Preliminary

DOES INFLATION TARGETING MATTER?

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"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, p. 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, p. 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, p. 288).

I. INTRODUCTION

Economists have long sought the ideal rule for monetary policy – there has been an "unending quest for monetary salvation" (Fischer, 1995). Starting in the early 1990s, a growing number of economists and policymakers have come to believe that they have finally found a good rule: inflation targeting. Most readers of this paper know the story: inflation targeting began in Canada and New Zealand in the early 1990s, spread to other industrial countries in the mid-90s, and is now increasingly common among middle-income countries as well. By one count, there were 20 inflation targeting countries as of 2002, and more are surely on the way; there is speculation that the two major holdouts, the U.S. and the Euro area, may adopt inflation targeting after their current leaders retire. The movement toward inflation targeting has been widely applauded by academics.

As illustrated by the quotations above, proponents of inflation targeting have cited many benefits. Inflation targeting can solve the dynamic consistency problem that produces high average inflation. A constant target reduces inflation variability. "Flexible" inflation targeting of the type currently practiced can stabilize output as well (Svensson, 1997). Inflation targeting locks in expectations of low inflation, which reduces the inflationary impact of macroeconomic shocks. A number of cross-country empirical studies have reported evidence of such beneficial effects, including Bernanke et al. (1999), Clifton et al. (2001), Sheridan (2001), Corbo et al. (2002), and Neumann and von Hagen (2002).

This paper attempts to measure the effects of inflation targeting by comparing economic performance in twenty OECD countries, seven that adopted inflation targeting and thirteen that did not. Our findings differ from much previous work. Not surprisingly, economic performance varies greatly across individual countries, both targeters and non-targeters. But on average, 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, there is clear evidence that performance improved on average between the period before targeting and the targeting period; for example, inflation became lower and more stable, and output growth also stabilized. However, countries that did <u>not</u> adopt inflation targeting experienced similar improvements in performance around the same times as targeters. This finding suggests that improvements in performance resulted from widespread developments in policymaking or the economic environment other than inflation targeting.

For some measures of performance, both inflation targeters and non-targeters show improvements over time, but the improvements are larger for targeters. For example, average inflation fell for both groups between the pre-targeting and targeting periods, but the average for targeters went from a level substantially above that of non-targeters to roughly the same as targeters. Similar findings have led authors such as Neumann and von Hagen (2002) to argue that inflation targeters do not perform better than non-targeters, but that targeting promotes "convergence": it allows poorly-performing countries to 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, we find that the apparent benefits of inflation targeting disappear.

Section 2 describes the countries and sample periods that we study and our methods for comparing them. We examine average economic performance before and after the start of inflation targeting in both targeters and non-targeters. (For non-targeters, we date the start of the "targeting" period by the average start date for targeters.) We also distinguish between parts of inflation targeting regimes in which the target is constant and transitional periods in which targets are declining toward their long-run level. Theoretically, some of the benefits of inflation targeting, such as reduced persistence of inflation movements, should arise only when the target is constant.

Sections 3 and 4 examine univariate statistics capturing the behavior of inflation and output respectively. Controlling for regression to the mean, we ask whether the introduction of targeting affected the change in these statistics between the pre-targeting and targeting periods. There are occasional hints of beneficial effects and occasional hints of adverse effects, but overall it appears that inflation targeting does not matter.

Section 5 turns to the behavior of interest rates, and produces 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. This result is consistent with our findings that targeting does not affect the variability of output or inflation.

Section 6 investigates the effects of inflation targeting on several multivariate relations: the slope of the output-inflation tradeoff, the inflationary effects of supply shocks (specifically changes in commodity prices), and the response to inflation movements of inflation expectations, as measured by OECD 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 point once again to no important effects of targeting.

Section 7 compares our results to those of previous studies. Section 8 concludes by interpreting our results. To be clear, we do not present a case <u>against</u> inflation targeting. We do not find that targeting does anything harmful, and we can imagine future circumstances in which it could be beneficial. Our results suggest, however, that proponents of inflation targeting should be modest in their claims about the benefits that have occurred so far.

II. METHODOLOGY

This paper seeks to measure the effects of inflation targeting on dimensions of economic performance such as the mean and variability of inflation, output growth, and interest rates. We examine each aspect of performance in turn, using a common methodology to measure the effects of targeting. This section describes this methodology.

A. The Sample

We aim to examine major developed, moderate-inflation economies. Specifically, we start with all members of the OECD as of 1980 (thus excluding the developing and transition economies that have joined since then). We delete countries that lacked an independent currency before the Euro (Luxembourg) or have experienced annual inflation over 15% since 1990 (Greece, Iceland, and Turkey). We are left with twenty countries, which are listed in Table I. Previous macroeconomic studies using the same sample of countries include Layard et al. (1991) and Ball (1997).

Seven of the countries in our sample adopted inflation targeting before 1999: Australia, Canada, Finland, Spain, Sweden, U.K., and New Zealand. For each of these countries, we examine performance before and after the introduction of inflation targeting. We define the beginning of targeting as the first 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 et al (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 philosophy is that many of the intended effects of inflation targeting, such as those working through expectations, occur only if agents know that they are currently in a regime with a certain target.

As an example of our procedure, consider Sweden. Sweden announced its shift to inflation targeting during 1993, so Bernanke et al (1999) and Scheater et al (2000) date the regime from then. However, the first target that was announced was a target of 2 percent for twelve-month inflation at the end of 1995. Since this target applied to inflation over all of 1995, we choose 1995:1 as the first quarter of the targeting regime. Table I gives the starting dates of targeting for the other targeters along with brief explanations for our choices. The starting dates range from 1990:3 for New Zealand to 1995:2 for Sweden.

The targeting period lasts through 2001 for all countries except for Finland and Spain; for these countries, we end the sample in 1998 because they gave up independent monetary policy to join the Euro. For each country, we compare the targeting period to two pre-targeting periods, a longer one that begins in

1960 and a shorter one that begins in 1985 (and is roughly the same length as the targeting period for most countries). The last quarter of the pre-targeting period is the last full quarter before inflation targeting began; this is 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 the brief targeting periods of these countries from our sample and treat Switzerland and Norway as non-targeters. Otherwise, we again end the sample in 2001 for non-Euro countries and 1998 for Euro countries. Following our approach for targeters, we compare pre-targeting periods starting in 1960 and 1985 to post-targeting periods. For the non-targeters, we define the post-targeting period as beginning at the mean of the start date for targeting in the targeters; this is 1993:3. Thus the split into pre- and post-targeting periods is the same for non-targeters as for the average targeter. The details of our dating of samples are given in Table II.

Of the thirteen non-targeters that we consider, eight joined the Euro in 1999; previously, they were part of the European Monetary System and their policy was aimed at fixing exchange rates and meeting the criteria for monetary union. Two of the countries, Germany and Switzerland (one also in the EMS) followed loose systems of monetary targeting (Bernanke et al., 1999). The remaining four countries did not follow any announced policy rule – they pursued what Mishkin (1999) has called the policy of "just do it." In our main results, we lump these countries together and compare their performance to that of inflation targeters. We have also checked, however, whether there are systematic differences among the non-targeting groups and fail to find any (although it is difficult to tell with only a few countries in each group). Because convergence to the Euro might be thought to have important effects on inflation behavior, we have computed all of our average statistics for inflation targeters and non-targeters excluding Euro countries (which leaves five targeters and five non-targeters). This produces no noteworthy changes in results, and so we omit this breakdown from our tables.[1]

[1] In addition, we tried adding a Euro dummy to all of our cross-country regressions. This variable was usually insignificant. The only exception is that Euro countries experienced larger falls in the standard deviation of output growth between the pre- and post-inflation-targeting periods. Even in this case, there is no change in our finding that inflation targeting does not matter.

B. Constant Inflation Targeting

In addition to comparing performance before and after inflation targeting, we examine periods in which countries are constant inflation targeters – periods in which they have an unchanging target or target range. In some countries this is the same as the inflation targeting period, but in others the constant-targeting period is preceded by a transitional period in which inflation targeting is in effect but the target is higher than its final level. We focus on constant targeting periods because some benefits of inflation targeting might not arise if the target changes over time. For example, economists sometimes argue that changes in inflation are less persistent under targeting, but obviously a changing target can produce a permanent change in inflation.[2]

Throughout this paper, we present results comparing inflation targeters (IT) to non-targeters (NIT) and comparing constant-inflation targeters (CIT) to non-constant-targeters (NCIT). Spain is an inflation targeter, but its target fell throughout its targeting period; thus, when we split countries

[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% to 0-3% in 1997. The implied change in the midpoint of half a percent was smaller (and of the opposite sign) than the target changes during transitional periods that we exclude from constant targeting samples. In our judgment the 1997 episode was not a substantial change in policy.

into CIT and NCIT, Spain is included in the second group, leaving only six CIT countries. When we compare CIT and NCIT countries, we examine pre-targeting and post-targeting periods with definitions parallel to those for our IT/NIT comparison. For example, the start date of the post-targeting period for NCIT countries is the average of the start dates for constant targeting in CIT countries; see Table II for details.

We call the two pre-inflation-targeting periods, those starting in 1960 and 1985, samples 1 and 2, respectively. Sample 3 is the post-targeting period. Similarly, samples 4 and 5 are the two pre-constant-targeting periods, and sample 6 is the post-constant-targeting period. While the distinction between IT and CIT is important in principle, the changes in economic performance from the pre- to the post-targeting period is usually similar in the two cases.

C. Comparing Targeters and Non-Targeters

To understand how we measure the effects of inflation targeting, suppose we are interested in its effect on a variable X – this can be the average level of inflation, the variability of inflation or output, or whatever. We first calculate the value of X for each of our 20 countries in each of our six sample periods. Then, for each sample period, we calculate the average value of X over inflation targeters and non-targeters (or, for samples 4-6, constant inflation targeters and non-constant targeters). Comparing these averages shows whether targeters have systematically different values of X than non-targeters in each sample period.

As we have mentioned, most measures of economic performance show improvements on average between the pre-inflation targeting and post-targeting periods. This reflects the fact that the period since the early 90s has been one of low and stable inflation and stable output growth in most of the developed world. If we examine inflation targeting countries alone, it is easy to detect evidence of economic improvements that one might be tempted to attribute to targeting. But to learn about the true effects of targeting, we must compare improvements in targeting countries to improvements in non-targeting countries.

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

$$X_{post} - X_{pre} = a_o + a_1 D + e ,$$

where X_{post} is a country's value of X in the post-targeting period, X_{pre} is the value in the pre-targeting period, and D is a dummy variable equal to one if the country is a targeter. There are various versions of this regression corresponding to different start dates for the pre-targeting period (1960 or 1985) and whether targeting means IT or CIT. If the coefficient a_1 is significantly different from zero, this suggests that inflation targeting matters for the variable X.

In some cases, however, this regression can be misleading, because of the simplest kind of regression-to-the-mean. For some versions of the variable X, the initial value, X_{pre}, is substantially different on average for inflation targeters than for non-targeters. For example, over the period from 1985 to the start of targeting, inflation is higher and more variable in countries that subsequently adopted targeting. This is not surprising: it suggests that the new regime of inflation targeting was most attractive to countries with poor past performance, while countries with better performance saw less need for change. A problem arises, however, because countries that start with the poorest performance are most likely to make improvements. If inflation targeters are generally poor initial performers, the dummy variable for targeting in the above regression is likely to be significant, suggesting a beneficial effect of targeting, even if targeting is really irrelevant.

As a simple analogy, suppose that short people are unhappy about their stature because it makes it difficult to dunk a basketball. They know that height is positively correlated across generations, and therefore fear for their children's basketball careers. A charlatan publishes an article claiming that large doses of Kool-Aid will promote growth in children, even though it really doesn't; many short people, dazzled by the elegance of the charlatan's theoretical arguments, give their kids lots of Kool-Aid. Most tall people don't bother. Because of pure regression to the mean, the Kool-Aid-drinking offspring of short people will on average exceed the heights of their parents by more than the Kool-Aid-deprived children of tall people. A differences-in-differences regression would suggest that drinking Kool-Aid has a positive effect on the change in height across generations, even though it does not.

Fortunately, there is a simple way to eliminate this problem: include the initial value of the variable X in the differences regression. That is, we run

$$X_{post} - X_{pre} = a_o + a_1 D + a_2 X_{pre} + e \ .$$

The variable X_{pre} controls for the effect of the initial level of inflation on the change in inflation (or the effect of initial height on the change in height). The coefficient on the targeting dummy now shows whether there is an independent effect of targeting – whether targeting adds to the improvement in performance for a given initial level of performance. As we will see, controlling for regression-to-the-mean in this way is important for our results.

III. INFLATION

In a speech shortly before he was named Governor of the Bank of England, Mervyn King 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.

A. Average Inflation

Table III presents our results concerning the average level of inflation. Inflation is measured by the percentage change in consumer prices from the IMF's International Financial Statistics. In Panel A of the table, we show the average level of inflation at annual rates in each of our twenty countries for each of our six sample periods, along with averages across the targeting and non-targeting groups of countries. Panel B reports our regressions of changes in average inflation on the targeting dummy and the initial level of inflation.

Not surprisingly, there is considerable variation across countries in average inflation levels. For sample 2, for example (1985 to start of inflation targeting), average inflation ranges from double digits in New Zealand and Portugal to less than two percent in Japan and Netherlands. Every country in the sample experienced disinflation: average inflation was lower during the targeting periods (samples 3 and 6) than in the pre-targeting periods. The variation in inflation across countries is lower for the targeting periods, when all inflation rates were below four percent.

Turning to the cross-country averages, we see that the IT group had higher inflation than the NIT group before the introduction of targeting. (Here and elsewhere, the comparison between the CIT and NCIT groups is similar.) For the longer pre-targeting sample, average inflation is 7.2% for IT and 6.0% for NIT; for the shorter pre-targeting sample, the numbers are 5.8% and 3.7%. In the targeting period, by contrast, average inflation for the IT group moves slightly below the average for the NIT group, 1.88% vs. 1.95%. This convergence of targeters to the lower inflation rates of non-targeters is echoed in the first part of Panel B, where we regress the change in average inflation on the targeting dummy. For the shorter pre-targeting sample, the targeting dummy has a coefficient of -2.2: this is how much more average inflation fell in targeters than in non-targeters. This coefficient does not contain new information, as it is simply the difference in differences of means between samples 2 and 3. However, the regression reveals that the coefficient is statistically significant (t=2.5).

Inflation targeting is important if it really reduces average inflation by more than two percentage points. However, most of this apparent effect is illusory: it reflects the fact that inflation targeters had high initial inflation, and there is regression to the mean. Equation 2 in Panel B shows that there is strong regression to the mean: the coefficient on initial inflation is -0.78. Once we control for this effect, the estimated effect of targeting is only -0.55, and its significance can be generously described as borderline (t=1.57, p-value=0.14). Thus the statistical evidence that inflation targeting matters is weak, and even the point estimate that targeting reduces inflation by half a percentage point is a modest effect. Looking ahead, however, we will see that this finding is one of the more positive results about the effects of targeting!

Note how much of the variation in inflation changes is explained by initial inflation: including this variable raises the R^2's from 0.2 or below to 0.9. Figure 1 illustrates this point by plotting the change in inflation from sample 2 to sample 3 on the level in sample 2. The Figure shows a tight relationship, confirming that regression to the mean is the dominant determinant of changes in average inflation. Since the targeting countries tend to have high initial inflation they tend to have large inflation decreases, but the change in inflation for a given initial level looks similar for targeters and non-targeters.

B. Inflation Variability

Tables IV and V examine the variability of inflation, using the same format as the results for average inflation. Table IV gives the standard deviation of quarterly inflation for each country and sample. Table V gives the standard deviation of "trend inflation," defined as in some previous work (e.g. Ball, 1994) as a centered nine-quarter moving average of inflation. We examine trend inflation because one might guess that inflation targeting would stabilize this variable even though monetary policy cannot eliminate high-frequency movements in inflation arising from supply shocks and so on.[3]

There is no evidence whatsoever that inflation targeting reduces inflation variability. In all of our sample periods, the standard deviations of inflation and trend inflation are smaller for non-inflation targeters (or non-constant-inflation targeters) than for targeters. For all groups of countries, the standard deviation falls during the targeting period: since the early 90s, inflation has become more stable throughout the developed world. But the non-targeters have more stable inflation both before and after targeting. The results of regression equation 1 suggest that inflation targeting has a negative effect on the change in standard deviations, but this result disappears when we control for regression to the mean in equation 2. In fact, the results in Table IV imply that, controlling for regression to the mean, inflation targeting raises the standard deviation of inflation, and this effect is sometimes statistically significant. We do not take this perverse result very seriously, as it is likely a fluke (given our large number of regressions, conventional statistical tests should produce some Type I errors). The robust

[3] 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. Thus we exclude observations near the beginnings and ends of our usual samples.

point is that there is no evidence that inflation targeting is beneficial.

C. Inflation Persistence

Finally, we estimate the persistence of inflation in our different sample periods. For each country and sample, we estimate an AR-4 model for quarterly inflation. For each sample, we then average each AR coefficient across targeting and non-targeting countries. Finally, using these average coefficients, we compute impulse response functions showing the effects of inflation innovations on future inflation for each group of countries in each period.

Figure 2 presents some of our results. We use solid lines for impulse response functions for inflation targeting countries and dashed lines for non-targeters; for each group of countries, there are impulse response functions for the long pre-targeting period (samples 1 and 4) and the targeting period (samples 3 and 6). We omit the responses for the short pre-targeting samples, which always lie between the responses for the samples we show.

The Figure shows that inflation persistence has decreased over time. For the period from 1960 to the start of targeting, a unit shock in quarter t has an effect of roughly 0.4 or 0.5 on inflation at quarter t+1, and this effect dies out quite slowly.

For the targeting period, the t+1 effect is half as big or less, and it disappears by t+4. Crucially, this pattern holds for both targeting and non-targeting countries. That is, inflation has become more anchored under inflation targeting – the effects of a shock die out more quickly than in the past – but inflation has become equally anchored in countries without targeting. (Since Figure 2 makes our point fairly clear, we will not go on to other exercises here, such as correcting for regression to the mean).[4]

IV. OUTPUT GROWTH

We now examine the effects of inflation targeting on the average level and variability of real output growth, using the same methods we used for studying the average level and variability of inflation. Here we use annual data from the IFS, as reliable quarterly data on output are not available for all the 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.

[4] 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 coefficients as a fluke, as negative impulse responses seem unlikely a priori.

A. Average Growth

It is not obvious a priori 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 behavior.) Nonetheless, Mishkin (1999) suggests

> "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." (p. 597)

Here we examine this idea, with inconclusive results.

Table VI presents our results concerning average growth rates. Average growth increased in inflation targeting countries after targeting began, while it decreased slightly in non-targeting countries. When we control for regression to the mean in equation 2, the point estimates imply that targeting raises average growth by a substantial amount: from 0.5 to 0.9 percentage points, depending on the specification. However, the t-statistics range from 0.7 to 1.1. Underlying these imprecise results is large variation in average growth across individual countries. Note that growth in our samples of eight years or less is affected by the cyclical position of the economy at the starts and ends of samples as well as by the growth of potential output. It is too early to tell whether inflation targeting affects average growth.

B. Output Variability

Some economists argue that the current practice of "flexible" inflation targeting stabilizes output as well as inflation. Others, such as Cecchetti and Ehrmann (1999), suggest that targeting raises the variance of output. Once again, we find that targeting has little effect either way.

Table VII presents our results about output variance (recall this is variance at the annual rather than quarterly frequency). The results mostly echo our results about inflation variability. Variability is always lower in non-targeting countries than in targeting countries. Variability decreases for both groups in the targeting period. When we control for regression to the mean in equation 2, the point estimates suggest that targeting raises variability, but they are not statistically significant.

V. INTEREST RATES

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

A. Average Long-Term Rates

We have seen that reductions in the level of inflation since the early 1990s have been similar in inflation targeting and non-targeting countries. Targeting proponents often argue, however, that low inflation is more secure under this policy: it locks in low inflation, whereas “just do it” regimes pose the risk that inflation might rise because of shocks or shifts in policy. If the public understands this, inflation should produce lower long-term inflation expectations, and also less uncertainty about future inflation. As discussed by King (2002), both effects should reduce long-term nominal interest rates (the latter because of lower risk premia).

We investigate this idea with series on long-term interest rates from the OECD. The data start in 1970, so our samples 1 and 4 begin then rather than in 1960, as in other tables. The interest rates are rates on ten-year government bonds. The data are annual, and so we date our samples by years, as in our analysis of output behavior. (Interest-rate data in the IFS, the source of our other series, is less consistent across countries.)

Table VIII presents our results, which are highly reminiscent of our results about inflation and output. If we define better performance by lower average interest rates, then both targeters and non-targeters improved during the targeting period; non-targeters always perform better than targeters in a given period; the improvement in performance over time is somewhat greater for targeters; but the effect of targeting disappears when we control for regression-to-the-mean in equation 2. The point estimates in equation 2 imply that targeting raises interest rates slightly, but the t-statistics are less than one.

B. The Variability of Short-Term Interest Rates

In addition to examining macroeconomic outcomes, we would like to know whether inflation targeters move their policy instruments differently than non-targeters. In principle, a natural way to ask this question is to estimate Taylor rules showing the reaction of short-term interest rates to output and inflation. In practice, it appears difficult to get meaningful estimates of such rules for the short samples at hand. We therefore examine a cruder measure of policy behavior, the variance of short-term interest rates. Note this variance should change if policy rules shift. For example, some authors suggest that inflation targeting produces stronger policy responses to inflation movements. This suggests that interest rates become more volatile unless targeting makes inflation less volatile, an effect that we fail to detect above.[5]

While our data on long-term interest rates are annual, we want to measure the variability of short-term rates at the quarterly frequency. We use quarterly data on interbank rates from the IFS (Line 60b). We examine only the shorter of our pre-targeting samples, the ones starting in 1985, because little data is available before then. For once, we succumb to the urge to throw out some troublesome outliers. For all countries, we delete three quarters during the ERM crisis, 1992:3 through 1993:1, which produced large spikes in interest rates.

The results, in Table IX, follow the pattern we have seen again and again. Short-term interest become more stable over time and are always more stable for non-targeters. The decrease in variance is larger for targeters if we ignore regression to the mean but not if we take it into account.

VI. MULTIVARIATE RESULTS

So far we have compared univariate statistics from different countries and time periods. In principle, we would like to look

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

more deeply to see whether inflation targeting changes the structure of the economy. For our short samples, however, it is impractical to estimate sophisticated relationships with many parameters. Here we take one step beyond our univariate analysis by examining three bivariate relations: the relation between the output gap and the change in inflation; the effect of changes in commodity prices on inflation; and the effect of inflation on expected future inflation, as measured by OECD forecasts.

A. Methodology

For each country and each of our six sample periods, we now run three regressions:

(1) $\Delta\pi = a(y-y^*)$,

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

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

where y^* is the trend level of output (measured by the Hodrick-Prescott filter with smoothing parameter 100); Δp^{com} is an index of commodity prices in U.S. dollars, from the IFS; π^{US} is U.S. inflation; and π^{fore} is the OECD's forecast of inflation. All regressions are based on annual data, since several of the variables are available only at that frequency.

Equation (1) can be interpreted as an accelerationist Phillips curve: it shows how the difference between actual and trend output – the "output gap" -- affects inflation. Equation (2) shows how inflation is influenced by a common measure of "supply shocks," the change in the relative price of commodities. We construct the relative price change by subtracting U.S. inflation from the change in commodity prices in dollars; the resulting variable is the same for all countries. Finally, equation (3) shows how expectations of inflation respond to movements in the previous year's inflation. We measure expectations by OECD forecasts because they are produced in consistent ways for all our countries (in contrast to measures of private-sector expectations, which vary greatly).[6]

The past literature suggests that inflation targeting should influence the coefficients a, b, and c in these equations. For example, the quote from Bernanke et al. at the start of this paper implies that targeting reduces the effects of inflation movements on expectations (c should fall) and therefore reduces the inflationary impact of shocks (b should fall). The effects on the Phillips curve slope are debatable. The idea of anchored

[6] 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. 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), B(-1) is inflation in year -1 as estimated by the OECD in December of that year, when they make forecasts for the following year.

inflation suggests a fall in a; on the other hand, authors such as Corbo et al. (2002) argue that targeting reduces the output cost of disinflation, which suggests a rise in a.

With few degrees of freedom, our estimates of equations (1)-(3) for individual countries and time periods are imprecise, and averaging across countries is not always a solution. For example, for inflation targeters in sample 2, the average Phillips curve coefficient is 0.08, but it becomes 0.22 if one excludes New Zealand with a coefficient of –0.75. The standard error of each coefficient is 0.31 on average and 0.88 for New Zealand. One must be careful in interpreting such results!

In trying to extract information from these estimates, we account for the fact that there is considerable variation in precision across countries (for example, the standard error of a in sample 2 is less than 0.1 for Canada and Finland). This fact implies that the optimal estimator of the average coefficient for a group is a weighted average of the individual country estimates, with weights that depend on the standard errors of the estimates. The Appendix discusses how to construct the optimal weights. Similarly, we use weighted least squares to estimate our differences-in-differences regressions for our estimates of a, b, and c. We do not attempt here to control for regression to the mean. Adding an initial estimate of a parameter to our regressions would introduce the additional headache of measurement error in an independent variable.

B. Results

Table X presents our multivariate results. For the last time, we find that there have been changes in economic behavior over time, but that the changes are similar for inflation targeters and non-targeters. The most striking change over time is in the effect of commodity-price changes on inflation, which has decreased by an order of magnitude. For non-inflation targeters, for example, the average coefficient in sample 1 (1960 to the start of IT) was 0.06. This implies that a ten point rise in the relative price of commodities raises inflation by six tenths of a percentage point. For the IT period, sample 3, the effect is 0.006. There have been more moderate decreases in the effects of past inflation on inflation forecasts, supporting the idea that inflation expectations have become more anchored. Phillips curve coefficients have also fallen, supporting the idea of anchored inflation rather than lower sacrifice ratios. A natural explanation for this last finding is the decrease in the average level of inflation, which should flatten the Phillips curve by increasing nominal price rigidity (Ball et al., 1988).

This effect might also help explain the lower inflationary effects of supply shocks (Takhtamanova, 2003). In many specifications, these changes over time are statistically significant (as measured by the constant terms in the weighted-least-squares recessions).

In contrast, the dummy variable for inflation targeting is never significant at the five percent level, and only once out of twelve times at the ten percent level. The point estimates do not suggest any robust stories about effects of targeting.

VII: COMPARISON TO OTHER STUDIES

The closest study to ours is that of Neumann and von Hagen. Their paper and ours have the same title. Part of their paper, like ours, compares the volatility of inflation, output, and interest rates across different time periods in inflation targeters and non-targeters. But their bottom line is "Taken together, the evidence confirms the claim that IT matters" (p. 144). We disagree.

Our study differs from Neumann and von Hagen in many details, but the crucial difference appears to 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 the performance of targeters has moved toward the performance of non-targeters along some dimensions, but this convergence was not caused by targeting.

Other studies report effects of inflation targeting on various economic relationships. In some cases these results appear at odds with our findings. For example, there are reports that targeting steepens the Phillips curve (Clifton et al., 2001); that it reduces the level of expected inflation (Johnson, 2002); and that it increases the predictability of inflation (Corbo et al., 2002). (See also the literature review in Neumann and von Hagen.) In some of these cases, regression to the mean may explain the findings; for example, Corbo et al. conclude that "Inflation targeters have consistently reduced inflation forecast errors (based on country VAR models) toward the low levels prevalent in non-targeting industrial countries" (p. 263).

Often it is difficult to compare our results to previous work, as we focus on univariate statistics while many studies estimate multivariate relations with sophisticated econometrics.

We believe, however, that our results cast doubt on these earlier findings. It seems unlikely that inflation targeting changes the relationships that previous papers estimate without affecting the first or second moments of inflation, output, or interest rates.

VIII: CONCLUSION

Suppose a Martian economist tried to figure out which countries on our planet adopted inflation targeting during the 1990s. His job would be easy if he read the speeches of central bank governors, for targeters are clear in announcing their policies. But suppose the Martian tried to deduce who adopted targeting simply by observing the behavior of macroeconomic variables, such as inflation, output, and interest rates. Our results suggest he would have a tough time. He might look for countries that experienced unusual improvements in their economic performance, given their initial conditions. But this approach would be no more successful than random guessing, since targeting has little effect on performance. (If the Martian were clever at political economy as well as macroeconomics, he could do better by choosing countries with poor initial performance, since he might correctly expect they would be likely to adopt a new policy regime – even one that did not turn out to change performance.)

Our results concerning short-term interest rates, while crude, are consistent with the hypothesis that the behavior of policy is similar in inflation-targeting and non-targeting countries. Thus one interpretation of our results is simply that non-targeters have acted like targeters. Indeed, observers of countries such as the U.S. have suggested that they are "covert inflation targeters" even though policymakers do not announce any targets (Mankiw, 2001). Theoretical work suggests that the behavior of interest rates needed to implement inflation targeting is similar to the Taylor rules that appear to fit non-targeters (e.g. Svensson, 1997; Ball, 1999). To the extent that economic outcomes depend on the behavior of policy instruments, it is not surprising that we see similar outcomes in targeting and non-targeting countries. Our results imply, however, that the formal and institutional aspects of inflation targeting – the public announcement of targets, the inflation forecasts, the enhanced independence of central banks, and so on – are not important to the economy.

Our results do not provide an argument <u>against</u> inflation targeting, for we have not found that it does any harm, and there may be benefits that we do not measure. First, aspects of inflation targeting may be desirable for political rather than macroeconomic reasons. Bernanke et al. argue that the openness implied by targeting makes "the role of the central bank more consistent with the principles of a democratic society" (p. 333).

Second, inflation targeting might improve performance in the future even though it has not done so yet. Perhaps it takes more than a decade for targeting to become fully credible, so we have not yet seen effects on expectations that occur in theory and will eventually occur in reality. Most important, many central banks in our sample, whether targeting or "just do it," have not been tested severely in the inflation targeting era, because their economies have not experienced major adverse shocks. Perhaps future policymakers will face supply shocks of the size experienced in the 1970s, or perhaps there will be strong political pressures for unwise policies. At that point, we may see that inflation targeters handle these challenges better than non-targeters.

Thus a study that seeks to replicate this paper in 25 or 50 years may find ample evidence that inflation targeting improves performance. The evidence is not there, however, in data through 2001.

APPENDIX

This Appendix discusses the weighting of the average coefficients and regressions in Table X, which gives our results about multivariate relations.

Consider the problem of estimating the average of a certain coefficient for a certain sample and certain group of countries – for example, the average Phillips curve slope for IT countries in sample 1. Let Y_i be the coefficient for an individual country i and let μ be the average coefficient. Tautologically, we can write

(A1) $$Y_i = \mu + \epsilon_i ,$$

where $\epsilon_i \equiv Y_i - \mu$. We observe only an estimate of Y_i for each country (e.g. the estimated slope of the Phillips curve); letting $\hat{Y}_i$ denote this estimate,

(A2) $$\hat{Y}_i = \mu + \epsilon_i + \eta_i ,$$

where $\eta_i \equiv \hat{Y}_i - Y_i$. We interpret (A2) as a regression equation with dependent variable $\hat{Y}_i$, a constant as the only independent variable, and an error $\epsilon_i + \eta_i$. We assume that ϵ_i is homoscedastic but η_i is not: Y_i is estimated with different precision for different countries. The best linear unbiased estimator of μ is a weighted version of regression (A2), with the weight on each observation proportional to the inverse of root[Var(ϵ_i)+Var(η_i)].

We do not observe Var($,_i$) and Var(O_i), so we estimate (A2) with a two-step approach. As an estimate of Var(O_i), we use the squared standard error of $\hat{Y}_i$ from our time-series regression for country i. To estimate Var($,_i$), recall that it is the same for all i. The variance of the composite residual $,_i$+O_i, averaged across countries, is Var($,_i$) + AvgVar(O_i), where AvgVar(O_i)is the average variance of O_i. We estimate this sum with the average squared residual from estimating (A2) by OLS. Subtracting the average of our estimates of Var(O_i) yields an estimate of Var($,_i$).

In practice, we find that our estimates of Var($,_i$) are always close to zero. (Sometimes they are slightly negative.) This result means that the errors in estimating Y_i for each country (O_i) are large compared to the true variation in Y_i across countries ($,_i$). Thus we set Var($,_i$) to zero, which means that the variance of the error term in (A2) is Var(O_i), which is estimated by the square of the standard error of $\hat{Y}_i$. We estimate (A2) by weighted least squares with weights proportional to the inverse of the standard error of $\hat{Y}_i$. One can show that the resulting estimate of $\hat{G}$ is equal to a weighted average of $\hat{Y}_i$ with weights proportional to the inverse of the squared standard error. These are the weighted averages that we present in Table X.

Our WLS regressions of changes in coefficients on inflation-targeting dummies follow a similar procedure. We again find that the errors in estimating each coefficient dominate the true cross-country variation in coefficients. Consequently, the optimal weight for each observation is proportional to the inverse of root[Var($Y_{i,post}$)+Var($Y_{i,pre}$)]. We estimate the variances in this expression by squaring the standard errors of $\hat{Y}_i$ in the post and pre samples.

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Table I: Starting Dates for Inflation Targeting and Constant Inflation Targeting Regimes

Country	Inflation Targeting	Constant Inflation Targeting	Rationale for choice of starting date [a]
Australia	Q4 1994 [b]	Q4 1994 [b]	In a speech given in September 1994, the Governor of the Reserve Bank of Australia announced that "underlying inflation of 2 to 3 per cent is a reasonable goal for monetary policy". See BLMP (1999) pp. 218-220 for further discussion.
Canada	Q1 1992	Q1 1994 [b]	The Bank of Canada announced formal targets for inflation in February 1991: A target with a midpoint point of 3 percent year-over-year inflation was set for the end of 1992. In December 1993, the target range of 1 to 3 percent was extended through the end of 1998 - this marks the start of the constant inflation targeting regime.
Finland [c]	Q1 1994	Q1 1994	Following abandonment of markkaa's peg in September 1992, the Bank of Finland introduced inflation targeting in February 1993, stating that they intended to "stabilize the rate of inflation permanently at the level of 2% by 1995".
New Zealand	Q3 1990 [b]	Q1 1993	The first Monetary Policy Statement, released in April 1990, specified 3-5% inflation by December 1990 (BLMP (1998) pg. 104), In February 1991, a target of zero to 2 percent for the year to December 1993 was announced, implying a CIT start date of Q1 1993.
Spain [c]	Q2 1995	Q1 1994 [b] (NCIT start date)	The adoption of inflation targeting framework was announced in December 1994. The first target was to be inflation of "less than 3 percent over the course of the next three years". Concerned about the impact of a VAT increase, no target was set for 1995, instead aimed for inflation of 3.5 to 4 percent by early 1996.
Sweden	Q1 1995	Q1 1995	Riksbank announced that it would adopt inflation targeting in January 1993. The objective "was to limit the annual increase in the consumer price index from 1995 onwards to 2 percent". This was clarified later; the target did not apply to the individual months of 1995 but to the period from December 1994 to December 1995. (Svennson (1995)).
United Kingdom	Q1 1993 [b]	Q1 1993 [b]	Setting of quantitative targets coincided with announcement of an inflation targeting regime during Q4 1992.
<u>Non-inflation Targeting Countries</u>			
Austria[c], Belgium[c], Denmark, France[c], Germany[c], Ireland[c], Italy[c], Japan, Netherlands[c], Norway[d], Portugal[c], Switzerland[e], United States.	Q3 1993	Q1 1994 [b]	The starting date was computed as an average of the inflation targeting or constant inflation targeting countries.

[a] In choosing the starting date for the inflation targeting (and constant inflation targeting regime), the following criteria were applied. First, the numerical inflation target must be publicly announced. Second, the regime is considered to have begun with the first quarter for which the central bank is obliged to meet the target. Third, if the regime starts in the middle of a quarter, the next quarter is chosen as the starting date for the regime (and the quarter in which the announcement was made is removed from the sample).

[b] The previous quarter is dropped from the NIT or NCIT sample.

[c] The inflation targeting regime (or non-inflation targeting regime) ends with the start of EMU: the final observation in the sample is Q4 1998.

[d] Norway announced the start of an inflation targeting regime on March 29 2001, therefore the last observation in the sample is Q4 2000.

[e] Switzerland introduced inflation targeting and inflation targets for 2000, therefore the last observation in the sample is Q4 1999.

Table II: Sample Definitions

Country		Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Australia	*start of sample*	1960:1	1985:1	1994:4	1960:1	1985:1	1994:4
	end of sample	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, Denmark		1960:1	1985:1	1993:3	1960:1	1985:1	1994:1
		1993:2	1993:2	2001:4	1993:3	1993:3	2001:4
Austria, Belgium, France, Germany, Ireland, Italy, Netherlands, Portugal		1960:1	1985:1	1993:3	1960:1	1985:1	1994:1
		1993:2	1993:2	1998:4	1993:3	1993:3	1998:4
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

Table III: Mean Inflation Rate (Annualised)

Panel A

	Sample (1)	Sample (2)	Sample (3)	Sample (4)	Sample (5)	Sample (6)
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
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

Panel B

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)
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-squared	0.08	0.21	-0.02	0.12	0.85	0.90	0.85	0.87

Standard Errors are in Parentheses

Table IV: Standard Deviation of Inflation Rate

Panel A

	Sample (1)	Sample (2)	Sample (3)	Sample (4)	Sample (5)	Sample (6)
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
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

Panel B

Dependent Variable: Change in the 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)
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-squared	-0.06	0.04	-0.04	0.06	0.89	0.83	0.92	0.92

Standard Errors are in Parentheses

Table V: Standard Deviation of Trend Inflation Rate (9 quarter centered moving average)

Panel A

	Sample (1)	Sample (2)	Sample (3)	Sample (4)	Sample (5)	Sample (6)
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
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	0.49
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	0.45

Panel B

Dependent Variable: Change in the 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)
Constant	-2.92	-0.58	-3.00	-0.57	0.16	0.30	0.16	0.33
	(0.37)	(0.20)	(0.36)	(0.20)	(0.18)	(0.13)	(0.19)	(0.13)
Inflation targeting	-0.25	-0.58	0.01	-0.91	0.15	0.08	0.20	0.09
dummy	(0.62)	(0.33)	(0.66)	(0.36)	(0.14)	(0.16)	(0.15)	(0.19)
Initial value					-0.92	-0.87	-0.92	-0.89
					(0.05)	(0.09)	(0.05)	(0.10)
Adjusted R-squared	-0.05	0.10	-0.06	0.22	0.95	0.84	0.95	0.85

Standard Errors are in Parentheses

Table VI: Mean Annual Growth Rates

Panel A

	Sample (1)	Sample (2)	Sample (3)	Sample (4)	Sample (5)	Sample (6)
Australia	3.65	3.09	3.87	3.65	3.09	3.87
Canada	4.04	2.52	3.02	3.94	2.30	3.40
New Zealand	4.12	2.99	3.11	3.99	2.90	3.33
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	4.77
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	1.16	5.67	4.12	1.16
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
Netherlands	3.48	2.50	4.19	3.48	2.50	4.19
Portugal	4.10	4.41	3.08	4.10	4.41	3.08
Norway	2.76	1.68	2.88	2.76	1.68	2.88
Switzerland	2.55	2.01	1.18	2.55	2.01	1.18
Averages						
IT	3.44	2.34	3.38	...	...	...
NIT	3.53	2.93	2.88	...	...	...
CIT	...	...	...	3.27	2.19	3.52
NCIT	...	...	...	3.60	2.97	2.89

Panel B

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)
Constant	-0.65	-0.04	-0.71	-0.08	2.40	1.98	2.20	1.90
	(0.48)	(0.47)	(0.46)	(0.45)	(1.69)	(1.21)	(1.73)	(1.23)
Inflation targeting dummy	0.59	1.09	0.96	1.41	0.51	0.68	0.70	0.89
	(0.82)	(0.80)	(0.84)	(0.83)	(0.77)	(0.79)	(0.81)	(0.84)
Initial value					-0.86	-0.69	-0.81	-0.67
					(0.46)	(0.39)	(0.46)	(0.39)
Adjusted R-squared	-0.03	0.04	0.02	0.09	0.10	0.15	0.12	0.18

Standard Errors are in Parentheses

Table VII: Standard Deviation of Annual Growth Rates

Panel A

	Sample (1)	Sample (2)	Sample (3)	Sample (4)	Sample (5)	Sample (6)
Australia	2.24	1.91	0.94	2.24	1.91	0.94
Canada	2.50	2.60	1.42	2.53	2.48	1.28
New Zealand	5.80	1.19	2.11	5.53	1.09	2.29
Sweden	2.27	2.10	1.36	2.27	2.10	1.36
United Kingdom	2.17	2.33	0.78	2.17	2.33	0.78
Finland	3.23	3.95	1.09	3.23	3.95	2.65
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	1.30	4.00	1.74	1.30
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
Netherlands	1.85	1.66	1.36	1.85	1.66	1.36
Portugal	3.59	1.98	0.47	3.59	1.98	0.47
Norway	2.85	3.06	1.78	2.85	3.06	1.78
Switzerland	2.77	1.92	0.84	2.77	1.92	0.84
Averages						
IT	3.03	2.35	1.28	...	...	...
NIT	2.60	1.82	1.08	...	...	...
CIT	...	...	...	2.99	2.31	1.55
NCIT	...	...	...	2.63	1.81	1.06

Panel B

Dependent Variable: Change in the 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)
Constant	-1.52	-0.74	-1.58	-0.75	0.74	1.18	0.57	0.83
	(0.25)	(0.27)	(0.24)	(0.24)	(0.34)	(0.28)	(0.41)	(0.32)
Inflation targeting dummy	-0.33	-0.37	0.13	-0.01	0.06	0.14	0.43	0.43
	(0.43)	(0.46)	(0.43)	(0.44)	(0.22)	(0.23)	(0.27)	(0.28)
Initial value					-0.87	-1.05	-0.82	-0.88
					(0.12)	(0.14)	(0.15)	(0.16)
Adjusted R-squared	-0.02	-0.02	-0.05	-0.06	0.74	0.76	0.61	0.60

Standard Errors are in Parentheses

Table VIII: Long-term Interest Rates

Panel A

	Sample (1)	Sample (2)	Sample (3)	Sample (4)	Sample (5)	Sample (6)
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
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

Panel B

Dependent Variable: Change in mean long term interest rates between samples

	(3) - (1)	(3) - (2)	(6) - (4)	(6) - (5)	(3) - (1)	(3) - (2)	(6) - (4)	(6) - (5)
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	-0.30	-1.18	-0.03	-0.76	0.33	0.20	0.27	0.12
dummy	(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-squared	-0.05	-0.01	-0.06	-0.03	0.63	0.88	0.61	0.86

Standard Errors are in Parentheses

Table IX: Standard Deviation of Short-term Interest Rates (Quarterly Data)

Panel A

	Sample (2)	Sample (3)	Sample (5)	Sample (6)
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
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

Panel B

Dependent Variable: Change in the standard deviation of the short term interest rate

	(3) - (2)	(6) - (5)	(3) - (2)	(6) - (5)
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-squared	0.28	0.31	0.76	0.82

Standard Errors are in Parentheses

Table X: Multivariate Results

Panel A: Phillips Curve Coefficients

	Sample (1)	Sample (2)	Sample (3)	Sample (4)	Sample (5)	Sample (6)
Weighted Averages						
IT	0.76	0.46	0.14	...	...	...
NIT	0.76	0.49	0.35	...	...	...
CIT	...	...	...	0.76	0.24	0.09
NCIT	...	...	...	0.76	0.49	0.40

Dependent Variable: Change in estimated coefficient between samples (WLS)

	(3) - (1)	(3) - (2)	(6) - (4)	(6) - (5)
Constant	-0.14	-0.09	-0.41	-0.37
	(0.13)	(0.15)	(0.10)	(0.10)
Inflation targeting	-0.17	-0.06	-0.21	-0.30
dummy	(0.22)	(0.28)	(0.16)	(0.18)

Panel B: Effect of Commodity-Price Changes on Inflation

	Sample (1)	Sample (2)	Sample (3)	Sample (4)	Sample (5)	Sample (6)
Weighted Averages						
IT	0.047	0.037	0.005	...	...	...
NIT	0.058	0.070	0.006	...	...	...
CIT	...	...	...	0.052	0.084	0.014
NCIT	...	...	...	0.057	0.067	0.006

Dependent Variable: Change in estimated coefficient between samples (WLS)

	(3) - (1)	(3) - (2)	(6) - (4)	(6) - (5)
Constant	-0.052	-0.052	-0.053	-0.050
	(0.018)	(0.032)	(0.035)	(0.037)
Inflation targeting	0.006	-0.012	0.017	-0.027
dummy	(0.023)	(0.039)	(0.043)	(0.044)

Standard Errors are in Parentheses

continued

Table X, continued

Panel C: Response of Expected Inflation to Inflation

	Sample (1)	Sample (2)	Sample (3)	Sample (4)	Sample (5)	Sample (6)
Weighted Averages						
IT	0.83	0.71	0.43	...	...	...
NIT	0.83	0.71	0.66	...	...	...
CIT	...	...	...	0.82	0.63	0.49
NCIT	...	...	...	0.83	0.71	0.66

Dependent Variable: Change in estimated coefficient between samples (WLS)

	(3) - (1)	(3) - (2)	(6) - (4)	(6) - (5)
Constant	-0.10	-0.09	-0.23	-0.21
	(0.12)	(0.14)	(0.08)	(0.08)
Inflation targeting	-0.13	-0.05	-0.15	-0.10
dummy	(0.16)	(0.17)	(0.10)	(0.11)

Standard Errors are in Parentheses

Figure 1: Average Inflation Rates

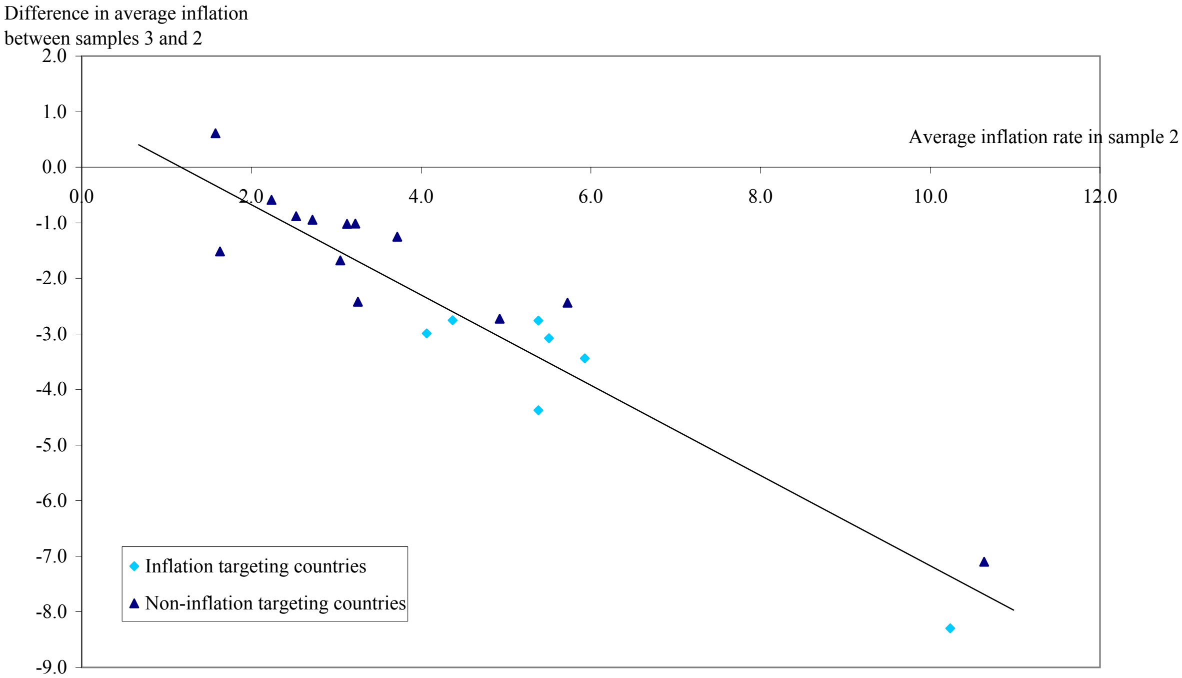

Figure 2: Inflation Persistence