INFLATION TARGETING AND ITS EFFECTS ON MACROECONOMIC PERFORMANCE

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Abstract

An increasing number of countries have adopted inflation targeting since New Zealand first adopted this framework in early 1990. Currently there are 21 countries using inflation targeting in every continent of the world. This paper discusses the characteristics of these countries and how the adoption of inflation targeting has affected their economic performance along several dimensions. The main conclusion is that inflation targeting has largely been a success. The new framework has made central banks, which previously lacked credibility, able to change the way they do monetary policy towards what is commonly considered best practice. In many respects they have even been leading in creating a new benchmark for how to formulate monetary policy.

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TABLE OF CONTENTS

1 Introduction

Economists have long realised the importance of establishing a credible nominal anchor for inflation expectations. Doing so contributes to a low and stable rate of inflation, which is widely agreed to be the primary objective of monetary policy. At the same time, it is generally felt that the monetary policy framework needs to offer sufficient scope for responding to temporary shocks, which can help to dampen business cycles without jeopardising the credibility of the nominal anchor.

However, these two aspects have proved difficult to integrate in practice. The gold standard was regarded as too inflexible an anchor, while pure discretion with no clearly defined nominal anchor led to excessive inflation without delivering any sustainable long-run economic benefits. Targeting money supply growth was considered to provide a credible anchor, but its relation to price inflation became increasingly unstable as the development of financial markets gained momentum. Fixing the exchange rate of the domestic currency was another way to anchor monetary policy. In effect, this was done by importing the credibility of the anchored currency. Deregulation of capital movements exposed the problems with this framework, however, and in recent years countries have increasingly abandoned unilateral fixed exchange rates in favour of "hard" pegs (e.g. a common currency such as the euro) or a floating exchange rate with a different nominal anchor.

One example of such an anchor is a formal inflation target, which has been adopted by an increasing number of countries since New Zealand first adopted the framework in early 1990. Currently there are 21 countries using inflation targeting in every continent of the world. A number of others countries have adopted certain aspects of this new regime and some are currently considering adopting fully-fledged inflation targeting in the next few years. The reason for this increasing popularity is that inflation targeting is thought to combine the two aspects considered important for successful monetary policy, i.e. providing a credible medium-term anchor for inflation expectations but at the same allowing policy enough flexibility to respond to short-run shocks without jeopardising the credibility of the framework.

This paper both surveys the expanding literature on the macroeconomic effects of inflation targeting and presents a number of new empirical results using an up-to-date country sample of inflation targeting countries. These

empirical results suggest that inflation targeting seems largely to have been a success. Inflation has been brought down, although it has certainly fallen globally. Inflation in the targeting countries is currently similar to that in non-targeting industrial countries which are generally considered to conduct a successful monetary policy. This must be considered as some achievement since many of the inflation targeting countries had been fighting high inflation for decades before adopting the new regime. These countries have also managed to maintain low inflation more easily than in the past, with fluctuations in inflation also subsiding. This has been accomplished without harming output growth or increasing business cycle variability. The inflation targeting countries have therefore managed to change the way they conduct monetary policy towards what is commonly considered best practice. In many respects they have even been leading in creating a new benchmark for how to formulate monetary policy.

The paper is organised such that the next section defines the main features of inflation targeting. Section three examines which countries have adopted the framework, their main reasons for changing their monetary policy regimes and the characteristics that distinguish them from similar non-targeting countries. Section four analysis the economic effects of inflation targeting on inflation, growth, interest rates and exchange rates. The fifth section discusses various scepticisms towards inflation targeting that have been raised in the literature. The sixth section concludes.

2 Definition of inflation targeting

An inflation-targeting regime is not as simple to define as it may seem on first impression. Monetary policy within what is generally referred to as the inflation-targeting countries has diverse characteristics, many of them common to this group but others practised by many countries generally not considered as inflation targeters.

Accordingly, various definitions of the basic features of inflation targeting have been proposed.[2] As a rule, an inflation target involves the formal establishment of price stability as the primary objective of monetary policy, with precedence over any other listed objectives. The idea is to signal a clear message about the main task of monetary policy and the criteria to be used for assessing the central bank's performance. Price stability is further defined with a numerical inflation target, preferably some years ahead. This does not imply that price stability is a more important objective than other economic policy goals, but merely reflects what monetary policy is capable of achieving and what not.[3]

The problem with this definition of inflation targeting is that price stability is the primary monetary policy objective of most central banks today, and many of them which are not generally termed inflation targeters publicly announce numerical targets. An obvious example is the European Central Bank, which has price stability as its sole monetary policy objective, more specifically a rate of inflation below (but close to) 2%. The ECB is not normally regarded as being on an inflation target, an interpretation that the bank itself has stressed (see the citations in Truman, 2003).

One distinguishing feature of inflation-targeting countries may be the emphasis given by their central banks to greater transparency and accountability, which have accordingly been identified as important

[2] Ranging from very broad terms, e.g. in Leiderman and Svensson (1995) and Cottarelli and Giannini (1997), to a detailed list of conditions, e.g. in Mishkin (2000a). Alternative definitions can also be found in, e.g., Mishkin and Schmidt-Hebbel (2001), Masson, et al. (1997), Bernanke et al. (1999) and Truman (2003).

[3] Although economic growth cannot be systematically maintained above the growth of potential output, a sensibly formulated monetary policy which produces a low and stable rate of inflation can enhance the efficiencies of the market economy, thereby helping to dampen business cycle volatility and boost potential output growth. In practice this is monetary policy's main contribution to improved general prosperity.

characteristics of inflation targeting. Although the emphasis on transparency and accountability has increased in most countries (see Eijffinger and Geraats, 2002), this has been most apparent where the central bank is responsible for attaining a clearly defined numerical target.

Another frequently mentioned characteristic of inflation targeting is the lack of a proper intermediate target. All relevant information is used to achieve the inflation target, thereby in effect casting the central bank's inflation forecast in the role of intermediary target (see Svensson, 1997, and Mishkin, 2000). This distinguishes inflation targeting from a fixed exchange rate and money supply targeting, which inevitably make developments in the exchange rate and money aggregates the most important guidelines for policy decisions. Under inflation targeting, all economic data that can possibly affect inflationary developments matter. This also means that the inflation target does not depend on a steady relationship between inflation and a single variable such as money supply.

Central bank instrumental independence has also sometimes been emphasised as another chief characteristic of inflation targeting (e.g. Mishkin and Schmidt-Hebbel, 2001). However, with the general trend towards central bank independence this can no longer regarded as a distinctive feature of inflation-targeting countries (see Pétursson, 2000), although they have certainly been at the forefront of these developments.

Another difficulty with any precise definition of inflation targeting is the fact that the countries themselves apply the framework to varying extents.[4] For example, central bank independence has not always been granted at the same time as the inflation target is adopted – this was not done for the Bank of England until 1997 and Swedish Riksbank until 1999, although both adopted inflation targeting some years earlier. Nor was monetary policy always particularly transparent when inflation targeting was introduced. In many cases publication of inflation reports did not begin until several years after the country moved on to the target. The Bank of Israel, for example, only began publishing an inflation report in 1998 and the Central Bank of Chile in 2000, six and ten years respectively after they had formally begun targeting. Furthermore, official inflation forecasts were often not published until some time after targeting was adopted, e.g. in Sweden, and is still not published by the central banks of Mexico and Poland. Similarly, fixed and publicly

[4] A detailed description of the differences in the inflation targeting frameworks in these countries can be found in Pétursson (2004).

announced meetings for monetary policy decisions were not arranged in Australia and Canada until some time after the target was introduced, and they have still not been established in Iceland. Finally, it should be added that the survey by Schmidt-Hebbel and Tapia (2002) found that only twelve of the sampled twenty inflation-targeting countries interpreted their inflation forecasts as intermediate monetary policy targets.

On the basis of the above, inflation targeting would seem best described as a general framework that incorporates the best elements of different forms of different monetary policy regimes,[5] rather than a genuinely new policy regime or a formal rule (Bernanke et al., 1999). Nonetheless, the chief characteristic of inflation targeting can be said to involve a public announcement of a numerical target to which the central bank commits itself to keep inflation as close as possible by implementing a forward-looking monetary policy. The bank's inflation forecast several years ahead plays a key role in communicating information about monetary policy and its likely next steps. This commitment to publish regular inflation forecasts based on credible analysis also imposes an important constraint on the central bank. Other policy features include a firm emphasis on institutional support for the target and transparent decisions and accountability on the part of the central bank, to signal its commitment to the inflation target.[6] That said, the framework remains sufficiently flexible to take into account short-term developments in the real economy. Inflation targeting therefore combines the advantages of a strict monetary policy rule and a pure discretionary monetary policy. Indeed, Bernanke et al. (1999) describe inflation targeting as "constrained discretion", where the target imposes the constraint while the interpretation and implementation provide the flexibility.[7]

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[5] This is obvious, for example, from discussions among the governors of central banks in the inflation-targeting countries recorded in Sterne (2002).

[6] While all these features can be found in the monetary frameworks of other central banks, inflation targeting is the only framework in which they are all present within a single framework. For example, the Bundesbank can be regarded as a pioneer in numerical target setting and the US Federal Reserve in forward-looking monetary policy. Both principles typify the inflation targeting framework.

[7] Thus inflation targeting does not involve turning the central bank into a haven for "inflation nutters", to quote Mervyn King, now Governor of the Bank of England (King, 1996). Academic research into monetary policy often distinguishes between strict inflation targeting, where only inflation matters, and flexible inflation targeting which also takes into account other variables, see Svensson (2001). No inflation-targeting central bank follows the strict form, although it may be argued that some came close to it in the early years of their framework when investing in credibility.

3 The inflation-targeting countries

3.1 Timing and background

Twenty-three countries can be said to have followed an inflation target, on the basis of the general characteristics discussed above: the 21 listed in Table 1, plus Finland and Spain, which abandoned the regime when they joined EMU in 1999. Switzerland is usually included in this group since in effect its policy regime shares all the characteristics of inflation targeting outlined above (see, however Truman, 2003, who excludes Switzerland), even though the Swiss National Bank does not seem to regard itself as such (see Rich, 2000).

There is some discrepancy in the exact timing of the adoption of inflation targeting in some of the countries in the literature. Largely this is because the regime was adopted gradually, with the central banks taking time in adjusting their structure to the new regime, even though its introduction was announced well in advance. In some cases it also took some time to adopt all the main targeting features discussed above. This makes exact timing of adoption somewhat difficult and different dates can be argued for, based on which of these criteria are deemed necessary for the regime to be defined as formal inflation targeting. One alternative would be the date when the central bank has adopted all of the above features. Another would be the first announcement of a numerical target, even if the bank has not adopted any other inflation targeting features and even formally adhered to another monetary policy at the same time. Table 1 shows the targeting group and the timings adopted in this paper.

This paper follows Fracasso et al. (2003), which again follow the timing convention in Mishkin and Schmidt-Hebbel (2001), except where some central banks have suggested alternative starting dates (Korea, New Zealand, Peru and Thailand). There are, however, three exceptions. Fracasso et al. (2003) define the starting date of inflation targeting in New Zealand as being April 1988 when a numerical object for inflation was first announced in the New Zealand's Government budget statement. Following Mishkin and Schmidt-Hebbel (2001), this paper defines the starting date as March 1990 when the first Policy Targets Agreement between the Minister of Finance and the Governor of the newly independent Reserve Bank of New Zealand was published, specifying numerical targets for inflation and the dates by which

Table 1. The inflation targeting countries

Countries	*Start of framework*	*Current target*	*Long-run target*
Australia	April 1993	2–3%	Same as current
Brazil	June 1999	3¼% (±2%)	3¾% (±2½%)
Canada	February 1991	1–3% (2% midpoint)	Same as current
Chile	September 1990	2–4%	Same as current
Columbia	September 1999	5½% (±½%)	3%
Czech Republic	January 1998	2½–4½%	2–4%
Hungary	January 2001	3½% (±1%)	Same as current
Iceland	March 2001	2½% (±1½%)	Same as current
Israel	January 1992	1–3%	Same as current
Korea	April 1998	3% (±1%)	2½–3½%
Mexico	January 1999	3% (±1%)	Same as current
New Zealand	March 1990	1–3%	Same as current
Norway	March 2001	2½% (±1%)	Same as current
Peru	January 2002	2½% (±1%)	Same as current
Philippines	January 2002	4½–5½%	4–5%
Poland	October 1998	3% (±1%)	2½% (±1%)
South Africa	February 2000	3–6%	Same as current
Sweden	January 1993	2% (±1%)	Same as current
Switzerland	January 2000	0–2%	Same as current
Thailand	May 2000	0–3½%	Same as current
United Kingdom	October 1992	2%[1,2]	Same as current

1. Formally, the inflation target of the Bank of England also defines a ±1% range. The Bank does not interpret this as a formal range for the target but only as a threshold for the Bank to write an open report to explain if inflation breaches the range. 2. The target was previously 2½% but was lowered when the price index of the targeting framework was changed in December 2003.

Sources: Fracasso et al. (2003), Mishkin and Schmidt-Hebbel (2001), Pétursson (2004), Schaechter et al. (2000), Truman (2003) and central banks homepages.

they were to be achieved.[8] The second country is Chile, where this paper follows Truman (2003) and defines the starting date as September 1990, when the Central Bank of Chile first announced an inflation target, rather than January 1991 as in Fracasso et al. (2003) which is the start of the first calendar year of the new regime. Others, such as Schaechter et al. (2000) define the starting date as September 1999 when the crawling exchange rate peg was

[8] An alternative starting date could be July 1989 when a new act for the Reserve Bank was first introduced (e.g. Schaechter et al., 2000), or December 1989 when the new act was passed through Parliament (Truman, 2003). This example clearly depicts the various issues concerning the exact timing of inflation targeting adoption in some countries.

Table 2. Background for inflation targeting adoption

Country	*Previous anchor*	*Main reason for inflation targeting adoption*
Australia	None	Provide a new monetary anchor and lock in disinflation
Brazil	Exchange rate	Forced off a fixed exchange rate regime, search for a new anchor within IMF programme
Canada	None	Provide a new monetary anchor and bring down inflation
Chile	Exchange rate	Provide a new monetary anchor; gradual disinflation
Columbia	Exchange rate	Dissatisfaction with earlier framework, search for a new anchor within IMF programme
Czech Republic	Exchange rate and money supply	Forced off a fixed exchange rate regime, bring down inflation with future EU membership in mind
Hungary	Exchange rate	Increasing incompatibility of fixed exchange rate regime and disinflation; bring down inflation with future EU membership in mind
Iceland	Exchange rate	Dissatisfaction and problems with fixed exchange rate regime, considered the only realistic option as long as EU/EMU membership is ruled out
Israel	Exchange rate	Lock in disinflation and define the slope of the exchange rate crawling peg
Korea	Money supply	Part of extensive reforms following the Asian crisis; price stability set as the sole monetary policy objective
Mexico	Money supply	Problems with earlier fixed exchange rate and monetary target; provide a new nominal anchor
New Zealand	None	Part of extensive reforms, dissatisfaction with earlier outcomes; provide a new nominal anchor
Norway	Exchange rate	Final phase in gradual movement towards flexible exchange rate and stronger emphasis on price stability
Peru	Money supply	Formalisation of earlier regime; greater transparency of policy
Philippines	Exchange rate and money supply	Formalisation and simplification of earlier regime; greater transparency and focus on price stability
Poland	Exchange rate	Considered the most effective way to bring down inflation as a precondition for subsequent EU membership
South Africa	Money supply	Formalisation of earlier policy; greater transparency of policy
Sweden	Exchange rate	Forced off a fixed exchange rate regime; search for a new anchor to secure price stability
Switzerland	Money supply	Dissatisfaction with earlier regime; however, the central bank does not seem to consider itself on a formal target
Thailand	Money supply	Inflation targeting considered more appropriate with floating exchange rate than money supply targeting
UK	Exchange rate	Forced off a fixed exchange rate regime; search for a new anchor to rebuild credibility

Sources: Carare and Stone (2003), Fracasso et al. (2003), Fry et al. (2000), Hoffmaister (2001), Jonas and Mishkin (2003), Kongsamut (2001), Mishkin and Savastano (2001), Mishkin and Schmidt-Hebbel (2001), Rich (2000), Schaechter et al. (2000), Soikkeli (2002), Truman (2003) and respective central bank websites.

abolished and a fully-fledged inflation targeting regime finally in place.[9] The third country is Australia. Following Schaechter et al. (2000) the starting date is here defined as April 1993 when the Reserve Bank of Australia announced the adoption of the new framework, rather than September 1994 when an exact numerical target was first announced (cf. Bernanke et al., 1999).

As Table 2 shows, it is often the case that countries switch from an exchange rate peg to inflation targeting (ten countries), although it is worth noting that three did not specify any nominal anchor before moving on to an inflation target.[10] The main reason for adopting an inflation target varies. In four cases (Brazil, Czech Republic, Sweden and the UK) the central banks were forced by currency speculators to abandon their previous regime. Seven countries experienced growing discontent with their earlier regime and faced increased incompatibility between the ultimate goal of price stability and the official anchor (Colombia, Hungary, Iceland, Israel, Mexico, New Zealand and Switzerland). Finally, in ten cases the inflation target represented a natural conclusion to a process of monetary policy evolution over various lengths of time, or the formalisation of a de facto policy (Australia, Canada, Chile, Korea, Norway, Peru, the Philippines, Poland, South Africa and Thailand).[11]

3.2 Structure and size

Inflation targeting has been introduced by prosperous industrial countries in Western Europe, North America and Oceania, Eastern European transition economies or developing and new market economies in Africa, Asia and South America. In all they comprise more than 10% of IMF member states and account for almost 20% of global output.

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[9] It is sometimes assumed that the inflation target was adopted at a later date in Israel and Poland, again referring to the adoption of a fully-fledged inflation targeting regime, which was in June 1997 in Israel and March 1999 in Poland. Some authors also define the starting date for Colombia, Mexico, Peru and the Philippines earlier than is done here. They define the starting date as the date the central banks of these countries started declaring numerical inflation objects for one year hence, which was 1994 in Peru and 1995 in Colombia, Mexico and the Philippines.

[10] New Zealand followed a fixed exchange rate regime, while Australia and Canada had tried a money supply anchor towards the mid-1980s. Until the mid-1990s Mexico and Thailand followed fixed exchange rate regimes, but after speculative attacks on their currencies they switched to targeting money supply and then inflation a few years later.

[11] Inevitably, this classification is fairly imprecise, since in many cases the determining factor of targeting adoption can be identified as a combination of all these reasons. The classification is meant to be descriptive rather than a precise definition of the basic reason for switching to an inflation target.

Table 3. Inflation-targeting countries: Structure and size

Country	*Population (million)*	*GDP (US$ billion)*	*GDP per Capita in US$ thousand*	*Open-ness*[1]	*Stock market turnover*[2]	*Treasury debt*[2]
Australia	19.4	369	19.0	44.4	65.3	15.4
Brazil	172.4	509	3.0	27.4	12.8	99.7
Canada	31.1	694	22.3	82.5	66.5	58.5
Chile	15.4	66	4.3	67.3	6.4	15.6
Columbia	43.0	82	1.9	38.4	0.4	29.8
Czech Republic	10.2	57	5.6	143.7	5.9	16.7
Hungary	10.2	52	5.1	123.3	9.3	53.1
Iceland	0.3	8	27.3	81.4	17.6	38.7
Israel	6.4	110	17.3	86.9	21.2	97.8
Mexico	99.4	624	6.3	57.0	6.4	23.2
New Zealand	3.8	50	13.1	69.1	16.7	31.0
Norway	4.5	166	36.8	74.2	31.5	20.5
Peru	26.3	54	2.1	33.0	1.6	43.8
Philippines	78.3	71	0.9	95.5	4.4	65.5
Poland	38.6	183	4.7	59.8	4.1	38.9
South Africa	43.2	114	2.6	52.7	61.0	46.8
South Korea	47.3	427	9.0	82.2	164.8	10.4
Sweden	8.9	210	23.6	87.0	143.7	45.9
Switzerland	7.2	247	34.2	86.6	121.8	26.7
Thailand	61.2	115	1.9	125.7	31.0	29.8
UK	58.8	1,424	24.2	56.4	131.4	49.5
Median	26.3	115	6.3	74.2	17.6	38.7
Industrial countries	8.1	228	23.9	77.8	65.9	34.8
Emerging market countries	43.0	110	4.3	67.3	6.4	38.9
Other industrial countries[3]	10.6	230	23.2	72.0	44.1	55.3
G3 countries [4]	285.3	6,094	32.6	26.2	73.1	60.9
Other emerging market economies[5]	29.2	88	1.7	65.8	5.7	66.3

Data are from 2001, except for treasury debt which uses the most recent available data (over the period 1997–2001). 1. Imports and exports as a percentage of GDP. 2. Percentage of GDP. 3. The median of fifteen industrial countries which are not on an inflation target. 4. Median of the USA, euro area and Japan. 5. Median of nineteen emerging market economies which are not on an inflation target.

Sources: EcoWin, IFS and World Bank: World Development Indicators.

Table 3 shows that these are generally small or medium sized industrial countries, or medium to large emerging market economies. As a rule, inflation-targeting countries seem more open to international trade and have less fiscal debt than similar economies following a different regime. They also tend to be wealthier and have more advanced financial systems (however, this does not apply when compared with the G3 countries, i.e. the euro area, Japan and the US).

This comparison could provide some indication of the factors affecting the selection of monetary policy regimes, and in particular whether these countries consider inflation targeting to be an appropriate policy framework. In general, inflation-targeting countries appear to be more advanced in terms of GDP per capita and stock market turnover, which may suggest that an effective inflation target regime requires an advanced institutional infrastructure and financial system. This is supported by the empirical findings in Carare and Stone (2003), who find that the probability of moving to inflation targeting significantly increases the more advanced a country's financial system. In the country sample used by Truman (2003), this effect is however found to be insignificant.

Table 3 also suggests that inflation-targeting countries are more open for international trade than similar non-targeting countries. This is supported by the empirical findings in Mishkin and Schmidt-Hebbel (2001), who show that the probability of adopting inflation targeting increases the more open the economy is. As open economies are more vulnerable to external shocks, they may have difficulties maintaining a fixed exchange rate regime, therefore choosing an inflation targeting to provide a nominal anchor (c.f. Calvo and Mishkin, 2003). This is also supported by the findings in Gerlach (1999) who concludes that countries with a relatively undiversified exports base are more likely to adopt inflation targeting.[12] The reason is that the less diversified the export base, the greater the vulnerability to external shocks, making it difficult to maintain a fixed exchange rate, with a floating exchange rate and inflation targeting often the main alternative. Gerlach (1999), however, finds a negative direct effect of openness on the probability of inflation targeting adoption (although it is on the borderline of statistical significance). This is consistent with the findings of Truman (2003) who finds no significant relation between openness and inflation targeting adoption. He suggests that

[12] Gerlach (1999) also uses the share of commodities in the export base to measure export diversification. His findings suggest a high correlation with the country's export product range and diversity relative to the average of other countries. These measures are also found to be closely linked to volatility in export revenues and the terms of trade.

the reason is that exchange rate volatility has more effect on the general price level in open economies, which can lead to more frequent target misses therefore making inflation targeting less desirable in open economies.

Finally, Table 3 suggests that government debt among inflation-targeting countries is lower than in comparable non-targeting countries, perhaps reflecting a need to avoid fiscal dominance from threatening the inflation target and tarnishing its credibility. This is indeed what the empirical results in Truman (2003) suggest; the probability of adopting inflation targeting increases with improved fiscal position. It should, however, be noted that this may reflect fiscal performance after targeting rather than a prerequisite for target adoption as reflected in the results in Amato and Gerlach (2002) who show that the government position of inflation targeting countries was often rather weak before targeting.

Other factors influencing the decision to adopt inflation targeting have also been mentioned in the literature. Truman (2003), for example, finds that poor economic performance and experience of a currency crisis in the past increases the probability of inflation targeting adoption. Both factors reflect dissatisfaction with and poor experience of earlier frameworks, which makes the government more likely to explore new policy avenues. This does, however, not include past inflation performance where Truman reaches the opposite conclusion which he attributes to most countries having already brought down inflation before the target is adopted (see below). This is contrary to the findings in Mishkin and Schmidt-Hebbel (2001), using a different country sample, who find that high inflation in the past increases the probability of inflation targeting adoption.

Finally, Mishkin and Schmidt-Hebbel (2001) and Truman (2003) argue that the more independent the central bank, the greater the probability of adopting an inflation target, since independence increases the institutional support for the regime, hence increasing the likelihood that the regime will be a success. Mishkin and Schmidt-Hebbel (2001) find that instrument independence significantly increases the probability of adopting inflation targeting, but that goal independence significantly reduces the probability of target adoption, which they interpret as showing that the adoption of inflation targeting tends to go hand in hand with the transfer of decisions on monetary policy objectives to the government. Truman (2003) does not find any significant relation between inflation targeting adoption and overall central bank independence, which is consistent with the findings of Mishkin and Schmidt-Hebbel (2001). Gerlach (1999) argues, however, for a negative

relation between overall central bank independence and the probability of adopting an inflation target. He suggests that an inflation target can act as substitute for formal independence, as it may be easier for the central bank to withstand political pressure if it has a clearly defined target to aim for.

4 Economic effects of inflation targeting

A number of studies on the economic effects of inflation targeting have emerged in recent years as the experience with this new framework has increased and the number of countries adopting inflation targeting has expanded.[13] Still, this literature is slightly handicapped by a relatively small number of inflation targeters and by the fact that many of these countries have yet to go through a complete business cycle with the new regime. This especially applies to the emerging market countries in the sample, of which many have only adopted inflation targeting in the last few years. Another problem for empirical studies on inflation targeting is the fact that the new regime was adopted under different economic conditions in each country. These conditions have recently also been quite favourable in most countries, inflation targeters and non-targeters alike. Global growth has been quite strong at the same time as inflation has fallen (with nominal interest rates following). Part of this favourable inflation performance can be related to global structural factors such as increased international competition and the emergence of new suppliers of manufacturing and traded goods. An attempt is made to account for these global factors when estimating the role played by inflation targeting in these developments.

4.1 Effects on inflation

4.1.1 Average inflation

At first sight one might argue that the appropriate metric for measuring the success of inflation targeting should be the frequency of hitting the official inflation targets over time. Even though the results in Corbo et al. (2001) indicate that the deviations of inflation from target have in general been quite small, one can argue that looking only at the success of hitting inflation targets gives a too narrow perspective. All the inflation targeting central banks emphasize the flexibility of the framework and that temporary deviations from target should be allowed if the economic situation so demands. The main purpose of the inflation targeting framework is to provide a credible anchor for monetary policy over the medium-term. It is therefore more appropriate to

[13] Recent surveys of these empirical results can be found in Ball and Sheridan (2003), Neumann and von Hagen (2002) and Truman (2003).

Table 4. Inflation prior to and after inflation targeting

Countries	*Average inflation the 5 years prior to adoption*	*Average inflation the year prior to adoption*	*Average inflation after adoption*	*Inflation 2002*	*Average inflation 1981–90*	*Average inflation 1991–02*
Australia	5.0	0.9	2.6	3.0	8.1	2.5
Brazil	462.2	2.6	7.1	8.4	699.8	507.4
Canada	4.5	4.8	2.1	2.4	6.0	2.1
Chile	19.6	22.3	9.2	2.5	20.5	8.4
Columbia	19.2	14.8	8.0	6.4	23.8	17.9
Czech Republic	10.6	9.3	4.7	1.8	-	10.6
Hungary	14.3	9.9	6.8	5.3	10.9	18.2
Iceland	2.8	5.1	5.8	4.9	35.0	3.6
Israel	18.5	19.0	7.7	5.7	121.0	8.6
Korea	5.2	5.7	3.2	3.0	6.3	4.8
Mexico	22.8	16.1	9.2	5.0	69.8	16.5
New Zealand	11.3	5.7	2.2	2.7	10.8	1.9
Norway	2.3	3.1	2.2	1.4	7.6	2.3
Peru	5.0	2.0	0.2	0.2	1,061.7	200.7
Philippines	6.6	6.0	3.1	3.1	14.8	8.1
Poland	22.9	12.8	6.4	1.9	129.3	24.5
South Africa	7.3	5.0	6.9	9.4	14.7	8.7
Sweden	6.9	2.3	1.6	2.2	7.6	2.3
Switzerland	0.8	0.9	1.1	0.7	3.4	1.8
Thailand	4.9	-0.1	1.3	0.7	4.4	4.0
United Kingdom	6.4	4.0	2.5	1.7	6.6	2.8
All countries	31.4	7.2	4.5	3.4	113.1	40.8
Except hyperinflation[1]	8.9	6.8	4.3	3.3	15.6	6.9
Industrial countries[2]	5.0	3.3	2.5	2.4	10.6	2.4
IT-6 group[3]	9.0	6.7	3.4	2.4	9.9	3.3
Non-inflation targeting industrial countries[4]	–	–	–	1.5	5.2	2.1

Quarterly data for the period 1981:1–2002:4 (except for the Czech Republic, were the data start in 1990:4). The table reports periodic averages for percentage changes in the consumer price index from the previous year's quarter. 1. The country group except Brazil, Israel, Peru and Poland. 2. Australia, Canada, Iceland, New Zealand, Norway, Sweden, Switzerland and the UK. 3. Australia, Canada, Chile, New Zealand, Sweden and the UK. 4. Denmark, Germany, France, Italy, Japan and the US.

Sources: EcoWin, IFS, central bank homepages and Central Bank of Iceland, Economics Department.

measure the success of inflation targeting by looking at how successful the inflation targeting central banks have been in bringing inflation down to a rate that corresponds to price stability and keeping it close to that level. Indeed, temporary deviations from target do not seem to have seriously damaged the credibility of the banks (see, for example, Schaechter et al., 2000). One explanation is the great effort the banks have put into explaining probable target misses prior to their occurrence.

Table 4 shows the average inflation in the 21 targeting countries in the last five years prior to target adoption, the last year prior to adoption and after adoption. Also shown is average inflation in the 1980s and 1990s. For comparison, the table reports average inflation in six non-targeting industrial countries (Denmark, France, Germany, Italy, Japan and the US).

Inflation has clearly fallen on average after the adoption of inflation targeting when looking at all the targeting countries. Inflation went from over 30% in the last five years prior to adoption to roughly 4½% after inflation targeting. Included in this comparison is, however, inflation in the four former hyperinflation countries, Brazil, Israel, Peru and Poland. When these four countries are excluded, average inflation in the five years prior to targeting is just under 9% but, again, roughly 4½% after. The table also compares inflation in a group of six countries with the longest history of inflation targeting, again excluding Israel due to its hyperinflation past (the IT-6 group). All these countries have over a ten year experience with inflation targeting (Australia, Canada, Chile, New Zealand, Sweden and the UK). Again the same picture emerges, with inflation falling from 9% to 3½%. Finally, the table shows inflation in the eight industrial countries in the sample. In the five years before targeting, inflation was on average about 5%, but falls to 2½% after adoption.

Inflation has therefore clearly fallen on average after the adoption of inflation targeting. Average inflation in the year prior to adoption, however, suggests that this disinflation process had already started before the adoption of inflation targeting (this can also be seen graphically in the Appendix). Hence, inflation targeting may have been more important in locking in the disinflation that had already been achieved than to bring down inflation (cf. Bernanke et al., 1999, and Corbo et al., 2001). This, however, seems to apply more to the industrial countries in the group than the emerging market countries. Two-thirds of the 2½ percentage fall in inflation in the industrial countries had already been accomplished in the year before adoption, whereas only one-third of the 6½ percentage fall in inflation in the emerging market countries (excluding the four former hyperinflation countries).

Comparing average inflation after inflation targeting with average inflation in the five years prior to adoption suggests that inflation targeting has contributed to bringing down inflation, especially in the emerging market countries of which many had been fighting high inflation for decades. It is, however, not clear whether this fall in inflation can be directly attributed to inflation targeting. Central bank legislation has, for example, been altered and the emphasis on price stability strengthened, with increased understanding of the importance of low and stable inflation for general economic welfare (see, for example, Pétursson, 2004). Adoption of inflation targeting can be interpreted as one type of manifestation of these developments. This can be seen when comparing inflation in targeting and non-targeting industrial countries. Inflation fell from more than 5% in the 1980s to roughly 2% in the 1990s in the non-targeting group. At the same time inflation fell from 10½% to 2½% in the targeting industrial countries.

As it is not clear whether falling inflation in inflation targeting countries can be related to the adoption of inflation targeting or whether this is simply a global phenomenon, a formal empirical analysis is needed. To do that the following panel model is estimated for the sample of N inflation targeting countries

$$\pi_{it} = \alpha_{\pi i} + \beta_{\pi} IT_{it} + \gamma_{\pi}\pi_{it-1} + \mu_{\pi} y_{it-1} + \lambda_{\pi 0}\pi_t^w + \lambda_{\pi 1}\pi_{t-1}^w + \varepsilon_{\pi it}; \quad i = 1,...,N; t = 1,...,T \quad (1)$$

where π_{it} is inflation in inflation targeting country i at time t, y_{it} is output growth in inflation targeting country i at time t which captures the effects of the domestic business cycle on inflation in each country, π_t^w is the average inflation in six non-targeting industrial countries (Denmark, France, Germany, Italy, Japan and the US), proxying the effects of the global disinflation trend and IT_{it} is a dummy variable which equals one from the first quarter after the adoption of inflation targeting and zero otherwise. The model also includes lagged own inflation to account for a possible bias due to potential correlation between the dummy variable and past inflation performance, i.e. if high inflation countries are more likely to adopt inflation targeting.

The model is estimated as a seemingly unrelated regression (SUR) with fixed country effects for the period 1981:1–2002:4, using different country samples. The first country sample includes all the 21 inflation targeting countries. The second sample includes the 13 countries that had adopted inflation targeting prior to 2000. The third sample includes the 7 countries that had adopted inflation targeting prior to 1999 and had inflation on average below 25% in the

1980s. The fourth sample includes the 6 countries that had adopted inflation targeting prior to 1999 and had inflation on average below 15% in the 1980s. The final sample includes the 5 industrial countries that had adopted inflation targeting prior to 1999.

The main results are reported in Table 5. The effects of inflation targeting are generally found to be statistically significant from zero, even after accounting for the global disinflation trend and domestic business cycle developments (both effects have the expected signs and are found to be statistically significant from zero). According to the estimates in (1), inflation targeting leads on average to a 2½ to more than 3 percentage fall in inflation, depending on which country sample is used, and the hypothesis that the effect is equal in

Table 5. Estimation of the effects of inflation targeting on inflation
Estimates from equation (1)

	All countries	*Adoption prior to 2000*	*Adoption prior to 1999 and average inflation 1981–90 below 25%*	*Adoption prior to 1999 and average inflation 1981–90 below 15%*	*Industrial countries and adoption prior to 1999*
β_π	-0.075	-0.213	-0.337	-0.249	-0.150
	(0.053)	(0.085)	(0.099)	(0.102)	(0.106)
$\beta_\pi/(1-\gamma_\pi)$	-1.077	-2.353	-3.326	-3.030	-2.207
	(0.769)	(0.928)	(1.002)	(1.241)	(1.496)
Number of countries	21	13	7	6	5
Number of observations	1,777	1,082	600	513	426
R^2	0.721	0.786	0.935	0.916	0.923
Wald test (*p*-value)	0.528	0.054	0.141	0.179	0.205

The first country group includes all the 21 inflation targeting countries. The second group includes the 13 countries that had adopted inflation targeting prior to 2000 (Australia, Brazil, Canada, Chile, Columbia, Czech Republic, Israel, Korea, Mexico, New Zealand, Poland, Sweden and the UK). The third group includes the 7 countries that had adopted inflation targeting prior to 1999 and had inflation on average below 25% in the 1980s (Australia, Canada, Chile, Korea, New Zealand, Sweden and the UK). The fourth group includes the 6 countries that had adopted inflation targeting prior to 1999 and had inflation on average below 15% in the 1980s (Australia, Canada, Korea, New Zealand, Sweden and the UK). The fifth group includes the 5 industrial countries that had adopted inflation targeting prior to 1999 (Australia, Canada, New Zealand, Sweden and the UK). β_π measures the impact effect of inflation targeting. $\beta_\pi/(1-\gamma_\pi)$ measures the long-run effect of inflation targeting. Numbers in parenthesis are standard errors with standard errors on the long-run effect obtained using the delta method (see Table 16 for details). The estimation period is 1981:1–2002:4 (T = 87). Information on the data and the countries for which data for the whole period was not available can be found in Tables 4 and 10. The Wald test tests the hypothesis that the inflation targeting impact was equal in all the countries ($\beta_{\pi i} = \beta_\pi$, i = 1, ..., N). The table reports *p*-values.

all countries is not rejected. The effects of inflation targeting on inflation are, however, not found to be significant in the final country sample of five industrial countries with the longest inflation targeting history. This is probably explained by the fact that these countries had already accomplished about three-quarters of the convergence towards price stability before target adoption. The inflation target in these countries more served the role of locking in the disinflation already achieved, as discussed before.

An alternative estimation approach is to include the non-inflation targeting countries in the sample group and to approximate the global disinflation trend with a time trend polynomial, $\lambda_\pi(t)$. In this case the inflation target countries can be thought of as the "treatment group" and the non-inflation target countries as the "non-treatment group". Hence, equation (1) is re-estimated with the trend polynomial replacing π_t^w and with the six non-inflation target countries and the two former inflation target countries, Finland and Spain, included in the country sample (in total 29 countries)[14]. For the former six, the inflation target dummy takes the value zero for the whole period, but for the latter two the variable takes the value unity one quarter after the start of the targeting framework until 1999 and zero otherwise

$$\pi_{it} = \alpha_{\pi i} + \beta_\pi IT_{it} + \gamma_\pi \pi_{it-1} + \mu_\pi y_{it-1} + \lambda_\pi(t) + \varepsilon_{\pi it}; \qquad i = 1,...,N+M; t = 1,...,T \quad (1')$$

where the country sample includes N inflation targeting countries and a control group of $M - N$ countries. The disinflation trend is approximated with a second-order polynomial, $\lambda_\pi(t) = \lambda_{\pi 1} t + \lambda_{\pi 2} t^2$. Table 6 reports the results.[15]

The average long-run effect is now found to be around 2 percentage points instead of up to 3 percentage points in equation (1). The effects are significant in all the country samples, even in the sample including all the 29 countries. Again, the least significant effects are found in the sample only including the five industrial inflation targeting countries with the longest targeting history, although the effects are now only marginally significant at the 5% critical level.[16]

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[14] Following Mishkin and Schmidt-Hebbel (2001), the inflation target is assumed to start in February 1993 in Finland and in November 1994 in Spain. Both end in January 1999.

[15] A Wald test for equality of the inflation targeting impact across all the countries cannot be performed in this case as the targeting dummy equals zero throughout for the non-targeting countries.

[16] Alternative estimation periods were also tried, both by starting later to reduce the near unit root properties in the data and by finishing earlier so that some countries in the treatment group became non-treated. The finding of a significant inflation targeting effect remained robust and in some cases a larger effect was found than reported here. The effect also remained significant when allowing for a country specific disinflation trend and lagged inflation.

Table 6. Estimation of the effects of inflation targeting on inflation
Estimates from equation (1')

	All countries	*Adoption prior to 2000*	*Adoption prior to 1999 and average inflation 1981–90 below 25%*	*Adoption prior to 1999 and average inflation 1981–90 below 15%*	*Industrial countries and adoption prior to 1999*
β_π	-0.096	-0.146	-0.153	-0.130	-0.117
	(0.041)	(0.054)	(0.059)	(0.061)	(0.062)
$\beta_\pi/(1-\gamma_\pi)$	-1.332	-1.922	-2.127	-1.909	-1.916
	(0.564)	(0.711)	(0.849)	(0.922)	(1.047)
Number of countries	29	21	15	14	13
Number of observations	2,473	1,778	1,296	1,209	1,122
R^2	0.723	0.788	0.948	0.916	0.952

The inflation targeting country groups are defined in Table 5. Also included in all country samples are the two former inflation targeting countries, Finland and Spain, and six non-inflation targeting countries, Denmark, France, Germany, Italy, Japan and the US. β_π measures the impact effect of inflation targeting. $\beta_\pi/(1-\gamma_\pi)$ measures the long-run effect of inflation targeting. Numbers in parenthesis are standard errors with standard errors on the long-run effect obtained using the delta method (see Table 16 for details). The estimation period is 1981:1–2002:4 ($T = 87$). Information on the data and the countries for which data for the whole period was not available can be found in Tables 4 and 10.

The results therefore suggest that the adoption of inflation targeting led to a significant reduction in average inflation in the region of 2 to 3 percentage points on average, even after taking account of the global disinflation trend and domestic business cycle developments. These findings are similar to the findings of other studies, such as Haldane (1995), Bernanke et al. (1999), Corbo et al. (2001), Neumann and von Hagen (2002) and Truman (2003).[17] Ball and Sheridan (2003) are, however, more sceptical and argue that the adoption of inflation targeting played no significant role in bringing inflation down in these countries. They argue that the main reason for earlier support for the importance of inflation targeting for bringing down inflation lies in the simple fact that the targeting countries usually had higher inflation than other similar countries (especially industrial countries) prior to adoption. The observed reduction in inflation towards other industrial countries, such as Germany and the US, can therefore be explained by a simple regression to mean. Inflation in countries with high inflation is likely to fall faster than in countries with low inflation, irrespective of whether they have adopted inflation targeting or not.[18]

[17] The fall in inflation explained by the adoption of inflation targeting is roughly the same as in Truman (2003), although he uses somewhat different estimation methods.

[18] Truman (2003) points out that the adoption of inflation targeting could have speeded up the adjustment towards low inflation.

If this argument is correct, one should expect the inflation targeting dummy variable to depend on historical inflation, i.e. countries with high inflation in the past are more likely to adopt inflation targeting than countries with low inflation.[19] It is therefore necessary to correct for this potential bias by adding historical inflation to the panel regressions. When Ball and Sheridan (2003) do that, the beneficial effect of inflation targeting is no longer statistically significant which leads them to the above conclusion. This is also done here by adding lagged inflation to the regressions but the effect of inflation targeting remains significant, except in the sample of five industrial countries with the longest experience of the framework, i.e. Australia, Canada, New Zealand, Sweden and the UK, where the effects are either marginally significant or insignificant from zero. In the other country groups the effect remains significant. This is important as the Ball and Sheridan (2003) inflation targeting country sample only covers these five countries (plus Finland and Spain) but does not cover emerging market countries, such as Chile, Israel and Korea. As discussed previously, the industrial countries had already accomplished a substantial part of the disinflation process before adopting inflation targeting. Thus, the generalisation made by Ball and Sheridan (2003) that the adoption of inflation targeting did not matter may not hold when one looks outside the narrow group of industrial countries. Truman (2003) also attempts to control for this potential bias, although in a different way than done here, and still finds significant effects of inflation targeting on average inflation.

4.1.2 Fluctuations in inflation

Another important issued is whether inflation targeting contributes to reducing inflation volatility. Table 7 compares fluctuations in inflation before and after inflation targeting (using standard deviations). It is clear that fluctuations in inflation have decreased after inflation targeting. This should not be surprising considering the reduction in inflation, given the close relationship between fluctuations in inflation and the level of inflation. The table shows that fluctuations in non-targeting industrial countries have also fallen.[20]

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[19] As discussed above, however, the findings in Truman (2003) suggest that this is not obvious. In fact his findings suggest the opposite: the choice of inflation targeting seems to be negatively associated with past inflation.

[20] This reduction in inflation variability could influence the previous statistical inference which implicitly assumes constant variability throughout the sample period. The direction of this influence is, however, difficult to predict. The uncertainty in coefficient estimates could be underestimated, but the information in the low variability period could be swamped by the volatility of the earlier period, thus underestimating the statistical significance of the inflation targeting effect.

Table 7. Fluctuations in inflation prior to and after inflation targeting

Countries	*Average fluctuations the 5 years prior to adoption*	*Average fluctuations after adoption*	*Average fluctuations 1981–1990*	*Average fluctuations 1991–2002*
Australia	3.0	1.7	2.2	1.7
Brazil	1,165.4	1.6	1,273.4	957.3
Canada	0.5	1.4	3.0	1.4
Chile	5.2	6.8	6.9	5.8
Columbia	3.0	1.3	4.5	7.6
Czech Republic	3.4	3.5	-	10.0
Hungary	4.9	2.2	7.3	8.7
Iceland	1.5	2.5	20.2	2.3
Israel	2.1	4.4	130.0	5.2
Korea	1.2	2.1	5.6	2.3
Mexico	13.0	4.7	41.7	10.9
New Zealand	5.2	1.6	5.1	1.2
Norway	0.7	1.2	2.9	0.8
Peru	2.7	1.0	2,198.9	889.4
Philippines	2.2	0.4	14.5	4.0
Poland	8.5	3.3	264.7	21.5
South Africa	2.2	2.7	2.2	3.4
Sweden	3.0	1.4	2.5	2.5
Switzerland	0.7	0.5	1.9	1.7
Thailand	3.2	0.7	3.3	2.6
United Kingdom	2.3	0.8	2.7	1.3
All countries	58.7	2.2	199.7	92.5
Except hyperinflation	3.2	2.1	7.9	4.0
Industrial countries	2.1	1.4	5.1	1.6
IT-6 group	3.2	2.3	3.7	2.3
Non-inflation targeting industrial countries	–	–	2.9	1.0

Quarterly standard deviation of percentage changes in the consumer price index from the previous year's quarter for the period 1981:1–2002:4. Information on the data and the country groups can be found in Table 4.

Sources: EcoWin, IFS, central bank homepages and the Central Bank of Iceland, Economics Department.

This might suggest that inflation targeting has contributed to stabilising inflation (see also Neumann and von Hagen, 2002). The results from Johnson (2002) and Truman (2003), however, suggest that this contribution does not go beyond the effect through the inflation level. The results from Corbo et al. (2001), however, suggest that inflation targeting has reduced inflation uncertainty and inflation forecast errors.

Finally, it is interesting that even though fluctuations in inflation have fallen, they are still larger on average than the inflation target range commonly used, which is ±1% on average (see Pétursson, 2004). The danger is that trying to cover a large part of the probability distribution of inflation within the target range might hurt the credibility of the regime and reduce its transparency (see also Haldane and Salmon, 1995). A narrower target range has always been chosen, on the basis that inflation fluctuations will be smaller in the future than suggested by historical experience. As discussed in Pétursson (2004), the inflation targeting central banks have decided to tackle the inevitable control problem that arises using alternative methods, such as longer target horizons corresponding to the transmission lags of monetary policy, by defining ex ante escape clauses, and by specifying reactions to large deviations from target using, e.g., open letters.

4.1.3 Inflation persistence

Kuttner and Posen (1999) show that temporary price shocks should have less persistent effects on inflation if the formulation of monetary policy changes after the adoption of inflation targeting in such a way that the emphasis on fighting inflation increases. Reduced inflation persistence would also indicate that the credibility of monetary policy has increased and that inflation expectations are more forward looking after the introduction of inflation targeting.

To analyse whether inflation targeting has affected inflation persistence a univariate AR(2) model is estimated (both autoregressive lags are found significant in all cases)

$$\pi_{it} = \alpha_i + \phi_1 \pi_{it-1} + \phi_2 \pi_{it-2} + \theta IT_{it} \pi_{it-1} + \lambda(t) + \xi_{it}; \qquad i = 1,...,N+M; t = 1,...,T \quad (2)$$

The model also includes the trend polynomial, $\lambda(t)$, to capture the effects of slowly falling average inflation. The memory of the inflation process is given by $\phi_1 + \phi_2$ prior to targeting and by $\phi_1 + \phi_2 + \theta$ after targeting. A significantly negative θ would therefore suggest that inflation persistence had fallen so that the durability of the effects of temporary price shocks on inflation had decreased.[21]

[21] The autocorrelation coefficients of the inflation process are given as $\rho_1 = (\phi_1 + \theta IT)/(1 - \phi_2)$, $\rho_2 = (\phi_1 + \theta IT)^2/(1 - \phi_2) + \phi_2$ and $\rho_k = (\phi_1 + \theta IT)\rho_{k-1} + \phi_2\rho_{k-2}$, $k = 3, 4, ...$ The coefficients are therefore lower after the adoption of inflation targeting (i.e. when $IT = 1$) if $\theta < 0$. It did not matter which lag the dummy variable was imposed on.

Table 8. Estimation of effects of inflation targeting on inflation persistence (θ)

	All countries	*Adoption prior to 2000*	*Adoption prior to 1999 and average inflation 1981–90 below 25%*	*Adoption prior to 1999 and average inflation 1981–90 below 15%*	*Industrial countries and adoption prior to 1999*
			Sample period 1981–2002		
Estimates of θ	-0.076	-0.087	-0.083	-0.082	-0.067
	(0.011)	(0.014)	(0.016)	(0.019)	(0.021)
			Sample period 1990–2002		
Estimates of θ	-0.055	-0.050	-0.020	-0.063	-0.051
	(0.006)	(0.009)	(0.011)	(0.016)	(0.017)

Standard errors are given in parenthesis. The inflation targeting country groups are defined in Table 3. Also included are the two former inflation targeting countries, Finland and Spain, and six non-inflation targeting countries, Denmark, France, Germany, Italy, Japan and the US. The estimation period is 1981:1–2002:4 (T = 87). Information on the data and the countries for which data for the whole period was not available can be found in Table 4.

The estimation of θ is given in Table 8. The coefficient is found to be significantly negative in all cases, suggesting that inflation targeting has reduced inflation persistence. Due to the near unit root properties of the inflation data for the whole period one should, however, be careful in interpreting these results. In an attempt to reduce this problem, the model is re-estimated for a shorter period from 1990, where the autoregressive roots are somewhat smaller and further away from unity. The estimates of θ are found to be smaller but still remain statistically significant below zero in all country samples.

It is also interesting that the effect is found significant in the industrial country group, where an effect of inflation targeting on average inflation was not found previously. As discussed before, the main role of the target in this group was to lock in the disinflation already achieved rather than to facilitate disinflation. These countries had already accomplished a significant share of the disinflation process prior to adopting inflation. Even so, significant effects of inflation targeting on inflation persistence remains.[22]

These results are consistent with the findings in Siklos (1999), Bernanke et al. (1999), Corbo et al. (2001). Their findings also suggest that the properties of the inflation process in the inflation targeting countries are now much more

[22] In some cases these results remain sensitive to the exact choice of sample period, suggesting that some care in the interpretation of the results are in order.

in line with non-targeting countries with a long history of credible monetary policy, such as Germany and the US. The results of Levin et al. (2004) even suggest that inflation in the inflation targeting industrial countries has become less persistent than in their non-targeting industrial counterparts.

4.1.4 Speed of convergence to the long-run target

An important issue for countries adopting inflation targeting when inflation is above the long-run target consistent with price stability, is to decide the speed of convergence towards the long-run target. Disinflating too fast might incur temporary losses in output and jobs which could harm the support for the disinflation program and the independence of the central bank. Too slow convergence towards price stability risks, however, that inflation expectations get stuck at a higher level of inflation which would make further disinflation all the more difficult. This especially applies if initial credibility of the regime is low. Investing in increased credibility with tight policy early on might in that case be sensible, which could allow for more flexibility later. Tightening too much, however, risks the loss of public support as mentioned before.

Theoretically, one can argue that there exists an optimal speed of convergence which minimises the sacrifice ratio (see, for example, Jonas and Mishkin, 2003). The determination of this optimal speed of disinflation is, however, a complicated problem with the level affected by a number of factors such as the underlying shocks driving the disinflation process, institutional factors such as country openness to trade and labour market centralisation, and the degree of public support for the disinflation program.

It is common for countries in a disinflation phase to specify short-run inflation targets, usually for one year ahead. In these cases the question often arises how to respond if inflation falls below the short-run target but remains above the long-run target consistent with price stability, cf. the experience in the Czech Republic and Poland (see Jonas and Mishkin, 2003). The central bank might take the short-run target literally and cut interest rates to push inflation back up to the annual target, although attaining such short-run targets is notoriously difficult given the transmission lags of monetary policy. An alternative approach would be opportunistic disinflation, were the unexpected fall in inflation is locked in, as was the case with the above mentioned Eastern European countries. This implies that the inflation targeting regime is asymmetric in the convergence period, i.e. the central bank fights inflation above the short-run target but accommodates inflation below it.

Table 9. Speed of convergence towards long-run inflation target

Countries	*Midpoint of Inflation target*[1]	*Initial Inflation*[3]	*Speed of convergence (quarters)*[4]	*Estimated speed of convergence (quarters)*[7]
Australia	2.5	1.2	0	0
Brazil	3.75	2.3	0[5]	0
Canada	2.0	5.3	5	5
Chile	3.0	24.6	37	34
Columbia	3.0	9.6	14[6]	10
Czech Republic	3.0	10.2	5	11
Hungary	3.5	10.3	8	11
Iceland	2.5	4.2	8	3
Israel	2.0	18.5	32	26
Korea	3.0	9.0	4	9
Mexico	3.0	18.0	16[6]	23
New Zealand	2.0	7.2	7	8
Norway	2.5	3.1	3	1
Peru	2.5	0.2	0	0
Philippines	4.5	4.4	0	0
Poland	2.5	11.1	15	14
South Africa	4.5	2.1	0[5]	0
Sweden	2.0	2.2	0	0
Switzerland	1.0	1.5	0	1
Thailand	1.75	1.0	0	0
United Kingdom	2.5[2]	3.6	1	2
All countries	2.7	7.1	7	8
Except hyperinflation	2.7	6.9	6	7
Industrial countries	2.1	3.5	3	2
IT-6 group	2.3	7.3	8	8

1. Long-run inflation target or midpoint of target range from Table 1. 2. The table does not report the newly adopted 2% target for Bank of England as this change only occurred in December 2003 and is based on a different price index from the one used here. 3. Annual inflation in the quarter prior to adoption of inflation targeting. 4. Number of quarters until inflation is less than ½ percentage point from the long-run target. 5. Inflation rose somewhat above the target later on. 6. The adjustment process was not completed by the end of 2003. 7. The speed of adjustment regressed on the absolute difference between initial inflation and the long-run target, for a cross section of the 21 countries (White heteroscedasticity-consistent standard error in parenthesis):

$$C = \underset{(0.144)}{1.568}|\pi - \pi^T|; \qquad R^2 = 0.895,\ s = 3.38$$

where C is the speed of convergence in quarters, π is the initial inflation and π^T is the midpoint of the long-run inflation target. Information on the country groups can be found in Table 4.

Sources: Table 1, EcoWin, IFS and Central Bank of Iceland, Economics Department.

The main argument for such an asymmetric approach is the lack of credibility at the announcement of the new framework. When inflation is relatively high, the central bank runs the risk of serious damage to credibility if he cannot avoid inflation moving above the target. It might, however, be risky to try to lock in unexpected disinflation resulting from temporary external shocks, such as terms of trade shocks, as considerable costs to the real economy might ensue any attempt to prevent inflation from rising again when the shock is reversed. It is therefore clear that monetary policy can go too far in attempting to lock in unexpected disinflation in the adjustment process towards the long-run target. It is also clear that as soon as the long-run target is achieved, the argument for the asymmetric treatment of the target no longer holds. The symmetric treatment of the inflation target is in fact one of the important benefits of the regime. In that way the central bank credibly signals its intention to avoid deflation, with the symmetric treatment also contributing to increased stability of the real economy.

Table 9 shows the speed of convergence towards the long-run inflation target in the 21 inflation targeting countries. Defining price stability as inflation less than ½ a percentage point above the long-run target in the quarter before adoption (hence, the inflation target at the beginning of the framework is not used), gives eight countries which had already achieved price stability before adopting the new regime.[23] In addition, the UK accomplished its convergence in one quarter and Norway falls just outside the upper limit of the definition of completing the process (inflation 0.6 percent above the criteria). Of these eight countries, two of them (Brazil and South Africa) have subsequently run into problems with inflation rising considerably above target.

The long-run inflation target has been reached in seven quarters on average for the whole country sample but only in three quarters in the industrial countries, reflecting the fact that inflation was much lower in the industrial countries than in other targeting countries at the start of the regime, as discussed before. Not surprisingly, given its high initial inflation, the longest transition period is found in Chile and Israel. According to the above definition of price stability, the transition process was not yet accomplished in Colombia and Mexico by the end of 2003.

[23] Included are five countries where inflation was already below the long-run target at the start of the regime. The adjustment process is considered as complete in these countries, even though inflation was more than ½ a percentage point below the target. The results do not materially change when these deviations are also taken account of.

There is a close relationship between the speed of convergence and the distance of initial inflation from the long-run target. On average it takes roughly 1½ quarter to reduce the distance by one percentage point. This suggests that the speed of convergence was shorter than might be inferred from the distance of initial inflation from the long-run target in the Czech Republic and Korea, but longer in Colombia, Iceland and Israel.

4.2 Effects on growth and business cycle variability

4.2.1 Effects on average growth

Those who tend to interpret inflation targeting as a strict monetary rule argue that inflation targeting can be harmful for growth (see the discussion in Section 5). This seems to be confirmed when looking at the average growth performance of all the 21 targeting countries. As reported in Table 10, growth has fallen slightly on average after inflation targeting in this group. This is however reversed when the four former hyperinflation countries are excluded, or when looking at the industrial countries or the IT-6 group. In these groups a slight increase in average growth is found. The growth record of the inflation targeting countries also compares quite favourably with the non-targeting industrial countries, although the poor growth record in Japan might bias this comparison.

Table 10 also shows that growth in most industrial countries was quite low in the year before adopting the new regime, reflecting the general tendency to time the adoption in an economic slack when inflation is low (see also Schaechter et al., 2000). This is less obvious for the emerging market countries.

It is therefore difficult to infer from Table 10 whether inflation targeting has affected growth. To do that a similar panel approach as used previously is adopted

$$y_{it} = \alpha_{yi} + \beta_y IT_{it} + \gamma_y y_{it-1} + \mu_y (r_{it-1} - \pi_{it-1}) + \phi_y e_{it-1} + \lambda_{y0} y_t^w + \lambda_{y1} y_{t-1}^w + \varepsilon_{yit}; \quad (3)$$
$$\text{with } i = 1,...,N; t = 1,...,T$$

where y_{it} output growth in inflation targeting country i at time t, $r_{it} - \pi_{it}$ is the real interest rate in inflation targeting country i at time t, e_{it} is the real exchange rate in inflation targeting country i at time t (a rise in e_{it} denotes an appreciation) and y_t^w is average output growth in six non-targeting industrial countries (Denmark, France, Germany, Italy, Japan and the US).

Table 10. Output growth prior to and after inflation targeting

Countries	*Average growth the 5 years prior to adoption*	*Average growth the year prior to adoption*	*Average growth after adoption*	*Growth 2002*	*Average growth 1981–90*	*Average growth 1991–02*
Australia	2.3	2.9	4.4	3.8	3.3	3.8
Brazil	2.6	0.6	2.5	1.5	2.4	2.6
Canada	2.9	-0.2	2.7	3.4	2.9	2.7
Chile	6.8	5.2	5.6	2.1	3.3	5.6
Columbia	1.7	-2.9	1.5	1.5	3.4	2.5
Czech Republic	2.3	-0.9	1.9	2.0	-	1.1
Hungary	4.4	4.5	3.4	3.2	1.2	1.8
Iceland	5.1	5.6	1.1	-0.5	2.9	2.5
Israel	4.5	6.2	3.9	-1.0	3.5	4.1
Korea	6.5	2.7	5.1	6.3	8.7	6.0
Mexico	2.9	4.5	2.3	0.9	1.7	2.8
New Zealand	1.0	-0.4	2.7	4.2	2.1	2.9
Norway	3.6	2.9	1.5	1.0	2.6	3.4
Peru	2.2	0.6	5.3	5.3	-0.2	4.0
Philippines	2.9	3.2	5.2	5.2	1.6	3.2
Poland	11.9	4.8	5.1	1.2	0.2	4.4
South Africa	2.6	2.0	3.1	3.0	1.6	2.0
Sweden	0.6	-1.7	2.9	1.9	2.1	2.2
Switzerland	1.3	1.5	1.4	0.1	2.1	0.8
Thailand	0.9	4.6	3.5	5.2	8.0	4.2
United Kingdom	1.6	-0.1	2.6	0.4	2.7	2.1
All countries	3.4	2.2	3.2	2.4	3.0	3.1
Except hyperinflation	2.9	2.0	3.0	2.6	2.9	3.1
Industrial countries	2.3	1.3	2.4	1.8	2.6	2.5
IT-6 group	2.5	0.9	3.5	2.6	2.7	3.2
Non-inflation targeting industrial countries	–	–	–	0.9	2.7	1.9

Quarterly data from 1981:1–2002:4 (except for New Zealand, where the data start in 1983:2, and the Czech Republic, where the data start in 1991:1). The table reports periodic averages for percentage changes in constant price GDP from the previous year's quarter. Information on the country groups can be found in Table 4.

Sources: EcoWin, IFS, central bank homepages and Central Bank of Iceland, Economics Department.

An alternative specification, similar to (1'), is also estimated. This specification includes the non-targeting industrial countries and Finland and Spain in the sample group

$$y_{it} = \alpha_{yi} + \beta_y IT_{it} + \gamma_y y_{it-1} + \mu_y (r_{it-1} - \pi_{it-1}) + \phi_y e_{it-1} + \varepsilon_{yit}; \quad \text{with } i = 1,...,N+M; t = 1,...,T \tag{3'}$$

where the country sample includes N inflation targeting countries and a control group of $M - N$ countries. The results are shown in Table 11.[24] The positive effects of inflation targeting on output growth is only significant in country groups including the countries with relatively high inflation prior to adopting inflation targets. There is, however, no evidence suggesting that inflation targeting has harmed growth.

Table 11. Estimation of the effects of inflation targeting on output growth

	All countries	*Adoption prior to 2000*	*Adoption prior to 1999 and average inflation 1981–90 below 25%*	*Adoption prior to 1999 and average inflation 1981–90 below 15%*	*Industrial countries and adoption prior to 1999*
Estimate of β_y from (3)	0.151	0.257	0.136	0.154	0.263
	(0.073)	(0.085)	(0.141)	(0.164)	(0.177)
Estimate of β_y from (3')	0.160	0.179	0.109	0.148	0.141
	(0.058)	(0.065)	(0.084)	(0.090)	(0.092)

Definitions of country groups can be found in Table 5. Numbers in parenthesis are standard errors. The estimation period is 1981:1–2002:4 (T = 87). Information on the data and the countries for which data for the whole period was not available can be found in Tables 4, 10, 13 and 15.

These results are consistent with findings in the literature. Truman (2003) and Ball and Sheridan (2003) find positive effects of inflation targeting on growth, but these effects remain statistically insignificant (Ball and Sheridan, 2003) or on the borderline (Truman, 2003). It is, however, appropriate to keep in mind, as pointed out by Ball and Sheridan (2003), that any effects of this new regime on growth are likely to take some time to emerge. The history of inflation targeting is therefore probably too short to give a definite answer on the link between inflation targeting and economic growth, even in the countries with the longest targeting history.

[24] As expected a real exchange rate appreciation and a higher real interest rate lower growth and both effects are usually found statistically significant from zero. The interest rate and exchange rate data are described in Tables 13 and 15.

4.2.2 Effects on growth variability

Table 12 compares fluctuations in output growth before and after inflation targeting, where output growth fluctuations are measured with standard deviations of output growth. It seems that growth variability has decreased in general after the adoption of inflation targeting, with the largest gain in emerging market countries.

These findings are consistent with the view that flexible inflation targeting does not only reduce variability in inflation but also in growth, as discussed before, and is consistent with the empirical findings from Corbo et al. (2001), Neumann and von Hagen (2002) and Truman (2003). Ball and Sheridan (2003), however, find no significant effects. Cecchetti and Ehrmann (2000) also argue that reduced output variability can more likely be attributed to a more stable external environment and that an increasing focus on the inflation target may lead to increased output variability.

4.3 Effects on interest rates and exchange rates

4.3.1 Effects on interest rate level and monetary policy credibility

Table 13 shows that short-run nominal interest rates have in general fallen in the last decade, inflation targeters and non-targeters alike.[25] This is not surprising given the fall in inflation at the same time.

Increased credibility of monetary policy after inflation targeting should be reflected in a fall in inflation expectations and the inflation risk premium on nominal interest rates. Both should lead to lower nominal interest rates. It is therefore interesting to test whether nominal interest rates have fallen by more than explained by the fall in inflation and the general fall in interest rates around the world, and whether this excess fall in interest rates can be attributed to the inflation targeting regime. To answer this question, the following panel model is estimated

[25] In some respects a long-run interest rate would be more appropriate than a short-run rate but the latter was chosen due to a lack of continuous data for all the countries. More or less identical results to those reported here were found using the long-run data that was available.

Table 12. Output fluctuations prior to and after inflation targeting

Countries	*Average fluctuations the 5 years prior to adoption*	*Average fluctuations after adoption*	*Average fluctuations 1981–1990*	*Average fluctuations 1991–2002*
Australia	2.1	1.6	2.7	2.1
Brazil	1.6	1.8	3.3	1.9
Canada	2.2	2.0	3.0	2.0
Chile	1.8	3.3	5.9	3.3
Columbia	2.8	1.0	1.4	2.4
Czech Republic	2.4	1.5	-	3.4
Hungary	0.7	0.4	3.2	3.9
Iceland	2.6	2.8	5.4	3.6
Israel	3.0	3.8	2.9	3.7
Korea	3.1	6.5	2.8	4.7
Mexico	3.9	2.7	2.8	2.9
New Zealand	3.9	2.9	4.6	2.8
Norway	2.7	1.9	2.5	2.5
Peru	3.5	1.7	10.8	5.6
Philippines	1.4	2.0	4.4	1.9
Poland	11.8	4.9	5.7	14.5
South Africa	1.5	0.4	3.0	2.1
Sweden	1.9	1.8	2.0	2.3
Switzerland	1.1	1.5	1.9	1.3
Thailand	5.6	1.6	3.0	5.0
United Kingdom	2.5	1.5	2.1	1.9
All countries	3.0	2.3	3.3	3.5
Except hyperinflation	2.5	2.1	3.2	2.8
Industrial countries	2.4	2.0	3.0	2.3
IT-6 group	2.4	2.2	3.4	2.4
Non-inflation targeting industrial countries	–	–	1.8	1.6

Quarterly standard deviation of percentage changes in the constant price GDP from the previous year's quarter for the period 1981:1–2002:4. Information on the data can be found in Table 10. Information on the country groups can be found in Table 4.

Sources: EcoWin, IFS, central bank homepages and Central Bank of Iceland, Economics Department.

$$r_{it} = \alpha_{ri} + \beta_r IT_{it} + \gamma_r r_{it-1} + \delta_r \pi_{it} + \mu_r \pi_{it-1} + \phi_r y_{it-1} + \lambda_{r0} r_t^w + \lambda_{r1} r_{t-1}^w + \varepsilon_{rit}; \quad \text{with } i = 1,...,N; t = 1,...,T \tag{4}$$

where r_{it} is the short-run nominal interest rate in inflation targeting country i at time t, π_{it} is the inflation rate in inflation targeting country i at time t, y_{it} is the output growth in inflation targeting country i at time t and r_t^w is the

average interest rate in six non-targeting industrial countries (Denmark, France, Germany, Italy, Japan and the US).

Table 13. Short-run nominal interest rates prior to and after inflation targeting

Countries	*Average interest rates the 5 years prior to adoption*	*Average interest rates the year prior to adoption*	*Average interest rates after adoption*	*Interest rates 2002*	*Average interest rates 1981–90*	*Average interest rates 1991–02*
Australia	12.0	5.9	5.7	4.8	14.8	6.1
Brazil	28.1	30.6	18.9	21.3	-	23.2
Canada	10.3	12.7	5.1	2.7	11.2	5.1
Chile	23.8	35.2	14.2	2.8	30.5	13.0
Columbia	36.9	35.5	17.5	12.7	31.3	31.2
Czech Republic	9.0	10.8	6.9	2.7	-	7.9
Hungary	15.9	10.9	8.9	7.4	21.4	19.2
Iceland	8.2	11.1	9.7	6.4	-	8.1
Israel	18.8	13.5	11.4	9.2	22.0	11.5
Korea	14.0	15.9	6.9	4.9	12.1	11.4
Mexico	27.7	25.5	13.3	7.5	58.9	20.1
New Zealand	17.8	13.7	7.4	5.7	16.5	7.0
Norway	5.4	6.8	7.0	6.5	12.8	6.9
Peru	19.5	14.0	10.1	4.8	-	17.8
Philippines	11.5	9.7	5.5	5.2	18.0	12.5
Poland	25.1	23.1	16.3	7.8	24.7	16.1
South Africa	14.6	12.9	10.3	12.4	14.2	13.1
Sweden	11.9	12.7	5.3	3.7	11.9	6.5
Switzerland	1.8	1.3	2.3	0.6	4.7	3.3
Thailand	9.4	1.6	1.9	1.7	11.8	7.3
United Kingdom	12.0	10.2	5.9	3.9	11.4	6.6
All countries	15.9	14.9	9.1	6.4	18.8	12.5
Except hyperinflation	14.3	13.7	7.9	5.4	18.8	10.9
Industrial countries	9.9	9.3	6.0	4.3	11.9	6.2
IT-6 group	14.6	15.1	7.3	4.0	16.0	7.4
Non-inflation targeting industrial countries	–	–	–	2.0	9.8	4.9

Quarterly short-run interest rates (3 month treasury bill rates, money market rates or discount rates) for the period 1981:1–2002:4, except for Brazil (from 1996:1), the Czech Republic (from (1993:1), Hungary (from 1987:1), Iceland (from 1993:1), Israel (from 1986:1), Peru (from 1995:1) and Poland (from 1983:1). Information on the country groups can be found in Table 4.

Sources: EcoWin, IFS, central bank homepages and Central Bank of Iceland, Economics Department.

Similar to (1') the model is also estimated including the non-targeting industrial countries and Finland and Spain in the sample group, with a linear trend proxying the downward trend in nominal interest rates (the quadratic trend was not found significant)

$$r_{it} = \alpha_{ri} + \beta_r IT_{it} + \gamma_r r_{it-1} + \delta_r \pi_{it} + \mu_r \pi_{it-1} + \phi_r y_{it-1} + \lambda_{r1} t + \varepsilon_{rit} \quad (4')$$
$$\text{with } i = 1,...,N; t = 1,...,T$$

where the country sample includes N inflation targeting countries and a control group of $M - N$ countries. The results are shown in Table 14.[26]

Table 14. Estimation of the effects of inflation targeting on nominal interest rates

	All countries	*Adoption prior to 2000*	*Adoption prior to 1999 and average inflation 1981–90 below 25%*	*Adoption prior to 1999 and average inflation 1981–90 below 15%*	*Industrial countries and adoption prior to 1999*
Estimate of β_r from (4)	-0.310	-0.650	-0.618	-0.596	-0.422
	(0.091)	(0.137)	(0.155)	(0.158)	(0.164)
Estimate of β_r from (4')	-0.265	-0.355	-0.309	-0.308	-0.289
	(0.042)	(0.047)	(0.050)	(0.050)	(0.050)

Definitions of country groups can be found in Table 5. Numbers in parenthesis are standard errors. The estimation period is 1981:1–2002:4 (T = 87). Information on the data and the countries for which data for the whole period was not available can be found in Tables 4, 10 and 13.

The results suggest that inflation targeting has led to a fall in nominal interest rates beyond what can be explained by the fall in domestic inflation, the position of the domestic business cycle and the general global fall in interest rates. In all cases are the inflation targeting effects found statistically significant from zero. Inflation targeting therefore seems to have increased the credibility of monetary policy and reduced the inflation risk premium of nominal interest rates.

This runs counter to the results in Ball and Sheridan (2003), who find no significant effects of inflation targeting on long-term interest rates, but is consistent with the findings in Bernanke et al. (1999), Corbo et al. (2001), Johnson (2002) and Levin et al. (2004) on the effects of inflation targeting on inflation expectations.[27] By using the slope of the yield curve and inflation expectations surveys, they find that after inflation expectations have fallen, it

[26] As expected, increased inflation and growth lead to rising nominal interest rates and the effects are usually found to be statistically significant from zero.

[27] The empirical results from Johnson (2002) indicate the inflation targeting has reduced inflation expectations by 2½% on average, which is consistent with earlier findings in this paper on the effects of inflation targeting on average inflation.

remained easier for the inflation targeting central banks to keep them low in later upswings than had been possible prior to the inflation targeting regime. Their results suggest, however, that this credibility gain was only reaped some time after the adoption of the inflation target and that the effects were small at the start of the regime. The disinflation following the adoption of inflation targeting therefore came at a surprise, which is reflected in the fact that actual inflation often remained somewhat below measured inflation expectations for the first few years of the regime. This is also consistent with the findings in Ammer and Freeman (1995) and Bernanke et al. (1999) using VAR models based on data prior to the adoption of inflation targeting. These models consistently over-predict inflation for the first few years of the new regime.

This gradual gain in credibility is also found by Ammer and Freeman (1995), Debelle (1997) and Bernanke et al. (1999) who find that inflation targeting did not reduce the sacrifice ratio. The targeting countries had to go through a contraction to reduce inflation, which supports the above conjecture that the targeting regime initially lacked credibility. The results in Corbo et al. (2001) are slightly more positive, looking at a broader group of countries and measuring the sacrifice ratio using industrial production rather than GDP. Their results indicate that the adoption of inflation targeting led to a reduction in the sacrifice ratio, although the disinflation process still remained costly.

Closely related is the analysis in Kahn and Parrish (1998), Cecchetti and Ehrmann (2000), Corbo et al. (2001) and Neumann and von Hagen (2002) on whether inflation targeting has led to changes in central bank behaviour, especially concerning reaction to inflationary pressures. Using Taylor rules and impulse response analysis from VAR models, their results suggest that responses to transitory inflation shocks have become less aggressive but long-run responses to inflation have increased. These studies also imply that monetary policy in the inflation targeting countries has been converging towards other industrial countries which have a long history of credibility, such as Germany and the US.

Improved credibility of monetary policy can also be read from comparing central bank performance in dealing with the two oil shocks in the late 1970s and 1990s. Neumann and von Hagen (2002) show that (after controlling for various economic factors) the inflation targeting central banks managed to keep inflation under control with much less interest rates hikes in the latter episode than in the first one. This suggests that monetary policy in the inflation targeting countries had gained greater credibility so that they found it much easier to cope with the second oil shock. They also show that the credibility

gain was much larger for the inflation targeting countries than for the non-targeting industrial countries in their study, implying that the adoption of inflation targeting played a crucial role in creating this increased credibility.

Together, these results suggest that the adoption of inflation targeting increased credibility of monetary policy in the targeting countries which reduced inflation expectations and the inflation risk premium in nominal interest rates. This credibility improvement was, however, not gained immediately. Announcing an inflation target does therefore not appear to be enough. The central bank needs to show real progress in fighting inflation and in the disinflation phase to be willing to accept temporary contraction in the real economy before credibility is gained.

4.3.2 Effects on fluctuations in exchange rates and interest rates

It is sometimes argued that the adoption of inflation targeting will lead to increased exchange rate fluctuations as too much emphasis is placed on stabilising the domestic value of the currency instead of its external value. Various theoretical arguments do, however, suggest that low and stable inflation should contribute to exchange rate stability.[28] It has, however, been notoriously difficult to link exchange rate fluctuations with any behaviour in economic fundamentals, cf. Kuttner and Posen (2000) who find that monetary policy transparency is more important for exchange rate volatility than fluctuations in economic fundamentals.

Table 15 compares fluctuations in real exchange rates before and after inflation targeting. Exchange rate fluctuations are calculated using standard deviations of year-on-year real exchange changes.[29] Real exchange rate variation seems to

[28] One should keep in mind that fluctuations in exchange rates are not bad per se. One of the benefits of floating exchange rates is that it acts as an absorber for real shocks. Exchange rates have a tendency, however, to fluctuate beyond what can be explained by economic fundamentals and it is this excessive volatility that is referred to in the main text. It is interesting to note in this connection that the results in Sabbán et al. (2003) suggest that the importance of real shocks in nominal and real exchange rate fluctuations have increased after the adoption of inflation targeting, suggesting that the ability of the exchange rate to act as a shock absorber has increased after the adoption of inflation targeting.

[29] Exchange rate fluctuations were also calculated as the standard deviations of the real exchange rate level, as the standard deviation of quarterly changes in the real exchange rate, and as the percentage difference between the peak and through of the exchange rate cycle within each regime. The main results continue to hold, irrespective of the measure of exchange rate fluctuations used. The same applied whether the nominal or real exchange rate were used. Note, however, that these measures do not capture prolonged deviations from equilibrium exchange rates which are just as important as the short-run fluctuations in exchange rates captured here. With modern financial hedging opportunities available one may even argue that these latter type of fluctuations are more important.

have decreased on average when looking at all the inflation targeting countries. In fact it seems only in the industrial countries that exchange rate fluctuations have increased on average.[30] When looking at individual countries it appears that exchange rate fluctuations have increased in ten countries, but fallen in eleven. It does therefore not seem obvious that inflation targeting necessarily leads to increased exchange rate volatility. In fact, it is interesting that all the four industrial countries, where exchange rate variability increases, were previously on a fixed exchange rate. In addition, four of the six emerging market countries previously using fixed exchange rates experienced an increase in exchange rate variability after adopting inflation targeting. Exchange rate fluctuations, however, fell in all the four industrial countries and in four of the seven emerging market countries previously on a floating exchange rate.

Increased exchange rate volatility therefore seems to be related to exiting a fixed exchange rate regime rather than to the adoption of inflation targeting per se. Inflation targeting seems to have reduced exchange rate volatility rather than increasing it in those countries which had a floating exchange rate before adopting inflation targeting, consistent with Kuttner and Posen (2000), who argue that increased transparency of monetary policy reduces exchange rate variability.

Some of those sceptical about the usefulness of inflation targeting also worry that a too rigid framework will lead to excessive fluctuations in the policy instrument, i.e. that variability of the short-term interest rate will increase with inflation targeting. This is, however, not obvious as one can easily argue that interest rate volatility can be larger in a fixed exchange rate framework, especially when the central bank is defending the peg against a speculative attack, cf. the Swedish experience in the early 1990s.

Table 15 compares fluctuations in short-term real interest rates prior to and after inflation targeting. Interest rate variability falls in general after adoption,[31] consistent with the results in Kahn and Parrish (1998) and Neumann and von

[30] One should be careful in comparing exchange rate fluctuations prior to and after inflation targeting for countries which have very recently adopted the new regime as the short period after adoption may not be representative for exchange rate fluctuations that will follow the adoption of inflation targeting. This especially applies to countries where the new regime was adopted after the currency came under heavy pressure, with large exchange rate fluctuations following the abolishment of the exchange rate peg during which the accumulated disequilibrium was corrected. This might influence the results.

[31] Fluctuations in interest rates only increase in three countries (Iceland, Korea and Switzerland) and two of these have adopted inflation targeting very recently. This might complicate the interpretation of the results. It is also interesting that interest rate volatility has increased in the non-targeting industrial countries. The results remained more or less the same whether nominal or real, or short or long, interest rates were used.

Table 15. Fluctuations in real exchange rates and real interest rates prior to and after inflation targeting

	Average fluctuations the 5 years prior to adoption		*Average fluctuations after adoption*		*Average fluctuations 1981–1990*		*Average fluctuations 1991–2002*	
Countries	Ex.rate	Int.rate	Ex.rate	Int.rate	Ex.rate	Int.rate	Ex.rate	Int.rate
Australia	9.3	1.9	6.7	1.6	9.6	2.6	6.6	1.8
Brazil	12.4	9.5	15.9	3.9	18.0	-	14.2	8.0
Canada	6.3	1.7	4.4	1.7	5.7	1.9	4.4	1.7
Chile	8.7	8.5	6.0	3.3	13.3	27.5	6.0	4.1
Columbia	9.5	4.2	8.4	2.6	10.3	4.0	9.5	5.3
Czech Republic	6.1	2.9	6.4	1.7	-	-	7.5	2.7
Hungary	2.8	1.6	2.0	1.2	6.3	5.4	5.7	4.2
Iceland	2.9	0.9	11.8	2.0	7.5	-	5.8	1.5
Israel	5.3	11.0	6.1	4.0	6.3	11.0	6.0	4.0
Korea	9.6	1.7	12.5	2.5	10.0	3.7	10.2	3.1
Mexico	18.1	10.8	7.0	2.6	22.8	27.1	13.0	7.5
New Zealand	11.3	2.9	7.5	1.3	9.4	4.1	7.8	1.3
Norway	2.4	1.4	3.8	1.1	3.0	2.8	4.2	2.8
Peru	5.1	6.7	2.5	5.6	21.8	-	9.2	6.7
Philippines	10.6	1.9	3.9	0.9	10.8	10.1	9.6	2.4
Poland	4.0	6.1	8.5	1.8	19.6	279.2	15.6	12.8
South Africa	8.7	2.0	10.6	1.9	13.1	5.2	8.7	3.2
Sweden	3.1	3.1	8.5	1.5	5.9	2.0	7.9	2.5
Switzerland	4.6	0.5	3.1	0.8	5.6	1.7	4.7	1.1
Thailand	11.1	3.8	4.7	0.7	6.8	3.3	7.6	3.2
United Kingdom	6.1	1.0	8.3	0.6	7.4	1.8	7.9	1.1
All countries	7.5	3.8	7.1	2.1	10.1	23.3	8.2	3.9
Except hyperinflation	7.7	2.9	6.8	1.7	9.2	6.0	7.5	2.9
Industrial countries	5.8	1.7	6.8	1.3	6.8	2.4	6.2	1.7
IT-6 group	7.5	2.9	6.9	1.9	8.5	4.4	6.8	2.1
Non-inflation targeting industrial countries	–	–	–	–	6.2	1.5	5.9	2.0

The real exchange rate data is quarterly for the period 1981:1–2002:4 (except for the Czech Republic, where the data start in 1990:4). The data is obtained from the International Monetary Fund (except for Iceland (from the Central Bank of Iceland) and for Brazil, Peru and Thailand (from JPMorgan)). The table reports the standard deviations of percentage changes in the real exchange rate from the previous year quarter. The real interest rate is calculated by subtracting annual inflation in a given quarter from the same quarter's nominal interest rate. The table reports the standard deviations of interest rate levels. Information on the inflation and interest rate data can be found in Tables 4 and 13. Information on the country groups can be found in Table 4.

Sources: EcoWin, IFS, JP-Morgan, central bank homepages and Central Bank of Iceland, Economics Department.

Hagen (2002). This supports the argument that the weight of short-run developments in the formulation of monetary policy has decreased and that the medium-term horizon is more prominent, as discussed earlier. The results also suggest that inflation targeting central banks do not interpret the framework as a rigid rule (as strict inflation targeting, cf. Svensson, 2001), but rather as a flexible framework where interest rate smoothing is important, contributing to increased stability of the real economy and reduced probability of financial instability.

4.4 The total long-run level effects of inflation targeting

A potential shortcoming of the above analysis is that it only captures the direct effects of inflation targeting, e.g. the direct impact on inflation but holding the effects on output and interest rates constant, thus omitting the potential effect on inflation operating through its impact on output growth and interest rates.[32] Thus, for example, if output affects inflation and the interest rate affects output then there are indirect effects of inflation targeting on inflation via its effects on interest rates and output. The same would be true for all variables if such feedback effects exist, thus biasing the true total, long-run effects of inflation targeting on macroeconomic performances although it is unclear in what direction this bias would be.

To work out this total effect, one can write the three-dimensional system as follows

$$\mathbf{A}_0\mathbf{x}_t = \boldsymbol{\beta} IT_t + \mathbf{A}_1\mathbf{x}_{t-1} + \boldsymbol{\Phi}\mathbf{z}_t + \boldsymbol{\varepsilon}_t \tag{5}$$

where $\mathbf{x}_t = (\pi_t, y_t, r_t)'$, $\boldsymbol{\beta} = (\beta_\pi, \beta_y, \beta_r)'$, $\mathbf{z}_t$ is a vector containing all the exogenous variables, $\boldsymbol{\varepsilon}_t$ is a residual vector, and $\mathbf{A}_0$, $\mathbf{A}_1$ and $\boldsymbol{\Phi}$ are coefficient matrices.

This system has the following long-run solution

$$\mathbf{x} = \boldsymbol{\Omega}^{-1}\boldsymbol{\beta} IT + \boldsymbol{\Omega}^{-1}\boldsymbol{\Phi}\mathbf{z} = \boldsymbol{\theta} IT + \boldsymbol{\Omega}^{-1}\boldsymbol{\Phi}\mathbf{z} \tag{6}$$

where $\boldsymbol{\Omega} = (\mathbf{A}_0 - \mathbf{A}_1)$. The total long-run effects of inflation targeting are therefore given by (where the direct long-run effects can be read off the diagonal)

[32] I would like to thank Mike Wickens for suggesting this point.

$$\theta = \begin{pmatrix} 1-\gamma_{\pi} & -\mu_{\pi} & 0 \\ \mu_{y} & 1-\gamma_{y} & -\mu_{y} \\ -(\delta_{r}+\mu_{r}) & -\phi_{r} & 1-\gamma_{r} \end{pmatrix}^{-1} \begin{pmatrix} \beta_{\pi} \\ \beta_{y} \\ \beta_{r} \end{pmatrix} \tag{7}$$

Table 16 compares the direct and total long-run effects (with standard errors calculated using the delta method) with non-significant variables removed in the final system estimation. The total effects are usually either smaller or equal to the direct effects, although the differences are small. The direct inflation effect is on average (across country samples and model specifications) 0.5 percentage point larger than its corresponding total effect. The direct output effect is on average 0.3 percentage point larger, and the direct interest rate effect on average 40 basis points larger. Furthermore, the statistical inference remains largely unchanged; the only changes are that the long-run inflation effect becomes statistically insignificant in the second country sample using equation (1) and the first country sample using equation (1') (with the second country sample now only significant at the 10% significance level).

Table 16. Direct and total long-run effects of inflation targeting

	All countries	*Adoption prior to 2000*	*Adoption prior to 1999 and average inflation 1981–90 below 25%*	*Adoption prior to 1999 and average inflation 1981–90 below 15%*	*Industrial countries and adoption prior to 1999*
			Inflation		
Equation (1)					
Direct effect	-1.077	-2.353	-3.326	-3.030	-2.207
	(0.769)	(0.928)	(1.002)	(1.241)	(1.496)
Total effect	-0.005	-1.066	-3.147	-3.030	-2.021
	(0.978)	(1.068)	(1.057)	(1.241)	(1.596)
Equation (1')					
Direct effect	-1.332	-1.922	-2.127	-1.909	-1.916
	(0.564)	(0.711)	(0.849)	(0.922)	(1.047)
Total effect	-0.362	-1.226	-1.912	-1.909	-1.916
	(0.617)	(0.736)	(0.890)	(0.922)	(1.047)
			Output growth		
Equation (3)					
Direct effect	1.569	1.859	0.515	0.531	0.787
	(0.757)	(0.629)	(0.528)	(0.553)	(0.508)
Total effect	1.653	1.569	0.340	0.000	0.111
	(1.101)	(0.561)	(1.834)	–	(0.110)
Equation (3')					
Direct effect	1.287	1.108	0.487	0.619	0.584
	(0.466)	(0.405)	(0.375)	(0.376)	(0.377)
Total effect	1.603	1.080	0.318	0.000	0.000
	(0.436)	(0.393)	(2.992)	–	–
			Interest rates		
Equation (4)					
Direct effect	-3.103	-5.480	-3.794	-4.061	-3.215
	(0.763)	(0.975)	(0.834)	(0.943)	(1.129)
Total effect	-1.992	-4.084	-4.878	-5.197	-3.980
	(0.923)	(1.119)	(0.813)	(1.187)	(1.174)
Equation (4')					
Direct effect	-4.623	-6.269	-5.371	-5.623	-5.664
	(0.757)	(0.898)	(0.961)	(1.033)	(1.127)
Total effect	-2.449	-4.460	-5.113	-5.738	-5.651
	(0.877)	(0.973)	(0.793)	(0.949)	(1.022)

The table reports the estimated long-run effects of inflation-targeting adoption. The direct long-run effects are calculated as $\beta_k/(1 - \gamma_k)$, where $k = \pi, y, r$. The total long-run effects are calculated from equation (7). Standard errors, reported in parenthesis, are calculated using the delta method: $V(\boldsymbol{\theta}(\boldsymbol{\kappa})) = (\partial\boldsymbol{\theta}(\boldsymbol{\kappa})/\partial\boldsymbol{\kappa})' V(\boldsymbol{\kappa})(\partial\boldsymbol{\theta}(\boldsymbol{\kappa})/\partial\boldsymbol{\kappa})$, where $V(\boldsymbol{\kappa})$ is the variance-covariance matrix of the original coefficients ($\boldsymbol{\kappa}$), and $V(\boldsymbol{\theta}(\boldsymbol{\kappa}))$ is the variance-covariance matrix of the derived long-run coefficients ($\boldsymbol{\theta}$).

5 Scepticism on the usefulness of inflation targeting

5.1 Flexibility of the framework

Some of those sceptical about the usefulness of inflation targeting worry that the regime is too rigid and may therefore hinder the central bank in paying sufficient attention to real economy developments. They fear that inflation targeting may therefore be harmful for growth and increase business cycle fluctuations, at least temporary (see, for example, Friedman and Kuttner, 1996).[33] As discussed above this interpretation of inflation targeting as a rigid monetary policy rule is not correct. On the contrary, the flexibility of the framework is ensured by its medium term orientation and by basing policy on all relevant information for inflation developments, including real economy developments. A contraction which usually goes hand in hand with falling inflation calls for monetary policy easing which helps ease the contraction. An overheating, caused by excessive demand, by the same token leads to increasing inflation with the inflation targeting central bank responding by raising interest rates which curbs the demand pressures in the economy. Monetary policy therefore not only ensures that the inflation target is maintained but also reduces business cycle variability for shocks originating on the demand side of the economy (see also Bernanke et al. (1999) and the results in the previous section).

Supply shocks are, however, harder to deal with and can create temporary conflicts between the inflation target and the real economy. As previously discussed, inflation targeting central banks respond to these problems by specifying the target for a relatively long horizon which also emphasises the floor of the target. They also often apply measures of core inflation which excludes the first round effects from supply shocks on inflation and even use escape clauses allowing them to ignore the inflationary effects of certain pre-specified supply shocks. All this is done to increase the flexibility of the inflation targeting framework with respect to supply shocks. In fact, inflation targeting may help central banks to deal with supply shocks by helping them to convince the public that the effects of a supply shock will be limited to a one-time rise in the price level, rather than leading to a prolonged rise in the inflation rate.[34]

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[33] This view seems prominent among many in the Board of Governors of the Federal Reserve in the US, including the Governor Alan Greenspan. See Truman (2003) and the relevant references in there.

[34] Examples include the experience of Canada with a large hike in indirect taxes in 1991, the large currency depreciations after exchange rate pegs exits in Sweden and Iceland, and the experience in many inflation targeting countries with the large terms of trade shocks after the East Asian crisis and the oil price hike in 1998.

Others, such as Calvo (2000) and Rich (2000), argue that inflation targeting is too flexible and does therefore not provide monetary policy with a sufficiently credible nominal anchor. This, they argue, will lead to discretionary policy resulting in higher inflation than can be ensured with a more rigid monetary policy rule. As Bernanke et al. (1999) point out, however, increased transparency and accountability of monetary policy under inflation targeting should provide sufficient discipline. It would be difficult for an inflation targeting central bank to ignore its overly expansive policies in its regular analysis and forecasts where the bank needs to explain in a credible fashion systematic deviations of inflation from target (see also Mishkin, 1999, Mishkin and Savastano, 2001, and Truman, 2003).

5.2 Inflation targeting preconditions

Other economists are simply sceptical that inflation targeting can work, considering all the preconditions sometimes thought necessary to satisfy for inflation targeting to work (see the discussion of these preconditions in Pétursson, 2004). This is thought to apply especially to emerging market countries (see, for example, Calvo, 2000). One should, however, be careful in over-emphasising these preconditions. They are indeed desirable but that applies to any type of framework for monetary policy. In fact, many countries have adopted inflation targeting successfully without satisfying all these conditions at the outset.

5.3 Imperfect control of inflation

It is sometimes argued that a serious problem with inflation targeting is the fact that central banks have much less control over inflation than, say, narrow money. The causes of this imperfect control lie in the transmission lags of monetary policy and the fact that these lags can be variable, depending on the business cycle position and the credibility of monetary policy actions. Other factors also influence inflation in the short run, such as fiscal policy, economic policy in other countries, and various demand and supply shocks. In addition, there is uncertainty about the structure of the economy, the transmission mechanism of monetary policy, the current position of the business cycle, and the origins and durability of shocks hitting the economy. Close control of inflation is therefore extremely difficult.

This argument is therefore perfectly valid and calls for emphasis on forward looking and transparent monetary policy. Policy decisions are therefore based on likely future outcomes for inflation, as reflected in the bank's inflation

forecast. If the bank thinks that inflation will deviate too greatly from the target it will respond in a timely fashion. This is in fact a description of the inflation targeting framework where the inflation forecast basically becomes the intermediate target of policy. This framework is much more likely to work than a reactive policy which only responds to inflation when it has become a problem and then raises interest rates sharply when really it has become too late. In fact, such a "stop-go" policy is more likely to be procyclical as experience of many countries shows, including many of the current inflation targeters.

Finally, it should also be noted that monetary policy based on a fixed exchange rate or money supply targets is in fact faced with many of the same problems. It is also of limited use for central banks to have closer control over some narrow definitions of money if the relationship between that quantity and inflation is frequently changing and proves unpredictable. The fact remains, however, that monetary policy with an inflation target is more difficult the less ability the central bank has to influence and forecast inflation, for example in emerging market countries where government controlled prices and exchange rate driven price movements are likely to be more important than in most industrial countries.

5.4 Inflation targeting and exchange rate fluctuations

With most inflation targeting countries being small, open economies, increased attention has been paid to the role of exchange rate fluctuations within the inflation targeting framework. It is sometimes argued that due to this open-economy aspect and the fact that many inflation targeting countries are emerging market economies, exchange rate fluctuations need to be dampened and in doing so will eventually lead to conflicts with the inflation target, implying that the target can never be fully credible.

As discussed in Svensson (2000) there are several reasons why exchange rate developments are important for inflation targeting central banks. Exchange rate movements are an important channel in the transmission of monetary policy. They affect domestic prices directly, through prices of imported goods, and indirectly through the effects on domestic demand.[35] Exchange rate

[35] Recent research suggests that the importance of exchange rate shocks for domestic inflation has fallen is recent years (see, for example, Schaechter et al., 2000, and Corbo et al., 2001), which can be explained, inter alia, by the increasing flexibility of exchange rates after the adoption of inflation targeting and the increasing credibility of the targets. The results in Kamin and Klau (2003) suggest, for example, that the importance of exchange rate shocks have fallen with falling inflation.

movements also play an important role in transmitting international shocks into the domestic economy. Emerging market countries may even want to pay greater attention to exchange rate developments as their financial system is usually underdeveloped and their currency not internationally traded, which makes them especially vulnerable to excessive fluctuations in exchange rates. Foreign borrowing is also common in these countries which makes domestic balance sheets more vulnerable to a sharp exchange rate depreciation which could trigger a financial crisis, whereas a sharp appreciation would make domestic businesses less competitive and lead to a current account deficit which again could increase the risk of a currency crisis when the capital inflow suddenly halts and turns into outflow (see the discussions in Mishkin and Savastano, 2001, Mishkin and Schmidt-Hebbel, 2001, and Jonas and Mishkin, 2003). It may therefore be appropriate for an emerging market inflation targeting central bank to try to avoid large exchange rate swings if the bank thinks that they can undermine financial stability, even though the bank has no specific exchange rate target.

It is therefore clear the exchange rate movements matter in small, open economies (especially emerging market economies) even though the central bank adopts inflation targeting. Monetary policy responses, however, need to reflect the nature and source of the exchange rate shock. A depreciation caused by a pure portfolio shock is more likely to increase inflation than a depreciation caused by real shocks, as a reduction of domestic demand will ease the inflationary pressures in the latter case, thus counteracting increasing imported inflation. The proper response of monetary policy in the former case is to raise interest rates but this is less clear in the latter one. A monetary policy easing may even be warranted if the contraction in domestic demand is sufficiently large to outweigh the direct effect of the depreciation on import prices. This would prevent inflation from undershooting the target and ensure that the economy will not get trapped in a deflationary trap.

The risk is, however, that the central bank will focus too much on exchange rate developments, thus transforming the exchange rate into a nominal anchor that takes precedence over the inflation target (cf. Mishkin and Schmidt-Hebbel, 2001). This could lead the central bank to pay too much attention to short-run exchange rate fluctuations, resulting in excessive variability in policy instruments and the real economy.[36] It is interesting in this context to compare the experience of New Zealand and Australia in the East

[36] See, for example, the results in West (2003), which suggest that monetary policy can reduce real exchange rate fluctuations but only at a cost of increasing fluctuations in growth, inflation and interest rates.

Asian crisis in 1997–8 (see the discussion in Svensson, 2001, and Mishkin and Schmidt-Hebbel, 2001).

The Reserve Bank of New Zealand initially used annual inflation targets and emphasised the transmission of monetary policy through the exchange rate channel. This led the Bank to focus on the exchange rate as an indicator of the monetary policy stance. This was eventually institutionalised in early 1997 when the Bank adopted a Monetary Condition Index (MCI), first developed by the Bank of Canada few years earlier, as its primary indicator of monetary policy. The MCI weights together short-term interest rates and the exchange rate.[37] A rising index indicates that monetary policy is tightening which calls for a reduction in the monetary policy interest rate until the index returns to a level thought to reflect a neutral stance. The problem is, however, that such an interpretation is not appropriate in circumstances where exchange rate movements reflect real shocks (such as terms of trade shocks). Using the MCI can therefore lead to serious policy mistakes.

These shortcomings of the MCI became very clear in the East Asian crisis in 1997 when New Zealand was hit by a large terms of trade shock which led to a depreciation of the New Zealand dollar and sharp decline in the MCI. The Reserve Bank responded by raising interest rates by over 200 basis points, resulting in a substantial tightening of monetary policy which, with the negative effects of the terms of trade shock, pushed the economy into a recession (at the same time the economy was hit by a severe drought which led to a crop failure). Inflation fell below the target range with actual deflation in 1999. The Reserve Bank, however, quickly reversed its course and started lowering interest rates in the middle of 1998, and abandoned the MCI a year later. The Bank has since then focussed much less on exchange rate developments when formulating monetary policy. It therefore seems that the MCI resulted in a policy mistake where the Bank tightened policy when an unchanged stance, or even an easing, was needed. The emphasis on exchange rate stability had therefore misled the Bank into taking the wrong policy decision.[38]

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[37] The weights were set 1:2, such as a 2% appreciation in the New Zealand dollar was considered to have similar effects on future inflation as a 1 percent rise in short-run interest rates.

[38] The Central Bank of Chile responded to the Asian crisis in a similar way due to its fear that a depreciation might undermine the newly gained credibility of the Bank. This led to a temporary contraction in the economy late in 1998, with inflation falling below the target. The Bank was heavily criticised and soon changed course and decreased interest rates. The crawling peg was finally abolished in September 1998 and the exchange rate allowed to float freely. Bernanke et al. (1999) also argue that the crawling peg of the Bank of Israel delayed the disinflation process in Israel.

This can be compared to the responses of the Reserve Bank of Australia to the same terms of trade shock. Instead of raising interest rates, as its New Zealand counterpart did, the Bank immediately lowered its overnight cash rate by 50 basis points and by further 25 basis points in the end of 1998. In this way the Reserve Bank allowed the Australian dollar to depreciate in response to the terms of trade shock, thus easing the negative effects on the economy. Output growth therefore remained strong throughout the Asian crisis and inflation remained stable and low despite a more than 20% depreciation of the Australian dollar against the US dollar. Mishkin and Schmidt-Hebbel (2001) argue that the inflation target played a crucial role in ensuring that this large depreciation did not feed into inflation expectations. The inflation targeting framework allowed the Reserve Bank to credibly explain that the interest rate cuts were necessary to ensure that inflation would not fall under the lower range of the target.

The conclusion from this therefore seems to be that it is important for small, open economies to pay attention to exchange rate movements in the formulation of monetary policy. Even though an inflation targeting framework calls for exchange rate flexibility with clear precedence of the inflation target, a clean float is not the only option, especially for countries with underdeveloped financial markets (see, for example, Amato and Gerlach, 2002, and Truman, 2003).[39] The central bank needs, however, to be careful not to over-emphasise short-run fluctuations in the foreign exchange market and its possible temporary effects on inflation developments instead of focusing on the medium-term inflation outlook when inflationary effects of the exchange rate fluctuations have disappeared. Too much focus on short-term exchange rate fluctuations runs the risk of misleading policy decisions, resulting in poorer policy performance. Mishkin and Schmidt-Hebbel (2001) argue that the same applies to target other asset prices.

[39] Truman (2003) points out that increasing transparency of monetary policy, and the exchange rate flexibility in general, should decrease uncertainty and force the general public into greater risk management which should reduce the probability of financial crisis. The risk of financial crisis should also be reduced by emphasizing the floor of the inflation target as much as the ceiling as very low inflation or even deflation usually follows financial crisis (Debelle, 2001).

6 Conclusions

Monetary policy based on an inflation target has gained increasing attention and popularity since New Zealand first adopted this framework in early 1990. By 1993 only five countries had adopted inflation targeting and five years later they were ten. Five years further the number of countries had doubled again, with 21 countries currently basing their monetary policy on an inflation target.

These countries have moved on to an inflation target for a variety of reasons. For some it was a natural conclusion to an evolving process lasting for various lengths of time, or a formalisation of a de facto policy. In other cases an earlier regime had finally been abandoned after it failed or produced unsatisfactory results. Common features of all these reforms, however, was the attempt to communicate the ultimate goals of monetary policy more clearly, to improve the framework for conducting monetary policy and to provide a clearer anchor for inflation expectations.

Inflation-targeting countries are highly diverse in size and structure. In general they are either relatively small or medium-sized industrial countries, or relatively large emerging market economies. They tend to be more open to international trade and have a lower level of treasury debt than similar non-targeters, and also seem more prosperous and have fairly developed financial systems.

This paper analysis the effects of inflation targeting on several key macroeconomic variables. The main conclusions from this analysis is that inflation targeting has played a significant role in bringing inflation down in the targeting countries, thus also decreasing inflation fluctuations. There is also evidence that inflation targeting has reduced inflation persistence, reflecting the improved credibility of policy and suggesting that inflation expectations have become more forward looking than before. These changes are also reflected in lower nominal interest rates. This improvement in inflation performance does not seem to have come at the cost of lower output growth or increased output variability or increased real interest rate and exchange rate volatility. The results suggest that the observed increase in exchange rate volatility in some countries has more to do with exiting an exchange rate peg rather than inflation targeting per se. In fact, exchange rate volatility has in general diminished in those countries that previously had

a flexible exchange rate with an alternative nominal anchor, possibly due to greater transparency of monetary policy under inflation targeting.

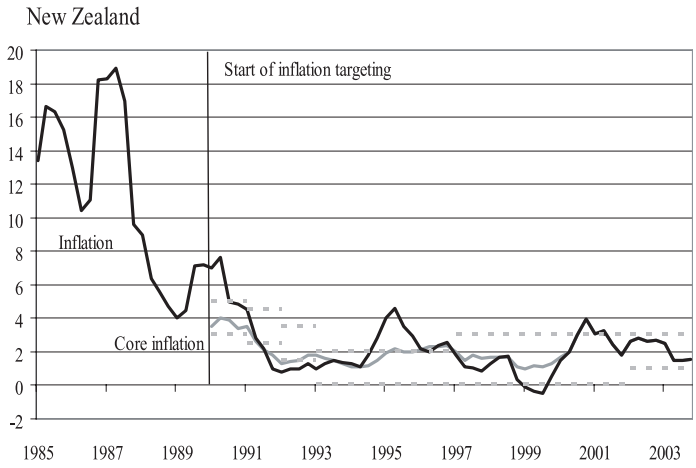
These results are consistent with a growing literature analysing various aspects of inflation targeting and suggest that inflation targeting, by increasing the transparency and accountability of the central bank, has led to improved understanding and greater credibility of monetary policy. Discussions on monetary policy inside and outside the central bank reflect better what the main tasks of monetary policy are and which goals it can achieve and which not. This makes it easier for the central bank to achieve its goals with smoother adjustments in its policy stance. Inflation targeting has in many ways made it possible for countries with persistent inflationary problems to turn around the corner and bring its monetary policy in line with best practice around the world. In many respects they have even been leading in creating a new benchmark for how to formulate monetary policy.

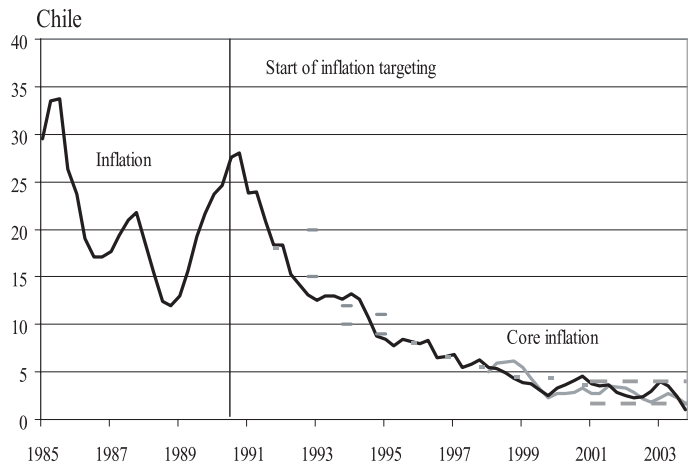
Inflation targeting is, however, no panacea. Complicated problems requiring careful analysis will continue to arise. Mistakes will inevitably continue to be made. Monetary policy will still need to decide on the causes and durability of shocks and the issue of how to deal with supply shocks will not disappear. The same applies to the role of exchange rate developments in the formulation of monetary policy in a small, open economy, especially where the domestic financial system is relatively underdeveloped so that excessive exchange rate fluctuations can undermine its stability. Conflicts between the inflation target and financial stability can also create problems, as do inconsistencies between monetary and fiscal policy. The key is, however, that flexible inflation targeting provides a framework which increases the probability that monetary policy reaches the correct decisions and that these decisions are explained in a clear and credible fashion.

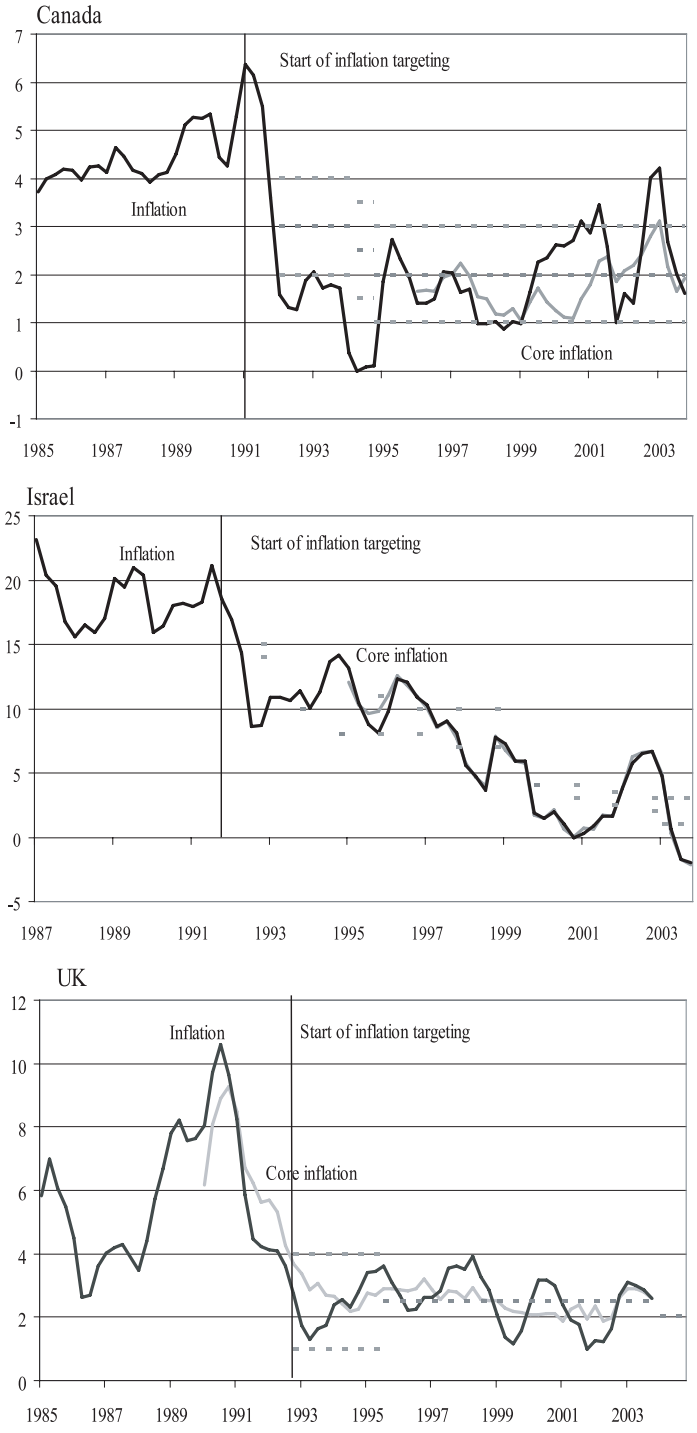
Appendix: Inflation and the evolution of inflation targeting

This Appendix presents inflation developments and the evolution of inflation targeting in the 21 countries, plus Finland and Spain, over the past two decades. Countries are arranged in chronological order based on when they moved on to an inflation target. The figures also show the numerical target (thin line) and the tolerance limits (thick lines).

Data extend to the end of 2003, but the charts to the scheduled end of the respective country's adjustment to the long-term target. This development is discussed in more detail in the main text and also in Pétursson (2004).






Canada
Start of inflation targeting
Inflation
Core inflation
7
6
5
4
3
2
1
0
-1
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
Israel
Inflation
Start of inflation targeting
Core inflation
25
20
15
10
5
0
-5
1987
1989
1991
1993
1995
1997
1999
2001
2003
UK
Inflation
Start of inflation targeting
Core inflation
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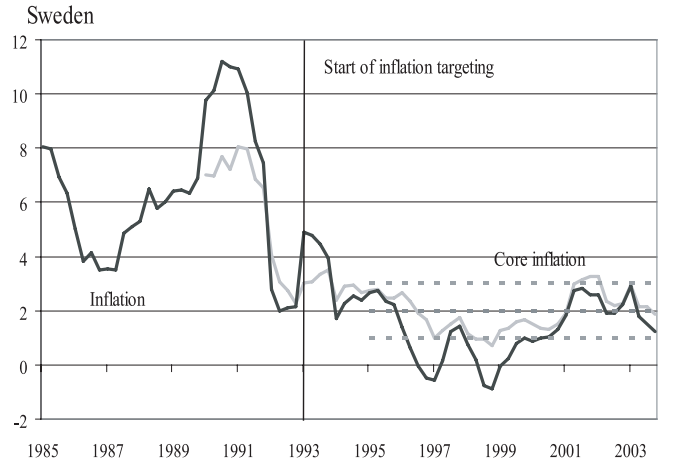
Sweden
Start of inflation targeting
Core inflation
Inflation
12
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1985
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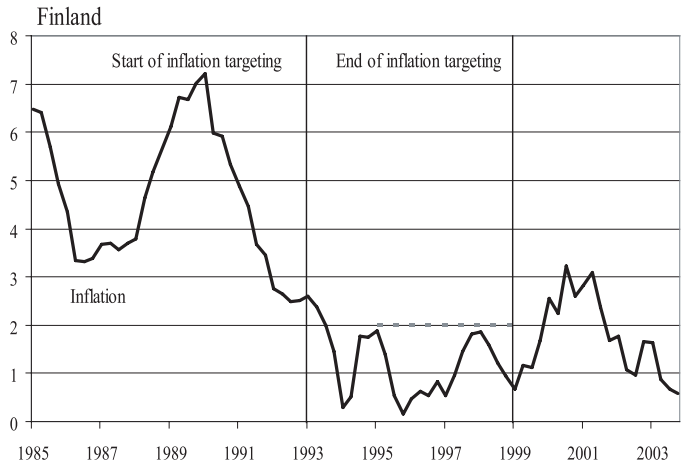
Finland
Start of inflation targeting
End of inflation targeting
Inflation
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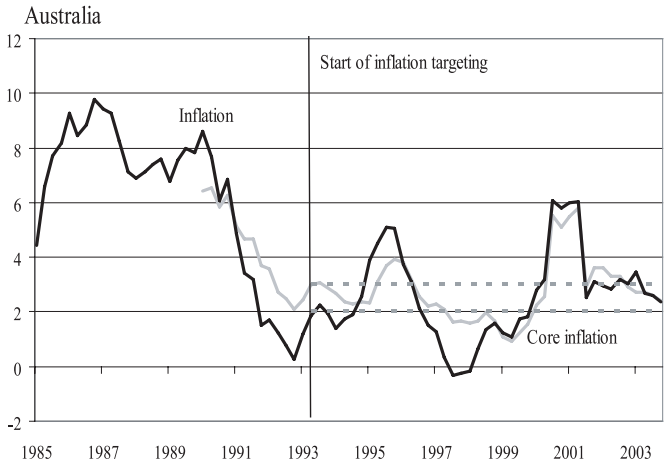
Australia
Start of inflation targeting
Inflation
Core inflation
12
10
8
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4
2
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1985
1987
1989
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1997
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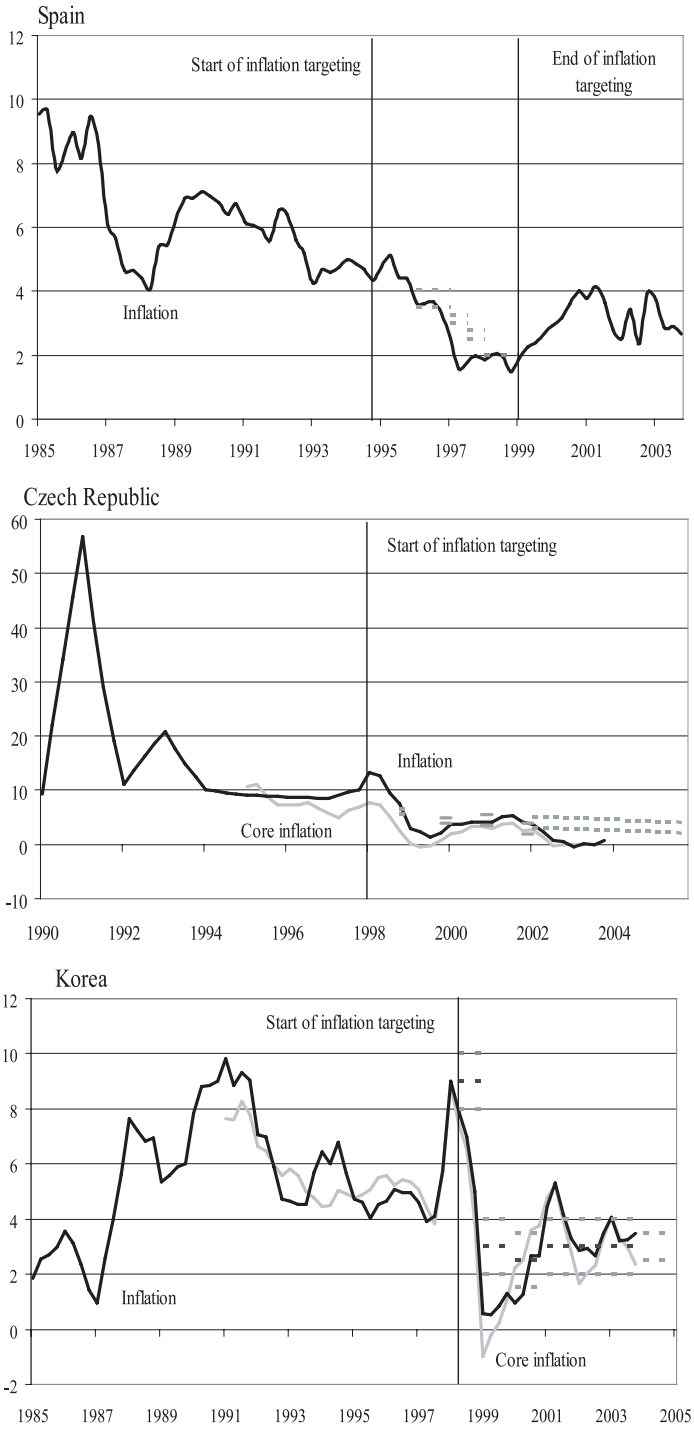
2003


Spain
Start of inflation targeting
End of inflation targeting
Inflation
12
10
8
6
4
2
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
Czech Republic
Start of inflation targeting
Inflation
Core inflation
60
50
40
30
20
10
0
-10
1990
1992
1994
1996
1998
2000
2002
2004
Korea
Start of inflation targeting
Inflation
Core inflation
12
10
8
6
4
2
0
-2
1985
1987
1989
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1993
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1997
1999
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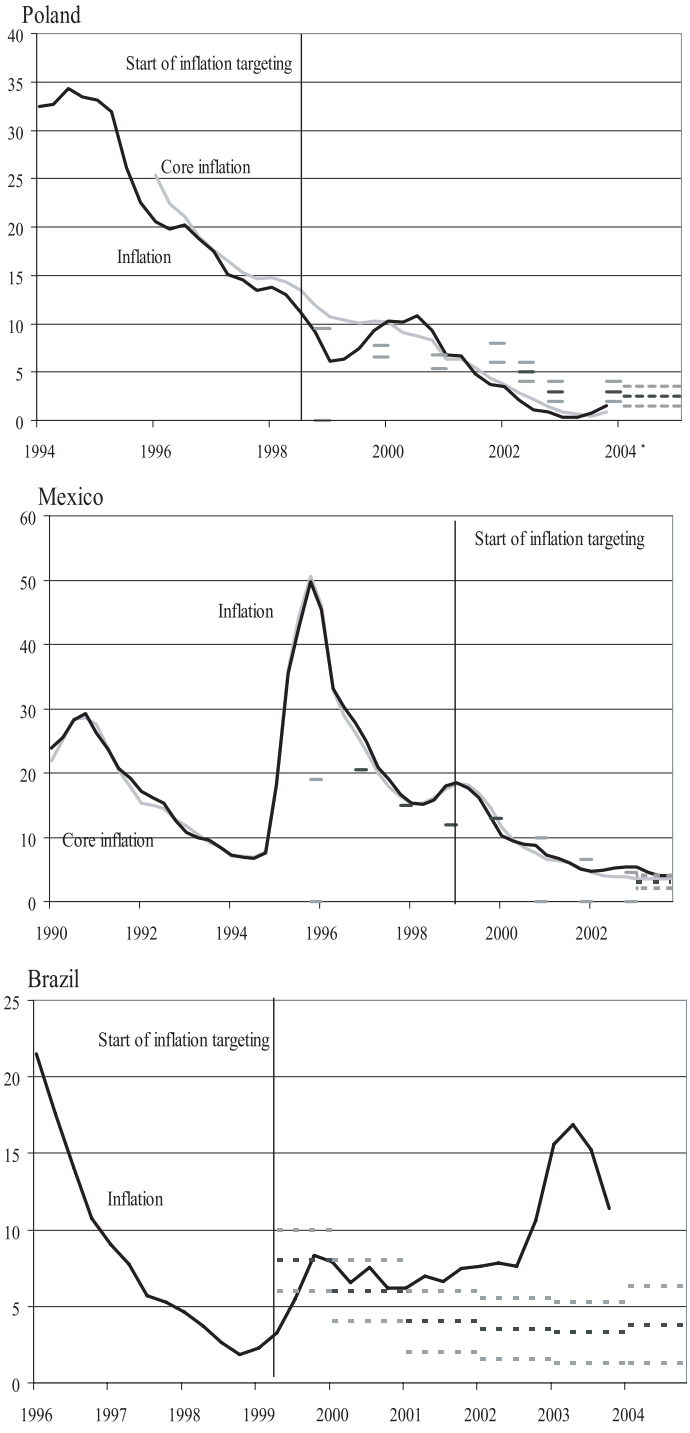
2003
2005


Poland
Start of inflation targeting
Core inflation
Inflation
40
35
30
25
20
15
10
5
0
1994
1996
1998
2000
2002
2004 *
Mexico
Start of inflation targeting
Inflation
Core inflation
60
50
40
30
20
10
0
1990
1992
1994
1996
1998
2000
2002
Brazil
Start of inflation targeting
Inflation
25
20
15
10
5
0
1996
1997
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2004


Colombia
Start of inflation targeting
Inflation
35
30
25
20
15
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5
0
1985
1987
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1991
1993
1995
1997
1999
2001
2003
2005
Switzerland
Start of inflation targeting
Inflation
Core inflation
7
6
5
4
3
2
1
0
-1
1985
1987
1989
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South Africa
Start of inflation targeting
Inflation
Core inflation
25
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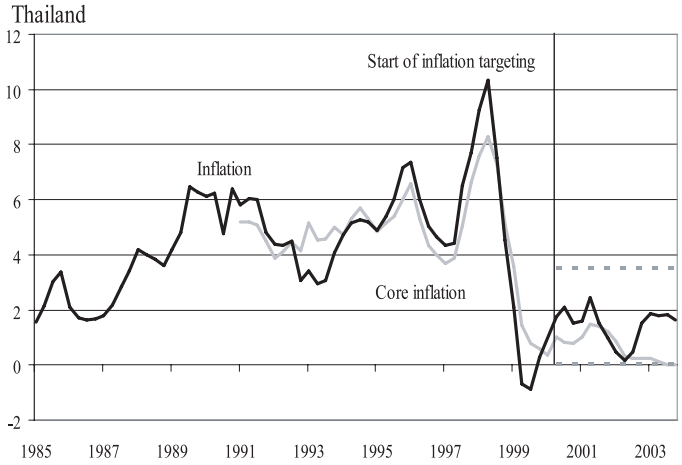
Thailand
Start of inflation targeting
Inflation
Core inflation
12
10
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1985
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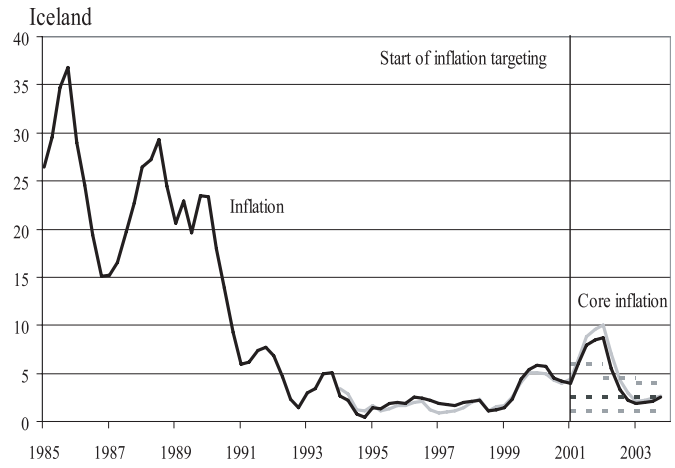
Iceland
Start of inflation targeting
Inflation
Core inflation
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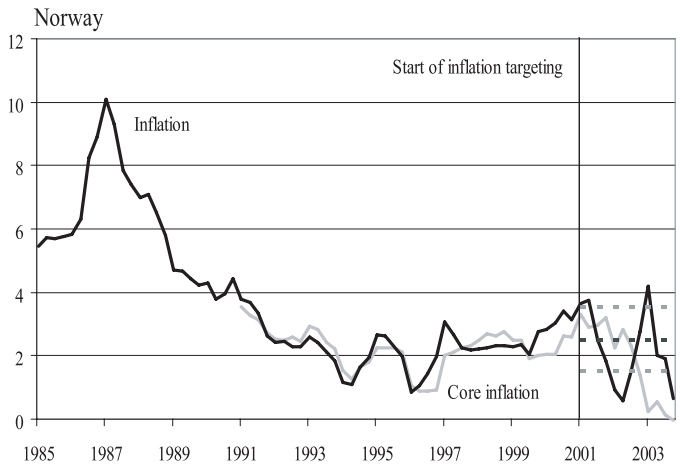
Norway
Start of inflation targeting
Inflation
Core inflation
12
10
8
6
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1985
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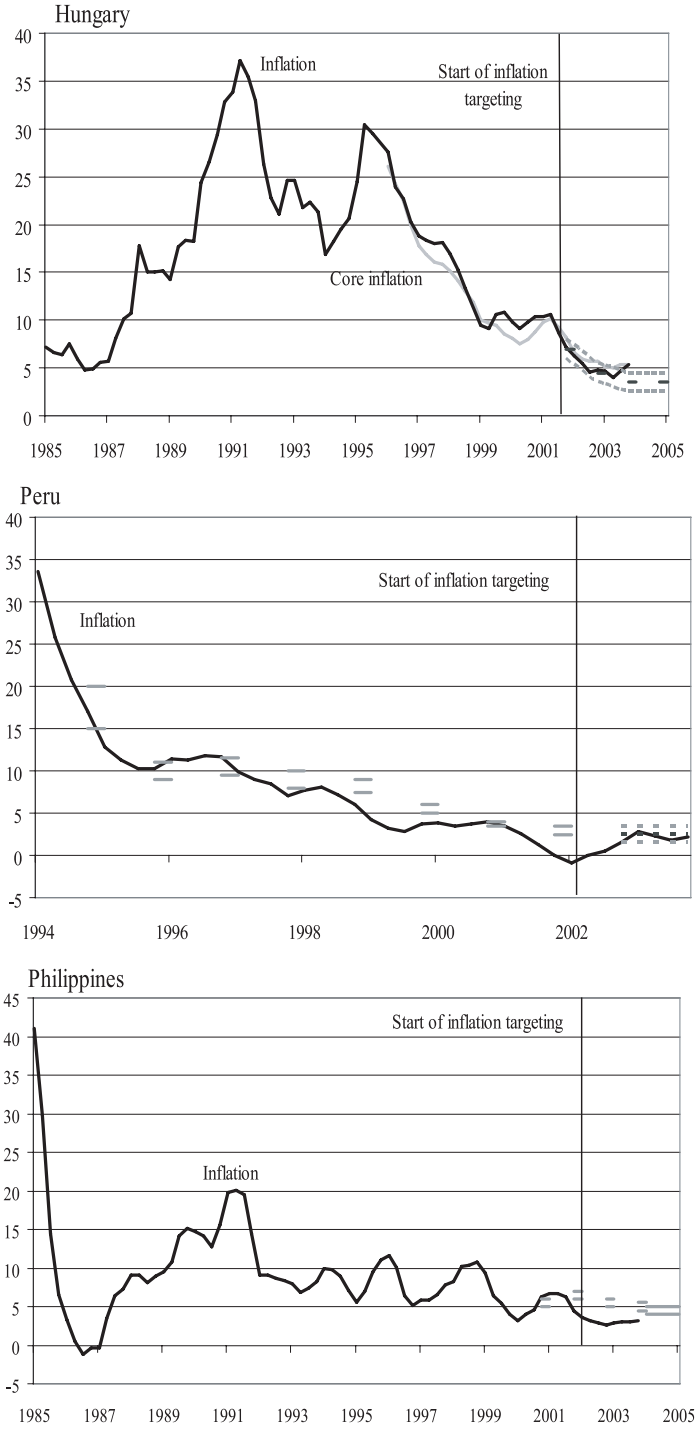
Hungary
Inflation
Start of inflation targeting
Core inflation
40
35
30
25
20
15
10
5
0
1985
1987
1989
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1993
1995
1997
1999
2001
2003
2005
Peru
Start of inflation targeting
Inflation
40
35
30
25
20
15
10
5
0
-5
1994
1996
1998
2000
2002
Philippines
Start of inflation targeting
Inflation
45
40
35
30
25
20
15
10
5
0
-5
1985
1987
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