Does the Adoption of Inflation Targets Affect Central Bank Behaviour?*

ALVARO ALMEIDA and CHARLES A.E. GOODHART

1. Introduction

Perhaps both the most difficult, and the most crucial, decision for a study of how those central banks which have adopted inflation targets have fared is to decide which central banks to include within the chosen set. Nowadays almost all central banks make price stability their main objective. Price stability is regarded, for this policy purpose, as a low rate of inflation,[1] low enough to prevent agents consciously factoring in expectations of future inflation into their price/wage setting decisions. Consequently virtually *all* central banks have an inflation target, though this may be unquantified and implicit rather than quantified and explicit. Our objective in this paper is not to discuss the adoption of price stability as the main objective for monetary policy, but to examine the implications of publicly announcing and making this objective explicit and precise. An explicitly numerically quantified inflation target is one feature that is common to all Inflation Targeting (IT) countries, but not unique to this group. Several non-IT

□ London School of Economics, Department of Economics, London (Great Britain) and Faculdade de Economia do Porto, Porto (Portugal).

London School of Economics, Financial Markets Group, London (Great Britain).

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[1] The alternative of adopting a target for the *price level* has been discussed by economists in several theoretical contributions, e.g. Fischer (1994), Goodhart (1994), McCallum (1995), but has not yet been considered a serious practical possibility by central banks. See Subsection 2.2 on this issue.

countries also publicly report a numerical value for the inflation rate which they are seeking to achieve at some future date (e.g. France, Italy or Portugal).

What does seem to be somewhat more distinct among IT countries is that there is no other specified, numerically quantified, intermediate target,[2] such as a monetary or an exchange rate target, the achievement of which is treated as a means of achieving the inflation target. But any dividing lines between IT and non-IT central banks remain fuzzy. For example, as we discuss in Subsection 2.3, the distinction between the role of the concurrent rate of monetary expansion on the monetary policy decisions in Spain and Germany is not that large. In both countries policy decisions are based on a wide set of indicators, with the growth of a money aggregate having a privileged role. The situation is, perhaps, even more indistinct with respect to exchange rates. In all the IT countries, variations in the exchange rate are perceived as having an important influence on future inflation, as we discuss in Subsection 2.4.1, although it is not regarded as a target in its own right. Nevertheless, given the inflation target, comfort zones for the exchange rate can be internally defined, and monetary policy could be based on those 'targets'. By comparison, the central banks in Latin America (e.g. Chile, Colombia, Mexico) generally combine both an exchange rate operating target and an inflation objective. But in these cases, the key operational decisions are primarily driven by the exchange rate target rather than the attempt to achieve a numerically specified inflation objective (see Masson, Savastano and Sharma 1997).

The most problematical case is that of Israel which combines an intermediate exchange rate objective (a crawling peg) with an explicit numerically quantified inflation target. In their conference on experiences with IT, which the Bank of England hosted in March 1995 (the proceedings of which can be found in Haldane 1995a), Israel was included as an IT country. We believe, however, that Israel should be included, with the Latin American countries, as primarily operating on the basis of an intermediate exchange rate target. Although increased importance has been attached to the targeting of inflation in

[2] The USA has no other intermediate targets either, but it is not regarded as an IT country. It has no explicitly quantified, numerical target for inflation, and is currently required (by Act of Congress) to take into consideration several other objectives besides price stability.

the last four years, the existence of an announced crawling band may sometimes force the central bank to take policy actions which are only triggered by exchange rate developments and are not related to inflation concerns, as it would happen in a pure IT country, but the distinction is fine.[3]

Our set of IT countries is the same as that adopted by the Bank of England, apart from Israel, which we exclude from our group, and the one adopted by the Bank for International Settlements, and includes Australia, Canada, Finland (until October 1996),[4] New Zealand, Spain, Sweden and the UK. What distinguishes this group from other countries where price stability is the sole objective of monetary policy is that there is an *official commitment* from the monetary authorities to achieve a *clearly defined*, numerically quantified, target for inflation,[5] together with the absence of any other intermediate target.[6] In the IT countries policy changes are usually explained and justified as caused by prospective movements in inflation, for which prior monetary or exchange rate movements will often be a prime explanation, whereas in the non-IT countries, policy decisions will normally be explained and justified in terms of the rate of growth of

[3] Israel will probably become an IT country, even according to our strict definition, since the relative importance of the inflation target and the exchange rate target has been changing in favour of the former. Since mid-1995 the width of the crawling band was enlarged and the exchange rate has been allowed to move more freely within the band, thus reducing the role of short-term exchange rate concerns in shaping monetary policy. The role of the exchange rate targets and inflation targets in the monetary policy of Israel is discussed, for example, in Ben-Bassat (1995).

[4] In October 1996 the Finnish markka joined the European Exchange Rate Mechanism (ERM) in preparation for becoming one of the initial participants in the euro in January 1999. Although it was announced that the inflation target of 2% would not be affected "under favourable conditions", at that time the President of the central bank clearly stated that the exchange rate would assume increasing importance in the conduct of monetary policy, with precedence over any other objective (Bank of Finland 1996, pp. 3-8). So Finland then ceased to meet our definition of an IT country.

[5] Although we chose this sample in part because we thought that these countries had clearly defined targets, after investigation we realized that, at least in some of them, the targets are somewhat less precise than we had initially believed. Still, the definition of the targets in the sample countries is more precise than in non-IT countries, where the policy objective is defined as 'price stability' with few details of what is meant by that.

[6] After completion of the first draft, we came across a paper by Svensson (1996) where the set of countries described as having an IT framework is the same as ours, and where the description of the characteristics of the IT framework is similar to our own.

some intermediate monetary target or some change in the exchange rate, unless there are good grounds for believing that these are not giving a reasonable prediction for future inflation.

The existence of an explicit and precise IT, instead of a simple reference to price stability being the objective of policy, provides an anchor for inflation expectations and helps to make the monetary authorities more accountable.[7] All of the countries in our sample have recently been granted greater independence from government for determining interest rates.[8] Unless there is an operational exchange rate target (and it is dubious whether the wide band ERM in being since August 1993 necessarily represents an operational target), or an unusually well-behaved demand-for-money (velocity) function, then the grant to central banks of greater independence to vary interest rates ('instrument independence' as defined by Fischer 1994) has usually in the last few years been accompanied by the acceptance by the central bank of a more transparent, and numerically quantified, inflation target. The exception to that may be the prospective European Central Bank, though it is still possible that it may set such a quantified inflation target for itself. The absence, in the Maastricht Treaty, of any requirement for such transparency and hence accountability has been criticized (Goodhart 1991 and 1992, Kenen 1992 and Cukierman 1995).

Another difficult choice we had to make regarded the dates of introduction of IT in the countries in our sample. It is hard to assign a specific date to changes in policy frameworks, especially for inflation targeting, given the similarities between inflation targeting and other frameworks where price stability is the objective of policy. This is a problem similar to the choice of countries to include in the IT set, and the reasons behind our choice of dates are the same as for our choice of countries. Our emphasis is on the existence of an official *explicit* commitment from the monetary authorities to achieve a *precisely defined*, numerically quantified, target for inflation. Thus, we

[7] The argument for adopting an explicit IT is discussed in Subsection 2.1.

[8] In the UK this occurred in two steps. While there was a move in that direction in 1992/93, the formal decision to alter interest rates remained with the Chancellor until May 1997. Then, after the election of the Labour government, the incoming Chancellor transferred autonomy to vary interest rates to the Monetary Policy Committee of the Bank of England, a committee consisting (after an initial transition period) of five bank officials and four independent outside experts. Briault, Haldane and King (1996) discuss why there has been a general move towards more central bank independence in recent years.

took the date of introduction of IT to be the date of the official announcement of the commitment to achieve a precisely defined target. According to this criterion, the dates of the announcements of inflation targets were as follows:

Australia	1993[9]
Canada	1991, February 26[10]
Finland	1993, February 2
New Zealand	1990, March 2[11]
Spain	1995, January 1[12]
Sweden	1993, January 15
UK	1992, October 8

Policy frameworks are not changed in one day, and it is likely that some central banks were already behaving as IT, even before the official announcement of the target. Furthermore, giving the usually long policy lags, some of the observed performance of IT countries must reflect monetary policies that were in place before the adoption of IT. These problems should be taken into consideration when ana-

[9] It is difficult to determine precisely the date of the announcement of IT in Australia. Initially the central bank unilaterally adopted a quantified numerical IT without the involvement or blessing of the government. Subsequently, however, Ministers came to speak approvingly of this initiative, and with a Labour government having thus consented to it, and the new Liberal government also in favour, IT in Australia can be viewed as firmly established. For the exercises that require the use of the announcement date, we assumed it to be 1/1/1993.

[10] This is the date of the joint announcement of the inflation-reduction targets by the government, as part of its annual budget presentation, and the Bank of Canada, through a press release. Although the Governor of the Bank of Canada, John Crow, had been publicly stressing for some time (at least since his Hansen Lecture of 1988) that price stability was the monetary policy objective, we believe these statements do not represent the sort of official commitment to a precisely defined target that we take to be the characteristic of IT countries.

[11] This is the date the first Policy Targets Agreement (PTA) between the Reserve Bank of New Zealand and the government was signed. Since April 1988, the Minister of Finance, Roger Douglas, and the Associate Minister of Finance, Peter Neilson (the Ministry of Finance was then responsible for monetary policy) had been making several statements stressing the government's intention of bringing inflation down to very low levels. Again, as in the case of Canada, we believe that these statements do not fulfil the characteristics of an IT as we define it, and that only after the signing of the first PTA New Zealand had an official commitment to achieve a precisely defined target.

[12] In Spain, the IT was announced in December 1994, but was formally adopted as of January 1, 1995.

lysing the results of our exercises that involve the use of the announcement dates.

Our chosen set of countries is small, and they have only adopted IT for a short period. Since our data period ends in most cases at the end of 1996 (in some cases in 1997), it is far too short a period to make any robust claims about the effectiveness of IT, as McCallum (1995) also emphasized in his recent review article on IT. Nonetheless such is the interest in this subject that we could not resist making such attempts.

One of the major problems is that the last few years have been characterized by a special worldwide set of conditions (themselves no doubt partly reflecting the shift of emphasis in monetary policies in many countries). Among these conditions have been a rapid decline in inflation to low levels, which was generally sharper than forecast either by central banks or private sector commentators, and in many, but not all, countries a further increase in unemployment. So, by comparison with their own earlier history, IT countries may be assessed as having been *a*) successful with their prime aim of reducing inflation, *b*) congenitally likely to exaggerate the future likelihood of a resurgent inflation, and *c*) having only achieved low inflation by higher unemployment. But all these phenomena may result more from the international context, rather than from any special particularities resulting from the adoption of IT itself.

In order to try to guard against such problems we have, in various exercises, tried to compare the results of the IT countries against those from a set of comparable countries. But which countries might be comparable? All our set of IT countries were industrialized OECD countries, so we restricted our comparator group to that set. Most of our IT countries started with middling inflation rates; so we chose as comparator countries those with roughly similar initial inflation rates.[13] Nevertheless, such a choice is always problematical so we chose four, overlapping, non-IT control groups. The first two groups consisted of countries with similar inflation levels in the Eighties (one is composed of 5 and the other of 7 countries), the third consisted of 5 countries with similar inflation levels in the period 1987-92, and the

[13] We regard this as an important criterion. Countries that had low inflation at the outset, e.g. Germany, may find it hard to improve on their performance; while the experience of initially high inflation countries may be startlingly good, or bad, and in either case bias the conclusions.

fourth is composed by 7 countries that we subjectively chose as facing similar economic environments as the IT countries.

But one cannot make a silk purse out of a sow's ear. Our selected set of IT countries is small, and the selection process debatable. So is the selection of a control group. The number of years in which the central banks have been applying IT is very small, and these years had some special worldwide characteristics. Given the lack of data, the results are likely to be sensitive to the empirical methods used. It is far too soon to reach any robust, statistically significant conclusions about the effects of that choice on the macroeconomic outcome.

Where it may be somewhat easier, at least in some matters, to establish whether the adoption of IT made a major difference is with respect to its influence on the behaviour of the central banks themselves. The adoption of a numerically quantified IT makes the comparative success, or failure, of a central bank more transparent. But the lengthy lags in the effect of interest rates on nominal incomes and on inflation make it necessary to adjust interest rates *now* to *forecast* future inflation, if there is to be much hope of controlling inflation to the desired degree of accuracy. With the central bank now also having greater responsibility for adjusting domestic interest rates, the shift to IT is likely to bring with it the need for revised and expanded communications, with both government and public, about both inflation forecasts and current actions. Moreover, there are some instances where the upwards shock to inflation comes from the supply rather than from the demand side.[14] In general the central bank should *not* seek to offset the first-round effect of that. How easily, if at all, can the central bank not only follow that precept, but also communicate it to the general public?

Large interest changes (especially if upwards) are not only unpopular but may also be destabilizing to the economy and to the financial system. Moreover, any reversals of direction of interest rate changes within any short period (e.g. up, then down) may give an appearance of vacillation in policy and uncertainty in approach. Whether for these, or other, reasons central banks have typically smoothed interest rate adjustments, i.e. they tend to make a consecu-

[14] The existence of continuing supply-side shocks is taken as axiomatic in much of the literature on central bank independence. With the important exception of the various oil shocks, it is less clear how large or frequent such supply-side shocks have been in practice.

tive series of some six, or so, small adjustments (of about 0.5% each typically) in discount (base) rates over a period lasting several quarters, rather than fewer, larger adjustments (see Rudebusch 1995 and Goodhart 1996). This syndrome has been criticized as 'too little, too late', and resulting in strong auto-correlation in inflation. Since the objectives of IT have been, as we shall demonstrate, demanding both in terms of level and permitted range of fluctuation (between the bands), has this caused any difference either to central bank's operating techniques or reaction functions? In particular, is there any evidence among IT countries that they have varied interest rates earlier or in larger steps than in the past?

Our main focus is, therefore, on whether and how the adoption of IT may have affected the behaviour of those central banks. This will, we believe, represent our main contribution. In order to obtain more information and understanding, especially on this aspect of the behaviour of IT central banks, we wrote to them in January 1996, and we received full, frank and helpful replies. (In view of subsequent events, e.g. in the UK in May 1997, we have updated this material for some countries.) We are particularly grateful to these senior officials for being so patient, courteous and helpful. Much of the body of this paper could only have been undertaken with their assistance.

2. The execution of monetary policy

2.1. *Reasons behind the adoption of inflation targets*

The adoption of IT has usually followed the recognition of the failure of the previous monetary policy framework. This is obvious in the cases of the UK, Sweden and Finland, where IT was adopted just after the collapse of the fixed exchange rate regimes.[15] The adoption of IT in Spain, although it followed the granting of autonomy to the central bank, also reflected some disappointment with the use of both monetary aggregates and the exchange rate as an intermediate target (following the 1992/93 ERM crisis and consequent widening of the fluctuation bands). In Canada, New Zealand and Australia, the adoption of IT followed a period of discretionary monetary policy, where no explicit and quantified target was used, a framework that was generally judged to have been unsatisfactory and was only implemented in the absence of a better alternative.[16]

[15] The Finnish markka and the British pound were floated in September 1992, the Swedish krona in November 1992, and IT was adopted in October 1992, January 1993 and February 1993, respectively in the UK, Sweden and Finland.

Given the differences in the monetary policy frameworks previously in place, we should expect the observed effects of the adoption of IT in the behaviour of the central banks in our sample to be substantially different for European and non-European central banks. The transition from a fixed exchange rate regime to a floating exchange rate regime implies, by itself, substantial changes in the execution of monetary policy. For the European countries in our sample, the adoption of an IT coincided with such a regime switch. Thus, we cannot separate empirically the changes in behaviour caused by the change in exchange rate regime and the adoption of IT. This is not the case for the non-European countries, where the adoption of an IT was not accompanied by any other major change in the monetary policy framework. In the following analysis, such differences between the two groups should be kept in mind.

The adoption of IT can be seen, in all the countries in our sample, as an alternative to discretionary monetary policy, in an environment where the use of exchange rates or money aggregates as intermediate targets is thought to be unsatisfactory. The official statements made at the time of the adoption of IT usually advance two arguments for the abandonment of a discretionary monetary policy: the need to provide an anchor for inflation expectations and the need to make the central bank[17] more accountable. The private sector cannot understand fully the stance and the consequences of a discretionary monetary policy, nor can they anticipate correctly the actions of the central bank. In this situation, the formation of inflation expectations becomes a complicated process, and uncertainty about future inflation is much higher than in a framework where a credible IT has been previously set. Also, under a discretionary monetary policy it is diffi-

[16] New Zealand had abandoned exchange rate targets in 1985. Monetary targets were used in Australia (from 1976 to 1985) and Canada (from 1975 to 1982), but were abandoned because they were not considered to be reliable indicators of policy.

[17] Or, in the UK case, until May 1997, the Chancellor, who was ultimately responsible for monetary policy.

cult to evaluate the performance of the central bank, since there are no clear and easy to verify benchmarks against which the performance can be compared. An explicitly and precisely set IT provides such a benchmark, thus making the central bank more publicly accountable.

Where the accountability of the monetary policy decision process was an important reason for the adoption of IT, such targets were set as the outcome of an agreement between the central bank and the government (in New Zealand and Canada) or by the government, acting unilaterally (in the UK). Where the main concern was to provide an anchor for inflation expectations, the IT was set unilaterally by the central bank, although in some cases these targets were later endorsed by the government (as happened in Australia, Finland and Spain). The fact that the IT is announced jointly by the central bank and the government may enhance the credibility of the target, as long as the joint announcement implies a commitment by one party, the agent, which is monitored by the other, the principal, especially if the agent deciding on monetary policy suffers an effective penalty if targets are not met.[18]

The first reason why a joint commitment could be credibility-enhancing is that in some countries budgetary measures may be necessary to help control inflation and inflation expectations. Where fiscal problems were one of the main causes of the past inflationary pressures, and high stocks of public debt can raise the spectre of the government eventually forcing a partial monetization of the debt, low inflation can only be a credible target if measures to reduce the budget deficit are put in place. A strong commitment from both the government and the central bank to an inflation target reinforces the likelihood that the targets will be achieved, if this joint commitment can be interpreted as a sign of monetary and fiscal policy coordination.

The other reason one could expect higher credibility from a joint commitment is the fact that as long as the right incentives are in place,[19] the external monitoring may play the role of a 'precommitment technology' that could overcome the 'time-inconsistency' problem of monetary policy, as described in Kydland and Prescott (1977) and Barro and Gordon (1983a). For central banks who unilaterally set the IT, there are few effective sanctions. A central bank Governor missing a pre-stated target is unlikely to sanction himself, though he might face public obloquy. Even if a government was secretly happy with faster monetary expansion (than the target would imply),[20] the fact of missing a published target to which the government had set its name will give rise to demands for it to respond; sacking, or fining, the Governor will be relatively painless for the government itself (in most cases). Also, a joint announcement is more likely to be realistic: knowing that it may be held accountable for missing it, the central bank will not accept the over-optimistic targets politicians tend to set.

The only incentive to stick to the target central banks who unilaterally set their target have, is the effect on their long-term reputa-

[18] Walsh (1995) and Persson and Tabellini (1993) show that an adequate incentive contract for central bankers may eliminate any inflationary bias they may have. The monitoring and associated penalties could be seen as such an incentive contract.

[19] In New Zealand, the central bank Governor may be dismissed if the inflation targets defined in the PTA, signed between the central bank and the government, are not met. Here the incentives to achieve the target are apparently high, since there are explicit sanctions for failures. In 1995 and 1996 the objective, the underlying Consumer Price Index (CPI), exceeded the target (then 0-2%) and this led the Governor to tender his resignation in 1996, but it was refused. Subsequently, following the election of a coalition government, the band was widened to 0-3%.

In Canada and the UK there are no pre-set sanctions, but the fact that one party publicly monitors the performance of the other may constitute a sufficient incentive. In the UK the Chancellor was responsible for monetary policy until May 1997, and the Bank of England then monitored the inflation performance: if targets were not met, the Bank of England publicly announced it, and this could have harmed the government politically. From May 1997 onwards, the tables were reversed. The Monetary Policy Committee (MPC) of the Bank of England became responsible for achieving the inflation target, set as 2.5% for RPIX on a continuous basis. [There are three main definitions of the RPI, headline RPI, RPIX excluding the effect of interest rates on the index, and the RIPY excluding the effect of both interest rates and indirects taxes.] If, and when, RPIX diverges from this target by more than 1% on either side, the MPC is required to write a letter to the Chancellor explaining why this has happened and outlining its intentions for restoring inflation to target. As King (1997, p. 441) remarked "Given past experience of inflation volatility, it is likely, even allowing for the change in policy regime, that the MPC will have many opportunities to restore the lost art of letter-writing to British life".

In Canada, the fact that an explicit target set by the government is missed may be used as a political argument not to reappoint a central bank Governor the government dislikes; if the targets are met, the non reappointment of a Governor that achieved the targets the government itself has set might be politically difficult to explain. The incentives to stick to the target exist in the three countries, although it may be argued that they are not strong enough to make the IT fully credible.

[20] The inflationary bias of politicians was one of the main arguments the *Roll Committee Report* (1993, Subsections 2.5 and 3.3) advanced against joint targets.

tion of missing (or constantly changing) it.[21] If their track record on inflation, before the adoption of IT, is not very good, their current reputation will be low, and losing it would not be a very serious problem. Only after the central bank has established a track record by meeting the targets for a reasonably long period, will the inflation target become credible, since only then will the damage to the reputation of reneging the announced targets have a significant cost. Rogoff (1985) suggested that if the central bank is independent from the government, and the central bank Governor is 'conservative', i.e. places a higher relative weight upon inflation stabilization, the 'time-inconsistency' problem may disappear. Thus, it could be argued that an IT announced by an independent central bank could be as credible as a joint commitment. The adoption of IT in the countries in our sample has been associated with changes to, or attempts to change, the legal framework of the central bank to make it more independent (although in the case of the UK, the adoption of IT in 1992 preceded the grant of greater autonomy to the MPC of the Bank of England in May 1997, and the passage of the associated Bank of England Act in 1998). However, even in the case of an independent central bank the credibility of the IT will not be as high as in the joint announcement with sanctions case:[22] first, because legal independence does not necessarily mean actual independence; second, because an independent central banker is not necessarily the same as a 'conservative' central banker.[23] To repeat, only after a reasonably long period of proving that the central bank is actually independent and the Governor is 'conservative' will the IT become credible. Making the central bank independent does not eliminate the need for reputation building.

[21] Reputational solutions for the time-inconsistency problem may be found, for example, in Barro and Gordon (1983b).

[22] Note that the argument for joint announcements only holds if the central bank is effectively independent from the government. If this is not the case, government and central bank are the same entity in terms of decision power, and in this case a joint announcement is in fact a unilateral announcement.

[23] Mexico provides an example of a central bank to which formal independence has been granted, but is perceived to be not completely independent from the government. Russia provides an example of an independent central bank that was less 'conservative' than the government: under Governor Gerashchenko, the monetary policy in Russia was highly inflationary, much more than the Yeltsin government desired.

Only the existence of external monitoring associated with an appropriate incentive scheme may have a short-term effect on credibility.

The issue discussed in the paragraphs above refers to what Andersson and Berg (1995) call "operational credibility" of IT, i.e. the likelihood that the IT will effectively be met, given the current institutional framework, which they distinguish from the "political credibility" of IT, i.e. the likelihood of a regime shift, where the current framework may be replaced by another not favouring price stability. 'Political credibility', *inter alia*, depends on the size of public debt and current budget deficits (as incentives to generate inflation in the future), but it depends above all of the support given to the IT framework by the political opposition. Any legislative framework favouring price stability introduced by one government may be reversed by future governments. If the opposition political parties are against the IT, the long-term credibility of the framework is seriously affected.[24] Only an IT endorsed by the current government and by all the opposition political parties that are likely to become (part of) the government in the medium term may be credible, and varying degrees of support by opposition parties is likely to be reflected in empirically observed varying degrees of credibility.[25]

[24] Svensson (1995) and Andersson and Berg (1995) argue that in the case of Sweden the main problem was of 'political credibility', especially before the elections of September 1994. The opposition social-democrats were against the IT, and they were expected to change the Riksbank board (and adopt inflationary policies) if they would win the elections, as they eventually did. After the election the social-democrats surprised observers by appointing an independent chairman to the board, who reinforced the IT as the monetary policy objective. Ammer and Freeman (1994) refer to similar doubts about the medium-term permanence of the IT before the 1993 elections in Canada. The 'political credibility' of the New Zealand IT was also affected in 1995 by calls to abandon the PTA framework by two opposition parties. After the election there in 1996 there was some uncertainty whether one of the parties in the new coalition government (New Zealand First) would accept continuation of IT. In the event the regime was extended, subject to a 1% widening of the band, a reform which many had felt to be technically desirable in any case. In the UK, the previous Conservative Chancellor, Ken Clarke, publicly opposed giving greater autonomy to the Bank in May 1997, but the position of the Conservative Party, as a whole on this issue has remained (at least at the time of writing at end 1997) unclear and probably divided.

[25] Evidence regarding the credibility of IT is presented below in Section 4.

2.2. *Choice of target*

An IT must be credible, to provide a good anchor for inflation expectations. This implies that it should be stated in a simple and clear way, and it has to be feasible. It must be flexible, in the sense that it should allow for monetary policy to accommodate some unexpected (supply) shocks and to adjust to changing economic environments. It must be easily verifiable, to make the central bank accountable. These desirable characteristics of an optimal IT restrict the choice of each central bank, but there is still some scope for differences. Box A compares the targets adopted by the countries in our sample, and the main trade-offs are briefly discussed below.

When defining an IT, the first choice to be made is which price index is going to be targeted. All central banks in our sample target consumer price inflation. The CPI is the best known and most commonly used (e.g. in wage negotiations) measure of inflation. It also has some technical advantages, like being promptly released and seldom revised. The impact on expectations and credibility of such a measure of inflation should be greater than alternative measures that rely on complex statistical treatment or are released with a considerable lag, like the GDP deflator.

Box A
DESIGN OF INFLATION TARGETS

Australia	
Index:	underlying CPI (excluding fruit and vegetables, petrol, interest costs, public sector prices and other volatile prices).
Caveats:	none.
Target:	2-3% on average.
Horizon:	immediate.
Canada	
Index:	CPI (underlying CPI – excluding food, energy and first round effects of indirect taxes – is used as the base for policy decisions).
Caveats:	large increases in oil prices, natural disasters.
Target:	2% ± 1%.
Horizon:	1995-98 (new target to be set by 1998).
Finland	
Index:	underlying CPI (excluding effects of taxes, subsidies and housing related capital costs).
Caveats:	none.
Target:	around 2%.
Horizon:	from 1995 (until effectively terminated in October 1996).

New Zealand	
Index:	CPI.
Caveats:	significant changes in indirect taxes or government charges, significant changes in import or export prices, interest costs, natural disasters (in practice, the target is an underlying CPI index, calculated by the Reserve Bank of New Zealand as the CPI modified by the caveats).
Target:	0-3% (since December 1996; previously 0-2%).
Horizon:	to the end of Governor's term.[1]
Spain	
Index:	CPI.
Caveats:	only generic caveats (e.g. role of fiscal policy and wage behaviour).
Target:	2%.
Horizon:	from 1998.
Sweden	
Index:	CPI.
Caveats:	none.
Target:	2% ± 1%.
Horizon:	from 1995.
UK	
Index:	RPIX (RPI excluding mortgage interest payments).
Caveats:	effects of indirect taxes and subsidies and interest costs.
Target:	2.5% (an explanatory letter has to be written when deviation from target is ±1%).
Horizon:	indefinitely until revised by the Chancellor of the Exchequer, which revision can be made at any time.

[1] The description of the New Zealand target refers to the situation as of November 1997. Following the announcement of the reappointment of the Governor for a further term of office to 31 August 2003, a new PTA was signed on 15 December 1997. This PTA extends the 0-3% target out to the expiry of the Governor's next term. It also changes the formal target from the CPI (headline inflation) to the CPI excluding the credit services component (CPIX). The Reserve Bank of New Zealand (RBNZ) has subsequently announced that it will cease calculating underlying inflation, and instead will use CPIX as the only target measure. It also will explain the effects of shocks on the CPIX measure, rather than adjust the target measure itself for the effect of those shocks.

However, the headline CPI is affected by a number of shocks that cannot be controlled by monetary policy, and do not reflect the underlying inflationary pressures the central bank should be worrying about. Changes in indirect taxes or subsidies are not usually related to inflationary pressures, but can have a significant (short-run) impact in the CPI. When the CPI includes interest related costs, it responds perversely to monetary policy changes: a tightening of policy

in reaction to rising inflation will imply higher interest costs, and thus even higher CPI. Some supply side shocks that raise inflation and lower output (like large changes in commodity prices or natural disasters) should be accommodated, to avoid the adverse implications for real activity of a restrictive monetary policy.[26] A flexible monetary policy, able to adjust efficiently to these problems, should be based on a target expressed in terms of some measure of underlying inflation that would exclude the effects of this type of shocks. The problem with the underlying CPI is that usually it does not have similar desirable features of statistical simplicity and general acceptability as the headline CPI. Thus, a target expressed in terms of underlying CPI tends to have a smaller impact on expectations. The alternative is to set the target in terms of headline CPI, but to include some escape clause (or caveats) that would justify missing it, in order to allow for some flexibility in monetary policy.

In both solutions mentioned above, transparency and accountability are affected. The performance of the central bank can only be easily verified if the targeted price index is calculated by an independent agency. In our sample, targets based on an underlying CPI are only used by Australia and Finland, and in both countries the underlying CPI targeted is computed by statistics' agencies independent of the central bank, and thus accountability is not jeopardized. The problem is that in most countries even when the statistics' agencies publish some underlying CPI, it seldom excludes all the relevant shocks. In this case, the central bank has to choose between calculating its own index (with the corresponding loss in transparency and credibility) or using the less adequate external index. A similar choice must be made regarding the caveats if the target is set in terms of headline CPI. Transparency suggests that the list of caveats must be precise and exhaustive, but this reduces flexibility, since some shocks are unpredictable, even in nature. It should be stressed, however, that in practice the distinction between headline and underlying CPI targets tends to become blurred. In all the countries where the formal target is based on headline CPI, monetary policy decisions are based

[26] Usual references to supply side shocks are to those increasing inflation, such as the oil price increases of the 70s, but there is no reason to rule out supply side shocks of the opposite sign. The disinflation process of the 90s might be partially explained by such shocks, e.g. the increased retail competition in the UK or the decline in food prices as a result of Finland's EU membership.

in some measure of underlying inflation, not headline inflation. Judging from our sample, it seems that there is no effective choice, and IT have to be set in terms of underlying CPI, since this is the price index monetary policy is best able to control.[27] The only real question arises in the long term, if the two measures exhibit persistent differences.[28] Then, if the target is defined in terms of headline CPI, the operational policy targets for underlying CPI have to be changed so that headline CPI comes within the target range. If the target is defined in terms of underlying CPI, no change is needed, and headline CPI will deviate from the target, but this may have an important impact on inflation expectations.

The design of IT in our sample suggests that central banks believe that monetary policy is able to control underlying inflation but not in a precise and accurate way. The targets are either range targets or point targets that are only supposed to hold on average, and in either case this means the inflation rate is not going to be kept constant at some pre-set level. Some (limited) volatility of the inflation rate will be tolerated since some uncontrollable shocks are likely to affect inflation and monetary policy technology is not considered to be accurate enough to forecast, or bring about, finely calibrated changes in the inflation rate. Where the target range is precisely defined, the usual band width is 2 or 3 percentage points.[29] The optimal band width involves a trade-off between the credibility-enhancing effects of choosing a demanding target and achieving it, and the credibility-

[27] See Section 3 on the controllability of inflation.

[28] Underlying inflation is supposed to capture the fundamental trends in headline inflation, and deviations between the two indices are usually assumed to be temporary, but this is not necessarily true. Yates (1995) presents some evidence (although not conclusive) that different price indices in the UK are not directly substitutable even in the long term (although they cointegrate).

[29] In Finland and Spain the target ranges were not precisely defined. In both countries the 2% target should be interpreted as the mid-point of a soft-edged band; the Bank of Finland explicitly stated that deviations on both sides would be allowed, but no explicit toleration ranges were specified. The target for Australia should be interpreted as a 'thick' point rather than a range. In the UK, from May 1997, only the mid-point target is defined, and the MPC is required to write an explanatory letter whenever RPIX diverges more than 1% from this. However, as King (1997) emphasized, "The inflation target is not a range of 1.5% to 3.5%, it is a target of 2.5% on average. Indeed, one of the main purposes of the open letters is to explain why, in some circumstances, it would be wrong to try to bring inflation back to target too quickly. In other words, the MPC will be forced to reveal in public its proposed reaction to large shocks".

damaging effects of missing it (Goodhart and Viñals 1994). This would suggest that central banks that need to build a reputation should choose narrow range targets, whilst more credible central banks may opt for wider bands. A highly credible central bank could even set a soft-edged band, similar to Finland's, where only the mid-point is defined and no explicit deviation ranges are set.[30] The choice of 2 percentage point bands seems to reflect a preference for credibility-enhancing narrow bands. If so, the question is whether monetary policy is precise enough to achieve an inflation level inside such a band. In Section 3 we discuss this issue in the light of the outcomes of monetary policy prior to the adoption of IT and the *ex post* success of the central banks in our sample in achieving their targets.

A common feature in our sample is the absence of price level targets. Price level targets reduce the uncertainty about the future price level, but are more restrictive since they imply that high inflation in one period must be compensated by low inflation next period. Also, since price levels are permanently affected by supply side shocks they are less flexible in accommodating those shocks. Central banks in our sample may have opted for price change (i.e. inflation) targets because they prefer to have more policy flexibility (even at the cost of higher uncertainty), but it could also be that they decided to go one step at a time. The new monetary framework was tried first with the less restrictive version of price change targets, instead of going straight to the stronger version of targeting price levels. If this was the case, we might expect to see some of them adopting price level targets some time in the future. But although there are no price level targets, there are point targets for inflation that should hold on average, as in Australia.[31] This kind of target might be interpreted as (moving) price level targets, since both have the same effects in terms of reducing uncertainty about the future price level. Setting an average inflation rate of 2% strictly means setting the future price level at any point in time,

[30] It is arguable, however, whether its high credibility was the reason behind the Bank of Finland's choice, given the country's inflation history and substantial depreciation of the markka at the time of the adoption of their point target. The single figure was preferred since it was considered that it would provide a better guide for the formation of inflation expectations (Brunila and Lahdenperä 1995, p. 129).

[31] Economists at the Bank of England (e.g. King 1996) also interpreted the UK target, pre-May 1997, as a point target that should hold on average, together with an indication of the range within which *ex post* inflation might be expected to lie if policy was directed at this point.

if 'average' means that an inflation rate of 3% in one period implies a rate of 1% in the next period. We are doubtful, however, whether average targets should be interpreted so strictly. In the event bygone misses are unlikely to be compensated by an (over) correction on the other side of the 'average'.

The adoption of IT reflects the view that price stability should be the only (medium- and long-term) objective of monetary policy. However, price stability does not necessarily mean a zero inflation rate.[32] In fact, for all the countries in our sample, the target is a positive rate of inflation, although small (around 2%). The question of the optimal rate of inflation, and the empirical and theoretical arguments that imply that the optimal rate of inflation is positive, has been extensively discussed.[33] The main theoretical arguments against a zero inflation rate refer to the non-negativity of the real interest rates (the 'Summers effect'),[34] to the existence of downward nominal rigidities

[32] Note that a price level target is not necessarily a constant level target. One may set a target for the price level that is higher than the current price level. In the short run (over one period), there is no fundamental difference between an inflation and a price level target: if the current price level is 100, it is equivalent to set an inflation target of 0-2% or a price level target of 100-102. This is not the case over several periods, since inflation targets allow for base drift, but price level targets do not. If inflation is higher than the inflation target in one period, the price level is permanently affected, since the future inflation targets will refer to the current (higher) price level. This is not the case under a price level target, since too high inflation in one period must be compensated by lower inflation in the following periods. A similar result arises if we use an inflation target that must hold on average, since for the average to hold, high inflation in one period must be compensated by low inflation in the following periods. For example, assume the current price level is 100, and price stability is defined as an inflation rate of 2% per period. If the targets are continuously met, it is (roughly) equivalent to set the targets as *i*) an inflation target that should hold every period, *ii*) an inflation target that should hold on average or *iii*) a price level target. The price level on the second period will be (approximately) 104 in every case. But assume that inflation in the first period is 3%, i.e. the price level is 103. Meeting the targets in the second period implies for target *i*) an inflation rate of 2%, i.e. a price level of 105; for target *ii*) a price level of 104, i.e. an inflation rate of 1%; for target *iii*) an inflation rate of 1% (so that the average is 2%), i.e. a price level of 104. The outcome is the same for targets *ii*) and *iii*), but not for target *i*).

[33] Yates (1995) provides a good review of the discussion.

[34] Summers (1991) pointed out that since nominal interest rates are always non-negative, a zero inflation rate implies that real interest rates must also be non-negative. Summers' argument for a positive inflation rate is that in some circumstances (like in a deep recession), negative real rates of interest might be appropriate. Even if the need for negative real interest rates may be infrequent, they could be very important in those rare cases and should not be ruled out by the adoption of a zero inflation rate.

in the labour and product markets,[35] to the optimal inflation tax,[36] and to bias in measures of consumer price inflation.[37] Of these, the only argument that one can find in the official statements of (some of) the central banks in our sample is the last one.[38] The IT of around 2% is said to reflect the average bias in the CPI caused by the introduction of new goods, the improvement in the quality of existing goods, and changes in consumer demand in response to changes in relative prices for which the measured CPI does not account. Estimates of this bias in different countries, however, suggest that the bias is in the 0.5-1.5% range.[39] Thus, some (or all) of the other arguments may also be behind the choice of a 2% target, although not explicitly stated.[40] Given the likely differences among countries in this statistical bias, and especially in the effects of the other arguments for a positive inflation rate, we find the similarity of the target levels striking. The mid point of the ranges is now between 1.5% and 2.5% for all countries, with the majority concentrating on 2%. We are not aware of any studies quantifying the optimal rate of inflation in each country, supporting *ex ante* the choice of a given target. Perhaps, central banks just assume that 2% is the small positive number that theoretical arguments suggest the optimal rate of inflation should be, or simply chose to target the same inflation level other countries were targeting.[41]

[35] If there is some downward nominal rigidity in the labour market, short-run decreases in the real wage cannot be achieved under zero inflation. In countries where the labour market structure is such that nominal wage cuts are rare (or ruled out by law), a positive rate of inflation may be the less costly way of generating short-run real wage decreases.

[36] An inflation tax may be part of the optimal mix of revenue-raising methods a government can use, and thus should not be ruled out by adopting a zero inflation target.

[37] On this, see the *Boskin Report* (1996).

[38] For example, this was the argument used by the Bank of England (1992).

[39] Brunila and Lahdenperä (1995) claim that the bias in the CPI might be as high as 1.5-2% in the US, but is likely to be smaller in the UK and in Canada (of the order of 0.5-1%).

[40] Only for New Zealand, which had a mid-point target of 1% until 1996, might one argue that the statistical bias was the only reason behind the choice of a positive inflation target. However, since it is likely that in New Zealand the bias in the CPI is smaller than elsewhere (Archer 1995), i.e. smaller than 0.5%, even for this country some of the other arguments were probably (implicitly) behind the choice of target.

[41] In Finland and Sweden the 2% target was chosen because this was the level of inflation other European countries were seen to be targeting.

Given the long lags in monetary policy, the target is usually set initially for some future date, at least 2 years ahead.[42] Where the current inflation was above the target, the central banks in our sample set a downward path for inflation, to reap as soon as possible the benefits of lower inflation expectations the IT is supposed to provide. These 'transition targets' could serve as a benchmark against which the progress towards the ultimate objective could be measured, and meeting the 'transition targets' would help to establish the credibility of the final target,[43] since it is likely that the credibility of the target, and its impact on expectations, would only be achieved by success in meeting it, and not by its simple announcement (see Section 4). Box B describes the timing of the targets in our sample. The inflation rate at the time of the announcement was above the final target range in Canada, New Zealand, Spain and the UK, but the intermediate targets only demanded a strong deflationary effort in Spain, since current inflation was inside the first 'transition target' in the other countries. The impact on expectations of a less ambitious target will tend to be smaller, although a too ambitious target might not be credible. The differences between less and more ambitious targets should be kept in mind when analysing whether inflation outcomes were consistent with the targets (in Section 3) and the impact on expectations of the announcement and subsequent inflation performance (in Section 4).

2.3. *Reaction function*

Under an IT framework the final objective is targeted directly, and no intermediary targets are used. Given the lags in monetary policy, this means that an (explicit or implicit) forecast of future inflation is

[42] Note that usually an initial date for the application of targets is set, but not a final date. At first, a planned path for a reduction in inflation may be set, but once inflation reaches the final target it should stay there indefinitely. The exceptions are Canada and New Zealand, where current targets hold only until 1998 and 2003, respectively, and new targets must be set before those dates to hold in subsequent periods.

[43] The 'transition targets' could also be useful as a guideline for policy decisions. Nicholl and Archer (1992, p. 322) claim that was the case in New Zealand, where the 'transition target' gave the RBNZ "a clear framework for policy decisions, and has provided the motivation to take policy actions that might be politically difficult".

Box B
TIMING OF TARGETS

	Date of announcement	Current inflation[1]	Target	Target date	Transition path
Australia	1993	1.9%	2-3%	1993	none
Canada	Feb. 1991	3.9%	1-3%	1995	2-4% Dec. 1992; 1.5-3.5% mid-1994
Finland	Feb. 1993	2.6%	2%	1995	none
New Zealand	Mar. 1990	3.3%	0-2%	1993	3-5% Dec. 1990; 2.5-4.5% Dec. 1991; 1.5-3.5% Dec. 1992[2]
Spain	Jan. 1995	4.3%	2%	1998	3.5-4% early 1996; <3% early 1997; 2.5% end 1997
Sweden	Jan. 1993	1.8%	1-3%	1995	underlying inflation not increasing
UK	Oct. 1992	4.0%	1-2.5%	1997	1-4%[3]

[1] Current inflation refers to the formal target index on the quarter before the time of the announcement, except for Canada and New Zealand where it refers to the underlying inflation index used for policy decisions.

[2] The final target here refers to the one set in the second and third PTAs. The targets in New Zealand were changed three times before November 1997. The first PTA, signed in March 1990 set the final target of 0-2% by the end of 1992, and in April the RBNZ announced the 'transition targets' of 3-5% in December 1990 and 1.5-3.5% in December 1991. A new PTA was signed in December 1990 extending the final target for the end of 1993, and following this the RBNZ announced in February 1991 the new 'transition targets' of 2.5-4.5% in December 1991 and 1.5-3.5% in December 1992. A third PTA was signed in December 1992 where the target was set to hold from that moment until the end of the Governor's term in 1998. Finally, this target was revised to 0-3% in a fourth PTA signed in December 1996. We took the targets to be the ones set more recently at each point in time, that is, the 'transition targets' to be 3-5% in December 1990, 2.5-4.5% in December 1991, 1.5-3.5% in December 1992, the final target of 0-2% to hold from the first quarter of 1993 until the fourth quarter of 1996, and the new target of 0-3% to hold from the first quarter of 1997. A fifth PTA was subsequently signed on December 1997 (see footnote 1 Box A for details).

[3] This transition path refers to the first inflation target announced in October 1992, which determined that inflation should be in the 1-4% range from that moment on, and in the lower half of that range "by the end of the current Parliament" (1997). This target was revised by the new Labour government elected in May 1997.

the intermediary target.[44] In principle, the monetary policy decision process would start with the computation of a point forecast for inflation X periods ahead, with X being the policy lag. Then, monetary conditions would be adjusted according to the relative position of the forecast to the target range: if the forecast is on target, no action is required; if the forecast is above the target, monetary conditions should be tightened; if the forecast is below the target, monetary conditions should be relaxed. Thus, IT would be different from the money or exchange rate targeting frameworks because policy reacts to a quantified inflation forecast, and not to current changes in the *ex post*, actual data for some financial variable. Also, in principle, IT involves a quasi-formalized reaction rule, that distinguishes it from a discretionary monetary policy. However, the actual policy decision processes do not always follow the simple rules outlined above, and the distinction of IT from other policy frameworks is less clear than the process outlined above might suggest.

In principle, IT involves the computation of a quantified inflation forecast that is going to be compared with the target. As we show in Box C, although quantified inflation forecasts are used in all the central banks in our sample, policy decisions are not based exclusively on those quantified forecasts, but also on a subjective evaluation of several leading indicators. In some countries (e.g. Australia, Finland), quantified inflation forecasts are just one of the indicators used for policy decisions. Even in the countries where the quantified inflation forecasts are the key input in the policy-decision process, much subjective judgement is put into the forecasts, and furthermore the policy-makers also look at other indicators, not only the point forecast. This is usually justified on the grounds that point inflation forecasts are deemed to be unreliable and subjective judgements of the inflationary pressures in the economy are thought to improve the results. Another way of avoiding the limitations of point forecasts is to do some form of 'risk analysis', by computing different forecasts under alternative scenarios,[45] or describing the inflation forecasts as a

[44] Svensson (1996) provides a formal analysis of the inflation forecast role in an IT framework.

[45] For example, at the Bank of Canada the staff prepares a base forecast and several alternative forecasts according to different scenarios for the exogenous variables; the management then will treat the different alternatives according to their view of the likelihood of such scenarios (Longworth and Freedman 1995).

probability distribution and not a point estimate.[46] For an extended discussion of this issues, see Haldane, Batini and Whitley (1998).

Box C

INFLATION TARGETING MONETARY POLICY FRAMEWORK

A. The inflation target is the final objective of monetary policy. Given the usually long policy lags, decisions have to be made in terms of future inflation, not current inflation. Future inflation can be assessed by means of a quantified inflation forecast or a subjective evaluation of future inflationary pressures based on several indicators:

Australia: subjective evaluation of several indicators, including inflation forecasts.

Canada: use econometric model (including judgement) to estimate the time path of monetary conditions necessary to keep future inflation (approximately 2 years ahead) near midpoint (monetary aggregates are used as an independent check on the economic projection).

Finland: subjective evaluation of several indicators; since October 1995, also inflation forecast 6 to 8 quarters ahead.

NZ: use econometric model (including judgement) to estimate the time path of monetary conditions necessary to keep future inflation (approximately 2 years ahead) near midpoint.

Spain: use of econometric models and subjective evaluation of several indicators.

Sweden: inflation forecast 1-2 years ahead.

UK: inflation forecast 2 years ahead.

B. The inflation outlook (point forecast or subjective evaluation) is based on several quantitative and qualitative indicators, covering a wide range of financial and non-financial variables, like exchange rates and other asset prices, expansion of money (and other financial) aggregates, inflation expectations, wage settlements and other cost and price increases and excess demand or supply in goods and labour markets. Each central bank pays special attention to a subset of indicators, and in some cases one indicator has a predominant role. The importance given to each indicator may change over time. For the central banks in our sample, the key indicators are:

Australia: inflation expectations, wage settlements, output gap.

Canada: M2+, M1, output gap, wage indicators.

Finland: wages, inflation expectations, exchange rate, yield curve, money aggregates.

NZ: exchange rate.

Spain: ALP (liquid assets held by private sector) growth of not more than 8% is used as a reference.

Sweden: output gap, inflation expectations, yield curve.

UK: output gap, inflation expectations, observed prices, M0, M4.

C. Monetary conditions (the operational target) are then adjusted according to the inflation outlook. Monetary conditions are tightened if inflation is forecast to be 'too high' and relaxed if inflation is forecast to be 'too low'. Given that the countries in our sample are medium and small open economies, the operational target is usually some combination of a short-term interest rate and the (trade-weighted) exchange rate. This combination can be expressed in terms of a computed 'monetary conditions index' (MCI)[1] or be left to subjective evaluation. The operational targets are:

Australia: money market overnight rate.

Canada: MCI, where the 90 day commercial paper rate weighs 75% and the exchange rate index 25%.

Finland: evaluation of monetary conditions, where the key interest rate is the one month tender rate.

NZ: MCI, where the 90 bank bill rate weighs 1/3 and the exchange rate index 2/3.

Spain: money market overnight rate.

Sweden: MCI, where the money market overnight rate weighs 75% and the exchange rate index 25%.

UK: commercial banks' base rate.

D. Policy instruments are then adjusted in order to achieve the desired level for the operational target. If policy changes are necessary, these are signalled by announcing new values for the policy instrument. The key variables for signalling policy changes are:

Australia: operating target for the overnight money market rate.

Canada: operating band for the overnight money market rate.

Finland: tender rate.

NZ: settlement cash balances at the RBNZ (used to influence the money market overnight rate).

Spain: intervention rate (10 day repo rate).

Sweden: repo rate.

UK: money market dealings rate.

[46] For example, the Bank of England stresses that the uncertainty surrounding inflation forecasting will make the inflation outcome 'always' different from the forecast. For this reason, since February 1996, the inflation forecasts in the *Inflation Report* are presented as confidence intervals, and not as point forecasts.

[1] The role of a 'monetary conditions index' in the conduct of monetary policy has been given considerable attention in recent research, in particular at the Bank of Canada (see, for example, Freedman 1995b).

Another of the distinctive features of the IT framework is the use of several indicators as inputs into the decision process and forecasting procedure, with no indicator having a predominant role, as an intermediary target would have. In practice, this distinction is less clear, since some central banks in our sample give a large weight to a particular variable, like the exchange rate in New Zealand or broad

money in Spain (see Box C, Section B). It is difficult to see, for instance, where the behaviour of the Banco de España differs, in this respect, from the behaviour of the central banks who use a monetary target framework, like the Bundesbank. In Spain, the growth of the monetary aggregate ALP is the main indicator behind policy decisions, although other indicators are also considered, and the liquidity growth targets are not taken as fixed rules, but just as a mean of achieving price stability. In money targeting countries, interest rate changes are said to be conditioned on the movement of some monetary aggregate, like the M3 in Germany, but other indicators are also considered, and the money targets are frequently overruled due to other economic factors.[47]

Finally, the IT framework differs from a discretionary policy because a quasi-formalised reaction rule exists. In practice, the straightforward application of the rule raises several problems, whose solution generally involves considerable discretion for the policy-makers (see Haldane, Batini and Withley 1998).[48] The first question is whether the target is the range or the mid-point of the range. In the latter case, the bands may be interpreted as confidence intervals indicating where *ex post* inflation might be expected to lie if policy is directed at the mid-point, and the central bank should act whenever the forecast differs from the mid-point. In Canada and the UK (post-May 1997), for example, policy actions are directed at keeping forecast inflation near the mid-point of the band. Where the target is the band, strictly, the rule only demands action when the forecast is outside the target range. However, even in this case a prudent central bank might

[47] Clarida and Gertler (1996) claim that in Germany the money targets are meant as guidelines and in no sense do they define a strict policy rule (p. 2), that the Bundesbank has tolerated deviations from the targets as a reaction to the development of economic activity (p. 7), and that moderating market interest rate fluctuations takes precedence over monetary targeting (p. 11). Helmut Schlesinger, former President of the Bundesbank, quoted in von Hagen (1995, p. 108) said that the Bundesbank has never conducted a rigid policy geared at the money supply alone, and all available information about financial markets and the economy is analysed regularly. Bernanke and Mihov (1996) claim that the Bundesbank is a 'closet' inflation targeter.

[48] The degree of ongoing discretion may be reduced by describing thoroughly all the details of the operation of the targets the moment they are announced. Many central banks have described in some detail how they interpret the targets, and this implies that many of the choices discussed in this and the following Sections were made *ex ante*. However, this was not always the case, and some central banks still have some degree of discretion in some of the issues discussed.

wish to act as long as the forecast is close to the boundaries, to minimize the risk of missing the target given the uncertainty surrounding any inflation forecast. In New Zealand, where the target is the band, the RBNZ initially would not react as long the forecast was inside the band. But, after an unexpected and short-lived surge in the price of fresh vegetables that drove underlying inflation 0.2% above target in the second quarter of 1995, although all the previous forecasts for that quarter were inside the target range, the RBNZ decided to adopt the strategy of acting as long as the forecast is close to the boundaries (Mayes and Riches 1996).

The second problem is whether any deviation from target, no matter how small, should trigger a reaction, or whether policy should only respond to significant deviations. The credibility and accountability of the IT would suggest reactions to any deviation, to minimize deviations from target, but some central banks will only react to significant deviations. The reason is that small deviations imply small adjustments in monetary conditions, and small adjustments might be undesirable (for instance, until now the Bank of England has only initiated interest rate changes of at least 0.25 percentage point, although the MPC has now reaffirmed that it would be prepared to make step changes of whatever size, smaller or larger, that it thought appropriate, see Bank of England, *Inflation Report*, 1997, p. 71).

The final question is, if the forecast lies off the target in one period, whether the policy response should be strong, so that inflation quickly returns to the range, or gradual. Again, the credibility and accountability issues would suggest a sharp response, to minimize the number of periods the target is going to be missed. However, some central banks (e.g. in Sweden and Spain) prefer a gradual approach, because a radical response could be destabilizing and drive inflation through the other end of the range, since forecasts are not precise and the effects of policy are not known exactly.[49]

The main concern relates to the trade-off that exists in the short-run, given wage/price rigidities in that horizon, between output variability and inflation variability. With such rigidities in place, there remains a downwards sloping short-run Phillips curve, and thus such a trade-off exists. As Haldane, Batini and Whitley (1998) demonstrate,

[49] Such concern is termed multiplicative, or Brainard, uncertainty (see Brainard 1967).

any attempt to use monetary policy aggressively to restore inflation to its target as soon as possible will cause avoidable instability in output, whereas a very slow adjustment will cause avoidable instability in inflation. Perhaps superficially surprising, the appropriate choice of inflation target horizon appears largely able by itself to deliver the best combination of inflation/output variability without any need to enter an output-gap variable into the central bank's reaction function. Thus Haldane, Batini and Whitley (1998, p. 30) report that

> "Almost any amount of output smoothing can be synthetically recreated with an inflation-only rule. Forecast-based rules are, in this sense, output-encompassing. Inflation-nutters and output-junkies may disagree over the parameters in [the reaction function] – that is a question of policy tastes. But they need not differ over the arguments entering this rule – that is a question of policy technology".

And later in their concluding Section (p. 42), they state that

> "Our main conclusions are:
>
> *a*) On lag-encompassing, an inflation forecast horizon of 1-2 years appears to deliver the best performance, in the context of inflation forecast-based policy rules. That is close to the forecast horizon targeted by inflation-targeting central banks in practice. Shorter horizons than this risk raising both output and inflation variability – the result of policy lags; while longer horizons risk macroeconomic instability. In general, the greater the degree of forward-lookingness on the part of the private sector, the less the compensating need for forward-lookingness by the central bank.
>
> *b*) An inflation-forecast-targeting rule, with an appropriately chosen targeting horizon, naturally embodies a degree of output-stabilisation. Moreover, any degree of output-smoothing can be synthetically re-creating by judicious choice of the parameters entering an inflation-forecast-targeting rule. There is no need for any explicit output terms to enter this rule. That is evidence of the output-encompassing nature of inflation-targeting".

2.4. *Instruments and operational targets*

The IT framework differs from other monetary frameworks in terms of the final objectives (a quantified level for inflation) and intermediary targets (no single intermediary target). There is no apparent reason why the adoption of IT would imply changes in policy instruments or operational targets. In fact, no central bank in our sample claimed to have made such changes due to the adoption of IT. Sections C and D of Box C describe the policy instruments and operational targets currently in use in the countries in our sample. Changes in policy instruments have occurred in the IT period, for instance in Finland, Sweden and the UK, but usually for microeconomic reasons. Nevertheless, being a new policy framework, IT should lead to different policy responses, that could be translated into a different usage of the policy instruments and in a different behaviour of the operational targets. In this Section, we try to identify any changes the adoption of IT induced in the behaviour of exchange rates and short-term interest rates.

2.4.1. *Foreign exchange rates*

If the sole objective of monetary policy is the control of inflation, then central banks must be prepared to accept the level of the exchange rate that is compatible with the inflation target, whatever that level is. This does not mean that IT is necessarily incompatible with some (loosely defined) desired level for the exchange rate. If inflation levels are similar at home and abroad, IT is also a rough mechanism for maintaining the external value of the currency, as long as PPP holds. However, conflicts between external and internal objectives may often arise. Under IT this must be resolved by the abandonment of the external objective, which implies that IT countries must be prepared to accept larger short- and medium-term swings in the exchange rate, if necessary.

Obviously, IT is an alternative to, and is different from, a regime of exchange rate targets. It could be argued that exchange rates fixed to low inflation currencies and IT are not fundamentally different, since they are just different ways of achieving price stability, and, if inflation is low at home and abroad, exchange rates will tend to be stable even under IT. However, in the presence of significant real shocks, under IT we might observe large swings in the nominal exchange rate, with no changes in inflation levels, as the real exchange

rate adjusts to the new economic conditions.[50] This type of adjustment could not occur under exchange rate targeting, at least as long as targets are kept unchanged.

Box D describes the role and the behaviour of foreign exchange rates under IT. Medium-term control of the exchange rate is only attempted if large changes threaten the IT, and short-term control is abandoned, as we show in Section A of Box D. No central bank in our sample has tried to stabilize the exchange rate in the short term, except the Bank of Finland who occasionally did intervene to avoid sharp intra-day movements, and this should imply higher short-term volatility of the exchange rate for the European countries, who had exchange rate targets before the adoption of IT. Evidence that supports this hypothesis is presented in Section B of Box D, where it is shown that short-term exchange rate volatility during the IT period is significantly higher than during the fixed exchange rate period, for the European countries. On the other hand, exchange rate volatility is significantly lower during IT than during the discretionary period, for all the countries in our sample.

Compared to a discretionary monetary policy, IT seems to be able to provide more stable foreign exchange rates. This could be explained by a reduction in the uncertainty of market participants regarding the future monetary policy, that the existence of a clear target for monetary policy could provide. Compared to exchange rate targets, the adoption of IT leads to a cost in the form of an increase in short- and medium-term exchange rate uncertainty, as would be expected, but allows for easier adjustments to real shocks and reduces the probability of speculative crises in the forex market.

[50] Examples of such an adjustment are the Finnish experience of 1992-94, and the UK experience of 1996-97.

Box D

FOREIGN EXCHANGE RATES UNDER INFLATION TARGETING

A. THE ROLE OF THE EXCHANGE RATE IN THE POLICY DECISION PROCESS

In the countries in our sample, exchange rates have, at least, an informative role in the policy-decision process. In some cases, exchange rates may act as operational targets, but they are not intermediary targets. In our sample, the role of the exchange rate is as follows:

Australia: exchange rate is only relevant if excessive depreciation threatens future inflation.

Canada: exchange rate is a component of the 'monetary conditions index', the operational target.

Finland: before October 1996, large changes in exchange rate were allowed, although some of the actions of the Bank of Finland in early 1993 were motivated by the threat of the collapse of the markka and it did occasional interventions on both sides to stop sharp intra-day movements (but not affecting the trend).

NZ: exchange rate is the key variable in the operation of monetary policy due to its strong and rapid influence on prices, but it is not a target in its own right; given the inflation forecasts, comfort zones for the exchange rate are defined, and adjusted as parameters are revised; movements of the exchange rate within the zone are normally tolerated until the rate approaches the margins; however there is no direct intervention on forex markets.

Spain: there is a formal commitment to keep the peseta within the widened bands of the ERM, but only permanent trends (not temporary fluctuations) shape policy decisions and as long as it may endanger the inflation target; forex stability is viewed more as a result that will come about with price stability than an end in itself.

Sweden: return to exchange rate targets only when it is compatible with price stability.

UK: there are no targets for the exchange rate.

B. SHORT-TERM EXCHANGE RATE BEHAVIOUR

Figure D.1 plots the absolute value of the daily changes in the exchange rate of the countries in our sample from 3/1/1986 to 11/12/1997.[1] For the Australian, Canadian and New Zealand dollar the exchange rates used are US dollar

[1] The exchange rate data are US dollar Bankers' Trust mid-quotes at 3.00 pm, New York time, available from *Datastream*. The DM rates were computed from the USD rates.

rates; for the Finnish markka, the Spanish peseta and the Swedish krona, DM rates are used; for the British pound both USD and DM are presented. The vertical dotted lines indicate the date of the adoption of IT. In some of the charts, large outliers were truncated for presentational purposes.

Visual inspection of Figure D.1 suggests that the adoption of IT was associated with higher short-term exchange rate volatility in Finland and Sweden, and with lower short-term volatility in New Zealand. To test formally for the existence of such changes in volatility we used the ARCH framework, where we allowed the conditional variance to be affected by changes in the monetary policy regime. Following Baillie and Bollerslev (1989) and Hsieh (1989) we assumed exchange rate returns follow a GARCH (1,1) process of the form:

$$r_{i,t} = \mu_i + \varepsilon_{i,t} \qquad \text{(d.1)}$$

$$\varepsilon_{i,t} \mid \psi_{i,t-1} \sim G(0, h_{i,t}) \qquad \text{(d.2)}$$

$$h_{i,t} = \gamma_i + \alpha_i \varepsilon^2_{i,t-1} + \beta_i h_{i,t-1} + \delta_i D_{i,t} \qquad \text{(d.3)}$$

where $r_{i,t}$ is the daily return for exchange rate i at period t; $D_{i,t}$ is a dummy variable, taking the value 1 before the adoption of IT; μ_i, γ_i, α_i, β_i and δ_i are parameters. The conditional distribution $G(\cdot)$ was assumed to be normal. The unconditional variance of the model in equations (d.1)-(d.3) for the IT period, σ^2_{iT}, and for the non-IT period, σ^2_{iN}, are given by

$$\sigma^2_{iT} = \gamma_i / (1 - \alpha_i - \beta_i) \qquad \text{(d.4)}$$

$$\sigma^2_{iN} = (\gamma_i + \delta_i) / (1 - \alpha_i - \beta_i) \qquad \text{(d.5)}$$

Table D.1 reports the results of estimations of this model, for the countries in our sample, over the period 3/1/1986 to 11/12/1997 (t-statistics in parenthesis).[2] A simple comparison of the exchange rate volatility in the IT and non-IT period, reveals significant decreases in the IT period for Australia, Canada, Spain, the UK, and, in particular, New Zealand, where average exchange rate volatility fell more than 75% after the adoption of IT. On the other hand, volatility increased with IT in Finland and Sweden. For these countries (and also for Spain and the UK, to a smaller extent) the non-IT period was mainly a period of fixed exchange rates, and that may explain the increase in volatility.

[2] The results reported for Finland were obtained from a model that included 2 dummies taking the value of 1 in 14/11/1991 and 9/9/1992, respectively, when major devaluations occurred. Without the inclusion of these dummies the variance (conditional on the monetary regime) would not be stationary.

FIGURE D.1

EXCHANGE RATE DAILY ABSOLUTE CHANGES

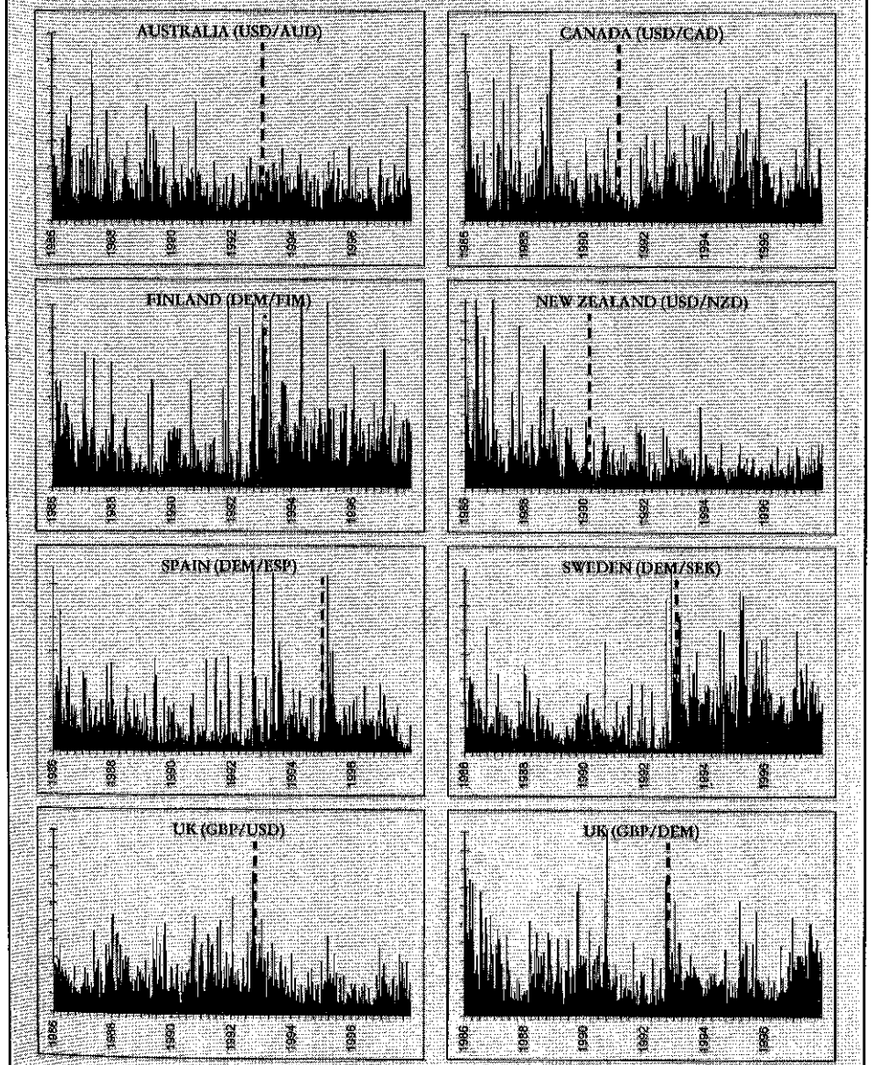


TABLE D.1

VOLATILITY OF DAILY EXCHANGE RATES BEFORE AND AFTER IT

	Dummies definition	γ_i (x 10000)	α_i	β_i	δ_i (x 10000)
Australia	D: t< 1/1/93	0.0673 (13.5)	0.1250 (11.2)	0.7510 (56.9)	0.0213 (5.3)
Canada	D: t<26/2/91	0.0103 (15.8)	0.1000 (12.7)	0.8210 (100.4)	0.0012 (2.4)
Finland	D: t<2/2/93 or t>12/10/96	0.4270 (16.5)	0.2580 (16.9)	0.5870 (46.0)	-0.2196 (-9.9)
New Zealand	D: t<2/3/90	0.0933 (21.1)	0.1620 (15.3)	0.6680 (53.9)	0.3060 (22.7)
Spain	D: t<1/1/95	76.207 (14.5)	0.2821 (33.9)	0.6515 (99.5)	45.953 (9.7)
Sweden	D: t<15/1/93	2.9959 (17.0)	0.3599 (39.9)	0.3628 (19.7)	-2.3148 (-14.6)
UK	D: t<8/10/92	0.0703 (12.9)	0.1034 (17.0)	0.8605 (166.7)	0.0133 (2.7)

In order to separate the effects of the adoption of IT and the floating of the currency, we estimated a model similar to the one in equations (d.1)-(d.3), but with equation (d.3) replaced by

$$h_{i,t} = \gamma_i + \alpha_i \varepsilon^2_{i,t-1} + \beta_i h_{i,t-1} + \omega_i M_{i,t} + \lambda_i F_{i,t} \qquad (d.3')$$

where $M_{i,t}$ is a dummy variable, taking the value 1 during the period of discretionary monetary policy, and $F_{i,t}$ is a dummy variable, taking the value 1 during the fixed exchange rate period.[3] The results of the estimation of this model are reported in Table D.2.

When we control for the existence of a fixed exchange rate period, then we observe that exchange rate volatility in the IT period is significantly higher than in the fixed exchange rate period in the 4 countries where such a regime existed, but significantly lower than in the discretionary regime for all the countries in our sample.

[3] We chose to include the exchange rate targeting of the ERM participants after the September 1992 crisis (Spain, Finland after October 1996) in the discretionary period because the exchange rate movements allowed under this regime are too large to be compatible with any definition of a fixed exchange rate regime.

TABLE D.2

VOLATILITY OF DAILY EXCHANGE RATES DURING IT AND THE FIXED RATE PERIOD

	Dummies definition	γ_i (x 10000)	α_i	β_i	ω_i (x 10000)	λ_i (x 10000)
Finland	M: 8/9/92<t<2/2/93 or t>12/10/96 F: t<=8/9/92	0.5394 (16.1)	0.2500 (15.2)	0.5280 (33.2)	0.5348 (3.7)	-0.2858 (-10.7)
Spain	M: t<19/7/89 or 15/9/92<t<1/1/95 F: 19/7/89<t<15/9/92	209.303 (17.1)	0.3669 (30.5)	0.4052 (28.9)	179.463 (15.1)	-85.777 (-8.2)
Sweden	M: 18/11/92<t<15/1/93 F: t<=18/11/92	3.4193 (16.3)	0.2599 (14.7)	0.3374 (12.8)	13.5662 (10.2)	-2.6681 (-14.4)
UK	M: t<5/10/90 or 15/9/92<t<8/10/92 F: 5/10/90<t<15/9/92	0.0919 (15.0)	0.0962 (15.0)	0.8500 (136.6)	0.0582 (8.0)	-0.0420 (-6.6)

2.4.2. *Short-term interest rates*

Given that a different policy framework should imply different policy responses, we investigated whether the adoption of IT implied a change in the use of the interest rate instrument. Our first hypothesis was that central banks would raise interest rates earlier than before, relative to observed inflationary pressures. The argument is that under IT, central banks can resist pressures not to raise them more easily, since interest rate changes can be justified with reference to the inflation forecast and the target. Although there is some evidence that could indicate a more forward-looking behaviour in the non-European countries, we could not find evidence of a systematic change in behaviour in the data available so far: the timing of interest rate changes, after the adoption of IT, was not unusually early relative to observed inflation, especially for the European countries. However, a general change to a more forward-looking attitude might have occurred, but the tests performed, presented in Box E, were not powerful enough to detect it, given the relatively short data series available.

Box E

INFLATION AND INTEREST RATE CHANGES

The hypothesis tested in this Box is whether the adoption of IT changed the timing of interest rate changes relative to observed inflation (see argument in main text). In order to test for Granger-causality between quarterly inflation and central bank controlled interest rates,[1] the following bivariate VAR was used

$$p_t = \alpha_1 + A(L)p_{t-1} + B(L)r_{t-1} + \varepsilon_t$$

$$r_t = \alpha_2 + C(L)p_{t-1} + D(L)r_{t-1} + \mu_t$$

where p_t and r_t are first differences[2] of inflation and short-term interest rates, respectively, and *A(L)*, *B(L)*, *C(L)* and *D(L)* are polynomials in the lag operator *L*, with four lags. F-tests on the parameters of *B(L)* and *C(L)* provide tests of Granger-causality from interest rates to inflation and from inflation to interest rates, respectively.

If the parameters in *C(L)* are jointly significant, then inflation Granger-causes interest rates, which may be interpreted as meaning that central banks react to past inflation, increasing interest rates only when the inflationary pressures are evident. The interpretation of joint significance for the parameters in *B(L)*, that is interest rates Granger-causing inflation, is less straightforward. The monetary policy transmission mechanism provides the theoretical economic causation from interest rates to inflation, with higher interest rates today causing lower inflation in the future. However, if central banks react to expected future inflation, increasing interest rates when expected future inflation is higher, then the data would also show Granger-causation from interest rates to inflation, not related to the transmission mechanism.[3] Our choice of lags in this exercise makes the latter more likely to be the legitimate interpretation. The monetary policy lag is usually considered to be longer than four quarters, but it is likely that central banks react to expected inflation four quarters ahead, given the difficulties in forecasting. Also, the two interpretations have different implications for the signs of the coefficients, since the transmission mechanism interpretation suggests a negative relationship between interest rates and inflation, but the second interpretation implies a positive relationship. Thus, the signs of the coefficients in *B(L)* could provide some clue to which is the legitimate interpretation. If the hypothesis tested here is true, then before IT inflation would Granger-cause interest rates, but after IT interest rates would Granger-cause inflation. An additional problem of interpretation arises in the countries where the headline CPI includes interest rate related costs; there, interest rates could Granger-cause inflation just because they are one of the components of the CPI. To avoid this problem we used indices of underlying inflation where available, but since the underlying inflation series usually do not cover the period before IT, we report the results with the headline CPI also.

Table E.1 summarizes[4] the significance levels of the Granger-causality tests performed, for the null hypothesis of non-causality. The tests were performed over two subsamples of the period 1982:1 to 1997:3: the first subsample, corresponding to the period before IT, ran from 1982:1 to the quarter of the adoption of IT; the second subsample, corresponding to the period after IT, ran from the quarter following the adoption of IT to 1997:3. Note that the number of degrees of freedom involved in the estimation of the VAR is small, especially for the 'after IT' model, and that tends to increase the significance levels of the tests. Thus, a high significance level should be interpreted as a signal that the data is not rich enough to allow for any conclusions, and *not* as a rejection of the causality hypothesis. On the other hand, a low significance level may be interpreted as a rejection of non-causality, i.e. one may accept the causality hypothesis.

Using the traditional significance levels, the results of the test suggest that after IT the central banks in the non-European countries have a forward-looking behaviour, although the available information does not allow one to rule out that this behaviour existed even before IT. In Canada, the headline inflation data suggests that this was not the case: Granger-causality from interest rates to inflation is evident in both indices after IT, and it did not exist in headline inflation before IT. In Australia, the opposite occurs: Granger-causality from interest rates to inflation is evident in both indices before and after IT, suggesting that no change in behaviour occurred. Finally, in New Zealand there is only a non-significant improvement in the only index that is available for both periods, in terms of Granger-causality from interest rates to inflation, although it seems that before IT the RBNZ had a backward-looking interest rate setting behaviour, that might have

[1] The headline inflation and interest rates data are from the *International Financial Statistics* (*IFS*). The headline inflation series are the quarterly average of year-on-year consumer price inflation. The interest rates used were the average of the overnight money market rate for Australia, Canada, Finland and Sweden, the end of period discount rate for New Zealand (although New Zealand does not have a discount rate, this is the name the *IFS* uses for the bank rate they provide) and Spain, and the end of period London clearing banks base rate, for the UK. The data for Sweden exclude the abnormally high interest rates of September 1992. The common assumption for all these rates is that they are determined by the central banks, and thus reflect accurately the monetary policy stance. We would prefer to use money market data in all countries, but sufficiently long series were not available. Tests over the sample periods for which data for both bank and market rates were available indicated the conclusions of this and other exercises on the paper would be similar whatever the interest rate used. The underlying inflation series for Australia, Canada and New Zealand were provided by the respective central banks. The 'RPIX' series for the UK was obtained from *Datastream*, and for Finland underlying inflation is the series "Indicator of underlying inflation (1990=100)", published in Bank of Finland (1992-97).

[2] First differences were used because pretesting of the data indicated that, for all countries in our sample, the quarterly inflation and interest rate series are I(1). The use of error-correction models was ruled out because pretesting also indicated that inflation and interest rates are *not* cointegrated. Details of these tests can be obtained from the authors.

[3] In general, time series that reflect forward-looking behaviour, such as financial asset prices, tend to Granger-cause many key economic time series. This does not mean that those series *cause* inflation or GNP to move up or down. Instead, the value of those series reflects the anticipated future movements in inflation or GNP. Granger-causality tests for such series may be useful for investigating whether markets (or central banks) are concerned with future inflation, but should not be used to infer a direction of economic causation. On the use of Granger-causality tests to assess forward-looking behaviour, see Hamilton (1994, ch. 11).

[4] Details of the estimation and the tests may be obtained from the authors.

been abandoned.[5] For the European countries there is no significant evidence of Granger-causality from interest rates to inflation or *vice versa*, with the exception of the former for the RPI in the UK (before and after IT), which is likely to be due to the importance of interest-rate related costs in this index.

TABLE E.1

GRANGER-CAUSALITY BETWEEN INTEREST RATES AND INFLATION
(in %)

Granger causality		From inflation to interest rates		From interest rates to inflation	
		Before IT	After IT	Before IT	After IT
Australia	headline	35	33	5	14
	underlying		97		0
Canada	headline	44	14	77	1
	underlying		88		4
Finland	headline	99	99	73	77
	underlying		86		57
New Zealand	headline	1	23	41	17
	underlying		36		4
Spain[6]		18	68	47	55
Sweden		81	39	30	69
UK	headline	46	91	6	3
	underlying	53	50	30	24

[5] In all the cases interest rates were found to Granger-cause inflation, the significant coefficients in the $B(L)$ polynomial were positive, supporting the view that this Granger-causality should be interpreted as central banks reacting to future expected inflation, and not as a consequence of the transmission mechanism.

[6] In the case of Spain, the tests were performed using 2 lags, instead of 4, so that the model could be estimated over the 'after IT' period.

The argument that central banks can justify their actions more easily under IT would also suggest that we would observe less interest rate smoothing, at least in the non-European countries. Supported by their inflation forecasts, a central bank could compute the necessary interest rate change to achieve the desired level of inflation, and do the change in one move, instead of doing it in a series of small changes of the same sign.[51] Again, we could not find such a change in behaviour in the data for our sample, although for some countries (e.g. Australia and Canada) there are some indications that the adoption of IT might lead to a more vigorous use of the interest rate instrument, as we describe in Box F. For the European countries, who previously had exchange rate targets, it is likely that before IT interest rates would be changed more frequently and in larger amounts. When the target is the exchange rate, the effects of the policy change are almost immediately observed, and policy must be continuously adjusted. Exchange rate targets demand monitoring and policy reactions almost to the minute, and it is possible that some of those reactions might have to be quick and vigorous, particularly during speculative attacks to the exchange rate. No such emergency policy reactions are needed under IT, and interest rate adjustments can be made more gradually, if interest rate smoothing is seen as desirable. The lack of accuracy of inflation forecasts and the uncertainty about the nature of shocks and the effects of monetary policy might recommend such gradual actions.[52]

[51] It could be argued that with free international capital movements, any interest rate changes are conditioned on the interest range changes in the core currency countries. If these countries smooth interest rates, then other countries have to smooth them too, and thus we should not expect a significant change in behaviour in that respect just due to the adoption of IT.

[52] For a detailed analysis on why central banks might prefer to smooth interest rates, see Goodhart (1996).

Box F

AGGRESSIVENESS OF INTEREST RATE INCREASES

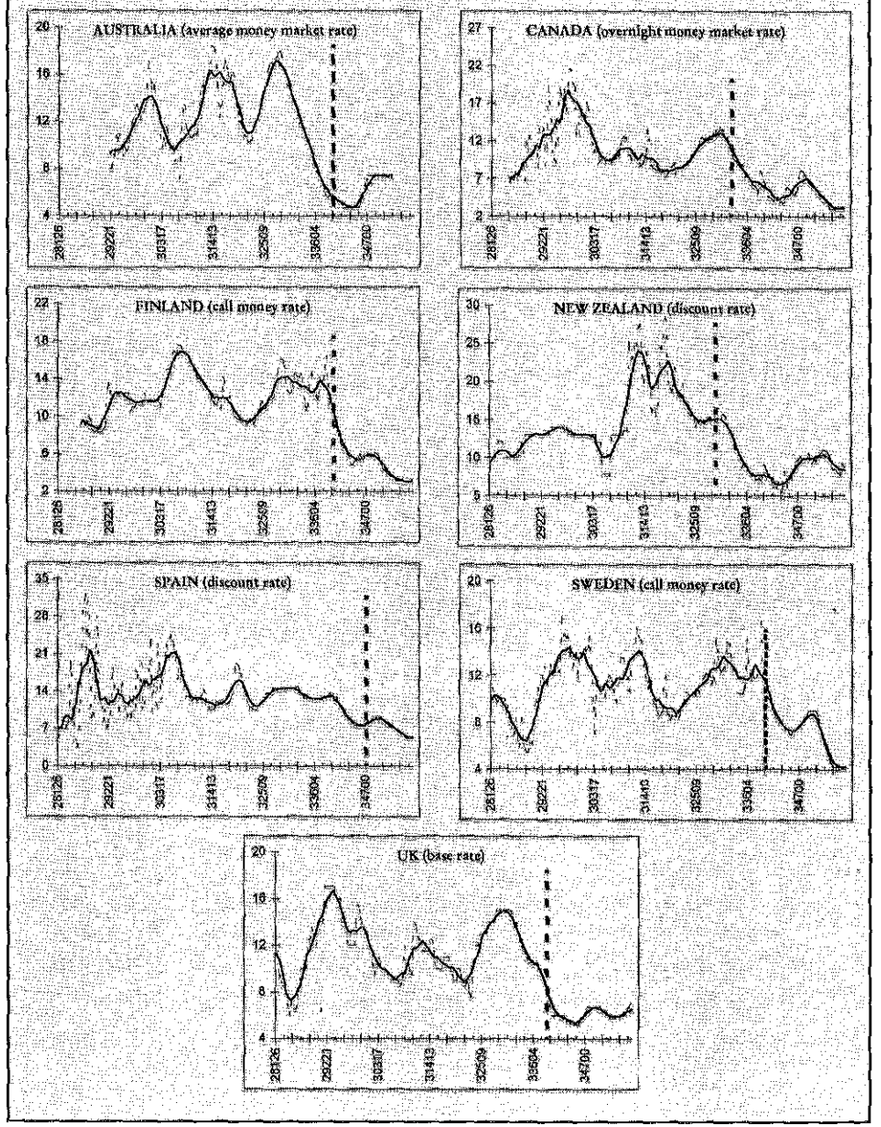
Using monthly data on short-term interest rates[1] from the *International Financial Statistics*, we tried to assess whether after the adoption of IT the central banks in our sample raised interest rates more aggressively than before. Since under IT the argument for not smoothing interest rates seems to be stronger (see main text), one could expect that after the adoption of IT increases in interest rates would be larger and quicker than before. Figure F.1 plots selected short-term interest rates for the countries in our sample. The vertical dashed lines indicate the date of the adoption of IT, the dotted lines the monthly rates, and the solid line is a 'centred' 12-month average, used to capture the 'trend' in interest rates.

Visually one cannot detect significant changes in the aggressiveness of interest rate increases after the adoption of IT. If interest rate changes were quicker, the interest rate curves would be steeper, but the slope of the curves does not seem to have changed significantly. The only apparent change seems to be in the magni-

[1] The interest rates used were the same as in Box E, just the frequency was changed from quarterly to monthly (see Box E for details). We have reasons to believe that the data for Australia and New Zealand in late 1983, early 1984 is inaccurate, but used them in the absence of a better alternative. None of the results is significantly affected by this.

FIGURE F.1

SHORT-TERM INTEREST RATES



tude of the changes, which seem to be smaller after IT. In order to provide quantified data that supports these visual conclusions, the previous Table describes the average monthly rate of change, magnitude and duration of significant interest rate increase episodes[2] in the period January 1977-September 1997.

The evidence in Table F.1 suggests that the interest rate increase after IT was less aggressive than previous interest rate increases, either in terms of magnitude or rate of increase. For all the countries in our sample, both the magnitude and the rate of increase were smaller, either in absolute or relative terms, than the average of the increases before IT, with the exception of the rate of increase in Australia and Canada. However, the evidence on Table should not be interpreted as suggesting the central banks in our sample became less aggressive after the adoption of IT, because the data are too scarce. One of the reasons why the interest rate increases were less aggressive was because the shocks they were counteracting were milder. The only episode of interest rate increases after IT was in 1994-95, when the inflationary shock and the interest rate increases worldwide were relatively mild by historical standards. If the 1994-95 inflationary shock is assumed to be mild, then the rates of increase in Australia and Canada could be seen as more aggressive, since they are higher than the historical average.

[2] Interest rate increase episodes were selected using a methodology similar to Ball (1994). First, 'trend' interest rate (the 12-month moving average) is used to identify 'peaks' and 'troughs'. A peak is a month in which 'trend' interest rate is higher than in the previous six and the following six months; a trough is defined by an analogous comparison. An interest rate increase episode is any period that starts at an interest rate trough and ends at an interest rate peak, with the 'trend' rate more than 1 percentage point higher than the trough. Then, the lowest and the highest monthly rates in each episode were used to compute the statistics in the Table. The 'duration' is the number of months between the month with the lowest and the month with the highest rates, the 'magnitude' is the difference between the rates in these months, and the 'monthly rate of increase' is the ratio of the 'magnitude' over the 'duration'. Statistics for each episode are not provided here, but may be obtained from the authors.

Absolute and relative changes are both used to describe interest rate increases because there are large differences in the level of interest rates across the sample period, ranging in some cases from 5 to 35%. The problem this large difference causes when comparing the size of different rate increases is whether we should consider a 3 percentage points increase from 5 to 8% or from 32 to 35% as being similar changes. The alternative is to consider as similar two 50% increases, be they from 5 to 7.5% or from 20 to 30%. The impact on real interest rates suggests we use the former criterion, but we also present the latter to provide a measure of the relative change.

TABLE F.1

EPISODES OF INTEREST RATE INCREASES

		Number of episodes	Avg. duration (months)	Avg. magnitude		Avg. monthly rate of increase	
				Absolute (pp)	Relative (in %)	Absolute (pp)	Relative (in %)
Australia	before IT	3	24	9.4	117	0.39	4.8
	after IT	1	6	2.8	60	0.46	10.0
Canada	before IT	3	31	9.0	132	0.32	4.6
	after IT	1	13	4.4	121	0.34	9.3
Finland	before IT	4	12	6.1	63	0.60	6.4
	after IT	1	16	1.3	28	0.08	1.7
New Zealand	before IT	3	11	11.9	126	1.17	10.6
	after IT	1	19	5.2	97	0.27	5.1
Spain	before IT	5	15	13.0	164	1.12	14.6
	after IT	1	6	1.9	25	0.31	4.2
Sweden	before IT	4	24	8.4	122	0.38	5.3
	after IT	1	13	2.0	28	0.15	2.1
UK	before IT	3	17	8.0	116	0.50	6.8
	after IT	1	6	1.5	29	0.25	4.8
All IT countries	before IT	25	19	9.5	121	0.66	8.0
	after IT	7	11	2.7	55	0.27	5.3

The evidence so far does not allow us to conclude that the adoption of IT has significantly changed the behaviour of the central banks regarding the use of the interest rate instrument, although for the non-European countries there are some indications that such a change in behaviour might be found in the future. Where we did find some differences is on short-term volatility of money market interest rates, analysed in Box G. For analogous reasons as those outlined in the previous paragraph, we would expect to find a lower short-term interest rate volatility after IT in the European countries, and indeed we found it. But we also found a lower short-term interest rate volatility in Australia and New Zealand, that cannot be explained by the transition from a fixed to a floating exchange rate. It seems under IT interest rates might be less volatile than in either discretionary or exchange rate targeting monetary policy frameworks. The reason for the difference with the former could be that, as we already mentioned for the

exchange rate, the adoption of IT provides market agents with a guideline that reduces uncertainty about future monetary policy.

Moreover, the variance and mean level of inflation are strongly positively correlated; the coefficient of variation is nearly constant, see for example Fry, Goodhart and Almeida (1996, Chapter 2). Consequently if the adoption of IT, or other aspects of the conjuncture, help to stabilize the level of inflation at a lower mean level, then its variance can be expected to decline also. Such a decline in the volatility of inflation will help to reduce the variance of interest rate reactions. Causation is clearly two-way.

Box G

SHORT-TERM INTEREST RATE VOLATILITY

To assess if the adoption of IT affects the behaviour of market short-term interest rates we analysed 3 month interest rates of the countries in our sample from 3/1/1986 to 10/12/1997.[1] The data was provided by *Datastream* and refer to Treasury bill rates for Australia, Canada, Sweden and the UK and interbank rates for Finland, New Zealand and Spain. Figure G.1 plots the absolute value of the daily changes in the 3 month interest rate. The vertical dotted lines indicate the date of the adoption of IT. In order to keep the scale the same in all charts, large outliers were truncated for presentational purposes in some of the charts.

The visual inspection of Figure G.1 suggests the adoption of IT is associated with lower daily volatility of short-term interest rates. This pattern can be seen in all the countries in our sample, except for Canada, where sufficient data for the period before IT was not available. To test formally for the existence of such changes in volatility we used a version of the EGARCH model developed by Nelson (1991), where we allowed the logarithm of the conditional variance to be affected by changes in the monetary policy regime. The model used was the following:

$$c_{i,t} = \mu_i + \varepsilon_{i,t} \qquad (g.1)$$

$$\varepsilon_{i,t} \mid \psi_{i,t-1} \sim P(0, h_{i,t}) \qquad (g.2)$$

$$g_{i,t} = \left|\frac{\varepsilon_{i,t}}{\sqrt{h_{i,t}}}\right| - \sqrt{\frac{2}{\pi}} - \phi_i \frac{\varepsilon_{i,t}}{\sqrt{h_{i,t}}} \qquad (g.3)$$

$$\ln h_{i,t} = \gamma_i + \alpha_i \ln h_{i,t-1} + \beta_i g_{i,t-1} + \delta_i D_{i,t} \qquad (g.4)$$

where $c_{i,t}$ is the weekly[2] change for interest rate i at period t; $D_{i,t}$ is a dummy variable, taking the value 1 before the adoption of IT in country i; μ_i, γ_i, α_i, β_i, ϕ_i and δ_i are parameters. The conditional distribution $P(\cdot)$ was assumed to be normal.

[1] For some countries, restrictions in data availability reduced the sample period.

[2] In our sample, the variance of daily interest rate changes tends to be integrated. Using weekly data, the likelihood of finding integrated variances is reduced.

FIGURE G.1

3 MONTH INTEREST RATE DAILY ABSOLUTE CHANGES

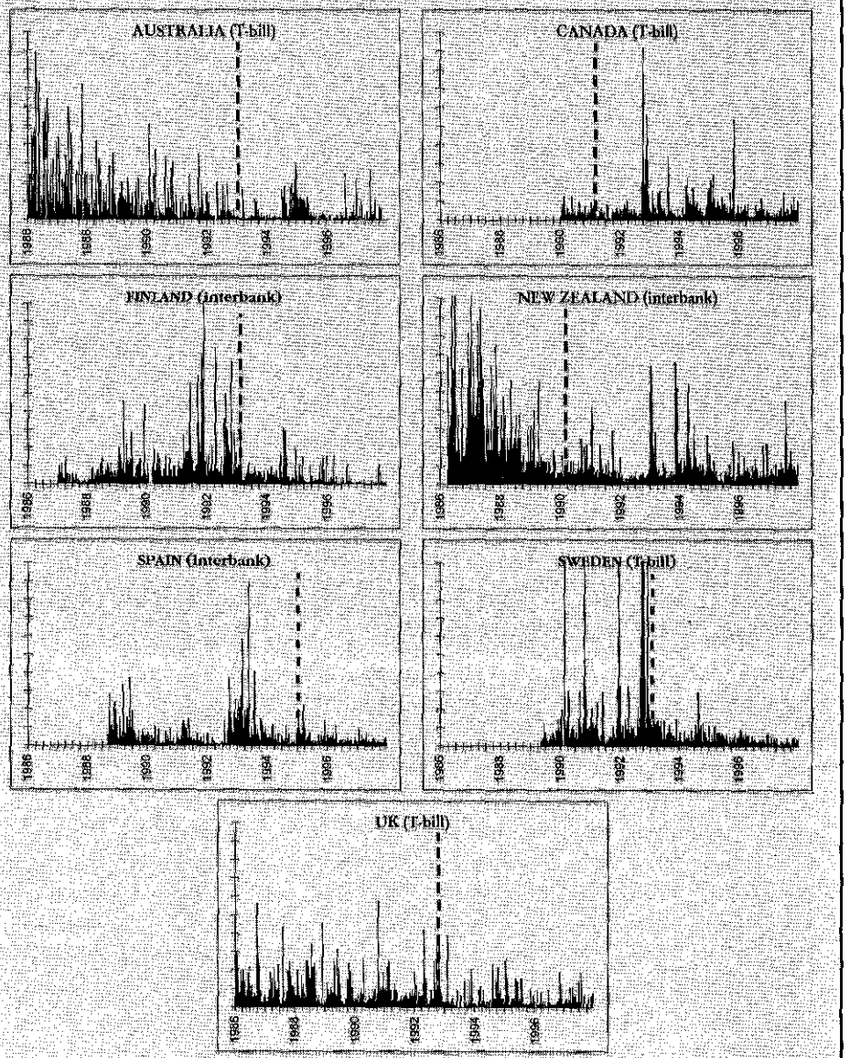


Table G.1 reports the results of estimations of this model, for the countries in our sample, over the period 3/1/1986 to 10/12/1997 (t-statistics in parenthesis). A simple comparison of the interest rate volatility in the IT and non-IT period reveals significant decreases in the IT period in all the models estimated,[3] that confirm the inferences from the visual inspection of the charts.

TABLE G.1

VOLATILITY OF WEEKLY INTEREST RATES BEFORE AND AFTER IT

	Dummies definition	γ_i	α_i	β_i	ϕ_i	δ_i
Australia	D: t<1/1/93	−0.3103 (−3.9)	0.9240 (50.2)	0.2009 (7.9)	−0.3410 (−5.2)	0.1323 (4.0)
Finland	D: t<2/2/93 or t>12/10/96	−0.0147 (−1.4)	0.9906 (359.8)	0.2093 (10.7)	−0.3963 (−5.7)	0.0240 (3.2)
New Zealand	D: t<2/3/90	−0.2344 (−3.8)	0.9057 (46.1)	0.4382 (10.2)	−0.1273 (−2.4)	0.1144 (2.3)
Spain	D: t<1/1/95	−0.1083 (−3.9)	0.9664 (143.0)	0.4155 (11.3)	−0.2083 (−4.5)	0.0374 (2.2)
Sweden	D: t<15/1/93	−0.3409 (−6.2)	0.8815 (48.0)	0.4635 (14.8)	−0.7217 (−6.6)	0.2517 (8.4)
UK[4]	D: t<8/10/92	−4.9646 (−5.6)	−0.2028 (−1.0)	0.0008 (0.0)	10.755 (0.0)	1.5526 (5.7)

[3] We did not estimate a model for Canada because we did not have a sufficiently long data series for the period before IT.

[4] The model used for the United Kingdom was modified by replacing equation (g.1) by: $c_{i,t} = \mu_i + \rho_i c_{i,t-1} + \varepsilon_{i,t}$.

The main apparent changes in the behaviour of the instruments or operational targets are related to the short-term volatility of financial market prices, interest and exchange rates.[53] Some of the changes are probably associated with the change from fixed to floating exchange rates, and not to the adoption of IT directly, although it is questionable whether we should consider these two events as completely distinct. The differences, in this respect, between the discretionary and the IT frameworks suggest that IT could be a key factor in providing stability to financial markets. Markets need a transparent monetary policy, one they can anticipate and understand, and this in-

[53] We also looked at the behaviour of narrow and broad money aggregates, before and after the adoption of IT. Again, we could not find any significant change. These tests are not reported here, but may be obtained from the authors.

crease in transparency is one of the main reasons behind the adoption of IT. If this is true, then IT may be the only feasible floating exchange rate framework in some situations. In an economy where money demand is not sufficiently predictable to allow for money targeting and the credibility of a discretionary monetary policy is not high enough to satisfy financial markets, then the only options available are between an exchange rate target or floating exchange rates with IT. The timing of the adoption of IT in the UK, Sweden and Finland, right after the abandonment of fixed exchange rates, suggests that this was probably the case in these countries.

2.5. *Communication with public and government*

One major area of change initiated by the adoption of IT is the communication of central banks with the public and government. Under IT, the effects of central bank's policy actions can only be observed after a long time, since monetary policy takes several quarters to influence inflation. Under other frameworks, the existence of intermediate targets that reflect policy actions more quickly makes monitoring of central banks easier, but no such intermediate targets exist with IT. We claimed above that credibility and accountability concerns were the main forces driving the adoption of IT. For these reasons, IT demands that central bank develop new forms of communication, to transmit clearly and precisely and to explain their policy actions to other agents. Box H describes the main changes in communication channels introduced by the central banks in our sample in recent years. Some of the changes were not directly related to the adoption of IT, but we include them in our analysis since they are all part of the same trend towards increased transparency and accountability.

Box H

COMMUNICATION WITH PUBLIC AND GOVERNMENT

A. NEW COMMUNICATION CHANNELS

All the central banks in our sample improved the communication channels with the public and government, in recent years. Although some of the changes were not contemporary with the adoption of IT, they are all part of the same trend towards increased transparency and accountability. The main changes introduced by each central bank regarding communication are:

Australia
- *Semi-Annual Statement on Monetary Policy* introduced in May 1997;
- *Quarterly Report on the Economy and Financial Markets* includes a large Section on inflation and extensive discussion of monetary policy changes;
- press releases announcing changes in policy, explaining in detail the reasons for the change.

Canada
- *Monetary Policy Report* introduced in May 1995, published twice a year;
- publication of the Governor's comments to the Board of Directors on *Economic and Financial Conditions and Monetary Policy* (after the following Board meeting);
- press releases announcing changes in policy;
- regular meetings of the Governor and Minister of Finance;
- appearances of the Governor before committees of the House and Senate;
- 'outreach program', under which members of the Board of Directors and senior Bank officials meet with groups of Canadians in all parts of the country.

Finland
- quarterly article on policy with focus on inflation outlook in the monthly *Bank of Finland Bulletin* (in English) and in the quarterly *Markka & Talous* (in Finnish);
- press statement after policy changes;
- more use of public speeches by the Governor to inform on monetary policy and inflation outlook.

New Zealand
- *Monetary Policy Statement* introduced in April 1990, published twice a year;
- quarterly *Economic Projections* (which include a monetary policy assessment Section), published in the quarters between the *Monetary Policy Statement*);
- occasional statements on unexpected developments that affect monetary policy;
- public scrutiny of the Governor by Parliament's Finance and Expenditure Committee;
- extensive programme of private and public speaking engagements by the Governor to inform on and explain policy developments.

Spain
- *Inflation Report* introduced in March 1995;
- press releases to explain some policy changes;
- Banco de España *Annual Report* and monthly *Economic Bulletin* improved to include more information on monetary policy;
- appearances by the Governor before the Parliamentary Committee for Economic Affairs.

Sweden
- *Inflation Report* introduced in October 1993 (initially under the name *Inflation and Inflation Expectations in Sweden*), published quarterly;
- public hearings before the Finance Committee of the Parliament;
- more regular and public reviews of central bank actions, in speeches and lectures by the Governor and staff;

UK
- *Inflation Report* introduced in February 1993, published quarterly;
- formalization of the regular monthly meetings between Governor and Chancellor, prior to May 1997, and since then of the Monetary Policy Committee (MPC);
- publication of the minutes of the meeting (two weeks after following one, between April 1994 and May 1997, and one week after since May 1997);
- press notice after each policy change explaining the main reasons for the change;
- Governor and other members of MPC appearances before the Treasury Select Committee;
- more use of public speeches by Governor and Directors;
- published open letter to the Chancellor from the MPC should inflation deviate more than 1% from central target.

B. INFLATION AND MONETARY POLICY REPORTS

Six of the seven central banks in our sample introduced special publications after the adoption of IT, to inform the public on inflation and monetary policy issues. In spite of the (slight) differences in the titles – some are called 'inflation' and other 'monetary policy' reports – the structure of these publications is very similar, and includes the following points:
- a discussion of recent monetary policy decisions, and their justification in the light of the inflation targets;[1]
- an overview of recent developments in inflation;
- a review of the trends for real and financial variables relevant to future inflation;
- an inflation outlook and its implications for monetary policy;
- 'technical boxes', where specific questions related to the implementation of policy or the analysis of economic indicators are discussed.

[1] The Bank of England's *Report* did not include any discussion on monetary policy decisions prior to May 1997, because in the UK the Chancellor was responsible for monetary policy, not the Bank. Since May 1997, the *Inflation Report* has come into line with those elsewhere on this front.

Given that the reports are usually directed to the general public, discussions in the main text are generally kept at a non-technical level, and almost all data is presented in charts, with very few Tables.[2] Deeper and more technical analyses are confined to the 'technical boxes'. Only the RBNZ's and the Bank of England's reports include quantified inflation forecasts. For the others the inflation outlook only includes the discussion of future trends.

[2] The only exception is the Banco de España's *Report*, that includes a statistical annex.

The public must know what policy actions the central bank is taking in order to have an impact on credibility, and they need to understand and believe those actions to be the appropriate ones to achieve the target. In order to achieve these goals, the central bank may use a set of different communication channels. First, a central bank can immediately and fully disclose policy changes, and the reasons for the change, through press releases issued at the precise moment the measures are taken. This is particularly important in those countries where there is no administratively set interest rate, and the central bank acts mainly through intervention in money markets. For instance, the Reserve Bank of Australia immediately announces, through press releases, any change in its operational target range for the money market rate, instead of just signalling it through market interventions, as happened previously. The disclosure of this information reduces uncertainty about current policy, and may contribute to reduce instability in financial markets, besides allowing agents to form a more informed view of future inflation prospects. Even in the countries where the nature of the policy instrument implies an immediate disclosure of the change, the accompanying press release has an important role in explaining the reasons for the move. For instance, in the UK, changes in the main instrument, the money market dealings rate, have to be immediately disclosed, since it is an administratively set rate. Nevertheless, the press release is important because it explains in some detail the reason for the change, and this justification may contribute to persuade the agents that the move is consistent with the inflation target, thus strengthening the credibility of the monetary policy.

Another channel central banks may use to improve the credibility of their policy is regular monetary policy and inflation reports.

These reports could take the form of a separate publication or they could be included in regular central bank bulletins. Most central banks in our sample (6 out of 7) preferred to introduce a separate publication, probably thinking that it would have a stronger impact on agents' expectations, because a separate publication will receive more attention from the media than a bulletin article. The structure of these reports is also described on Box H. Through these reports, the public can monitor and evaluate monetary policy with an inflation target. In some countries (e.g. Spain) the report is sent to Parliament, increasing the transparency and political accountability of the central bank activities. The main role of the reports is to make public the central bank's inflation outlook and explain how this outlook was formed. The reports may also be used to provide a detailed justification of current monetary policy actions, and explain why these actions are consistent with the inflation target. Finally, the reports may be used to educate the public on the problems involved in the execution of monetary policy, and the importance of price stability.

We would expect, in a situation where the public *i*) believe the central bank's implicit objectives coincide with the inflation target, *ii*) believe the model the central bank is using is adequate, and *iii*) believe all available information is being used by the central bank, that the report would have a major impact on expectations. In fact, in the ideal situation described above, there is no reason why agents would not take official forecasts as their own inflation expectations. However, that is not what we observe, as we will see below, when we discuss the quality of official forecasts and their impact on expectations, which suggests that the public suspects that the central bank's 'secret' objectives are different from the IT, or is sceptical about the technical abilities of the central bank's staff, or believes that the central bank has some private information that they are not disclosing.

The information disclosed in press releases and inflation reports may be complemented by regular speeches by the Governor and other senior officials. These speeches may play an important role in explaining policy decisions, or the importance of price stability, specially because they can address the particular concerns of specific audiences. For instance, the Governor of the RBNZ explained the implications of New Zealand's new policy framework to exchange rate developments in a speech delivered to the Auckland Manufacturers' Association, whose members had been expressing some concern

about the need to have a 'favourable' exchange rate (Brash 1992). This strategy has been pursued by some central banks in our sample (specially the RBNZ), who have increased significantly the number of contacts of central bank senior officials with the public, since the adoption of IT.

All this information disclosure improves, by itself, the accountability of the central bank. But democratic accountability could be enhanced by regular contacts with Parliament and government. Being obliged to explain their policies to democratically elected powers is an additional source of pressure that forces central banks to stick to targets, especially if penalties could be imposed on the central bank's Governor if the policy is not consistent with the IT. This is the case in New Zealand, where the Governor can be dismissed if targets are not met, and inflation outcomes are closely monitored. When in June 1995 underlying inflation overshot the target by 0.2 percentage points (and again in March 1996, when the target was overshot by 0.1 percentage points), the Minister of Finance immediately called for an official report on the performance of the Governor from the non-executive Directors at the RBNZ Board.

Finally, communication channels can be powerful policy instruments. In certain cases the communication of future developments in inflation is an instrument of monetary policy in itself. In New Zealand, for example, the financial markets almost invariably deliver the necessary monetary conditions as a reaction to central bank comments on inflation outlook. These comments are the instrument the RBNZ has used most frequently; the settlement cash instrument was used only 3 times since 1991.[54] In the UK, the Bank of England comments on the inflation outlook may have had the effect of putting pressure on the Chancellor, who prior to June 1997, had to decide on interest rate changes.[55] In so far as financial markets believe

[54] Mayes and Riches (1996, p. 8).

[55] It has been argued by some commentators (for example, Svensson 1996), that this is why the Bank of England's *Inflation Report* is, by far, the more detailed of all the reports. Although all the reports have similar structures, the detail of information provided varies significantly, with some (e.g. Canada and New Zealand) relying more on non-technical text and charts (with very few Tables), and others (e.g. UK) providing a more technical analysis and large amount of data. It could be argued this was a consequence of the incentives for writing the *Report*, with the former being directed at influencing the expectations of the non-expert general public and the latter being directed at influencing the Chancellor.

that central banks are truly committed to their ITs, they can work out for themselves (using their own models) what interest rate adjustments may be necessary to meet the target, and hence shift the term structure of (forward) rates to reflect that view. Consequently monetary policy may seem to become more "boring" as policy adjustments more often validate prior expectations.

As King (1997, p. 440) stated,

> "A transparent monetary policy implies that announcements of changes in interest rates by the MPC might come as rather little surprise. The news would not be in the outcome of the meetings of the MPC, but in the economics statistics published during the month. Markets would be able to anticipate the likely reaction of the MPC, and the decisions by the MPC would follow a predictable policy reaction function. In contrast, an opaque monetary policy means that the news is the outcome of the deliberations of the MPC and not developments in the economy. In the extreme case, when monetary policy decisions were random, news about the economy would have rather little impact on short-term market interest rates, and more of the news would come from the monetary meeting itself. It is of course tempting for central banks to make their own meetings the main story. But transparency should lead to policy being predictable. It is all part of the view that a successful central bank should be boring, a referee whose success is judged by how little his decisions intrude into the game itself.
>
> Some recent work by Andrew Haldane and Victoria Read at the Bank of England (1997) suggests that there is some evidence that boredom is starting to set in. They examined the extent to which forward market interest rates at different points of the yield curve jumped in response to changes in official interest rates. In the limiting case of perfect transparency, where the authorities' reaction function is known with complete certainty, market rates would not respond to changes in official interest rates. There would be no news in official interest rate announcements.
>
> Over the same period January 1985 to March 1997, Haldane and Read found that changes in forward interest rates along the entire yield curve were systematically related to changes in official interest rates. But the average response of market rates to changes in official interest rates has fallen significantly since 1992. The introduction of the inflation-targeting framework appears to have made British monetary policy less exciting – and a good thing too".

In general, if communication succeeds in shaping agents' expectations, it will give an important contribution to the final objective of controlling inflation, since inflation expectations play a key role in inflation developments. But agents will only be convinced if the quality of the information is high, and the central bank is credible. The quality of central bank forecasts and the credibility of monetary policy are the topics of the following Sections.

3. Inflation forecasting and controllability

The IT framework implies that an (explicit or implicit) inflation forecast is the intermediate target of policy. Svensson (1996, pp. 14-15) argues that the inflation forecast is an ideal intermediate target because it possesses a number of desirable characteristics (see also Haldane, Batini and Whitley 1998):

– the inflation forecast is the variable that has the *highest correlation* with the policy objective (future inflation);

– the inflation forecast is *controllable* through changes in monetary conditions (and it is even more controllable than future inflation itself);

– the inflation forecast is *easy to observe* (and easier to observe than future inflation).

Inflation forecasts have these characteristics virtually by definition, and we are not going to discuss whether inflation forecasts are better intermediate targets than other possible alternative intermediate target. In this Section, we investigate whether inflation forecasts are intermediate targets good enough to deliver the policy outcomes implicit in the design of the IT. The fact that inflation forecasts have the highest correlation with future inflation certainly does not imply that this correlation is 1, and not even that it is high enough to be consistent with staying within the target range. Inflation forecasts are not precise, and in Subsection 3.1 we discuss whether they are sufficiently accurate as a guide to future outcomes to serve as an intermediate target in a policy directed at keeping inflation inside a narrow

range. Not only are inflation forecasts inaccurate, but uncertainties about the timing and strength of monetary policy actions together with other limitations on their unfettered use imply that such actions cannot generally be taken to bring such forecasts back to their desired central level wisely and quickly, i.e. that inflation *forecasts*, as well as current inflation, cannot be precisely controlled. These facts, as well as late shocks affecting inflation after it is too late for monetary policy to be sensibly used to offset them, given the lengthy lags in their normal operation, will cause inflation outcomes to deviate from any pre-set target, and in Subsection 3.2 we discuss whether monetary policy may be expected to keep inflation inside a 2-3 percentage point wide band. Finally, in Subsection 3.3 we compare the inflation performance of IT countries with non-IT countries, to assess whether the IT framework has delivered superior outcomes.

3.1. *Forecasting record*

Inflation forecasts are central to the IT framework: as described in Subsection 2.3, the policy rule is defined in terms of an inflation forecast. Thus, an efficient IT policy framework demands good inflation forecasts, i.e. forecasts implying low forecast errors. In Box I, the quality of the forecasts made by some of the central banks in our sample is analysed. The results suggest that in the past forecast errors were large, relative to the width of IT bands. The average MSE for forecasts 4 quarters ahead has been larger than 0.5 percentage points in the countries analysed in Box I. This suggests that the probability of the targets being missed is quite high, even if the forecast is kept always at the mid-point of the band, if the forecasting accuracy does not improve. Also, central banks tended to overestimate or underestimate inflation for quite long periods. Nevertheless, there are some encouraging signs. The quality of the forecasts seems to be improving over time, which could suggest that the initial errors were the result of a period of learning of how to operate in a new framework, and that in time forecasts may achieve an improved level of accuracy.

Box I

INFLATION FORECASTS AND INFLATION OUTCOMES

The only data regarding central bank's forecasts available are for Australia, New Zealand and the UK. Table I.1 describes the forecast mean error and mean absolute error (MAE) for these 3 countries, over different periods of time, of the forecasts of inflation made 1 year before.

TABLE I.1

INFLATION FORECAST ERRORS

	Australia		New Zealand		UK	
	Mean	MAE	Mean	MAE	Mean	MAE
1981/88 *	-0.3	1.7	-0.6	2.1		
1988/92	0.2	1.1	0.3	1.6		
1993/96	0.2	0.5	-0.6	0.6	0.4	0.6
1994	0.5	0.5	-0.2	0.3	0.8	0.8
1995	-0.1	0.1	-0.7	0.7	0.3	0.4
1996	0.9	0.9	-1.0	1.0	0.1	0.5

* 1974/88 for New Zealand

Evidence from Table I.1 suggests that the Reserve Bank of Australia and the RBNZ tended to underpredict inflation during the high inflation period of the Eighties, and to overpredict it during the deflationary period of the early Nineties. More recently, this tendency to overestimate inflationary pressures has continued to be verified in the Reserve Bank of Australia, but in the RBNZ it has been replaced by a slightly regular underestimation of the inflationary pressures.

The mean absolute forecast error tends to be relatively large, even in the period of low and less volatile inflation, compared to the width of the target bands. Even if these central banks manage to keep forecast inflation exactly at the mid-point of the band, the error margins implicit in the target ranges (0.5 percentage points in Australia and 1.5 percentage points in New Zealand and the UK) are not much larger than the MAE, which suggests that the probability of missing the target must be high.

Early in our sample period forecasts tended to be less accurate. This is probably due to the higher levels of inflation, but it could also be the result of an improvement in the quality of forecasts, because of a learning process inherent in any period of transition between regimes.

The forecasts on Table I.1 were prepared under the technical assumption of unchanged monetary policy. It could be argued then that the differences between the outcomes and the forecasts could be explained by the policy actions taken on the basis of these forecasts, and are not a consequence of forecasting inaccuracy. Although we accept this could explain part of the divergence, we believe that this problem has a small influence, and most of the divergence reflects forecasting inaccuracy. First, because monetary policy is supposed to act on inflation with a lag of at least 6 quarters, policy changes made after the forecast should not have a significant effect in the 4 quarters ahead forecasting period. In a study of inflation for-

casts in Australia, over the period 1985-94, Stevens and Debelle (1995, p. 89) adjust the inflation outcomes for the effects of policy changes; using their data, and comparing them with official forecasts, one still gets MAE of around 1.3 percentage points, versus 1.8 percentage points before the adjustment. Second, evidence provided in the February 1996 Bank of England's *Inflation Report* suggests private forecasts tend to be no better or even worse than the Bank's forecasts. Data from the RBNZ also suggest that in New Zealand forecasts from the private sector are no better than the Bank's. Stevens and Debelle's data provide similar evidence: the official forecasts in Australia have MAE that are roughly equal to the ones of private forecasts (around 1.8 percentage points). Private forecasts should not have the drawback of assuming unchanged policies, and the errors in their forecasts may be taken as evidence of the limitations of current forecasting technology.

Forecasting inflation several quarters in advance is difficult. Central banks recognise that, either in their words (e.g. King 1996, p. 5) or their actions, since they do not apply the inflation target rule blindly and mechanically. As we have seen above, in practice there is not always a clear distinction between a discretionary policy and IT, since policy decisions are not based exclusively on inflation forecasts. The forecasting record of some of the central banks so far suggests that it is prudent to do so. In particular, the Bank of England emphasizes the probability distribution (in its now famous fan-chart) of its forecast for inflation and refuses to provide a single point estimate. Also note that the MPC tries to assess the varying balance of risk, so that the probability distribution is generally skewed, which has the consequence that the mean, median and mode of the probability distribution all differ from each other.

3.2. *Inflation controllability*

Before the adoption of IT, the general opinion was that inflation could not be controlled easily or precisely, and the initial comments on the adoption of IT reflected this view. This was also the view among the central banks that adopted this framework, and this was reflected on the adoption of ranges, instead of point targets, and on some clauses that determine the targets should not be met at every moment but should only hold on average. Past behaviour of inflation

and simulation studies justified such caution and suggested that even 2 percentage points bands might well be too narrow.[56]

Box J describes our efforts at assessing central bank' experiences with setting and achieving such targets. It is still too early to make any definitive judgements, given the short experience in most of the countries, but the results so far suggest that the target ranges have been set too narrowly (see Table J.1 in Box J). In New Zealand and Canada, the countries where IT was first introduced, headline CPI (the formal target) was outside the set target range for almost 50% of the quarters. In Canada, all the target misses consisted of undershooting the transition path, and do not relate to the 'final' target. In New Zealand, most of the deviations from target can be explained by the exemption caveats or an unexpectedly early success in reducing inflation, that caused inflation to undershoot the 'transition' targets. Still, even if the Bank of Canada and RBNZ can claim that they were successful in reducing inflation even faster than expected, these results raise two questions. First, although the results for New Zealand improve if we use underlying inflation, i.e. a measure of inflation that controls for all the caveats in the Policy Target Agreement, it is questionable whether we should use this measure when analysing the controllability of the IT. After all, the target is set in terms of headline CPI, and that measure of inflation was significantly outside the target for several quarters. If underlying inflation is the target, *de facto*,[57] then it would probably be better, from the point of view of credibility, to set the formal target in terms of the underlying inflation index. Second, while it can reasonably be argued that, given the prior history of high inflation in the countries in our sample, an undershooting of the transition path was a good outcome, not a bad one, from the point of view of *controllability*, this is still a sign that inflation was not accurately forecast, and hence easily controllable. If the central banks could have accurately forecast inflation, then they would have set a

[56] Freedman (1995a, p. 27) notes that empirical work undertaken at the Bank of Canada at the time of the IT adoption suggested bands wider than 2 percentage points should be used. Simulations for Australia (Stevens and Debelle 1995) and the UK (Haldane and Salmon 1995) also suggest that the optimal band width should be higher than the one adopted.

[57] As officials in the RBNZ claim it to be, and as it seems to be accepted by the public in New Zealand.

steeper transition path, compatible with what they thought was the desirable outcome for inflation.[58]

Box J

INFLATION TARGETS AND INFLATION OUTCOMES

In this Box we try to assess, from the experience of the central banks in our sample, how controllable inflation is, by comparing the targets that they had set with the inflation outcomes. The purpose of this exercise is to measure how easy it is for a central bank to set a target and achieve it, and *not* to measure the success of monetary policy. This is for several reasons; first, because in some countries the design of the IT does not require inflation to be inside the target range all the time, and thus missing the target in one quarter does not constitute a failure.[1] Second, because some targets are not precise enough to determine objectively if a given outcome is a success; we had to make some assumptions that may be questioned.[2] Finally, because some of the results include 'transition targets' that may have a secondary status relative to the 'final targets'.

[1] For example, the Bank of Canada recognizes that the role of monetary policy is not to keep inflation permanently inside the target range, but to ensure that inflation returns to the range if some shock pushes it outside. Other targets (e.g. New Zealand) are meant to hold at all times. For the UK, King (1997, p. 441) noted that "The MPC is required to send an open letter to the Chancellor if inflation is more than 1 percentage point on either side of the target of 2.5%. Given past experience of inflation volatility, it is likely, even allowing for the change in policy regime, that the MPC will have many opportunities to restore the lost art of letter-writing to British life. And it is important to stress that avoiding the need to write such a letter is not the objective of monetary policy. The inflation target is not a range of 1.5% to 3.5%, it is a target of 2.5% on average. Indeed, one of the main purposes of the open letters is to explain why, in some circumstances, it would be wrong to try to bring inflation back to target too quickly. In other words, the MPC will be forced to reveal in public its proposed reaction to large shocks".

[2] The first assumption refers to the definition of the Bank of Finland's IT: it is not obvious what should be considered as 'around 2%'. Given that the point of this Box is to assess how easy it is to meet a range target of the usual 2-3% width, for Table J.1 we assumed the Bank of Finland had a 2% ± 1.5% target. The Banco de España set 'transition targets' for 'early 1996' (which we took to mean the first quarter average), and upper references of 3% for the 'opening months of 1997' (assumed to be the first quarter) and 2.5% 'at the end of 1997' (assumed to be the fourth quarter). For the 1997 targets, the width of the band was assumed to be 2%. Finally, the RBNZ set 'transition targets' that were changed several times, and only refer to inflation in the 4th quarter of 1990, 1991 and 1992. The assumptions regarding the change of targets are described in footnote 45, and the targets for the 1st, 2nd and 3rd quarters of 1991 and 1992 assume a steady downward path for inflation.

[58] A related question is whether reactions to a breach in a final target range should be symmetrical. Will governments and public tend to accept undershooting, but not overshooting, of the target? In terms of final targets we do not have much evidence so far, but the reaction to the undershooting of the transition paths suggest that this is a possibility.

The exercise in this Box uses quarterly data, from the first quarter of 1988 to the third quarter of 1997, for the headline and underlying (where available) CPI.[3] Figure J.1 plots these data as well as the inflation targets adopted by each central bank. The thick solid line represents inflation measured by the index officially targeted, the thin dashed line represents the other measure of inflation, and the horizontal dotted lines represent the target limits.

The charts in Figure J.1 show that in most cases inflation was close to the target, although in some quarters it did not fall inside the target range. Table J.1 quantifies the number of quarters the targets have been in force up to 1997:3, and in how many of those the targets have been missed. We interpret the results in Table J.1 as evidence that the uncertainty surrounding inflation forecasting and the effects of monetary policy makes it difficult to set a 2 percentage points target range and achieve it. Only in Spain inflation was inside the band every quarter, but the number of observations is small. More data are available for the UK, where the targets have almost always been met, but there the width of the band was 3 percentage points until 1997:1.[4] In Australia, Canada, New Zealand and Sweden, the band seems to be too narrow, since inflation was outside the range almost half of the quarters.

TABLE J.1

OFFICIAL TARGETS AND INFLATION OUTCOMES

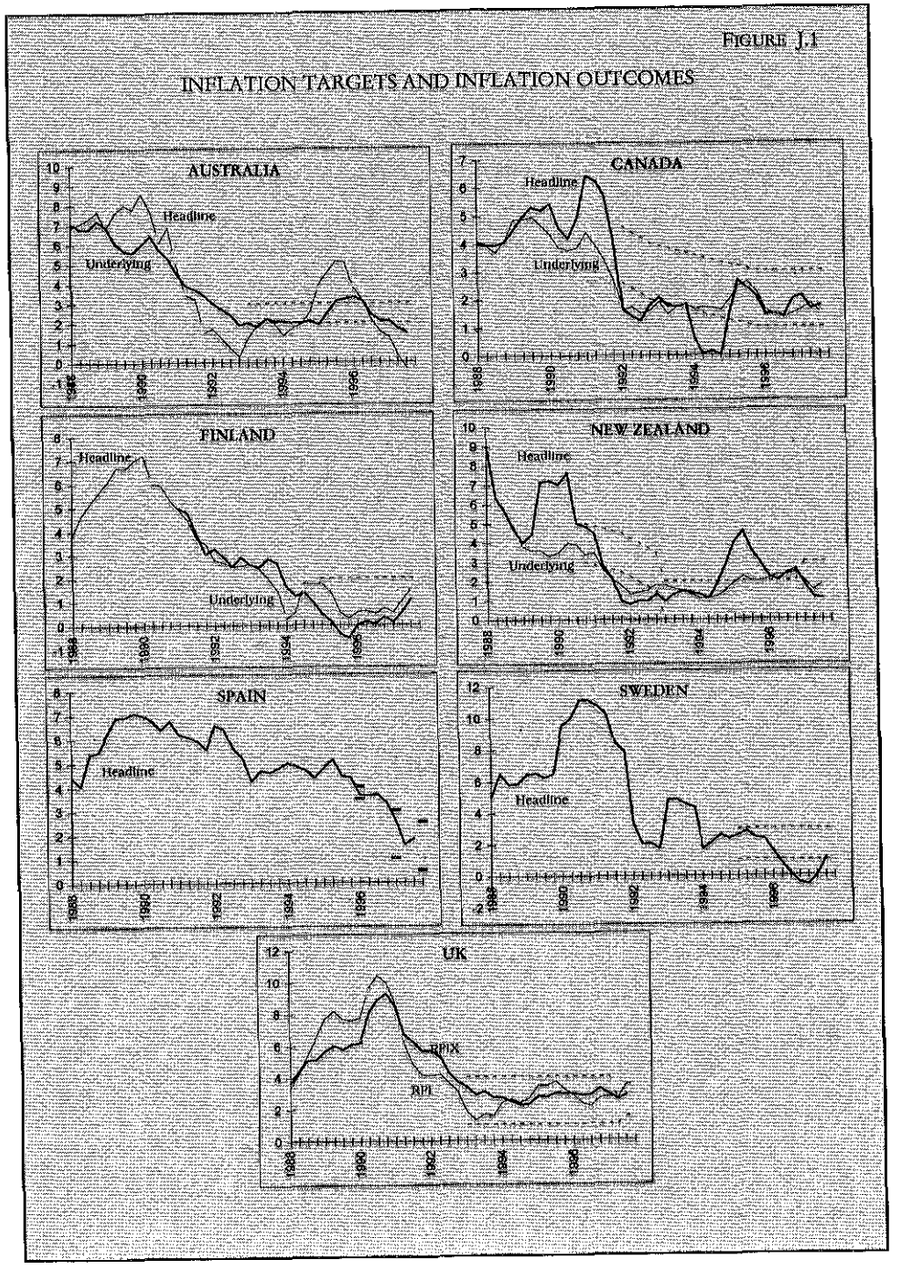
Official target	Quarters with target	Quarters outside target range	
		Number	Percentage
Australia	19	8	42
Canada	23	10	43
Finland	8	8	100
New Zealand	28	14	50
Spain	2	0	0
Sweden	11	5	45
UK	19	1	5

[3] The headline inflation data corresponds to the series "Annual changes for consumer prices" from the *International Financial Statistics*. The underlying inflation series for Australia, Canada and New Zealand were provided by the respective central banks. The 'RPIX' series for the UK was obtained from *Datastream*, and for Finland underlying inflation is the series "Indicator of underlying inflation (1990=100)", published in the *Bank of Finland Bulletin*. Except for Australia and New Zealand, where the inflation data is released quarterly, the quarterly inflation was computed as the average of the monthly inflation rates.

[4] In the UK the only observed miss was marginal, and occurred in the only quarter when the band width was 1.5%. This happened in 1997:2, the quarter corresponding to the end of the previous Parliament, when inflation should be below 2.5%, according to the initial IT. It turned out that average inflation for the quarter was 2.56%.

FIGURE J.1

INFLATION TARGETS AND INFLATION OUTCOMES



When analysing Table J.1, it must be taken into consideration that in Australia the targets are supposed to hold on average. The average underlying inflation for the period 1993:1 to 1997:3 in Australia was 2.3%, which means that so far the Reserve Bank of Australia has been meeting their target. Also, the Bank of Finland did not have an explicit band. Although the inflation outcomes would be outside a 3 percentage points band, it is a matter of judgement whether inflation outcomes in Finland were 'around 2%'. Anyhow, the mean absolute deviation from the 2% target, for the period Q1 1995 to Q4 1996 was 2.0 percentage points, which we interpret as evidence supporting our claim that ±1 percentage point bands are too narrow.

In New Zealand and in Canada, the inflation target is defined in terms of the headline CPI, but with some caveats, so that in practice the target is considered to be a measure of underlying inflation that extracts the influence of the caveats from headline inflation. Using these indices of underlying inflation, the likelihood of meeting the pre-set targets increases, as described in Table J.2.

TABLE J.2

INFLATION TARGETS AND UNDERLYING INFLATION

Underlying inflation	Quarters within target	Quarters outside target range	
		Number	Percentage
Canada	23	7	30
New Zealand	28	11	39

Even if we consider the exceptions in Table J.2, the likelihood of central banks meeting their targets is still relatively low. The countries with the longest record of targets, Canada and New Zealand, have missed them for a significant number of quarters. The only promising feature of the evidence in this Box is that most of the misses occurred in the transition period. If we consider only the 'final' targets, the results improve in particular in the case of Canada, where all the misses occurred in the transition period. However, in terms of 'final' targets the evidence is even more scarce,[5] and no strong conclusions can be drawn.

[5] 'Final' targets are the ones which correspond to the definition of 'a low and stable level of inflation' for each central bank. 'Final' targets are defined in opposition to 'transition' targets, which set a downward path for inflation. This does not mean that 'final' targets cannot be changed; in New Zealand and Canada, the current 'final' targets only apply until 1998. These 'final' targets have been in force in New Zealand, since the first quarter of 1993 (19 data points available), in Finland and Sweden, since the first quarter of 1995 (11 data points available), in Canada since the fourth quarter of 1995 (8 data points available) and in the UK since the second quarter of 1997 (2 data points available). The Australian target is in force since 1993 (19 quarters), but if we take the target to be the average inflation, then only 1 data point is available.

The results for some of the other countries (Australia, Spain and the UK) were more encouraging, with the targets being met so far (see Box J).[59] The fact that the targets in Australia and the UK (initially) were less ambitious (wider bands or average inflation) might have helped their better performance. Anyhow, even if the data are not rich enough to allow for definitive judgements, two conclusions may already be drawn. First, headline CPI is not as easily controllable as underlying CPI, a fact that puts into question the credibility of narrow targets set in terms of this index. The impact on expectations of establishing a target and missing it half of the time, even if you can justify the deviations using the caveats, is probably less than the impact of a target set in terms of a less transparent but more controllable index of underlying inflation. Second, as is obvious, even underlying inflation cannot be controlled perfectly, and some of the central banks in our sample have already missed the target for some quarters.

3.3. *Inflation performance in IT and non-IT countries*

If we accept the view that, given the prior history of high inflation in most of our sample, for many of the central banks it was more important to reduce inflation than to keep it inside a narrow range, the performance of the central banks in our sample could then be described as good. Average inflation after the adoption of IT was 2.3%, against 6.0% in the period between 1987 and the adoption of IT (see Box K). The average standard deviation was also lower (1.2% against 2.4%), although the decrease in variability of inflation is due to the lower levels of inflation (the coefficient of variation has increased from 0.37 to 0.58).

However, inflation performance in IT countries benefited from favourable international conditions. Box K reports the inflation outcomes in selected OECD countries compared to the outcomes in our sample. The results are very similar for IT and non-IT countries. The

[59] The only missed observed in the UK was marginal. In Australia the target does not have to hold at all quarters, only on average, so formally there was not a failure to meet the target, although inflation was outside the target range for more than a third of the quarters. In Finland, the target does not define explicit bands, so one cannot claim it was missed, although the deviations from the 2% target are larger than would be compatible with a band 3 percentage points wide.

fall in the levels and variability of inflation can be observed in all control groups. The only difference relates to the coefficient of variation, that increased significantly more in the IT countries than in the non-IT countries. The fact that relative variability increased in the IT but not in the non-IT countries could mean that IT causes inflation to become more unstable in the short term. In order to keep inflation inside a narrow range, IT central banks may have to seek constantly to pull it up and down, whether non-IT central banks may let inflation drift. Perhaps, the target instability that was observed in money and exchange rate targets may also apply to IT.

Box K

INFLATION OUTCOMES IN SELECTED COUNTRIES

Quarterly consumer price inflation data from the *International Financial Statistics* for the OECD countries was used to compare the inflation performance of IT and non-IT countries. In order to assess the impact on inflation performance of the adoption of IT, we compared our IT countries with a control group of similar non-IT countries. When making this type of comparisons, two main problems arise. The first problem is the choice of the period over which the exercise is going to be made. Somewhat subjectively, we decided to make the comparison over two sets of periods, 1980-89 versus 1990-97 and before IT (since 1987) versus after IT. Since the first IT was introduced in 1990, the first periodicity compares the 80s, a decade when the world did not know IT, with the 90s, the decade of IT. The second periodicity tries to compare the inflation performance of each country (in a shorter period) before and after IT. Since four of the countries in our sample introduced IT near the end of 1992, for the non-IT countries the period before IT was taken to be 1987-92 and the period after IT, 1993-97.[1]

The second question, the choice of a comparable group, is always problematical. In order to obtain more robust results, we chose to select four (overlapping) control groups, according to different criteria, as follows:

Group 1: the countries where average inflation for the period 1980-89 was within the range of average inflation in the IT countries (6.5-11.9%): Denmark, France, Ireland, Italy and Norway; this is a group of countries of similar inflation experiences in the 80s.

Group 2: group 1 plus USA and Portugal, the two countries where average inflation in the period 1980-89 was, respectively, immediately below and above group 1; this group was chosen to give group 1 the same number of countries (7) as in the IT group.

[1] The data for 1997 does not include the fourth quarter.

Group 3: a group of countries chosen to have the same average inflation in the period 1987-92 as the IT countries before IT (6.0%): Italy, Norway, Portugal, Switzerland and USA; the reason for the choice of this group is the same as in group 1, but according to the before IT versus after IT periodicity.

Group 4: a group of 7 countries that face similar economic environments as IT countries; this group is composed of Japan, USA, Norway and Denmark, France and Portugal, and Italy, that we subjectively chose to be the closest match to Australia, Canada, Finland and Sweden, Spain and New Zealand, and the UK.

Table K.1 reports the average inflation level in each of the periods considered, for these four groups as well as for our sample of IT countries. Also reported are t-statistics for two types of test. Test 1 compares the IT group with each control group, where the null hypothesis is that the control group and the IT group have the same average inflation. Test 2 compares the group average in both periods, for a given group, and the null hypothesis is that the group average is the same in both periods.[2]

TABLE K.1

AVERAGE INFLATION IN SELECTED OECD COUNTRIES

	Group average inflation				Test 1				Test 2	
	80s	90s	Before	After	80s	90s	Before	After	90s	After
IT	8.5	3.8	6.0	2.3					-6.5	-5.8
G1	8.6	2.8	4.0	2.3	-0.1	0.9	2.4	-0.1	-6.3	-2.6
G2	9.5	3.5	5.0	2.7	-0.6	-0.2	0.8	-0.8	-3.6	-2.2
G3	9.2	4.1	5.9	2.9	-0.3	-0.9	0.1	-1.1	-2.0	-2.1
G4	8.5	3.3	4.9	2.5	0.0	0.0	0.9	-0.4	-2.6	-2.0

The data in Table K.1 shows that average inflation has fallen significantly in the IT countries, but it also fell in the non-IT countries. The results for test 1 show that average inflation in IT countries is not significantly different from any of the control groups, either before or after the adoption of IT. The inflation experience of the IT countries seems to be shared by all our control groups, and it is not a specificity of the adoption of IT. The only data that might suggest IT countries are different refers to test 2. The significance level of the fall in inflation is generally higher than for the control groups, but this is probably a consequence of the fact that the IT group is more homogeneous than the control groups.[3] After realizing that IT did not have any significant impact in the level of inflation, we tested for differences in inflation uncertainty, measured by the standard deviation of quarterly inflation. Table K.2 reports the results of those tests.

[2] The 90s' are compared with the 80s' and the 'after' with the 'before' IT.

[3] The standard deviation of inflation levels in the IT group is lower than in the control groups. The lower standard deviation implies that any test to the average inflation in the group will tend to have higher significance levels.

TABLE K.2

INFLATION UNCERTAINTY IN SELECTED OECD COUNTRIES

	Average standard deviation				Test 1				Test 2	
	80s	90s	Before	After	80s	90s	Before	After	90s	After
IT	3.6	2.2	2.4	1.2					-2.9	-1.9
G1	4.7	0.9	1.1	0.7	-1.4	3.6	1.7	2.7	-4.9	-1.2
G2	4.9	1.3	1.2	0.7	-1.7	1.6	1.8	2.1	-4.4	-1.5
G3	4.3	1.9	1.5	1.0	-0.8	0.6	1.1	1.0	-2.1	-1.6
G4	4.2	1.4	1.3	0.8	-0.8	1.5	1.8	2.0	-3.5	-1.6

Again there is no evidence that the adoption of IT had a significant impact in inflation uncertainty. Inflation uncertainty decreased significantly in IT countries, but it also decreased in non-IT countries. Inflation uncertainty after IT is higher in IT countries than in the control groups (and significantly higher in one of the groups), but it was also higher before the adoption of IT. Finally, we tried to assess whether or not the lower standard deviation was a consequence of the lower levels of inflation, by looking at the coefficient of variation, reported in Table K.3.

TABLE K.3

RELATIVE INFLATION VARIABILITY IN SELECTED OECD COUNTRIES

	Average coefficient of variation				Test 1				Test 2	
	80s	90s	Before	After	80s	90s	Before	After	90s	After
IT	0.43	0.69	0.37	0.58					3.1	2.1
G1	0.54	0.32	0.27	0.28	-1.6	4.0	1.1	3.2	-3.2	0.2
G2	0.53	0.36	0.25	0.27	-1.7	4.0	1.6	3.7	-2.8	0.4
G3	0.50	0.46	0.29	0.37	-1.2	2.1	0.8	1.6	-0.5	0.6
G4	0.56	0.43	0.31	0.40	-1.7	2.3	0.7	1.2	-1.2	0.6

Here the results are somewhat different for IT and non-IT countries: the coefficient of variation increased in the IT countries more than in all the control groups. Although inflation variability fell in absolute terms in all groups, it increased in relative terms, and this effect was felt more significantly in the IT countries. This different behaviour in the two sets of countries could be a direct consequence of the adoption of IT: since IT central banks are trying to keep inflation inside a narrow range, they will tend to force it up and down more frequently than the non-IT countries, that are content to let inflation drift and only react to large swings. However, this could also be a small sample result, not related to IT adoption.[4]

[4] The behaviour of the coefficient of variation in the individual countries suggests this result might be robust. Among IT countries, only in the UK did the coefficient of variation decrease after the adoption of IT. Among the OECD countries, the coefficient of variation decreased in 7 out of the 17 non-IT OECD countries.

Even if the final results in terms of the fall in inflation were similar in the IT and non-IT countries, this does not mean that the adoption of IT did not make a difference for the disinflation processes. Because the adoption of IT may generate expectations of lower future inflation, it might have facilitated the disinflation process, inducing faster and/or less costly (in terms of increased unemployment or output lost) disinflations. In Box L we examine the disinflation episodes in IT and some non-IT countries, since 1980, and measure the rate of disinflation and sacrifice ratios in each episode.

The adoption of IT was associated with faster disinflation, at least relatively to disinflations in non-IT countries in the same period. It also seems that under IT the disinflation process is less costly, especially in terms of output lost, although the evidence is less conclusive in this issue. Thus, although the OECD countries with high inflation in the 80s managed to reduce it in the 90s, whether they adopted IT or not, how they did it seems to depend on the monetary policy strategy. The adoption of IT might have helped the disinflation process.

Box L

INFLATION, GROWTH AND UNEMPLOYMENT IN SELECTED COUNTRIES

The adoption of an IT may facilitate the process of disinflation, by immediately creating expectations of lower inflation. In this Box, we analyse the disinflation episodes, in the period 1981:1-1997:1, in IT and non-IT countries, and try to assess whether disinflation under IT was easier than before, and/or easier than in other non-IT countries, by measuring the speed of disinflation, and the costs in terms of unemployment and output growth in each episode. Apart from the countries in our sample, we analysed disinflations in the 4 control groups considered in Box K, and the quarterly data for these countries were obtained from the *International Financial Statistics* and *OECD Main Economic Indicators* and *Quarterly National Accounts*.[1] Disinflation episodes were identified using a methodology similar to Ball (1994): each disinflation episode is a period when 'trend' inflation falls substantially.[2] In each inflation episode we examined the disinflation rate and the cost in terms of unemployment and output.

[1] The inflation data are the yearly changes in consumer prices from the *International Financial Statistics*, the unemployment data are OECD standardized unemployment rates, and the GDP data are OECD standardized GDP volume indices (except for New Zealand, which were obtained from *Datastream*).

[2] Trend' inflation is defined as a centred, nine-quarter moving average of actual inflation. To identify disinflation episodes, we identify 'peaks' and 'troughs' in trend inflation: a 'peak' is a quarter in which trend inflation is higher than in the previous four and the following four quarters, and a 'trough' is defined by an analogous comparison. A disinflation episode is any period that starts at an inflation peak and ends at a trough with an yearly rate of inflation at least 2 percentage points lower than the peak. See Ball (1994) for a justification of the procedure.

The rate of disinflation was computed as the average fall in inflation per quarter, measured in percentage points, between the quarters with the highest and the lowest inflation in each episode. Table L.1 summarizes the results for each IT country and for each of the four control groups considered, for the whole 1981/97 sample and for 3 subsamples, for the periods 1981-89 (80s), 1990-97 (90s) and after the adoption of IT (IT).[3]

TABLE L.1

RATE OF DISINFLATION IN IT AND NON-IT COUNTRIES

	Number of episodes			Rate of disinflation (p.p./qrt)			
	80s	90s	IT	80s	90s	IT	81-97
Australia	1	2	1	1.1	0.8	0.8	0.9
Canada	1	1	1	0.6	0.5	0.5	0.6
Finland	1	1	#	0.4	0.3	0.2	0.4
New Zealand	2	2	2	2.0	0.9	0.9	1.5
Spain	1	1	#	0.6	0.1	0.3	0.3
Sweden	1	2	1	0.4	0.7	0.4	0.5
UK	2	1	#	1.0	0.9	0.8	1.0
IT	1.3	1.4		0.9	0.6	0.5	0.7
G1	1	1.2		0.7	0.2		0.5
G2	1.1	1.1		0.8	0.3		0.5
G3	1.2	1.2		0.8	0.3		0.5
G4	1.1	1.1		0.7	0.3		0.5

With few exceptions, one episode in the 80s and another in the 90s were identified. The speed of disinflation in the 90s episode is lower than in the 80s episode across all countries (except for Sweden) and groups. In the 80s episode, the average speed of disinflation was similar in the IT and non-IT countries, but in the 90s it was significantly higher in IT countries, whatever the control group used. If we assume the 90s correspond to the period of IT, then it would seem that IT was associated with a higher rate of disinflation. However, note that for some of the IT countries the 90s episode occurred (or at least started) before the adoption of IT (although when we take only the period under IT the results are not significantly affected).

[3] Results for each individual episode and country are not presented here but may be obtained from the authors. The episodes under IT are included in the 90s group. Only for Australia, Canada, New Zealand and Sweden can we identify a complete disinflation episode after IT. For Finland, Spain and the UK the 90s episode ended under IT, but started before; in these cases, marked '#', the data for the 90s is for the whole episode, but the data for IT is just for the period after IT.

Disinflation processes are usually associated with increases in unemployment and lower output growth. By contributing to create lower inflation expectations, the adoption of IT could help to reduce the unemployment and growth costs of disinflation. For each of the inflation episodes identified using the methodology above, we computed sacrifice ratios in terms of unemployment and output. The ratio for unemployment was computed as the increase in unemployment (Δu) over the decrease in inflation ($-\Delta\pi$), between the quarters with the highest and lowest inflation in each episode. Output lost due to a disinflation episode (λ) was computed as the difference between potential and actual output growth over the same period, with potential output growth assumed to correspond to a yearly rate of growth equal to the average over the 1981-94 period, for each country. The sacrifice ratio in terms of output growth is the ratio between the output lost (λ) and the decrease in inflation ($-\Delta\pi$). Table L.2 summarizes the results for the sacrifice ratios in terms of unemployment and output, for the same countries, groups, and periods used in the previous Table.

In all countries (with the exception of Canada) and groups the sacrifice ratios are higher for the 90s episode. In terms of unemployment, the IT countries have ratios similar to group 1, and above the other groups, either in the 80s or in the 90s. In terms of output, the sacrifice ratio is lower in the IT countries, but again this happens in both periods. If one takes only the period under IT instead of the 90s the performance of the IT countries improves; both ratios are lower than for any other group. Significance tests for the difference between the averages of the IT and the other groups (not presented here) show that the sacrifice ratio in terms of output (but not in terms of unemployment) is significantly lower under IT than in any other group. However, these results rely substantially on the data for Finland and the UK where the episode under IT is just part of a larger episode that started in early 1990. If one takes only the countries with a complete episode under IT, then the sacrifice ratios are not significantly different for the IT and other groups, although they are still lower. Even if one takes all the qualifications into account, the results on Table L.2, although not conclusive, still suggest that the adoption of IT may have made the disinflation processes somewhat less costly, especially in terms of output growth lost.

TABLE L.2

SACRIFICE RATIOS IN IT AND NON-IT COUNTRIES

	Unemployment ($\Delta u/-\Delta\pi$)				Output growth ($\lambda/-\Delta\pi$)			
	80s	90s	IT	81-97	80s	90s	IT	81-97
Australia	0.2	0.6	0.1	0.3	-0.3	1.0	0.1	0.2
Canada	0.4	0.0	0.0	0.3	0.1	0.1	0.1	0.1
Finland	0.1	2.0	0.9	0.9	-1.0	2.0	-2.6	0.2
NZ	0.1	0.3	0.3	0.2	-0.9	-0.7	-0.7	-0.9
Spain	0.4	1.4	-0.2	0.6	-0.3	1.2	0.0	0.1
Sweden	0.0	0.3	0.3	0.2	-0.8	-0.2	-0.9	-0.4
UK	0.2	0.5	0.1	0.3	-0.1	0.7	0.0	0.2
IT	0.2	0.7	0.2	0.4	-0.5	0.6	-0.6	-0.1
G1	0.2	0.7		0.3	-0.1	1.1		0.2
G2	0.1	0.5		0.2	-0.1	0.9		0.2
G3	0.1	0.3		0.2	-0.1	0.9		0.2
G4	0.1	0.5		0.2	-0.1	1.5		0.4

To conclude this Section, we must ask whether inflation is controllable to the point that we can expect inflation targets, with a 2-3 percentage points range, to be met if the central bank follows a sensible policy. It is too early to reach a conclusion, but it seems that it is not possible to control headline inflation, precisely or quickly. It is probably possible to control, on average and over a period of time, some measure of underlying inflation[60] within a reasonable range, but this might come at the cost of an increase in the short-term variability of inflation. If this lack of controllability is confirmed by future evidence, then the positive effects on the credibility of monetary policy that IT is hoped to have could even turn out to be of the opposite sign.

4. Credibility of the inflation target

One of the major objectives (if not the major) of the adoption of IT was to provide an anchor for inflation expectations. In this Section we try to evaluate if this objective was achieved, based on data from household and business surveys, financial markets and wage settlements. Again the lack of data prevents us from reaching definitive conclusions, but some tentative results can be extracted from the available information, although one must not forget that expectations are affected by an array of factors of which the monetary policy framework is just one; at the specific moment when IT was adopted, other factors (e.g. fiscal policy concerns or political instability) might have been affecting expectations in a way that would conceal any (eventual) impact of the IT adoption. Also, in some countries (e.g. Canada, New Zealand) price stability was seen as being the objective of monetary policy even before the central bank announced an explicit IT, and this might have reduced the impact of the announcement. Nevertheless, in this latter case, since the aim of this paper is to discuss the effect of publicly announcing an explicit IT, the lack of an announcement effect is still a sign that IT, as such, does not have an impact on credibility, at least not more than doing what many coun-

[60] This is something of a tautology, because the measure of underlying inflation is designed to include only the inflationary pressures monetary policy can control.

tries not included in our sample have done, that is adopting price stability as the objective for monetary policy.

4.1. *Household and businesses surveys*

Results from different consumer and business surveys that covered inflation expectations in the countries in our sample are reported in Box M. We could not identify any relation between the announcement of IT and inflation expectations. This suggests that the *announcement* of IT does not provide a credible anchor for inflation expectations: words without actions are not enough, as one would expect; it would be surprising to find that a central bank may earn credibility simply by setting a target. However, one would expect that words with actions should have an impact, and that the ability to follow a policy consistent with the target would build credibility: after some years of low inflation and some track record of meeting the targets, these should become credible, and expected inflation should be inside the target range. The evidence on Box M suggests that the targets are in general credible, even though in some countries this only happened after several years of observed low inflation.

Box M

HOUSEHOLDS AND BUSINESSES INFLATION EXPECTATIONS

Figure M.1 plots data of different surveys of inflation expectations. The surveys are of two types. In the first, used for the non-European countries and Sweden, individuals are asked which is the inflation rate they expect in the next 12 months. In the second, used for Finland, Spain and the UK, individuals are asked if they expect future inflation[1] to be higher or lower than current inflation, and the results presented correspond to the difference between the number of the two responses.[2]

[1] In the next 3 months, for the business surveys, and in the next 12 months in the household surveys.

[2] The data sources and expectations series for Figure M.1 are:

Australia: Westpac/IAESR inflation expectations survey (provided by *Datastream*).

Canada: Conference Board of *Canada Quarterly Survey of Forecasters* (provided by the Bank of Canada);

Finland: Consumer survey of Statistics Finland, Business survey of the Confederation of Finnish Industry and Employers (published in Kuismanen and Spolander 1995).

The vertical dashed line marks the moment of the adoption of IT and the horizontal dotted lines the inflation targets.[3]

The main conclusions that may be drawn from Figure M.1 are that the *announcement* of IT does not seem to affect inflation expectations and that in some cases households and businesses do not find the targets fully credible. In Australia expectations were practically unchanged at about 4% from 1991 (before the adoption of IT) to 1996, and only recently they have started to converge to the 2-3% target. In Canada, the data corresponds to the expectations of professional forecasters, not to the expectations of the common non-expert household or business. These have been inside the target range most of the time, and might have been affected by the announcement. However, one cannot tell whether this is a consequence of the adoption of IT or just a good forecast of the actual inflation performance.[4] In New Zealand, household expectations are still above the 0-3% target. The RBNZ survey, which covers households and businesses, tends to show lower inflation expectations, but even those lie outside the target range for some periods. Only in Sweden do households seem to find the IT credible: since the target was adopted, household inflation expectations were always inside the 1-3% target range (but had been at those levels even before IT). However, initially the target was not fully credible for industrial agents, whose expectations tended to lie outside the target range until recently. Finally, although the data for Finland, Spain and the UK is more difficult to interpret, it shows that inflation expectations were not significantly affected by the IT announcement. In the UK (and to a smaller extent in Finland) there was even an increase in inflation expectations, which suggests that also in these countries the target announcements were not fully credible.

NZ: Marketscope survey of inflation expectations (households), Reserve Bank survey of expectations of senior business leaders and other key opinion leaders (provided by the Reserve Bank of New Zealand).

Spain: European Economy – consumer opinion on economic and financial conditions, Ministerio de Industria e Energia – Survey of manufacturing industry (provided by Banco de España).

Sweden: Statistics Sweden, National Institute of Economic Research (published in Sveriges Riksbank 1997).

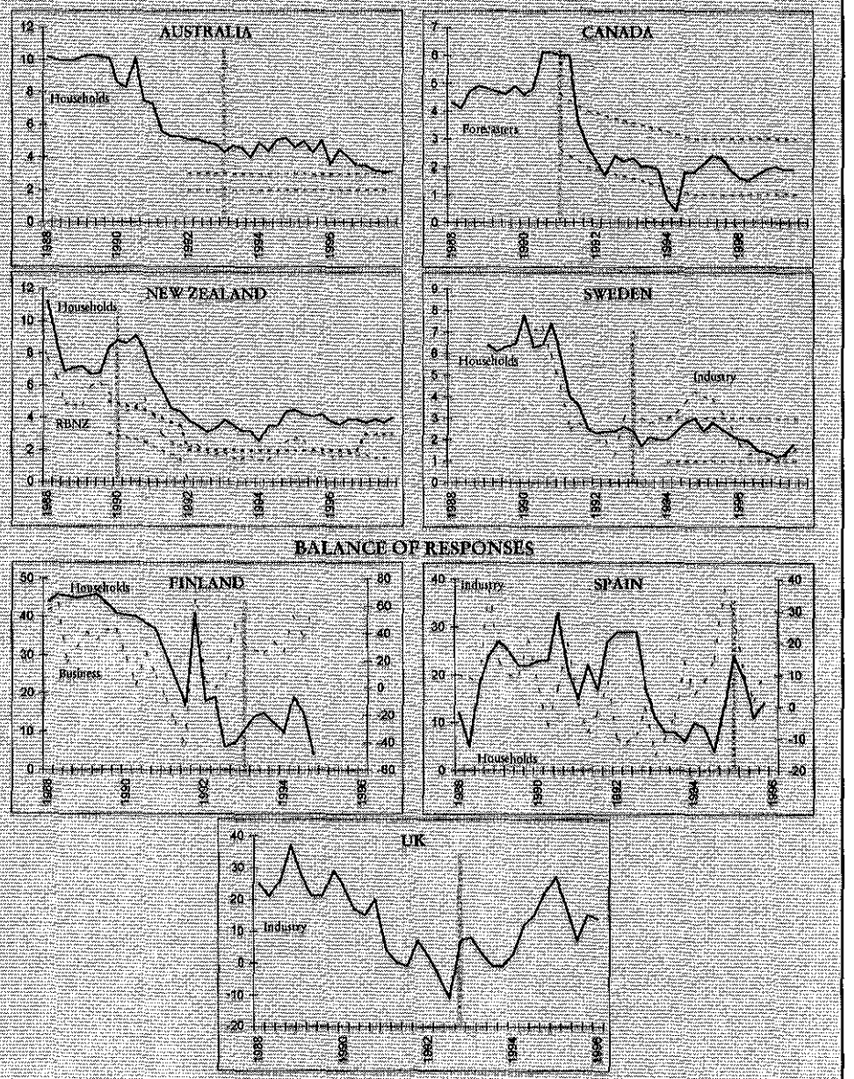
UK: Confederation of British Industry monthly inquiry – expected prices of domestic orders (provided by *Datastream*).

[3] The dates in the charts correspond to the moment the surveys were made. The targets were shifted back 12 months so they refer to the same period as the expectations do.

[4] The Bank of Canada's *Monetary Policy Report* of May 1996 mentioned that 83% of respondents to the Conference Board business confidence survey expected inflation to be 2% or less, which suggests that also among the business community the IT has (at least now) gained substantial credibility.

FIGURE M.1

HOUSEHOLDS AND BUSINESSES INFLATION EXPECTATIONS
Expected change in the CPI in the next 12 months



4.2. *Financial markets*

The evidence that long-term government bond yields were affected by the announcement of an IT is scarce.[61] Either in absolute terms or relative to the yield in Germany or the US, there was no significant change in long-term government bond yields, as can be seen in Box N, Sections A and B. There are only some signs that the adoption of IT may have contributed to the credibility of monetary policy in Finland, New Zealand, Sweden and previously in the UK, but these are not very strong. The evidence in the three European countries is probably related to the exchange rate regime change, and in New Zealand the change was not contemporaneous with the adoption of IT, although it might be argued it was helped by the achievement of the IT targets.

Data for bond market inflation expectations in Australia, Canada, Sweden and the UK (also in Box N, Section C) also reveals the relatively low initial credibility of the announcements: long-term expected inflation was above the target ranges, and even in the shorter horizons of 2 years expected inflation was not always inside the target ranges. However, recent data suggests that the targets may now be credible.

Whatever the measure of expectations used, a common feature among the countries in our sample is that inflation expectations were not significantly affected by the IT announcement, and the IT's credibility remained low during the early stages of the adoption of the framework. In most countries, there are some signs (e.g. medium-term expectations in Canada or bond yield differential in New Zealand) that early successes in meeting targets improved the credibility of monetary policy. However, the evidence is also consistent with a scenario where expectations formation is adaptive, and lower expected inflation is a consequence of the lower observed inflation, the adoption of IT having no effect whatsoever.

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[61] In the UK, even though bond yields did not respond to the announcement of IT, there was an important reaction to the Chancellor's May 1997 statement, granting more independence to the Bank of England. On that day, long nominal gilt yields immediately fell by 50 basis points (0.5 percentage points) both absolutely and relative to the yields on indexed gilts.

Box N

IT CREDIBILITY AND BOND YIELDS

A. LONG-TERM GOVERNMENT BOND YIELDS

Figure N.1 plots the redemption yield on long-term government bonds,[1] daily from 1/1/1988 to 12/12/1997. The vertical line marks the date of the IT announcement. From the charts, we cannot find any significant impact of the IT announcement. In Finland, Sweden and the UK the announcement is associated with a fall in bond yields, but these were already falling before the announcement, and were subsequently reversed. The change in bond yields for these three countries is most likely associated with the adoption of a floating exchange rate (and subsequent depreciation of the currency) than with IT.

Figure N.2 plots the same data, but only for a few months around the date of IT announcement,[2] so the specific effects of the announcement of IT may be easily identified. Finland, Sweden and the UK have similar patterns: a fall in bond yields on the day of the floating (particularly large in Sweden),[3] followed by subsequent falls for several weeks that extend beyond the IT announcement. The only effect the IT announcement appears to have in these countries is to reinforce the decreasing trend in yields. In the weeks immediately before the announcement, yields seem to have stabilized (in Finland) or slightly increased (in Sweden and the UK), but start falling again immediately after the announcement. If this pattern is really a consequence of IT, this would mean that IT helped to provide credibility to the monetary policy of countries where it had been questioned by the abandonment of the previous monetary framework. However, this effect is exclusive of these countries, since it cannot be found in Canada, New Zealand or Spain.

B. LONG BOND YIELD DIFFERENTIAL TO SELECTED NON-IT COUNTRIES

Government bond markets are global markets, thus changes in bond yields might not be caused by domestic factors, but be related to international events. In order to eliminate the effect of international conditions on bond yields, we computed the differential in bond yields between the countries in our sample and some reference country, which we took to be the USA for the non-European countries and Germany for the European countries.[4] Figure N.3 plots the monthly long bond yield differential. Apart from the fall in yields in Finland, Sweden and the UK we had already identified (and had associated more with the floating exchange rate regime than with the adoption of IT), the remarkable feature of Figure N.3 is the fall in the average yield differential in New Zealand from about 400 b.p. until the end of 1990, to about 150 b.p. from mid-1991 onwards. This dramatic change is not associated with the *announcement* of IT, since it occurred approximately one year after it, but it is contemporaneous with a large fall in inflation and the achievement of the first targets. Although it can be claimed that bond yields were only reacting to the fall in inflation, the size and the speed of the adjustment were probably increased by the achievement of the first inflation targets and its impact on monetary policy credibility.

C. INFLATION EXPECTATIONS IN BOND MARKETS

Changes in inflation expectations are just one of the many factors that determine bond yield changes. Comparing the yields in fixed rate and index-linked bonds allows a better measure of financial markets expectations about inflation to be computed. In some of the countries in our sample such measures of long-term inflation expectations are available. Figure N.4 plots quarterly data for the bond market implied inflation rates for Australia, Canada, Sweden and the UK.[5] The vertical dashed line marks the moment of the adoption of IT and the horizontal dotted lines the (medium-term) inflation targets. The common pattern of Figure N.4 is that inflation expectations are now consistent with the targets, even though at the time of the announcement the targets were not fully credible.

[1] The data in Figure N.1 and N.2 are indices of long-term government bonds computed by *Datastream*. The maturities of the bonds used on these indices differ slightly across countries: 10 years for New Zealand, 7 to 10 years for Australia, Sweden and the UK, 3 to 5 years for Canada, all maturities for Finland and 'long term' for Spain.

[2] Figure N.2 does not include Australia, because we are not aware of a specific IT announcement date for this country.

[3] In the day of the floating, bond yields fell 123, 34 and 17 basis points respectively in Sweden, Finland and the UK.

[4] The differential was computed using *Datastream* long-term government bond indices. Given the strong links between the UK and the US economies, we also computed the differential in bond yields in these two countries.

[5] The data for Sweeden and for the 2 year horizon in Canada are not computed from market yields, but are based on surveys of bond market investors. The data sources and expectations series for figure N.4 are:

- Australia: difference between nominal and indexed 10 year bond yields, adjusted for an 8 month indexation lag (provided by the Reserve Bank of Australia).
- Canada: differential between conventional and real return 30 year bond yields (calculated using the appropriate compound interest formula), *Consensus Economics Inc.*'s "Consensus Forecasts 2 years ahead (average)" (published in Bank of Canada 1996).
- Sweden: Aragon Fondkommission – Survey of bond investors' inflation expectations (published in *Inflation and Inflation Expectations in Sweden*, Sveriges Riksbank).
- UK: Bank of England's estimated market expectations of inflation, based on 2 and 10 year bond yields.

FIGURE N.1

LONG-TERM GOVERNMENT BOND YIELD

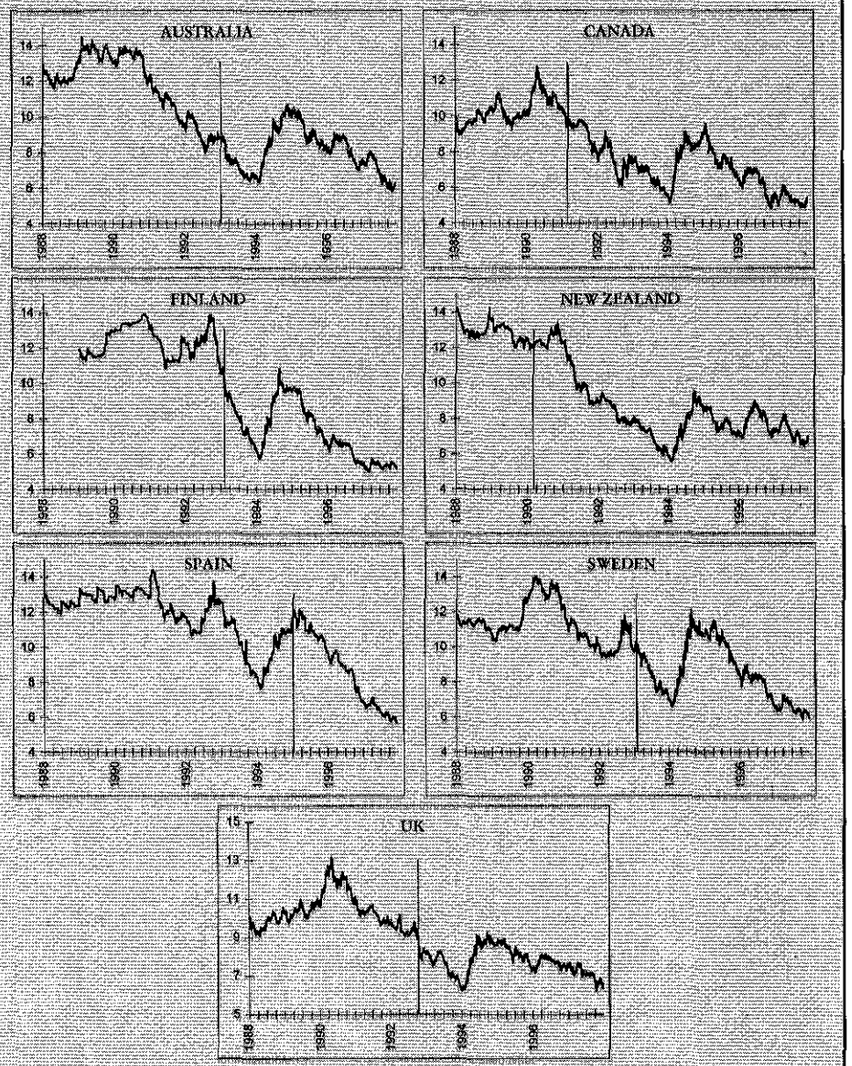


FIGURE N.2

LONG-TERM GOVERNMENT BOND YIELD
Around IT announcement

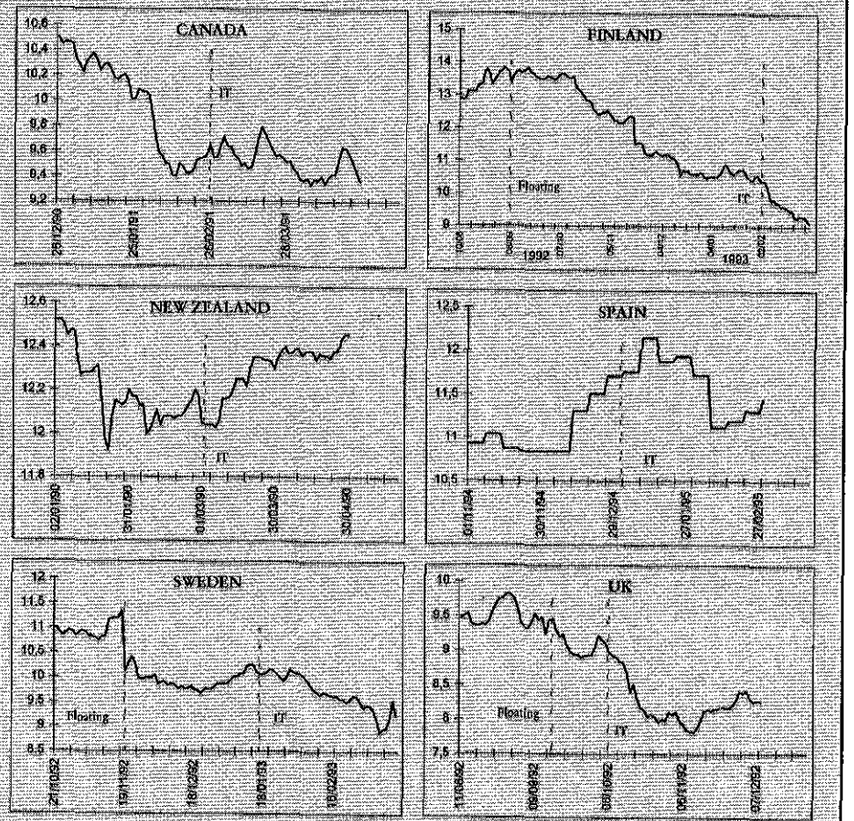


FIGURE N.3

LONG-TERM GOVERNMENT BOND YIELD
Different to Germany or the US

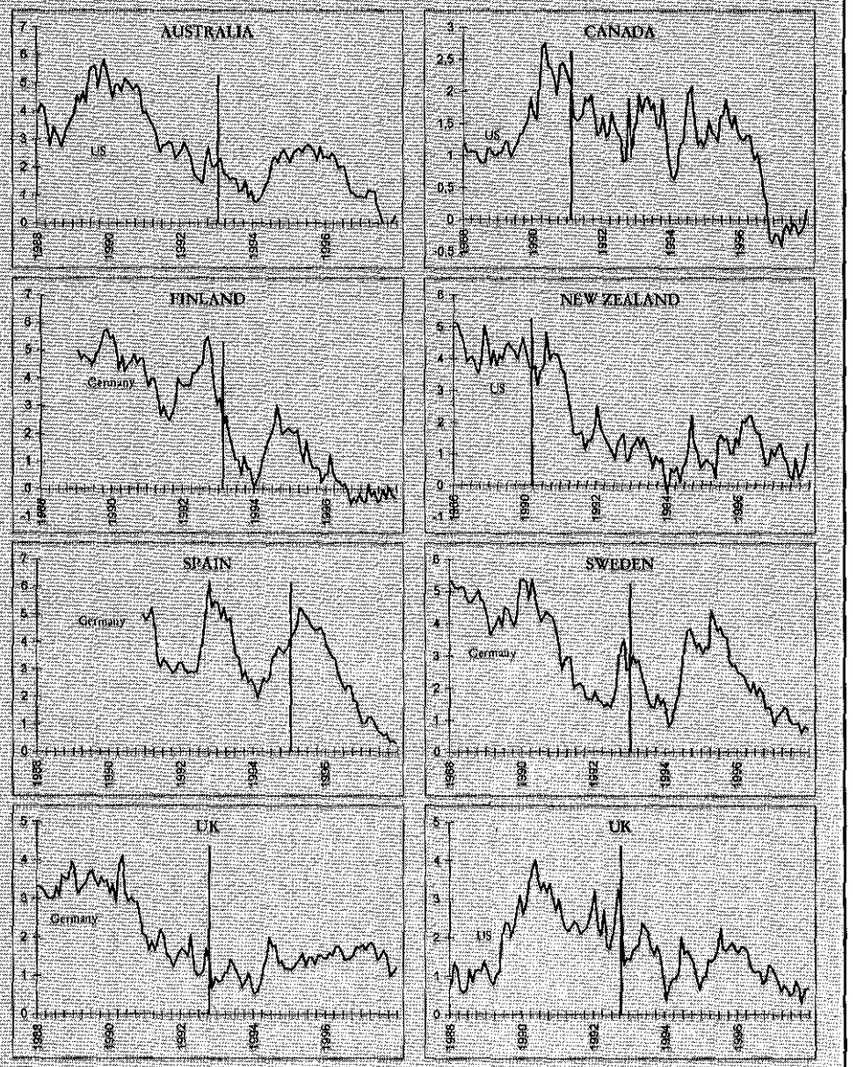


FIGURE N.4

BOND MARKET INFLATION EXPECTATIONS

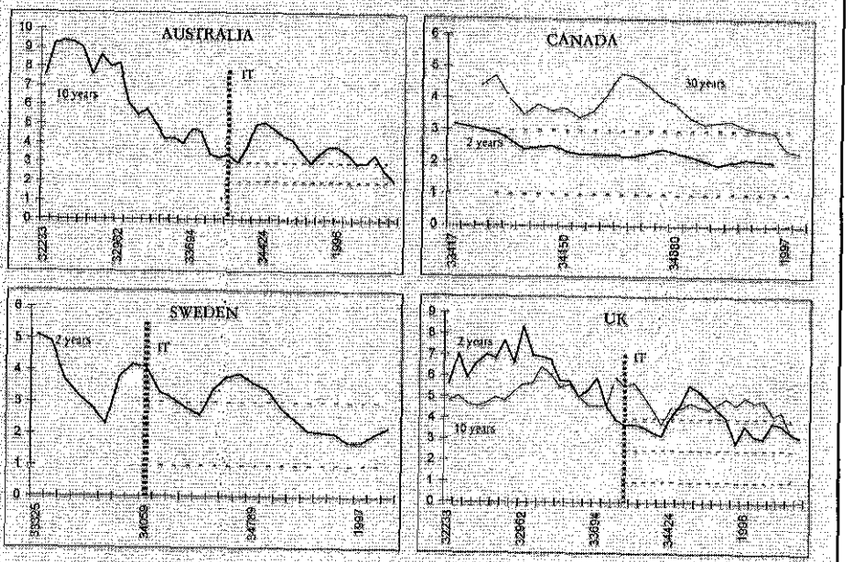
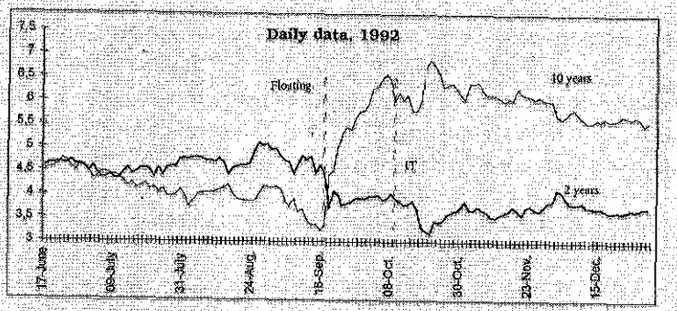


FIGURE N. 5

UK BOND YIELD IMPLIED INFLATION



The implied inflation data could also be used to analyse the impact on expectations of the announcement of IT. Figure N.5 plots 2 and 10 year implied inflation in the UK daily from 17/6/92 to 31/12/92, a period that covers both the change in exchange rate regime and the adoption of IT. The implied inflation data for the UK reinforces the pattern we observed in the previous charts. Expectations were affected by the floating of the British pound, but not by the announcement of IT, although the announcement is associated with the stabilization of the inflation expectations that had been increasing since the floating of the pound. This evidence supports our previous claim that IT helped to provide credibility to the monetary policy of countries where it had been questioned by the abandonment of the previous monetary framework.

Most measures of long-term expectations are now consistent with the targets, suggesting that the IT has 'political credibility' as well as 'operational credibility'. Note that agents could believe that under the current framework the targets may be achieved (operational credibility), but could fear that the framework was not going to be maintained (political credibility), and that future policy frameworks would be more inflationary. In this situation, long-term inflation expectations would be above the IT. The recent fall in these expectations may be associated with an increase in the political credibility of IT in countries where former opposition parties that gained power reaffirmed their commitment to the IT framework (e.g., New Zealand, Sweden and the UK).

4.3. *Wage settlements*

One of the major channels through which inflation expectations are supposed to affect actual inflation are wage settlements. Box O describes some anecdotal evidence that suggests the IT may have had some effect in centralized wage bargaining, and that in some countries wage increases have been relatively low. These are encouraging signs, given the importance of wage cost increases in inflationary processes. However, it is still too early to tell whether these changes in wage settlements are a result of the credibility of the target, or just a consequence of the unfavourable conditions workers faced in labour markets in this period. The relatively high levels of unemployment experienced in the early 90s in all the countries in our sample are likely to

have weakened the bargaining power of the workers in general, and the unions in particular. A definitive conclusion can be drawn only after we have observed some wage settlements reached under excess demand conditions in labour markets, although the evidence from New Zealand suggests that the IT might provide a good anchor for inflation expectations even under conditions more favourable to workers.

In the UK wages and earnings growth remained more subdued than many commentators had expected in 1997 as labour markets tightened and unemployment fell. But the same feature was also apparent in the USA. Even if it should turn out that the 'natural rate of unemployment' has fallen, and it is far too soon to be at all confident on that, the role of the monetary policy regime in bringing about that outcome would be extremely difficult to disentangle.

Box O

WAGE SETTLEMENTS

We have no hard evidence of changes in the wage setting behaviour, specially because it is still too soon to have a sufficient long time series of wage agreements to make any form of quantified statement. We only have anecdotal evidence from several sources, including the central banks in the answer to our letter. Some of this evidence is reported below:

Australia:	"Accord" between unions and government refers to the IT.
Canada:	some anecdotal evidence that negotiators pay more attention to IT.
Finland:	2 year centralized wage agreement (for 1996-98) provided very moderate pay increases with a reference to the inflation target; after IT, initially there were no nominal wage increases because of 'crisis consciousness' but comparatively high wage increases were negotiated at branch level for 1995.
NZ:	unions recognized the implications of the IT; wage settlements have been remarkably low in recent years (most in the 0-3% range, except for small categories of skilled staff), and that despite the fact that unemployment fell from 10.9% in 1991 to 6.1% in December 1995.
Spain:	wages have been bargained taking the IT as reference and wage settlements in 1995-97 were roughly in line with the IT (before 1994 wage increases were regularly above official inflation projections).
Sweden:	wage formation remains troublesome; despite the increased unemployment, wage increases have been higher than in the rest of the

	world; the centralized bargaining process is presently turning out around 4% annual increase in nominal wages, on top of a 6% increase in 1996, even at a rate of unemployment of 10%.
UK:	wage settlements have been consistent with IT; wage growth has undershot current inflation, and has been subdued even in the face of the tightening labour markets and falling unemployment in 1996/97.

Households and businesses probably do not understand the implications of the adoption of an IT, and it is even likely that in some cases they were not immediately aware of such a change. It was not surprising, then, that we did not find any impact on survey data expectations of the announcement of an IT. But asset prices are supposed to reflect the actions of well informed agents, who should be able to assess the true meaning of changes like the adoption of an IT, and we have only been able to find a few cases of a significant impact of the announcement of an IT on financial markets data. It seems that contrary to some central bankers and economists, market agents have initially believed that IT is not a different monetary policy framework, or at least, that in practice nothing has really changed yet with the adoption of IT.

5. Conclusions

In Scottish law, criminal cases do not have to be adjudged either guilty, or not guilty. There is a third category, unproven. Mainly because we have too few data on which to base our judgement, that, we believe, is for the time being the appropriate judgement. One needs a longer experience with IT for any significant differences in central bank behaviour to emerge, if they exist. There are some signs that IT might have had a positive impact, especially in the countries where it has been in force for a longer period (New Zealand and Canada), but most of these are country specific. Systematic patterns across all IT countries are hard to find.

The IT countries have been more successful than their central banks, or outside commentators, had initially expected in lowering,

and then holding their inflation rates to the low desired mean levels. But then so equally were our various control groups. Both groups were helped in this by the international context, although the IT countries may have achieved low inflation faster and at a lower cost in terms of output growth. On the other hand, IT countries have missed their own targets on several occasions, which suggests that in order to be successful the target ranges should be wider than the usual 2 percentage point bands.[62]

Many of the apparent changes in operational characteristics among IT countries were the natural and self-evident results of shifting from an exchange rate target (Finland, Spain, Sweden, UK) to an inflation target (i.e. the exchange rate becomes more volatile, the interest rate less so). Apart from those changes, there are few signs of any significant shift in operational behaviour. It seems that the adoption of IT is instrumental in achieving stability in financial markets, since it is associated with lower exchange rate and interest rate volatility. On the other hand, we looked hard to see if there was any evidence of interest rates being adjusted earlier or in larger jumps (more aggressively) in response to prospective inflationary pressures. There are a few straws in the wind (notably in Canada) and several of the central banks concerned are aware that such a change in behaviour might be needed, if the demanding targets are to continue to be kept. But the bulk of the evidence, so far, does not allow us to dismiss the null hypothesis of no significant change in operational behaviour.

We have, at several places in this paper, drawn a distinction between those IT central banks whose target is jointly set with the government, and those where it is unilaterally set by the central bank itself. *Pace* the *Roll Report*, we believe that the former, joint setting is likely to prove a far firmer bulwark against resurgent inflation. Consequently, we do see a greater likelihood of success in the Anglo-Saxon than in the continental European cases.[63] Perhaps because of this differentiation, it is in the Anglo-Saxon countries that there are

[62] This point received a lot of attention in New Zealand, the country with a longer experience in IT. In New Zealand there was in 1996 widespread criticism of the then current 2 percentage point bands, and several critics (including opposition parties) called for wider bands, which were introduced after their election.

[63] In Finland, Spain and Sweden because it is not clear how much the government is committed to the target; but in Finland and Spain the issue is likely to be overtaken by their participation in the euro; and, perhaps, later also for Sweden and the UK. So for the European countries the experiment with an IT regime may be short-lived.

some signs of a credibility effect. For the rest (including the UK) it is not, once more, possible at the moment to dismiss the null hypothesis of no maintained effect.

If expectations and inflation outcomes are not significantly affected, is there anything really new in the IT framework? The differences with an exchange rate target framework are the obvious differences between operating in a fixed or in a floating exchange rate regime. There is no fundamental difference between monetary targeting and IT; money targeting is just IT when inflation forecasts are exclusively based on money aggregates. When money aggregates are not good predictors of future inflation, IT is a clearly superior framework, and money targeting is not really an option. Where there is an option is between IT and a purely discretionary framework, compared to which IT has two main (positive) differences: the adoption of a quasi-formalized rule, that explicitly states price stability as the only objective for monetary policy, and increased transparency and accountability. The evidence we gather suggests that the impact on credibility of the adoption of a policy rule is small and limited to the short term.

The main difference is probably on the transparency and accountability side. The one field where there is clear evidence of a change in behaviour is in the nature of communications with both the public in general and government in particular. As documented earlier, such communication has generally become quicker, fuller and franker. In some instances, e.g. in Australia, some part of this shift towards greater transparency pre-dated the move to IT. Moreover this trend, towards more open communication, has been worldwide. Nevertheless we believe (though such a qualitative issue is hard to test statistically) that such greater openness has gone further, faster in IT countries than in non-IT countries. This is one patent benefit of the regime change, even if elsewhere much remains unproven.

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