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Author: Laurence M. Ball, Niamh Sheridan

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Does Inflation Targeting Matter?

Laurence Ball and Niamh Sheridan

> The performance of inflation-targeting regimes has been quite good. Inflation-targeting countries seem to have significantly reduced both the rate of inflation and inflation expectations beyond that which would likely have occurred in the absence of inflation targets. (Mishkin 1999, 595)

> [The U.K. data show] that not only has inflation been lower since inflation targeting was introduced, but that, as measured by its standard deviation, it has also been more stable than in recent decades. Moreover, inflation has been less persistent—in the sense that shocks to inflation die away more quickly—under inflation targeting than for most of the past century. (King 2002, 2).

> [O]ne of the main benefits of inflation targets is that they may help to "lock in" earlier disinflationary gains, particularly in the face of one-time inflationary shocks. We saw this effect, for example, following the exits of the United Kingdom and Sweden from the European Exchange Rate Mechanism and after Canada's 1991 imposition of the Goods and Services Tax. In each case, the re-igniting of inflation seems to have been avoided by the announcement of inflation targets that helped to anchor the public's inflation expectations and to give an explicit plan for and direction to monetary policy. (Bernanke et al. 1999, 288).

Laurence Ball is professor of economics at Johns Hopkins University and a research associate of the National Bureau of Economic Research (NBER). Niamh Sheridan is an economist at the International Monetary Fund (IMF).

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6.1 Introduction

Economists have long sought the ideal framework for monetary policy. Since the early 1990s, many have come to believe they have finally found the right approach: inflation targeting. Proponents of this policy cite many benefits. Inflation targeting solves the dynamic consistency problem that produces high average inflation. It reduces inflation variability, and if "flexible" it can stabilize output as well (Svensson 1997). Targeting locks in expectations of low inflation, which reduces the inflationary impact of macroeconomic shocks. For these reasons, many economists advocate inflation targeting for the Federal Reserve and the European Central Bank.

This paper attempts to measure the effects of inflation targeting on macroeconomic performance. We examine twenty Organization for Economic Cooperation and Development (OECD) countries, seven that adopted inflation targeting during the 1990s and thirteen that did not. Not surprisingly, economic performance varies greatly across individual countries, both targeters and nontargeters. On average, however, there is no evidence that inflation targeting improves performance as measured by the behavior of inflation, output, or interest rates.

If we examine inflation-targeting countries alone, we see that their performance improved on average between the period before targeting and the targeting period. For example, inflation fell and became more stable, and output growth also stabilized. However, countries that did *not* adopt inflation targeting also experienced improvements around the same times as targeters. This finding suggests that better performance resulted from something other than targeting.

For some performance measures, both inflation targeters and nontargeters improve over time, but the improvements are larger for targeters. For example, average inflation fell for both groups between the pretargeting and targeting periods, but the average for targeters went from above that of nontargeters to roughly the same. Similar findings have led authors such as Neumann and von Hagen (2002) to argue that inflation targeting promotes "convergence": it helps poorly performing countries catch up with countries that are already doing well. Our results, however, do not support even this modest claim of benefits from targeting. For many measures of performance, we find strong evidence of generic regression to the mean. Just as short people on average have children who are taller than they are, countries with unusually high and unstable inflation tend to see these problems diminish, regardless of whether they adopt inflation targeting. Once we control for this effect, the apparent benefits of targeting disappear.

The rest of this paper comprises eight sections. Section 6.2 describes the countries and sample periods that we study, and section 6.3 describes our methodology for measuring the effects of inflation targeting.

Sections 6.4 and 6.5 present our results concerning inflation and output growth. We estimate the effects of inflation targeting on these variables' average levels, variability, and persistence. There are occasional hints that targeting has beneficial effects and occasional hints of adverse effects, but overall it appears that targeting does not matter.

Section 6.6 turns to the behavior of interest rates and presents two main findings. First, inflation targeting has no effect on the level of long-term interest rates, contrary to what one would expect if targeting reduces inflation expectations. Second, targeting does not affect the variability of the short-term interest rates controlled by policymakers. At least by this crude measure, central banks respond neither more nor less aggressively to economic fluctuations under inflation targeting.

Section 6.7 investigates the effects of targeting on several bivariate relations: the slope of the output-inflation trade-off, the inflationary effect of supply shocks (specifically, changes in commodity prices), and the effect of inflation movements on expectations (as measured by OECD inflation forecasts). Here the results are imprecise, as it is difficult to estimate these relations over the short periods for which we have observed inflation targeting. However, the results suggest again that targeting has no important effects.

Section 6.8 compares our results to previous cross-country studies of inflation targeting. Finally, section 6.9 interprets our results. To be clear, we do not present a case *against* inflation targeting. We do not find that targeting does anything harmful, and we can imagine future circumstances in which it might be beneficial. Our results suggest, however, that no major benefits have occurred so far.

6.2 The Sample

This section describes the countries in our sample and the inflation-targeting and non-targeting periods that we examine.

6.2.1 Targeters and Nontargeters

We examine major developed, moderate-inflation economies. Specifically, we start with all members of the OECD as of 1990 (thus excluding the emerging-market economies that have joined since then). We delete countries that lacked an independent currency before the Euro (Luxembourg) or have experienced annual inflation over 20 percent since 1984 (Greece, Iceland, and Turkey). We are left with twenty countries, which are listed in table 6.1. Previous macroeconomic studies using the same sample of countries include Layard, Nickell, and Jackman (1991) and Ball (1997).

Seven of the countries in our sample adopted inflation targeting before 1999: Australia, Canada, Finland, Spain, Sweden, the United Kingdom,

Table 6.1 **Starting dates for inflation targeting and constant inflation targeting periods**

Country	Inflation targeting	Constant inflation targeting	Rationale for choice of starting dates
Australia	Q4 1994	Q4 1994	In September 1994, the Governor of the Reserve Bank of Australia announced that "underlying inflation of 2 to 3 percent is a reasonable goal for monetary policy." See Bernanke et al. (1999, 218–220) for further discussion.
Canada	Q1 1992	Q1 1994	The first target range was announced by the Bank of Canada in February 1991: 2 to 4 percent over 1992 (i.e. December 1991 to December 1992). In December 1993, a range of 1 to 3 percent was established for 1994, and the range has remained constant since then.
Finland	Q1 1994	Q1 1994	In February 1993, the Bank of Finland stated its intention to "stabilize the rate of inflation permanently at the level of 2% by 1995." It appears that they were referring to year-over-year inflation measured at the start of 1995; thus the period covered by the first target begins at the start of 1994.
New Zealand	Q3 1990	Q1 1993	A target of 3–5 percent over 1990 was announced in April 1990. A target of 0–2 percent for 1993 was announced in February 1991. The target range has remained roughly unchanged since then (but see footnote 2 in the text).
Spain	Q2 1995	Q1 1994	The first target, announced in December 1994, was for year-over-year inflation of 3.5–4 percent "by early 1996."
Sweden	Q1 1995	Q1 1995	The Riksbank announced in January 1993 that it aimed "to limit the annual increase in the consumer price index from 1995 onwards to 2 percent." This target applied to inflation over all of 1995, not to year-over-year inflation at the start of 1995 (Svensson 1995).
United Kingdom	Q1 1993	Q1 1993	In October 1992, the Bank of England announced a 2.5 percent target, beginning immediately.
Non-IT countries	Q3 1993	Q1 1994	The starting dates were computed as averages of the starting dates for inflation targeting or constant inflation targeting countries.

Note: Spain is an inflation targeter but not a constant inflation targeter. Q1 1994 is the start date of the constant-targeting period for nonconstant targeters.

and New Zealand. For each country, we define the beginning of targeting as the first full quarter in which a specific inflation target or target range was in effect, and the target had been announced publicly at some earlier time. This definition of targeting is more stringent than that of previous authors, such as Bernanke et al. (1999) and Scheater, Stone, and Zelmer

(2000). These authors often date the start of targeting at the point when targets were first announced, even if they were implemented with a delay. In other cases, targeting is said to begin when the central bank retrospectively said it did, even though it was not announced at the time. Our view is that many of the intended effects of targeting, such as those working through expectations, depend on agents knowing that they are currently in a targeting regime.

As an example of our dating, consider Sweden. Sweden announced its shift to inflation targeting during 1993, so Bernanke et al. (1999) and Scheater, Stone, and Zelmer (2000) date the regime from then. However, the first announced target was 2 percent for inflation over the twelve months to December 1995. We choose the first quarter of this period, 1995:1, as the beginning of the targeting regime. Table 6.1 gives the starting dates of targeting for the other countries along with brief explanations for our choices. The starting dates range from 1990:3 for New Zealand to 1995: 2 for Spain.

The targeting period lasts through 2001 for all countries except Finland and Spain, where it lasts through 1998 because of the advent of the Euro. For each country, we compare the targeting period to two pretargeting periods, a longer one that begins in 1960 and a shorter one that begins in 1985. The last quarter of the pretargeting period is the last full quarter before targeting began (either the quarter before the start of the targeting period or two quarters before, depending on whether targeting began at the start of a quarter or in the middle).

Throughout, we compare the seven inflation targeters to the other thirteen countries in the sample. Two of these countries have adopted inflation targeting recently: Switzerland in 1999 and Norway in 2000. We exclude these countries' brief targeting periods from our sample and treat Switzerland and Norway as nontargeters. Following our approach for targeters, we compare pretargeting periods starting in 1960 and 1985 to posttargeting periods. For the nontargeters, we define the posttargeting period as starting at the mean of the start dates for targeters, which is 1993:3. The posttargeting period ends in 1998 for Euro countries and 2001 for non-Euro countries besides Norway and Switzerland. Table 6.2 gives details of our dating.

Of the thirteen nontargeting countries, eight joined the Euro in 1999. Previously, these countries were part of the European Monetary System (EMS), so their monetary policies focused on fixing exchange rates and meeting convergence criteria. Two of the nontargeters, Germany and Switzerland (one also in the EMS), followed policies based on money-supply targets. The remaining four countries did not follow any announced rule—they pursued the policy of "just do it" (Mishkin 1999). In the results we report, we lump all nontargeting countries together and compare them to targeters. We have checked, however, whether there are systematic

Table 6.2 Sample periods

Country	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Australia	1960:1	1985:1	1994:4	1960:1	1985:1	1994:4
	1994:2	1994:2	2001:4	1994:2	1994:2	2001:4
Canada	1960:1	1985:1	1992:1	1960:1	1985:1	1994:1
	1991:4	1991:4	2001:4	1993:3	1993:3	2001:4
Finland	1960:1	1985:1	1994:1	1960:1	1985:1	1994:1
	1993:4	1993:4	1998:4	1993:4	1993:4	1998:4
New Zealand	1960:1	1985:1	1990:3	1960:1	1985:1	1993:1
	1990:1	1990:1	2001:4	1992:4	1992:4	2001:4
Spain	1960:1	1985:1	1995:2	1960:1	1985:1	1994:1
	1995:1	1995:1	1998:4	1993:3	1993:3	1998:4
Sweden	1960:1	1985:1	1995:1	1960:1	1985:1	1995:1
	1994:4	1994:4	2001:4	1994:4	1994:4	2001:4
United Kingdom	1960:1	1985:1	1993:1	1960:1	1985:1	1993:1
	1992:3	1992:3	2001:4	1992:3	1992:3	2001:4
United States, Japan,	1960:1	1985:1	1993:3	1960:1	1985:1	1994:1
Denmark	1993:2	1993:2	2001:4	1993:3	1993:3	2001:4
Austria, Belgium, France,	1960:1	1985:1	1993:3	1960:1	1985:1	1994:1
Germany, Ireland, Italy,	1993:2	1993:2	1998:4	1993:3	1993:3	1998:4
Netherlands, Portugal						
Norway	1960:1	1985:1	1993:3	1960:1	1985:1	1994:1
	1993:2	1993:2	2000:4	1993:3	1993:3	2000:4
Switzerland	1960:1	1985:1	1993:3	1960:1	1985:1	1994:1
	1993:2	1993:2	1999:4	1993:3	1993:3	1999:4

Notes: First number in column indicates start of sample. Second number in column indicates end of sample.

differences in performance among the nontargeting groups, and fail to find any. We have also performed our comparisons of targeters and nontargeters excluding all Euro countries (which leaves five targeters and five nontargeters). This produces no noteworthy changes in results.[1]

6.2.2 Constant Targeting

In addition to studying inflation-targeting periods, we examine periods in which countries are *constant* inflation targeters, meaning they have an unchanging target or target range. In some countries the target is always constant, but in others the constant-targeting period is preceded by a transitional period in which the target exceeds its final level. We examine constant-targeting periods because some benefits of targeting might not arise if the target changes. For example, proponents of targeting argue that it re-

1. In addition, we tried adding a Euro dummy to all of our cross-country regressions. This variable is usually insignificant. The only exception is that Euro countries experienced larger falls in the standard deviation of output growth between the pre- and posttargeting periods. Including the Euro dummy never changes our findings about the effects of inflation targeting.

duces the persistence of inflation movements, but a changing target causes permanent changes in inflation.[2]

Throughout this paper, we compare inflation targeters (IT) to nontargeters (NIT), and constant-inflation targeters (CIT) to non-constant-inflation targeters (NCIT). Spain is an inflation targeter, but its target fell throughout its targeting period; when we split countries into CIT and NCIT, we put Spain in the second group. For both CIT and NCIT countries, we examine periods before and after the start of constant targeting. The start date of the posttargeting period for NCIT countries is the average start date for constant targeting in CIT countries.

Table 6.2 lists sample periods for each of the twenty countries. We call the two pre-inflation-targeting periods, those starting in 1960 and 1985, samples 1 and 2, respectively. Sample 3 is the posttargeting period. Samples 4 and 5 are pre-constant-targeting periods, and sample 6 is the post-constant-targeting period. While the distinction between IT and CIT is important in principle, our findings about economic performance in the pre- and posttargeting periods are similar in the two cases.

6.3 Methodology

We want to determine how inflation targeting (or constant targeting) affects dimensions of economic performance such as inflation, output growth, and interest rates. We examine each aspect of performance in turn, using a consistent methodology to measure the effects of targeting. Here we describe the methodology.

Suppose we are interested in how targeting affects a variable X—for example, X might be the average level of inflation or the variance of output growth. We first calculate X for each of our twenty countries in each of our six sample periods. Then, for each period, we calculate the average value of X for inflation targeters and nontargeters (or, for samples 4 through 6, constant targeters and nonconstant targeters). These averages show whether X differs systematically across periods or across targeters and nontargeters.

As we have mentioned, many measures of economic performance improved on average between the pre-inflation-targeting and posttargeting periods. In most major economies, the period since the early 1990s has seen low and stable inflation and stable output growth. If we examine inflation-targeting countries alone, there are clear economic improvements that one might be tempted to attribute to targeting. However, to learn the

2. For New Zealand, we date the constant-targeting period from 1993:1 to the end of the sample even though the target range was widened from 0–2 percent to 0–3 percent in 1997. The half-point change in the midpoint was smaller (and of the opposite sign) than the target changes during transitional periods in other countries. In our judgment the 1997 episode was not a substantial change in policy.

true effects of targeting, we must compare improvements in targeting countries to improvements in nontargeting countries.

As a first pass at this comparison, we use a standard "differences in differences" approach. For our sample of twenty countries, we run the regression

$$X_{\text{post}} - X_{\text{pre}} = a_0 + a_1\text{D} + e, \tag{1}$$

where X_{post} is a country's value of X in the posttargeting period, X_{pre} is the value in the pretargeting period, and D is a dummy variable equal to 1 if the country is a targeter. We run several versions of this regression corresponding to different start dates for the pretargeting period (1960 or 1985) and whether targeting means IT or CIT. The coefficient a_1 is meant to measure the effect of targeting on the variable X.

This regression can be misleading, however. For some versions of the variable X, the initial value, X_{pre}, is substantially different on average for inflation targeters and nontargeters. For example, average inflation in the pretargeting period is higher for targeters. This fact is not surprising: a switch to targeting was most attractive to countries with poor performances under their previous policies. However, a problem arises because of regression to the mean. Poor performers in the pretargeting period tend to improve more than good performers simply because initial performance depends partly on transitory factors. If inflation targeters are poor initial performers, they will improve more than nontargeters, even if targeting does not affect performance. The coefficient on the targeting dummy can be significant, producing a spurious conclusion that targeting matters.

As an analogy, consider the behavior of Major League batting averages. Suppose a crackpot sports consultant suggests that a hitter will perform better if he sleeps next to his bat at night. In reality, this idea does not work. Most .300 hitters merely chuckle at the consultant, but .220 hitters are desperate enough to try anything, and start taking their bats to bed. Because of regression to the mean, the low-average hitters who sleep with their bats will tend to improve more than the high-average hitters who leave their bats in their lockers. If the sports consultant regresses the change in a player's average on a bat-in-bed dummy, he will find a significant effect. He will claim incorrectly that the evidence supports his theory.[3]

For readers who prefer math to baseball, the appendix to this paper formalizes our argument. We assume that the variable X depends on a country effect, a period effect, a country-period effect, and possibly an inflation-targeting dummy. The presence of the country-period effect generates regression to the mean. If X_{pre} is correlated with the targeting dummy, as happens in practice, then regression (1) produces a biased estimate of the dummy coefficient.

3. Baseball statistics exhibit substantial regression to the mean. This fact explains the well-known "sophomore slump": the tendency of players with strong rookie years to do less well during their second years (e.g., Gilovich 1984).

Fortunately, there is a simple way to eliminate this bias: add the initial value of X to the differences regression. That is, we run

$$X_{\text{post}} - X_{\text{pre}} = a_0 + a_1\text{D} + a_2X_{\text{pre}} + e. \tag{2}$$

Including X_{pre} controls for regression to the mean. The coefficient on the dummy now shows whether targeting affects a country's change in performance for a given initial performance. If a_1 is significant, then a targeter with poor initial performance improves more than a nontargeter with equally poor initial performance. This difference implies a true effect of targeting.

Once again, the appendix formalizes our argument. Under the assumptions we make there, regression (2) produces an unbiased estimate of the dummy coefficient.

6.4 Inflation

In a recent speech, the next governor of the Bank of England posed the question "Ten Years of the Inflation Target: What Has It Achieved?" As quoted at the start of this paper, he suggests that targeting has reduced the average level, variability, and persistence of U.K. inflation. In contrast, we find little evidence in cross-country data that targeting has any of these effects.

6.4.1 Average Inflation

Table 6.3 presents our results concerning the average level of inflation. Inflation is measured by the annualized percentage change in consumer prices from the IMF's *International Financial Statistics* (IFS). In panel A of the table, we show average inflation in each of our twenty countries and six sample periods. For each period, we also show the averages across targeting and nontargeting countries. Panel B reports our estimates of equations (1) and (2) above.

Not surprisingly, there is considerable cross-country variation in average inflation. In sample 2, for example (1985 to start of inflation targeting), average inflation ranges from double digits in New Zealand and Portugal to less than 2 percent in Japan and the Netherlands. In almost every country, average inflation is lower in the targeting periods (samples 3 and 6) than in the pretargeting periods. The cross-country variation is smaller in the targeting periods, as all inflation rates are under 4 percent.

Turning to cross-country averages, we see that the IT group had higher inflation than the NIT group before targeting was introduced. (Here and elsewhere, the comparison between the CIT and NCIT groups is similar.) For the shorter pretargeting sample, average inflation is 5.8 percent for IT countries and 3.7 percent for NIT. In the targeting period, by contrast, average inflation is close to 1.9 percent for both groups. On average, targeters converged to the lower inflation levels of nontargeters.

Table 6.3 **Mean inflation rate (annualized)**

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
			Panel A			
Australia	6.23	5.38	2.62	6.23	5.38	2.62
Canada	5.35	4.37	1.62	5.16	3.83	1.58
New Zealand	8.62	10.23	1.94	8.08	7.48	2.00
Sweden	6.41	5.38	1.01	6.41	5.38	1.01
United Kingdom	7.54	5.50	2.43	7.54	5.50	2.43
Finland	6.90	4.07	1.08	6.90	4.07	1.08
Spain	9.16	5.93	2.49	9.35	6.12	3.06
United States	4.82	3.72	2.47	4.80	3.66	2.47
Japan	5.16	1.63	0.12	5.15	1.68	0.09
Denmark	6.50	3.23	2.21	6.47	3.19	2.23
Austria	4.30	2.72	1.77	4.29	2.72	1.64
Belgium	4.64	2.53	1.65	4.63	2.53	1.55
France	6.11	3.05	1.37	6.08	3.01	1.33
Germany	3.40	2.24	1.65	3.40	2.25	1.59
Ireland	7.85	3.13	2.11	7.82	3.13	2.05
Italy	8.43	5.72	3.29	8.40	5.69	3.18
The Netherlands	4.41	1.58	2.19	4.40	1.64	2.12
Portugal	11.99	10.64	3.54	11.96	10.54	2.94
Norway	6.26	4.93	2.20	6.22	4.81	2.28
Switzerland	3.89	3.26	0.84	3.87	3.22	0.79
Averages						
IT	7.17	5.84	1.88			
NIT	5.98	3.72	1.95			
CIT				6.72	5.27	1.78
NCIT				6.20	3.87	1.95

Dependent variable: Change in mean inflation between samples	Equation 1				Equation 2			
	(3) – (1)	(3) – (2)	(6) – (4)	(6) – (5)	(3) – (1)	(3) – (2)	(6) – (4)	(6) – (5)
				Panel B				
Constant	–4.03	–1.77	–4.25	–1.92	0.42	1.12	0.52	1.01
	(0.46)	(0.52)	(0.47)	(0.46)	(0.49)	(0.32)	(0.50)	(0.33)
Inflation targeting dummy	–1.26	–2.19	–0.68	–1.57	–0.38	–0.55	–0.29	–0.51
	(0.78)	(0.88)	(0.86)	(0.84)	(0.33)	(0.35)	(0.33)	(0.34)
Initial value					–0.74	–0.78	–0.77	–0.76
					(0.08)	(0.07)	(0.07)	(0.07)
Adjusted R^2	0.08	0.21	–0.02	0.12	0.85	0.90	0.85	0.87

Note: Standard errors are in parentheses.

This convergence result is echoed in the first part of panel B, where we regress the change in average inflation on the targeting dummy. For the shorter pretargeting sample, the coefficient on the dummy is –2.2: average inflation fell by 2.2 points more in targeters than in nontargeters. This coefficient is the same as the difference-in-differences of means between samples 2 and 3. The regression reveals that this inflation-targeting effect is statistically significant (t = 2.5).

Inflation targeting is important if it really reduces average inflation by more than 2 percentage points. However, most of this apparent effect is illusory: it reflects the facts that targeters had high initial inflation and that there is regression to the mean. Panel B shows that regression to the mean is strong: when initial inflation is included in the inflation-change equation, its coefficient is –0.78. Controlling for this effect, the estimated effect of targeting is only –0.55, and its statistical significance is weak (t = 1.57, p-value = 0.14). Looking ahead, however, we will see that this result is one of our more positive findings about inflation targeting!

Note how much of the variation in inflation changes is explained by initial inflation: including this variable raises the R-squares from 0.2 or below to 0.9. Figure 6.1 illustrates this point by plotting the change in inflation from sample 2 to sample 3 against the level in sample 2. Figure 6.1 shows a tight relationship, confirming the strong role of regression to the mean. The targeting countries tend to have high initial inflation and large decreases, but the decrease for a given initial level looks similar for targeters and nontargeters.

6.4.2 Inflation Variability

Tables 6.4 and 6.5 examine the variability of inflation, using the same format as the average-inflation table. Table 6.4 presents standard deviations of quarterly inflation, and table 6.5 presents standard deviations of "trend inflation," defined as a nine-quarter moving average. We examine

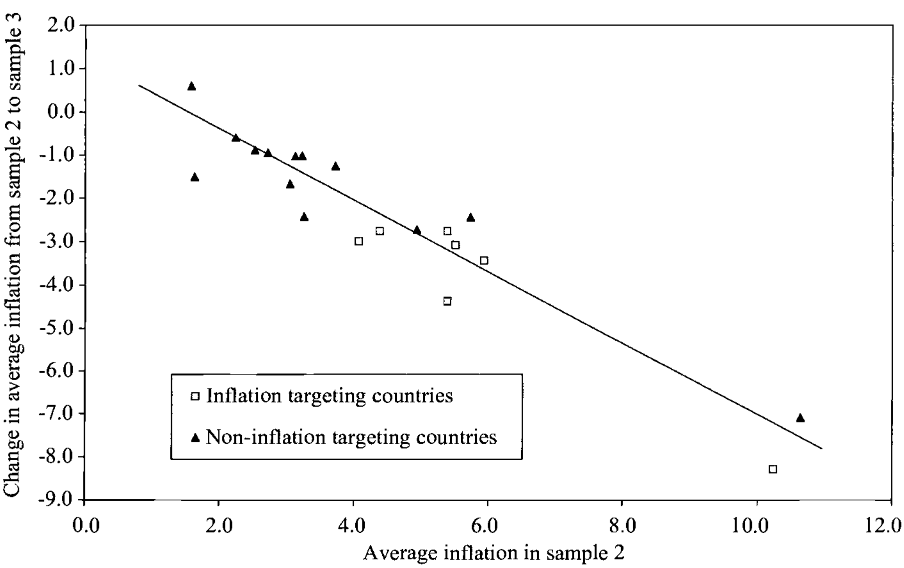

Fig. 6.1 Regression toward the mean

Table 6.4 Standard deviation of inflation rate

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
			Panel A			
Australia	4.62	3.51	3.01	4.62	3.51	3.01
Canada	3.34	1.75	1.59	3.35	1.93	1.75
New Zealand	5.83	7.42	1.70	5.88	7.21	1.78
Sweden	3.99	3.62	1.57	3.99	3.62	1.57
United Kingdom	5.70	2.80	1.34	5.70	2.80	1.34
Finland	4.51	1.87	1.16	4.51	1.87	1.16
Spain	5.80	2.00	1.38	5.85	2.07	1.64
United States	3.27	1.64	0.94	3.26	1.65	0.96
Japan	5.00	1.76	1.73	4.98	1.76	1.65
Denmark	4.77	2.14	0.68	4.77	2.12	0.70
Austria	2.70	1.36	1.18	2.69	1.34	1.15
Belgium	3.31	1.54	1.20	3.31	1.51	1.23
France	3.77	1.15	0.81	3.78	1.15	0.84
Germany	2.32	2.85	1.02	2.31	2.81	1.05
Ireland	6.52	1.54	1.04	6.50	1.52	1.06
Italy	6.08	1.55	1.60	6.06	1.54	1.64
The Netherlands	3.40	1.71	0.75	3.39	1.72	0.71
Portugal	9.21	3.86	2.50	9.18	3.84	1.52
Norway	3.84	2.52	1.24	3.85	2.57	1.24
Switzerland	2.73	2.61	0.89	2.72	2.57	0.89
Averages						
IT	4.83	3.28	1.68			
NIT	4.38	2.02	1.20			
CIT				4.67	3.49	1.77
NCIT				4.48	2.01	1.16

Dependent variable: Change in standard deviation of inflation between samples	Equation 1				Equation 2			
	(3) – (1)	(3) – (2)	(6) – (4)	(6) – (5)	(3) – (1)	(3) – (2)	(6) – (4)	(6) – (5)
			Panel B					
Constant	–3.18	–0.82	–3.31	–0.85	0.50	0.92	0.79	1.01
	(0.41)	(0.34)	(0.43)	(0.32)	(0.32)	(0.24)	(0.30)	(0.22)
Inflation targeting dummy	0.03	–0.78	0.41	–0.87	0.41	0.31	0.59	0.50
	(0.70)	(0.58)	(0.78)	(0.59)	(0.23)	(0.27)	(0.21)	(0.26)
Initial value					–0.84	–0.86	–0.92	–0.93
					(0.07)	(0.10)	(0.06)	(0.09)
Adjusted R^2	–0.06	0.04	–0.04	0.06	0.89	0.83	0.92	0.92

Note: Standard errors are in parentheses.

trend inflation because targeters might stabilize this variable even if they cannot smooth out higher-frequency inflation shocks.[4]

There is no evidence whatsoever that inflation targeting reduces inflation

4. In analyzing trend inflation, we include a quarter in a sample only if all quarters that contribute to the nine-quarter average are in the sample.

Table 6.5 Standard deviation of trend inflation rate (9-quarter moving average)

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
			Panel A			
Australia	3.80	2.76	1.37	3.80	2.76	1.37
Canada	2.89	0.44	0.53	2.88	0.92	0.53
New Zealand	4.43	3.55	0.83	4.48	4.20	0.92
Sweden	2.63	2.04	0.57	2.63	2.04	0.57
United Kingdom	4.59	1.69	0.34	4.59	1.69	0.34
Finland	3.54	1.26	0.28	3.54	1.26	0.28
Spain	4.66	0.79	0.42	4.65	0.67	0.92
United States	2.81	0.81	0.44	2.81	0.82	0.45
Japan	3.71	1.06	0.68	3.70	1.04	0.70
Denmark	2.85	0.95	0.27	2.87	0.99	0.27
Austria	1.78	0.82	0.49	1.78	0.83	0.41
Belgium	2.72	0.78	0.21	2.71	0.77	0.21
France	3.35	0.32	0.37	3.36	0.35	0.39
Germany	1.67	1.33	0.25	1.67	1.42	0.18
Ireland	5.20	0.41	0.31	5.20	0.43	0.25
Italy	5.35	0.54	1.10	5.34	0.56	1.06
The Netherlands	2.55	1.30	0.14	2.54	1.31	0.13
Portugal	7.21	1.37	0.72	7.19	1.47	0.50
Norway	2.51	1.92	0.33	2.53	1.96	0.33
Switzerland	1.92	1.68	0.41	1.91	1.65	0.39
Averages						
IT	3.79	1.79	0.62			
NIT	3.36	1.02	0.44			
CIT				3.65	2.14	0.67
NCIT				3.45	1.02	0.44

Dependent variable: Change in standard deviation of trend inflation between samples	Equation 1				Equation 2			
	(3) – (1)	(3) – (2)	(6) – (4)	(6) – (5)	(3) – (1)	(3) – (2)	(6) – (4)	(6) – (5)
				Panel B				
Constant	–2.92	–0.58	–3.00	–0.58	0.16	0.30	0.14	0.33
	(0.37)	(0.20)	(0.36)	(0.20)	(0.18)	(0.13)	(0.19)	(0.13)
Inflation targeting dummy	–0.25	–0.58	0.02	–0.90	0.15	0.08	0.21	0.10
	(0.62)	(0.33)	(0.65)	(0.36)	(0.14)	(0.16)	(0.15)	(0.19)
Initial value					–0.92	–0.87	–0.91	–0.89
					(0.05)	(0.09)	(0.05)	(0.10)
Adjusted R^2	–0.05	0.10	–0.06	0.22	0.95	0.84	0.95	0.85

Note: Standard errors are in parentheses.

variability. The standard deviations of inflation and trend inflation fall for all groups of countries during the targeting period. At all times, the standard deviations are lower for nontargeters than for targeters. Equation (1) suggests that targeters experience larger falls in standard deviations, but this result disappears when equation (2) controls for regression to the mean.

In fact, table 6.4 suggests that, controlling for regression to the mean, inflation targeting *raises* the standard deviation of inflation. This effect is sometimes statistically significant. Nonetheless, this perverse result is likely a fluke (given the number of regressions we run, our tests should produce some Type 1 errors). Our robust finding is that inflation targeting has no beneficial effects.

6.4.3 Inflation Persistence

Finally, we examine the persistence of inflation movements. For each country and sample period, we estimate a fourth-order autoregressive model (AR[4]) for quarterly inflation. Then, for each period, we average each AR coefficient across targeting and nontargeting countries. Using these average coefficients, we compute impulse response functions showing the effects of inflation shocks on future inflation.

Figure 6.2 presents some of our results. We use solid lines for the impulse response functions in targeting countries and dashed lines for nontargeters. For each group, we present results for the long pretargeting periods (samples 1 and 4) and the targeting periods (samples 3 and 6). We omit responses for the short pretargeting samples, which always lie between the responses that we show.

Figure 6.2 shows that inflation persistence has decreased over time—inflation has become more "anchored." In the pretargeting periods, a unit inflation shock in quarter t raises inflation at $t + 1$ by more than 0.4 points, and this effect dies out slowly. For the targeting period, the effect is around 0.2 at $t + 1$, and it disappears in a few quarters. Crucially, this pattern holds for both targeting and nontargeting countries. Once again, there is no evidence that targeting affects inflation behavior.[5]

6.5 Output Growth

We now ask whether inflation targeting affects output behavior. We examine the mean and standard deviation of real output growth, using the same methods we applied to inflation behavior. We use annual output data, as reliable quarterly data are not available for all countries in our sample. For each country, we include a year in a given sample period only if all four quarters of the year belong to the sample under our quarterly dating.

5. Note that the impulse responses for targeters in samples 3 and 6 are negative at some lags. We have checked the statistical significance of the negative responses with Monte Carlo experiments, following Sheridan (2001). The only response that is significantly negative is the response for CIT countries in period $t + 4$. We are inclined to dismiss the negative responses as a fluke, because they are not plausible theoretically.

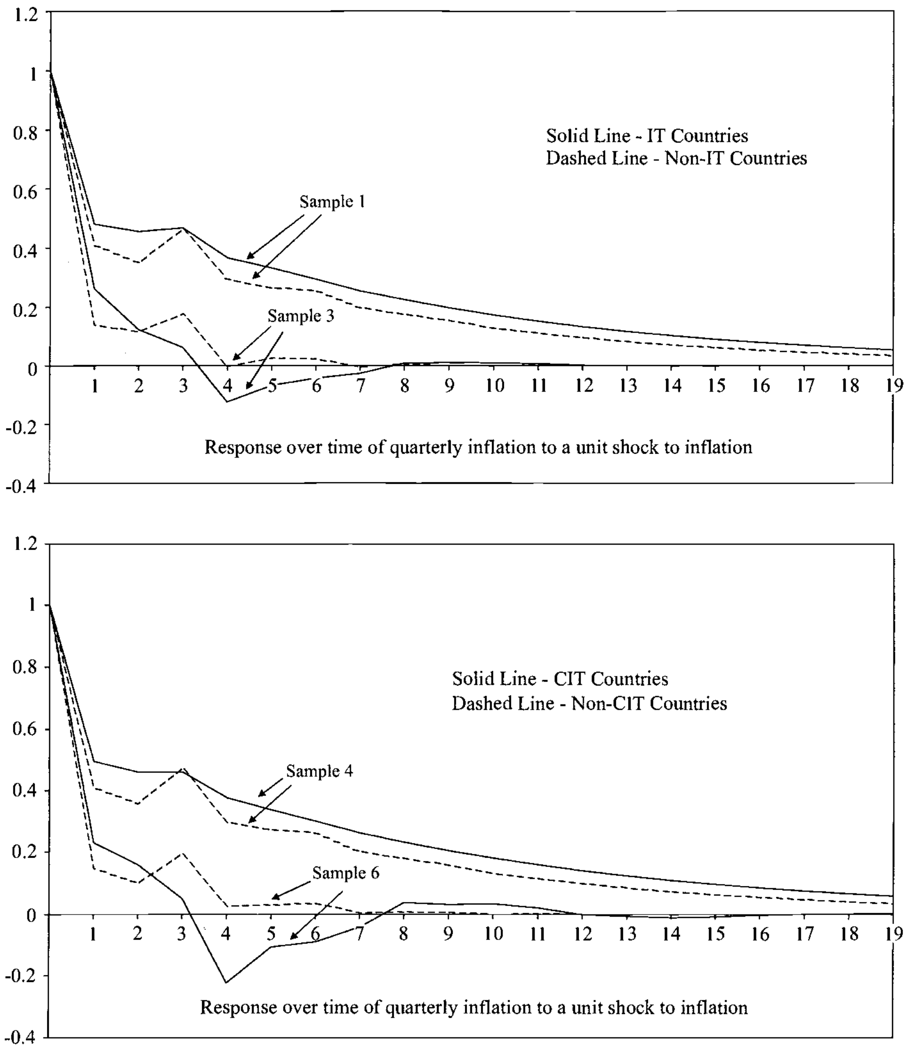

Fig. 6.2 Inflation persistence

6.5.1 Average Growth

There is no obvious theoretical reason that inflation targeting should affect average output growth. (It might if it affected inflation behavior and inflation affects growth, but see our negative findings about inflation.) Nonetheless, Mishkin (1999, 597) suggests that a

> conservative conclusion is that, once low inflation is achieved, inflation targeting is not harmful to the real economy. Given the strong economic growth after disinflation was achieved in many countries that have

adopted inflation targets, New Zealand being one outstanding example, a case can be made that inflation targeting promotes real economic growth in addition to controlling inflation.

Here we examine this idea, with inconclusive results.

Table 6.6 presents our results about average growth rates. Average

Table 6.6 Mean annual growth rates

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
			Panel A			
Australia	3.65	3.09	4.59	3.65	3.09	4.59
Canada	4.04	2.52	3.06	3.94	2.30	3.44
New Zealand	3.05	2.72	2.79	2.76	1.68	3.42
Sweden	2.51	1.18	2.82	2.51	1.18	2.82
United Kingdom	2.40	2.69	2.94	2.40	2.69	2.94
Finland	3.15	1.00	4.68	3.15	1.00	4.68
Spain	4.22	2.91	3.25	4.45	3.51	2.94
United States	3.40	2.84	3.39	3.40	2.84	3.39
Japan	5.67	4.12	1.17	5.67	4.12	1.17
Denmark	2.10	1.46	2.81	2.10	1.46	2.81
Austria	3.38	2.87	2.13	3.38	2.87	2.13
Belgium	3.32	2.56	2.54	3.32	2.56	2.54
France	3.64	2.55	2.02	3.64	2.55	2.02
Germany	3.44	4.31	1.62	3.44	4.31	1.62
Ireland	4.17	4.36	8.50	4.17	4.36	8.50
Italy	3.91	2.43	2.01	3.91	2.43	2.01
The Netherlands	3.99	2.90	3.19	3.99	2.90	3.19
Portugal	4.10	4.41	3.08	4.10	4.41	3.08
Norway	3.48	2.50	3.50	3.48	2.50	3.50
Switzerland	2.55	2.01	1.18	2.55	2.01	1.18
Averages						
IT	3.29	2.30	3.45			
NIT	3.63	3.02	2.86			
CIT				3.07	1.99	3.65
NCIT				3.69	3.06	2.86

Dependent variable: Change in mean annual growth rate between samples	Equation 1				Equation 2			
	(3) – (1)	(3) – (2)	(6) – (4)	(6) – (5)	(3) – (1)	(3) – (2)	(6) – (4)	(6) – (5)
				Panel B				
Constant	–0.77	–0.17	–0.82	–0.19	2.04	1.64	1.78	1.40
	(0.47)	(0.46)	(0.44)	(0.43)	(1.79)	(1.31)	(1.83)	(1.31)
Inflation targeting dummy	0.93	1.31	1.40	1.85	0.67	0.88	0.97	1.30
	(0.80)	(0.77)	(0.81)	(0.78)	(0.78)	(0.81)	(0.84)	(0.88)
Initial value					–0.77	–0.60	–0.71	–0.52
					(0.48)	(0.41)	(0.48)	(0.41)
Adjusted R^2	0.02	0.09	0.10	0.20	0.10	0.15	0.15	0.23

Note: Standard errors are in parentheses.

growth increased in inflation-targeting countries after targeting began, and it decreased slightly in nontargeting countries. When we control for regression to the mean, our point estimates imply that targeting raises average growth by a substantial amount: from 0.7 to 1.3 percentage points, depending on the specification. However, all the *t*-statistics are below 1.5, and three of four are below 1.2. Thus the point estimates do not mean much.

Our estimates are imprecise because growth rates vary greatly across individual countries. In our short samples, average growth depends on economies' cyclical positions when the samples start and end as well as growth in potential output. We need to observe inflation targeting over longer periods to see whether it affects average growth.

6.5.2 Output Variability

Some economists argue that "flexible" inflation targeting stabilizes output as well as inflation. Others, such as Cecchetti and Ehrmann (1999), suggest that targeting makes output more variable. Once again, we find that targeting simply does not matter.

Table 6.7 presents results about the standard deviation of annual output growth. These results mostly echo our findings about the standard deviation of inflation. In the short pretargeting periods and the targeting periods, output is more stable for nontargeting countries than for targeters. For both groups, output becomes more stable during the targeting period. When we control for regression to the mean, our estimates suggest that targeting raises output variability, but this effect is not statistically significant.

6.6 Interest Rates

We next examine the level of long-term interest rates, which should reflect inflation expectations, and the variability of short-term rates, which might indicate the activism of monetary policy.

6.6.1 Average Long-Term Rates

We have seen that inflation targeters and nontargeters have experienced similar reductions in inflation since the early 1990s. Targeting proponents argue, however, that targeting locks in low inflation permanently, while adverse events might reignite inflation under "just do it" policies. If the public believes this argument, then targeting should reduce both expected inflation and inflation uncertainty. As discussed by King (2002), both effects should reduce long-term interest rates.

We look for this effect in OECD data on ten-year government bond rates. The data are annual, so we date our sample periods by years, as in our work on output behavior. The data start in 1970, so we begin samples 1 and 4 in that year rather than 1960.

Table 6.8 presents our results, which are highly reminiscent of our infla-

Table 6.7 Standard deviation of annual growth rate

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
			Panel A			
Australia	2.24	1.91	1.73	2.24	1.91	1.73
Canada	2.50	2.60	1.46	2.53	2.48	1.32
New Zealand	2.82	3.50	2.28	2.85	3.06	1.93
Sweden	2.27	2.10	1.36	2.27	2.10	1.36
United Kingdom	2.17	2.33	0.77	2.17	2.33	0.77
Finland	3.23	3.95	1.09	3.23	3.95	1.09
Spain	3.13	2.08	0.73	3.05	1.66	0.68
United States	2.38	1.51	1.38	2.38	1.51	1.38
Japan	4.00	1.74	1.28	4.00	1.74	1.28
Denmark	2.31	1.50	1.26	2.31	1.50	1.26
Austria	2.23	1.17	0.74	2.23	1.17	0.74
Belgium	2.11	1.13	0.93	2.11	1.13	0.93
France	1.98	1.28	0.88	1.98	1.28	0.88
Germany	2.79	3.84	0.58	2.79	3.84	0.58
Ireland	2.08	1.86	1.92	2.08	1.86	1.92
Italy	2.91	1.01	0.66	2.91	1.01	0.66
The Netherlands	5.53	1.09	0.54	5.53	1.09	0.54
Portugal	3.59	1.98	0.47	3.59	1.98	0.47
Norway	1.85	1.66	1.70	1.85	1.66	1.70
Switzerland	2.77	1.92	0.84	2.77	1.92	0.84
Averages						
IT	2.54	2.73	1.45			
NIT	2.81	1.67	1.01			
CIT				2.55	2.64	1.37
NCIT				2.83	1.67	0.99

Dependent variable: Change in standard deviation of growth rate between samples	Equation 1				Equation 2			
	(3) – (1)	(3) – (2)	(6) – (4)	(6) – (5)	(3) – (1)	(3) – (2)	(6) – (4)	(6) – (5)
			Panel B					
Constant	–1.80	–0.65	–1.84	–0.68	1.59	0.95	1.53	1.08
	(0.32)	(0.24)	(0.30)	(0.23)	(0.38)	(0.30)	(0.34)	(0.28)
Inflation targeting dummy	0.52	–0.64	0.66	–0.60	0.29	0.30	0.32	0.43
	(0.54)	(0.41)	(0.55)	(0.43)	(0.22)	(0.28)	(0.21)	(0.26)
Initial value					–1.20	–0.96	–1.19	–1.06
					(0.13)	(0.16)	(0.11)	(0.15)
Adjusted R^2	0.00	0.07	0.02	0.05	0.83	0.69	0.86	0.75

Note: Standard errors are in parentheses.

tion and output results. If we define better performance by lower interest rates, then nontargeters always do better than targeters. Both groups improved during the targeting period; the improvement is somewhat larger for targeters, but the effect of targeting disappears when we control for regression to the mean.

Table 6.8 Long-term interest rates

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
			Panel A			
Australia	10.78	11.83	6.82	10.78	11.83	6.82
Canada	8.72	10.19	7.04	8.72	10.02	6.72
New Zealand	10.70	15.15	7.44	10.65	13.34	7.04
Sweden	9.22	10.99	6.48	9.22	10.99	6.48
United Kingdom	9.86	10.35	6.62	9.86	10.35	6.62
Finland	9.46	10.65	7.13	9.46	10.65	7.13
Spain	11.78	12.24	6.66	11.90	12.77	8.25
United States	7.61	8.43	6.05	7.61	8.43	6.05
Japan	7.01	5.65	2.45	7.01	5.65	2.45
Denmark	12.06	10.17	6.28	12.06	10.17	6.28
Austria	8.12	7.66	6.18	8.12	7.66	6.18
Belgium	8.51	9.05	6.33	8.51	9.05	6.33
France	9.44	9.68	6.26	9.44	9.68	6.26
Germany	7.60	7.32	6.03	7.60	7.32	6.03
Ireland	10.34	10.34	6.90	10.34	10.34	6.90
Italy	10.42	12.45	8.77	10.42	12.45	8.77
The Netherlands	7.43	7.43	6.02	7.43	7.43	6.02
Portugal	15.69	21.23	8.35	15.69	21.23	8.35
Norway	8.56	11.65	6.38	8.56	11.65	6.38
Switzerland	4.67	5.16	3.82	4.67	5.16	3.82
Averages						
IT	10.07	11.63	6.88			
NIT	9.04	9.71	6.14			
CIT				9.78	11.19	6.80
NCIT				9.24	9.93	6.29

Dependent variable: Change in mean long-term interest rate between samples	Equation 1				Equation 2			
	(3) – (1)	(3) – (2)	(6) – (4)	(6) – (5)	(3) – (1)	(3) – (2)	(6) – (4)	(6) – (5)
			Panel B					
Constant	–2.89	–3.57	–2.95	–3.64	2.57	3.38	2.23	3.23
	(0.47)	(0.73)	(0.44)	(0.69)	(0.98)	(0.67)	(0.96)	(0.70)
Inflation targeting dummy	–0.30	–1.18	–0.03	–0.76	0.33	0.20	0.27	0.12
	(0.80)	(1.24)	(0.80)	(1.25)	(0.49)	(0.45)	(0.49)	(0.47)
Initial value					–0.60	–0.72	–0.56	–0.69
					(0.10)	(0.06)	(0.10)	(0.07)
Adjusted R^2	–0.05	–0.01	–0.06	–0.03	0.63	0.88	0.61	0.86

Note: Standard errors are in parentheses.

6.6.2 The Variability of Short-Term Interest Rates

In addition to examining economic outcomes, we would like to know whether inflation-targeting central banks move their policy instruments differently from nontargeters. In principle, one can address this issue by estimating reaction functions for short-term interest rates (i.e., Taylor rules).

In practice, it appears difficult to get meaningful estimates of these equations with the short samples at hand. We therefore examine a cruder measure of policy behavior, the standard deviation of short-term rates. Differences in policy rules should affect this statistic. For example, if inflation targeters respond more strongly to inflation movements, then short-term rates should become more volatile (unless targeting stabilizes inflation, an effect we fail to find).[6]

We examine the volatility of short-term rates at the quarterly frequency. Our data are interbank rates from the IFS (line 60b). We examine only the shorter of our pretargeting samples, the ones starting in 1985, because consistent data are not available before then. For once, we throw out a few troublesome outliers. For all countries, we delete the three quarters of the exchange rate mechanism (ERM) crisis, 1992:3 through 1993:1, when interest rates jumped to very high levels.

The results, given in table 6.9, follow the pattern we have seen again and again. Interest rate volatility is lower for nontargeters than for targeters and falls over time for both groups. The decrease appears larger for targeters if we ignore regression to the mean, but not if we control for it.

6.7 Bivariate Results

So far we have examined the univariate behavior of inflation, output, and interest rates. In principle, we would like to look more deeply at whether inflation targeting changes the structure of the economy. For our short samples, however, it is impractical to estimate sophisticated structural equations. Here we take one step beyond our univariate analysis by examining several bivariate relations.

6.7.1 Methodology

For each country and sample period, we run three regressions:

$$\Delta\pi = a(y - y^*), \tag{3}$$

$$\Delta\pi = K_0 + b(\Delta p^{\text{com}} - \pi^{\text{US}}), \tag{4}$$

$$\pi^{\text{fore}} = K_1 + c\pi(-1), \tag{5}$$

where y^* is the trend level of output (measured by the Hodrick-Prescott filter with smoothing parameter 100); p^{com} is an index of commodity prices in U.S. dollars, from the IFS; π^{US} is U.S. inflation; and π^{fore} is an OECD forecast of inflation. All the data are annual.

6. Neumann and von Hagen (2002) and Kuttner and Posen (1999) estimate Taylor rules for inflation targeters. For a critique, see Mishkin's (2002) discussion of Neumann and von Hagen (2002).

Table 6.9 Standard deviation of short-term interest rates

	Sample 2	Sample 3	Sample 5	Sample 6
		Panel A		
Australia	4.15	1.07	4.15	1.07
Canada	1.87	1.21	2.35	1.20
New Zealand	5.24	2.35	5.85	1.79
Sweden	2.21	1.86	2.21	1.86
United Kingdom	2.10	0.85	2.10	0.85
Finland	2.26	1.10	2.26	1.10
Spain	2.59	1.97	1.99	1.82
United States	1.63	1.04	1.75	0.93
Japan	1.62	0.89	1.64	0.75
Denmark	1.01	1.70	1.03	1.14
Austria	1.94	1.11	1.91	0.78
Belgium	1.62	1.62	1.61	1.05
France	1.05	1.60	1.04	1.38
Germany	2.08	1.20	2.06	0.91
Ireland	2.00	0.77	2.08	0.76
Italy	1.51	1.93	1.59	2.00
The Netherlands	1.68	1.17	1.66	0.92
Portugal	2.77	2.54	2.79	2.38
Norway	1.73	1.27	1.97	1.30
Switzerland	2.55	1.27	2.51	1.10
Averages				
IT	2.92	1.49		
NIT	1.79	1.39		
CIT			3.15	1.31
NCIT			1.83	1.23

Dependent variable: Change in standard deviation of the short term interest rate	Equation 1		Equation 2	
	(3) – (2)	(6) – (5)	(3) – (2)	(6) – (5)
	Panel B			
Constant	–0.39	–0.60	1.04	0.96
	(0.23)	(0.24)	(0.28)	(0.26)
Inflation targeting dummy	–1.04	–1.24	–0.13	–0.11
	(0.39)	(0.44)	(0.28)	(0.28)
Initial value			–0.80	–0.85
			(0.14)	(0.12)
Adjusted R^2	0.28	0.31	0.76	0.82

Note: Standard errors are in parentheses.

Equation (3) can be interpreted as an accelerationist Phillips curve: it shows how the output gap affects the change in inflation. Equation (4) measures the inflationary effect of a change in the relative price of commodities, which we interpret as a "supply shock." The change in the relative price is the change in the U.S. dollar price minus U.S. inflation. Finally, equation (5) shows how expected inflation responds to movements in past inflation. We measure expectations with OECD forecasts, which are produced in consistent ways for all countries.[7]

Previous authors suggest that inflation targeting should affect the coefficients a, b, and c in these equations. For example, Bernanke et al. (1999) argue that targeting "anchors" inflation expectations, so c should fall. They also argue that targeting reduces the effects of supply chocks, so b should fall (see the quote at the start of this paper). The effects on a, the Phillips curve slope, are debatable. This coefficient might fall if inflation becomes more anchored. On the other hand, Corbo, Landerretche, and Schmidt-Hebbel (2002) argue that targeting reduces the cost of disinflation, which suggests a rise in a.

We are interested in the averages of a, b, and c for targeting and nontargeting countries. When we estimate these coefficients for individual countries, the standard errors vary greatly. Since there is more noise in some estimated coefficients than in others, a simple average is an inefficient estimator of the true average coefficient. We therefore compute weighted averages, with weights inversely proportional to the variances of the coefficient estimates. Similarly, we estimate our differences regression by weighted least squares, with weights inversely proportional to the standard deviations of the estimated changes in coefficients. We do not add estimates of initial coefficients to the right-hand sides of our regressions, because the measurement error in the coefficients would create bias.[8]

6.7.2 Results

Table 6.10 presents our bivariate results. For the final time, we find that economic behavior has changed over time, but the changes are similar for inflation targeters and nontargeters.

There are two significant changes over time: expectations respond less to inflation movements, and inflation responds less to commodity prices. Both results suggest a greater anchoring of inflation. Strikingly, the commodity-price coefficients fall by an order of magnitude. For example, the average coefficient in sample 1 (1960 to the start of IT) is 0.05 for nontargeters.

7. Some details: We exclude a constant term from equation (3) because $y - y^*$ has a zero mean and we want to rule out a deterministic trend in inflation. In equation (4), the change in relative commodity prices is the same for all countries. We have also estimated equation (4) with $y - y^*$ included, which can be interpreted as a Phillips curve augmented with supply shocks. Our results about the coefficient on the change in commodity prices do not change. In addition, we obtain similar results when we replace the change in commodity prices with the change in the relative price of oil. In equation (5), $\pi(-1)$ is inflation in year –1 as estimated by the OECD in December of that year, when they make forecasts for the following year.

8. In principle, the optimal estimators of the group means and equation (1) use weights that depend on both the variances of the coefficient estimates and the variances of true coefficients across countries in a group. Using the residuals from our cross-country regressions, we have estimated the variances of true coefficients, and we find they are small. We therefore set these variances to zero and derive the optimal weights based on the variances of coefficient estimates. These weights are the ones described in the text.

Table 6.10 Multivariate results

Panel A: Phillips-Curve coefficients

Weighted averages	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
IT	0.35	0.10	0.18			
NIT	0.27	0.25	0.17			
CIT				0.37	0.18	0.14
NCIT				0.27	0.25	0.18

Dependent variable: Change in estimated coefficient between samples	Equation 1 (weighted least squares)			
	(3) – (1)	(3) – (2)	(6) – (4)	(6) – (5)
Constant	–0.12	–0.07	–0.11	–0.05
	(0.07)	(0.09)	(0.07)	(0.07)
Inflation targeting dummy	0.13	0.20	0.00	0.07
	(0.12)	(0.12)	(0.13)	(0.11)

Panel B: Effect of commodity-price changes on inflation

Weighted averages	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
IT	0.044	0.036	0.005			
NIT	0.054	0.068	0.006			
CIT				0.049	0.082	0.014
NCIT				0.053	0.065	0.006

Dependent variable: Change in estimated coefficient between samples	Equation 1 (weighted least squares)			
	(3) – (1)	(3) – (2)	(6) – (4)	(6) – (5)
Constant	–0.048	–0.050	–0.047	–0.048
	(0.010)	(0.014)	(0.009)	(0.013)
Inflation targeting dummy	0.006	–0.012	0.012	–0.027
	(0.024)	(0.031)	(0.024)	(0.034)

Panel C: Response of expected inflation to inflation

Weighted averages	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
IT	0.83	0.71	0.43			
NIT	0.83	0.71	0.66			
CIT				0.82	0.63	0.45
NCIT				0.83	0.71	0.63

Dependent variable: Change in estimated coefficient between samples	Equation 1 (weighted least squares)			
	(3) – (1)	(3) – (2)	(6) – (4)	(6) – (5)
Constant	–0.23	–0.10	–0.25	–0.12
	(0.04)	(0.06)	(0.04)	(0.06)
Inflation targeting dummy	–0.15	–0.13	–0.10	–0.05
	(0.10)	(0.14)	(0.11)	(0.15)

Note: Standard errors are in parentheses.

This means that a 10 percent rise in the relative price of commodities raises inflation by 0.5 of a percentage point. For the IT period (sample 3), the coefficient is 0.006.

In contrast, there is no evidence that inflation targeting affects the coefficients that we consider. In the twelve regressions in table 6.10, the targeting dummy is never significant at the 10 percent level.

6.8 Comparison to Other Studies

The closest study to ours is that of Neumann and von Hagen (2002). Their paper and ours have the same title. Part of their paper, like this one, compares the volatility of inflation, output, and interest rates across time periods and groups of countries. But Neumann and von Hagen's conclusion differs from ours: "Taken together, the evidence confirms the claim that IT matters" (144).

Our study differs from Neumann and von Hagen (2002) in many details, but the crucial difference may be our treatment of regression to the mean. After the sentence quoted above, they continue: "Adopting this policy has permitted IT countries to reduce inflation to low levels and curb the volatility of inflation and interest rates; in so doing, these banks have been able to approach the stability achieved by the Bundesbank" (Neumann and von Hagen's main example of a non–inflation targeter). We, too, find that targeters have caught up with nontargeters along some dimensions, but this convergence was not caused by targeting.

A number of other studies report evidence that inflation targeting matters. For example, researchers report that targeting steepens the Phillips curve (Clifton, Hyginus, and Wong 2001); that it dampens movements in expected inflation (Sheridan 2001); and that it increases the predictability of inflation (Corbo, Landerretche, and Schmidt-Hebbel 2002).[9] Some of these results may again reflect regression to the mean rather than a true effect of targeting. This possibility is suggested by Corbo, Landerretche, and Schmidt-Hebbel's (2002, 263) conclusion that "Inflation targeters have consistently reduced inflation forecast errors (based on country VAR models) toward the low levels prevalent in non-targeting industrial countries."

It is difficult to compare our results directly to previous work, as the methodologies are quite different. We believe, however, that our results cast doubt on earlier findings that inflation targeting affects economic behavior. It seems unlikely that targeting would affect the relationships studied by previous authors and yet, as we find, have no effects on the means or standard deviations of inflation, output, or interest rates.

9. See also Johnson (2002) and the literature review in Neumann and von Hagen (2002).

6.9 Conclusion

We find no evidence that inflation targeting improves a country's economic performance. How should one interpret this result?

One possibility is that targeting and nontargeting countries pursue similar interest rate policies. Research suggests that the policies needed to implement inflation targeting are similar to the Taylor rules that fit the United States and other nontargeters (e.g., Svensson 1997; Ball 1999). Indeed, observers have suggested that the United States is a "covert inflation targeter" (Mankiw 2001). This view is supported by our finding of similar interest rate volatility for targeters and nontargeters. If targeting does not change the behavior of policy instruments, it is not shocking that economic outcomes do not change either. This result suggests, however, that the formal and institutional aspects of targeting—the public announcements of targets, the inflation reports, the enhanced independence of central banks—are not important. Nothing in the data suggests that covert targeters would benefit from adopting explicit targets.

Our results do not provide an argument *against* inflation targeting, for we have not found that it does any harm. In addition, there may be benefits that we do not measure. First, aspects of inflation targeting may be desirable for political rather than economic reasons. Bernanke et al. (1999, 333) argue that targeting produces more open policy making, making "the role of the central bank more consistent with the principles of a democratic society."

Second, inflation targeting might improve economic performance in the future. The economic environment has been fairly tranquil during the inflation-targeting era, and so many central banks have not been tested severely. Perhaps future policymakers will face 1970s-sized supply shocks, or strong political pressures for inflationary policies. At that point, we may see that inflation targeters handle these challenges better than policymakers who "just do it."

Thus, a paper that replicates this study in twenty-five or fifty years may find ample evidence that targeting improves performance. The evidence is not there, however, in the data through 2001.

Appendix

Consider the problem of estimating the effect of inflation targeting on X, some measure of economic performance. For concreteness, we will sometimes refer to X as "average inflation." We present a simple statistical model of the determinants of X in different countries and periods. In our model, regression (1) in the text, the differences estimator, produces a biased estimate of the effect of targeting if the targeting dummy is correlated with the pretargeting level of X. Adding the pretargeting X, as in regression (2), eliminates the bias.

Let X_{it} be the value of X in country i and period t. The t subscript takes on two values, "pre" and "post." We assume that X_{it} is given by

$$X_{it} = k + a_1 Q_{it} + \mu_i + \eta_t + \nu_{it}, \tag{A1}$$

where μ_i is a country-specific effect, η_t is a period-specific effect, v_{it} is an error term specific to country i in period t, and Q_{it} is a dummy equal to 1 if country i targets inflation in period t. For all countries, $Q_{i,\mathrm{pre}}$ equals zero and $Q_{i,\mathrm{post}}$ equals D_i, the targeting dummy in the text.

In equation (A1), the Q_{it} term captures the possible effect of inflation targeting. We would like to estimate its coefficient, a_1. The other terms are a conventional decomposition of the error term in a panel regression. By construction, the idiosyncratic shock ν_{it} is uncorrelated with μ_i and η_t, and $\nu_{i,\mathrm{pre}}$ and $\nu_{i,\mathrm{post}}$ are uncorrelated with each other.

Differencing equation (A1) over time yields

$$X_{i,\mathrm{post}} - X_{i,\mathrm{pre}} = (\eta_{\mathrm{post}} - \eta_{\mathrm{pre}}) + a_1 D_i + (\nu_{i,\mathrm{post}} - \nu_{i,\mathrm{pre}}), \tag{A2}$$

where we use the fact that $Q_{i,\mathrm{post}} - Q_{i,\mathrm{pre}} = D_i$. Thus, in cross-country data, the change in X depends on a constant $(\eta_{\mathrm{post}} - \eta_{\mathrm{pre}})$, the targeting dummy, and a composite error term. We can interpret regression (1), the differences estimator in the text, as an ordinary least squares (OLS) estimator of equation (A2).

Suppose that countries with higher initial inflation, $X_{i,\mathrm{pre}}$, are more likely to adopt inflation targeting. The error $\nu_{i,\mathrm{pre}}$ is one component of $X_{i,\mathrm{pre}}$, so a higher $\nu_{i,\mathrm{pre}}$ makes targeting more likely: $\nu_{i,\mathrm{pre}}$ is positively correlated with the dummy D_i. The error in (A2) includes $-\nu_{i,\mathrm{pre}}$, so the dummy is negatively correlated with the error. This correlation implies that the OLS estimate of the dummy coefficient, a_1, is biased downward. Consequently, regression (1) is likely to find that targeting reduces inflation even if there is no true effect.

Now consider what happens when we add the initial level of X to our regression. We can rewrite equation (A2) as

$$X_{i,\mathrm{post}} - X_{i,\mathrm{pre}} = (\eta_{\mathrm{post}} - \eta_{\mathrm{pre}}) + a_1 D_i + a_2 X_{i,\mathrm{pre}} + (\nu_{i,\mathrm{post}} - \nu_{i,\mathrm{pre}}), \tag{A3}$$

where the true value of a_2 is zero. We interpret regression (2) in the text as an OLS estimator of this equation. We now sketch a proof that the estimate of a_1 is unbiased even if $X_{i,\mathrm{pre}}$ affects the likelihood of targeting.

Rather than viewing $\nu_{i,\mathrm{pre}}$ as part of the error term in (A3), let us interpret it as a variable that is left out when we regress the change in X_i on the constant, D_i, and $X_{i,\mathrm{pre}}$. If $\nu_{i,\mathrm{pre}}$ were measured and included in the regression, then OLS would be unbiased, because all right-side variables would be uncorrelated with the remaining error $\nu_{i,\mathrm{post}}$. We can therefore use standard results to determine the biases that arise when $\nu_{i,\mathrm{pre}}$ is left out (Maddala 1989, 122). Specifically, the bias in the OLS estimate of a_1 is proportional to the expected coefficient on D_i in an auxiliary regression of $\nu_{i,\mathrm{pre}}$ on a constant, D_i and $X_{i,\mathrm{pre}}$. One can show that this expected coefficient is zero, implying zero bias. Intuitively, $\nu_{i,\mathrm{pre}}$ is correlated with D_i, but this correlation works through the effect of $\nu_{i,\mathrm{pre}}$ on $X_{i,\mathrm{pre}}$. When one controls for $X_{i,\mathrm{pre}}$ in the auxiliary regression, there is no relation between $\nu_{i,\mathrm{pre}}$ and D_i.

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Comment Mark Gertler

Introduction

This is an interesting and provocative paper. I enjoyed reading it. The authors make two main arguments:

1. The existing evidence in favor of inflation targeting is open to identification problems.
2. After taking into account this identification problem, the evidence suggests that inflation targeting has been irrelevant.

On the first point I completely agree. On the second point, however, I disagree. I do not think the authors' empirical framework is sharp enough to disentangle the effects.

The essence of the authors' argument is that the endogeneity of inflation targeting makes the existing evidence difficult to interpret. I will argue that this same endogeneity problem potentially clouds the interpretation of their empirical tests. In particular, to the extent that there is not much exogenous variation in the choice to adopt inflation targeting, it may be very difficult to identify the effects, particularly in a small sample.

A second major issue involves the classification scheme. The authors divide the countries into targeters and nontargeters. I will argue that many of the nontargeters (if not just about all), however, adopted monetary policies that were very similar in practice to formal inflation targeting. This lack of

Mark Gertler is Henry and Lucy Moses Professor of Economics and Chairman of the Economics Department at New York University and a research associate of the National Bureau of Economic Research.

sharpness in the classification scheme further complicates the task of disentangling the contribution of inflation targeting.

Below I elaborate on each of these points.

The Empirical Framework

The authors begin with a data set that consists of various economic indicators for most of the OECD countries over the period 1960 to the present. They then consider the following two econometric specifications:

$$X_{\text{post}} - X_{\text{pre}} = a_0 + a_1\text{D} + u \tag{1}$$

$$X_{\text{post}} - X_{\text{pre}} = a_0 + a_1\text{D} + a_2X_{\text{pre}} + v, \tag{2}$$

where X_{post} is variable X (say, inflation) in the second part of the sample and X_{pre} is the variable in the first part. In addition, D is a dummy that takes on a value of unity if the country adopted a formal inflation target in the second part of the sample (no countries adopted in the first part). Finally, u and v are error terms.

Equation (1) is the specification that much of the existing literature has considered. Under this specification, estimates of the coefficient a_1 are typically significant for the kinds of variables considered. For example, if X is inflation, a_1 is typically negative and statistically significant. The temptation in the literature has been to conclude that countries that adopted formal inflation targets experienced a significantly larger drop than countries that did not: that is, inflation targeting has made a difference.

As the authors correctly point out, however, this interpretation is problematic if (as one might think) the decision to adopt inflation targeting is endogenous. It is possible, for example, that high inflation in the early part of the sample induced countries to adopt inflation targeting. Indeed, countries that adopted inflation targeting did tend to have higher-than-average inflation in the first part of the sample. This potential endogeneity leaves open the possibility that inflation targeting did not have a true causal effect on a inflation. Rather, the drop in inflation could simply have been the result of what the authors call "regression to the mean" factors, with inflation targeting being merely a veil.

A sharper way to see the problem is as one of specification bias. It could be the case that estimate of a_1 is negative because the inflation-targeting dummy is negatively correlated with the error term u and not because D is truly causal. This negative correlation arises if (a) high inflation induces inflation targeting and (b) the drop in inflation merely reflects regression-to-the-mean factors, as the authors suggest.

The authors propose to correct for the specification bias by adding X_{pre} to the right-hand side, as in equation (2). When they do so, they find that coefficient a_2 is significantly negative but that a_1 now does not significantly differ from zero. That is, after controlling for initial inflation, the inflation-targeting dummy no longer has any explanatory power. The authors interpret this result as suggesting that inflation targeting does not matter.

I think the evidence is not sharp enough to draw any firm conclusion. The alternative interpretation is also consistent with the evidence: countries that experienced high inflation early on subsequently adopted inflation targeting as a consequence. Inflation targeting, in turn, facilitated the disinflation. Under this scenario (where the decision to adopt inflation targeting is completely endogenous), the impact of inflation targeting is embedded in the reduced-form coefficient a_2. The causal variable remains X_{pre}. However, inflation targeting is part of the propagation mechanism, which accounts for how countries with early high inflation experienced a larger drop in inflation in the second part of the sample.

Here one can make an analogy with the identified vector autoregression (VAR) literature. We know from this work that just because nonmonetary shocks account for most of the variation in output, one cannot conclude that monetary policy is not important. It could be that the response of the economy to these nonmonetary shocks is quite sensitive to the endogenous response of monetary policy. Similarly, the endogenous response of inflation targeting to high inflation within the OECD countries might have shaped the dynamic response of inflation. Given the nature of the evidence the authors present, it is difficult to sort out these competing explanations.

To the extent that there is some exogenous variation in decisions to adopt inflation targeting, the authors' empirical framework could in principle identify the effects of inflation targeting. Over the cross section of countries the authors consider, however, the correlation between initial inflation and the decision to adopt targeting appears very strong. That is, initial inflation seems to be a good indicator of whether a country adopts. Even if there is some residual exogenous variation in the adoption decision, however, it is not clear that the sample size is sufficiently large to identify the impact of this variation. That is, multicollinearity is likely an issue.

The Classification Scheme

The other key issue, as I noted earlier, is that the authors' classification scheme may not be sufficiently sharp. In principle, one can only assess the effects of inflation targeting by having a clear alternative monetary policy regime as a benchmark. That is, to draw conclusions about inflation targeting, one must ask what it is being compared to.

In this regard, it is not clear that the non-inflation-targeting countries in the sample followed monetary policies that were clearly distinct from those of the inflation-targeting countries. Many of the nontargeters belong to the European Monetary Union, which has adopted a hybrid of inflation targeting that involves explicit objectives for both inflation and money growth. In addition, while some nontargeting central banks, such as the Federal Reserve, may not have formal numerical objectives for inflation, it

Table 6C.1 **Countries in classification scheme**

Inflation targeters		Nontargeters	
Non-euro	Euro	Non-euro	Euro
Australia	Finland	United States	Austria
Canada	Spain	Japan	Belgium
New Zealand		Denmark	France
Sweden		Norway	Germany
United Kingdom		Switzerland	Ireland
			Italy
			The Netherlands
			Portugal

could be argued that they implicitly targeted inflation by managing interest rates in a way that is indistinguishable from what a formal inflation-targeting central bank might choose. Accordingly, given the fuzziness of the classification scheme, it is perhaps not surprising that it is difficult to disentangle any impact of inflation targeting. More formally, measurement error in D_t provides an additional reason why estimates of a_1 may be insignificant, even if inflation targeting really does matter.

It is useful to take a closer look at the classification. In table 6C.1, I divide the countries into the targeting and nontargeting groups. Within each group I divide the countries into the Euro and non-Euro members.

The sample consists of seven targeters and thirteen nontargeters. However, more than half of the nontargeters (eight) belong to the European Monetary Union (EMU), as do two of the targeters. Because EMU has followed a policy that is very close in spirit to inflation targeting, it is not clear that it is desirable to have these countries in the control group.

What about the non-Euro nontargeters? As I alluded to earlier, there is evidence to suggest that the United States under Volcker and Greenspan has acted like an implicit inflation targeter. Denmark has been on the verge of joining the EMU and has thus pursued a monetary policy that has been very close in spirit. Switzerland in fact follows a system of inflation and monetary targeting that is similar in practice to that of the EMU. It is not clear that Japan should be in the group, either: this country has had a drop in inflation that has been arguably too large. Since this country has experienced deflation, inflation targeting would have produced a more modest drop in inflation than what occurred. Including Japan thus seems to muck up the empirical predictions.

This leaves Norway. A (perhaps unfair) characterization of the authors' econometric framework is that they are trying to achieve identification by exploiting the differences between Norway and Sweden. In figures 6C.1 and 6C.2, I plot consumer price inflation and the call money rate for Sweden and Norway over the period 1972 to the present. In each case, the two

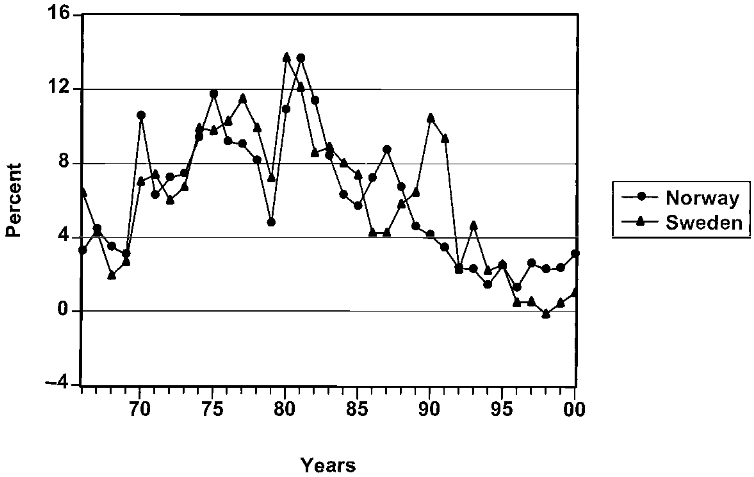

Fig. 6C.1 Inflation

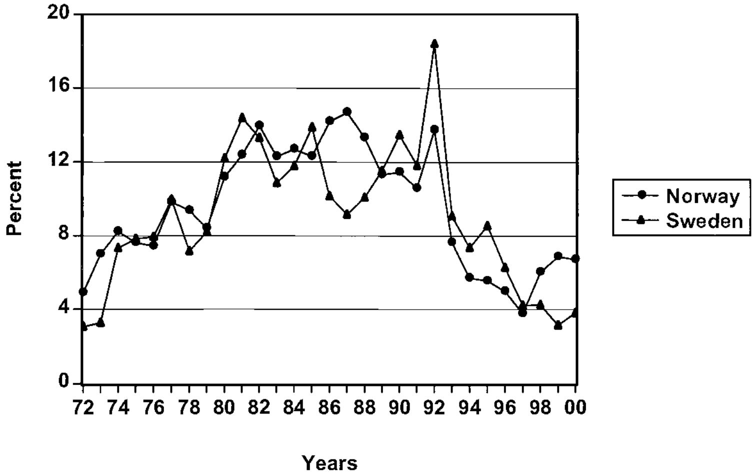

Fig. 6C.2 Call money rate

series move closely together: in this respect, Norway looks a lot like Sweden, although the classification puts them in different groups. What is going on? Even though Norway is not officially a targeter, it appears to have tied its monetary policy to a country that does inflation target (i.e., Sweden). It has done so by stabilizing its currency relative to the Swedish currency. In doing so, it may have reaped the benefits from inflation targeting, even though it is not officially categorized as an inflation targeter. The authors' classification scheme is not robust to this possibility.

Concluding Remarks

In sum, I do not think the authors have made the case that inflation targeting has been irrelevant (although they have certainly made the case that the evidence that it has mattered is also not definitive).

I do agree, however, that the adoption of formal inflation targets would have made little difference to the performance of the U.S. economy over the past twenty years. As I noted earlier, the conventional wisdom is that the Federal Reserve has behaved as an implicit inflation targeter. By establishing reputations for being focused on inflation stability, Volcker and Greenspan effectively achieved all the benefits that one might have otherwise obtained from having formal inflation targets. I think proponents of inflation targeting have this view. The case made for adopting formal targets in the United States is not that this system would improved past performance, but rather that it will help future performance by preserving the gains in credibility for Greenspan's successor. This makes sense to me. But is there clear evidence of this potential benefit in the data? Here the authors have some grounds for splashing a bit of rain on the parade. In the end, though, we can all agree: time will tell.

Discussion Summary

Ed Nelson pointed out that the paper's focus on averages across inflation-targeting and non-inflation-targeting countries entailed a loss of information, and that in particular the countries classified as non–inflation targeters had followed very different policies.

Stephen Cecchetti argued that cross-country comparisons of inflation and output variability did not answer the question of whether inflation targeting had helped to move the efficient policy frontier inward toward the origin. Instead, the results presented in the paper suggested that inflation-targeting countries located themselves at a different point on their output-inflation variability frontier from non-inflation-targeting countries.

Gregory Mankiw conjectured that the primary effect of inflation targeting had been to change the conversation between the central bank and the public. If so, it would be difficult for any cross-country study to draw a clear distinction between inflation targeters and non–inflation targeters, as countries without an explicit inflation target might focus in their public statements on the same issues as inflation targeters.

Donald Kohn pointed out that adoption of an inflation target had often occurred in combination with an increase in the central bank's independence, making it difficult to distinguish between the effects of one or the other.

Martin Feldstein suggested that the coefficient estimates on the lagged performance measure would be biased upward if the equation residual was serially correlated, thus inflating the explanatory power of the lagged dependent variable.

Michael Bordo argued that the regime change in the 1980s and 1990s was an increased emphasis on inflation control, which was not confined to inflation-targeting countries, and that beyond this regime change, inflation targeting was a second-order issue.

Jose De Gregorio expressed the view that the effect of commodity price changes on domestic inflation depended more on the exchange rate regime in place than on the presence or absence of an inflation target, creating an endogeneity problem for the study. He also pointed out that several inflation-targeting countries disinflated before adopting an inflation target.

Frederic Mishkin emphasized the lack of proper identification of the effects of inflation targeting in the paper. He also argued that the classification of countries into inflation targeters and non–inflation targeters compounded the identification problem. If, by analogy, one wanted to assess the success of monetary targeting in Germany, it would be inappropriate to treat those countries whose exchange rate to the deutsche mark had been fixed for decades as independent observations.

Christopher Sims pointed out that the reduction in the point estimates of the coefficients on the inflation-targeting dummy in the dynamic specifications may be deceptive, and that the quantitative implications may be very similar to those of the inflation-targeting dummies in the static equations.

Laurence Ball replied that there was no evidence that the adoption of an inflation target helped countries with initially high inflation rates to disinflate. On the question of the proper classification of countries, the authors had tried many different classifications without being able to find a significant effect of inflation targeting.