicly announced inflation targeting, in table 5.

We might expect inflation targeting countries to experience higher output volatility.[14] However, there is no reason to think that the monetary policy regime would have a direct impact on the persistence of output, and this is what we find. The first column of table 5 reports that inflation targeters experience slightly higher output persistence than nontargeters, but the differences are small in magnitude and not statistically significantly different from zero.

Table 5. Fixed-Effects Regression: Inflation Targeters versus Nontargeters[a]

Method and explanatory variable	*Output persistence* (ρ)	*Price persistence* (η)	*Horizon* (h)
HP filtering			
Inflation targeting (b)	0.06	−0.25	−1.10
	(0.42)	(0.01)	(0.07)
Linear detrending			
Inflation targeting (b)	0.04	−0.15	−2.33
	(0.47)	(0.04)	(0.17)

Source: Own computations based on IFS and OECD Economic Outlook data.
a. Regressions use HP detrending; p values are in parentheses.

It is both reassuring and unsurprising to find that the adoption of inflation targeting changes a country's price-level persistence. Our results show inflation targeting is correlated with large declines in η (regardless of the detrending procedure we use). The fall in the estimates is quite large—between 0.15 and 0.25. This means that the price process in inflation-targeting countries is substantially closer to price-path targeting than to inflation targeting. The implied horizon for target evaluation falls by more in these countries, as well—between one and two quarters.

5. Conclusion

The details of a country's monetary policy regime should depend on that country's economic structure. Whether the optimal approach pure inflation targeting, pure price-path targeting, or some hybrid depends on the country's output persistence. Once policymakers realize that the horizon for target evaluation can vary, any hybrid rule can be optimal.

14. Cecchetti and Ehrmann (2002) report that inflation-targeting countries tend to experience more output volatility than countries that do not target inflation.

For example, a rule that is weighted heavily toward inflation targeting but is evaluated over a long horizon will be equivalent to a rule that grants priority to the price-path but employs a shorter horizon.

This result bears a striking resemblance to Svensson's (1999a) important observation that the speed at which a central bank strives to bring inflation back to its target level depends on the weight of output fluctuations in its objective function. The higher the weight on output variability, the slower the path back. The same thing is happening here. The more persistent output, the more output variability is created by explicitly targeting inflation, and the longer the time horizon for policy evaluation. Thus, the more policymakers care about output variability or the more prone the economy is to prolonged movements away from potential output, the longer the time horizon over which policymakers should be operating.

Turning to our empirical results, we find that countries vary quite a bit in the degree to which output and the price-level are persistent. While developed and emerging market countries present few differences, inflation-targeting countries show a distinctly lower degree of price-level persistence. Moreover, our estimates of persistence generally fall when we adopt methods that allow for potential output growth to vary over time. Our comparison of the 1980s and the 1990s (based on the more reliable quarterly data) indicates that output persistence has not changed, but price-level persistence has fallen. This is surely, in part, a consequence of the adoption of formal inflation targets. Finally, our results imply that the optimal horizon for target evaluation has gotten shorter. There is a sense in which countries are closer to price-path targeting than they are to inflation targeting.

Appendix

Our data sources are as follows. Annual data on GDP, the consumer price index (CPI), and import prices data were obtained from the International Monetary Fund's *International Financial Statistics* CD-ROM (December 2004). Quarterly data for seasonally adjusted GDP, CPI, and import prices were obtained from the *OECD Economic Outlook* 76 (December 2004). Data on inflation targeting were taken from Mishkin and Schmidt-Hebbel (2002).

Table A1 provides our results by country, based on the annual data from 1973 to 2003, using linear detrending and the Hodrick-Prescott filter.

Table A1. Annual Data, 1970–2003

	Linear detrending			*HP filtering*		
Country	ρ	η	h	ρ	η	h
Algeria	0.91	0.94	8.76	0.82	0.87	3.92
Argentina	0.75	0.93	3.23	0.63	0.80	1.83
Australia	0.48	0.82	1.28	0.48	0.80	1.24
Austria	0.54	0.84	1.51	0.46	0.64	1.06
Belgium	0.50	0.86	1.38	0.35	0.62	0.82
Bolivia	0.90	0.49	2.58	0.91	0.50	2.81
Burkina Faso	0.24	0.66	0.65	0.04	0.63	0.32
Burundi	0.85	0.60	2.56	0.76	0.48	1.68
Cameroon	0.87	0.78	3.90	0.84	0.62	2.56
Canada	0.79	0.57	2.03	0.75	0.75	2.41
Chile	0.80	0.51	1.92	0.60	0.55	1.28
Colombia	0.92	0.73	4.44	0.76	0.73	2.42
Congo, Dem. Rep.	0.91	0.68	3.84	0.79	0.44	1.71
Costa Rica	0.97	0.67	5.86	0.84	0.55	2.33
Côte d'Ivoire	0.84	0.82	3.79	0.81	0.64	2.45
Denmark	0.52	0.89	1.50	0.53	0.86	1.49
Dominican Republic	0.84	0.85	4.06	0.68	0.94	2.59
Ecuador	0.45	0.69	1.06	0.43	0.72	1.06
Egypt, Arab Rep.	0.82	1.02	5.89	0.74	1.03	3.89
El Salvador	0.79	0.99	4.45	0.79	0.96	4.19
Finland	0.87	0.78	3.86	0.82	0.70	2.82
France	0.71	0.85	2.46	0.70	0.92	2.69
Gabon	0.49	0.82	1.33	0.43	0.65	0.98
Gambia, The	0.50	0.79	1.29	0.41	0.92	1.16
Germany	0.71	0.85	2.52	0.63	0.87	2.01
Ghana	0.91	0.58	3.13	0.65	0.47	1.29
Greece	0.88	1.08	14.87	0.69	1.34	9.35
Guatemala	0.91	0.93	8.04	0.98	0.90	16.08
Haiti	0.84	0.89	4.47	0.73	0.81	2.45
Honduras	0.78	1.04	4.90	0.74	0.88	2.85
Hungary	0.88	0.74	3.85	0.83	0.64	2.62

Table A1. (continued)

	Linear detrending			*HP filtering*		
Country	ρ	η	*h*	ρ	η	*h*
Iceland	0.85	0.87	4.46	0.76	0.87	3.06
India	0.58	0.56	1.25	0.28	0.48	0.63
Indonesia	0.91	0.71	4.14	0.83	0.62	2.53
Ireland	0.93	0.94	10.18	0.80	0.85	3.39
Italy	0.48	0.90	1.38	0.28	0.91	0.83
Japan	0.90	0.48	2.50	0.74	0.43	1.50
Kenya	0.86	0.84	4.25	0.71	0.83	2.38
Korea, Rep.	0.84	0.53	2.26	0.70	0.68	1.89
Lesotho	0.47	0.77	1.21	0.42	0.37	0.77
Luxembourg	0.82	0.79	3.23	0.75	0.62	1.98
Madagascar	0.55	0.85	1.57	0.27	0.78	0.74
Malaysia	0.75	0.51	1.68	0.57	0.44	1.08
Mexico	0.74	0.99	3.65	0.75	0.87	2.97
Morocco	0.40	0.87	1.10	0.13	0.71	0.48
Netherlands	0.83	0.85	3.88	0.77	0.78	2.67
New Zealand	0.74	0.93	3.10	0.74	0.90	2.94
Nicaragua	0.89	0.86	5.50	0.53	0.88	1.53
Nigeria	0.75	0.88	2.99	0.47	0.84	1.26
Norway	0.76	0.86	2.97	0.73	0.91	2.88
Pakistan	0.87	0.70	3.32	0.69	0.74	1.99
Paraguay	0.62	1.00	2.34	0.70	0.86	2.42
Peru	0.78	0.80	2.82	0.65	0.84	2.03
Philippines	0.81	0.92	4.13	0.74	0.34	1.31
Portugal	0.64	0.87	2.07	0.57	0.95	1.82
Rwanda	0.60	0.72	1.55	0.55	0.67	1.31
Senegal	0.69	0.77	2.07	0.42	0.63	0.96
Sierra Leone	0.85	0.96	5.79	0.54	0.92	1.66
South Africa	0.59	1.03	2.15	0.47	1.00	1.45
Spain	0.81	0.77	3.01	0.81	0.91	4.08
Swaziland	0.88	1.00	8.49	0.77	0.55	1.89
Sweden	0.78	0.90	3.45	0.75	1.00	3.88
Switzerland	0.62	0.84	1.89	0.58	0.84	1.68
Thailand	0.85	0.52	2.27	0.78	0.64	2.22
Togo	0.59	0.89	1.80	0.51	0.89	1.47
Trinidad and Tobago	0.99	0.90	18.85	0.81	0.64	2.46
United Kingdom	0.69	0.67	1.81	0.80	0.69	2.56
United States	0.52	0.52	1.07	0.58	0.71	1.44
Uruguay	0.81	1.08	6.78	0.65	1.12	3.18
Venezuela, RB	0.80	0.80	3.12	0.73	0.82	2.48

Source: Own computations based on IFS and OECD Economic Outlook data.

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