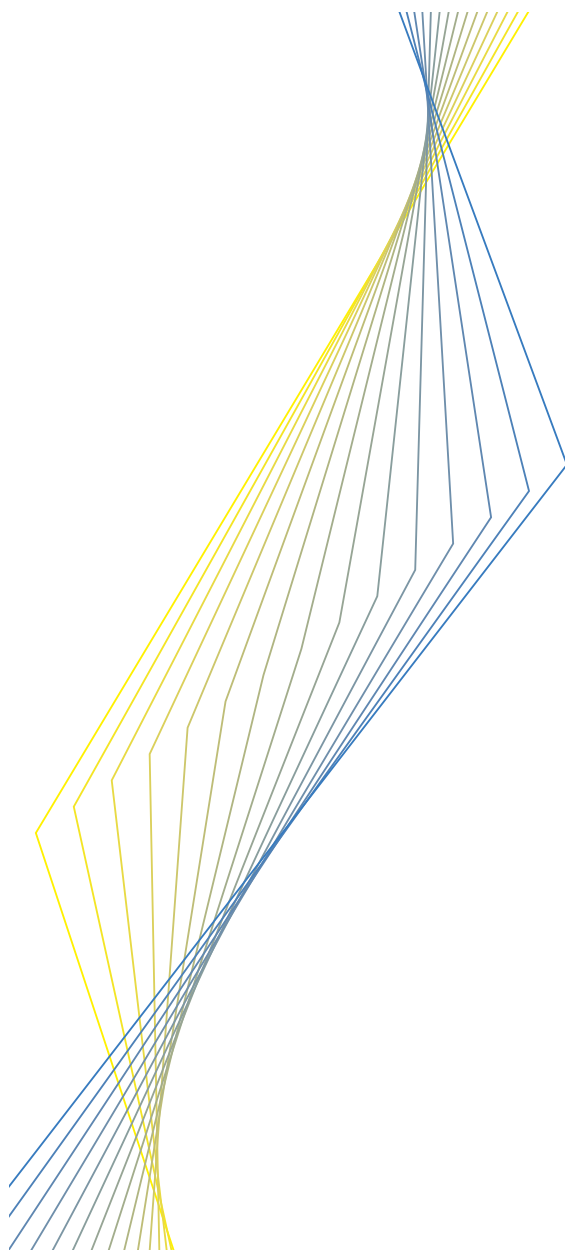ECB EZB EKT BCE EKP

WORKING PAPER NO. 273

DEFINITION OF PRICE STABILITY, RANGE AND POINT INFLATION TARGETS: THE ANCHORING OF LONG-TERM INFLATION EXPECTATIONS

**E. CASTELNUOVO,
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September 2003

BACKGROUND STUDY
FOR THE EVALUATION OF
THE ECB'S MONETARY
POLICY STRATEGY

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DEFINITION OF PRICE STABILITY, RANGE AND POINT INFLATION TARGETS: THE ANCHORING OF LONG-TERM INFLATION EXPECTATIONS[1]

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ABSTRACT

Announcing a quantitative objective for price developments has become a common practice in modern monetary policy making. While the specific features of such announced objectives vary across countries, a common rationale for this is to help anchoring inflation expectations. We use survey data on long-term inflation expectations in 15 industrial countries since the early nineties to investigate how well anchored are inflation expectations. We find that in all countries except Japan long-term inflation expectations are well anchored and, generally, increasingly so over the past decade. When comparing this evidence across types of announcements of the inflation objectives, we find that the specific features of announcements have no visible effect on the performance at anchoring inflation expectations. In particular, there does not seem to be evidence that the announcement of a quantitative objective in the form of a point or of a range for admissible inflation rates makes any appreciable difference.

NON-TECHNICAL SUMMARY

The announcement of a quantitative target is believed to be a powerful instrument for anchoring inflation expectations, providing a device for co-ordinating price and wage setting behaviours and thus for facilitating the conduct of monetary policy by the central bank. This papers attempts to shed light on the effects of central banks choosing (or eschewing to choose) a specific format for expressing or announcing their quantitative of objective for steering price developments. For this, three types of information are considered. First, we collect a description of practices and definitions of the quantitative objective for price developments by the central banks of 15 industrialised countries. Second, we provide an overview of the academic literature that considers economic implications of choosing different formats. Third, we attempt to assess the effects in practice of different formats chosen for the quantitative objective, for the anchoring of longer-term inflation expectations.

As regards the review of practices by major central banks in this respect (which is provided in Section 2 of the paper), we note that over the past fifteen years there has been a growing tendency among central banks to explicitly announce numerical targets for their objective of price stability. This reflects the widely shared consensus that price stability should be the ultimate objective of monetary policy. The announcement of a quantitative target is believed to be a powerful instrument for anchoring inflation expectations, providing a device for co-ordinating price and wage setting behaviours and thus for facilitating the conduct of monetary policy by the central bank. At the same time, while the announcement of quantitative targets is common to many central banks, the specific features of the announced targets vary across the different countries. The various practices include the announcement of a quantitative definition of price stability and inflation targets in the form of point or ranges for admissible inflation outcomes. Moreover, central banks in some countries have chosen not to announce quantitative objectives but have defined price stability only in qualitative terms.

When looking at the debate on the pros and cons of the different choices of a format for the quantitative objective – in particular with a view to the arguments for specifying a range or a point objective for inflation – the following points seem to emerge. The announcement of a range (rather than a point) permits the central bank to clearly signal the uncertainty surrounding future price developments and the imperfect controllability of inflation, particularly at short horizons. Moreover, a range may give more flexibility to accommodate possible moderate and gradual variations in the optimal inflation rate over time. On the other hand, a possible drawback of a range objective is that the bounds of the range may be seen as implying "hard edges", i.e. thresholds values which trigger actions in a quasi-automatic fashion. A point objective may be preferable in this respect. Moreover, a point objective probably increases the signalling properties of the announcement, as it may provide a more precise focal point for the expectation formation mechanism of agents in the economy.

Finally, this paper uses survey data on long-term inflation expectations in 15 major developed countries since the early nineties to investigate how well inflation expectations are anchored in practice. The

empirical evidence suggests that in all countries, with the exception of Japan, long-term inflation expectations are well anchored and, generally, increasingly so over the past decade. This is indicated by both a low and generally decreasing volatility of expectations and a low and a generally decreasing degree of correlation between revisions in short-term and long-term inflation expectations.

When comparing this evidence across types of announcements of the inflation objectives, we find that the specific features of such objectives have no visible effect on the performance at anchoring inflation expectations. In particular, there does not seem to be evidence that the announcement of a quantitative objective in the form of a point or of a range for admissible inflation rates makes any appreciable difference. As regards the euro area, indicators point at a very low volatility of long-term inflation expectations since 1999, at levels which are comparable to those of the best performing countries. With regard to the two countries in our review where no numerical value for the inflation objective was announced, the United States and Japan, inflation expectations appear to be well anchored in the former but not in the latter.

1. Introduction

As a result of the widely shared consensus that price stability is the ultimate objective of monetary policy, over the past fifteen years there has been a growing tendency among central banks to explicitly announce numerical targets for their objective of price stability. This trend is part of a wider process of transformation of the overall monetary policy framework, which has witnessed the acquisition by central banks of a high degree of independence and, in parallel, the adoption of a more open approach in the conduct of monetary policy. In this context, the announcement of quantitative definitions of price stability and explicit numerical targets for inflation is seen to be instrumental for a higher transparency of the policy framework and thereby for the accountability of the central banks. Moreover, the announcement of a quantitative target is believed to be a powerful instrument for anchoring inflation expectations, providing a device for co-ordinating price and wage setting behaviours and thus for facilitating the conduct of monetary policy by the central bank.

This paper reviews the different practices and operational concepts which are used to define the objective of maintaining price stability in 15 major developed countries and the performance of these countries in anchoring long-term inflation.[1] While the announcement of quantitative targets is common to many central banks, the specific features of the announced targets vary across the different countries. The various practices include the announcement of a quantitative definition of price stability and inflation targets in the form of point or ranges for admissible inflation outcomes. Moreover, central banks in some countries have chosen not to announce quantitative objectives but have defined price stability only in qualitative terms.

When looking at the debate on the pros and cons of the different choices – in particular with a view to the arguments for specifying a range or a point objective for inflation – the following points seem to emerge. The announcement of a range (rather than a point) permits the central bank to clearly signal the uncertainty surrounding future price developments and the imperfect controllability of inflation, particularly at short horizons. Moreover, a range may give more flexibility to accommodate possible moderate and gradual variations in the optimal inflation rate over time. On the other hand, a possible drawback of a range objective is that the bounds of the range may be seen as implying "hard edges", i.e. thresholds values which trigger actions in a quasi-automatic fashion. A point objective may be preferable in this respect. Moreover, a point objective probably increases the signalling properties of the announcement, as it may provide a more precise focal point for the expectation formation mechanism of agents in the economy.

Overall, the choice of the specific features of the announced objectives reflects the above trade-offs and appears to be inextricably linked to the overall policy framework and monetary policy strategy followed by the different central banks, in particular with regard to the specific mandates and the chosen horizon for the conduct of monetary policy. Using survey data on long-term inflation expectations, we evaluate the empirical evidence regarding the capability of the various countries in tightly anchoring inflation

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[1] The review also includes countries currently in the euro area for the period prior to 1999.

expectations since the early nineties. The results show that in all countries, with the exception of Japan, long-term inflation expectations are well anchored and, generally, increasingly so over the past 15 years. This is indicated by both a low and generally decreasing volatility of expectations and a low and generally decreasing degree of correlation between revisions in short-term and long-term inflation expectations. When comparing this evidence across types of announcement of the inflation objective, we find that the specific features of such objectives have no visible effect on the performance at anchoring inflation expectations. In particular, there does not seem to be evidence that the announcement of a quantitative objective in the form of a point or of a range for admissible inflation rates makes any appreciable difference. As regards the euro area, indicators point at a very low volatility of long-term inflation expectations since 1999, at levels which are comparable to those of the best performing countries. Finally, the two countries in our review where no numerical value for the inflation objective was announced, the United States and Japan, represent two extreme cases. While in the former country the tightness of inflation expectations is comparable to that of the best performing countries, in the latter expectations exhibit a relatively high volatility.

The rest of the paper is organised as follows. Section 2 briefly reviews the different practices and operational concepts adopted by major central banks in defining their primary objective of maintaining price stability. Section 3 analyses the main rationales, proposed either by the central banks or by outside observers, which may lie behind such choices, in particular with regard to the choice of specifying a range or a point objective for price developments. In Section 4, using survey data on long-term inflation expectations, we evaluate to what extent inflation expectations are well anchored in the various countries. Section 5 concludes the paper.

2. Overview of international practice

Table 1 below presents an overview of the basic features of the objectives announced in major developed countries around the world. While in all countries price stability represents a primary goal for monetary policy, actual practices vary somewhat across countries, ranging from no explicit quantitative definition to explicit quantitative definitions and inflation targets in the form of point targets or ranges for admissible inflation outcomes. In terms of the announcement of objectives for price developments we can distinguish between:

Central Banks that have not announced a quantitative target (the Federal Reserve System and the Bank of Japan).

In the United States there is a broad consensus that price stability deserves primary attention of monetary policy authorities.[2] The US Federal Reserve System (Fed), however, has not set an explicit, numerical objective for price stability. In the early 1990s, the Fed Chairman A. Greenspan clarified that price

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[2] In the Full Employment and Balanced Growth Act of 1978 (the Humphrey-Hawkins Act) a legal foundation is provided by stating that: "The Board of Governors of the Federal Reserve System and the Federal Open Market Committee shall maintain long-run growth of the monetary and credit aggregates commensurate with the economy's long run potential to increase production, so as to promote the goals of maximum employment, stable prices, and moderate long-term interest rates."

stability obtains when "households and businesses need not factor expectations of changes in the average level of prices in their decisions".[3] Later on he clarified that while price stability is the ultimate objective of the Fed, the difficulty to pin down exactly this notion (mainly due to the existence of significant measurement problems) prevents the Fed to adopt a specific numerical target.[4]

In the same vein, in <u>Japan</u> no explicit quantitative definition has been adopted by the Bank of Japan (BoJ) so far. For decades the BoJ has referred to price stability as a "prerequisite for sustainable economic growth and a primary objective for monetary policy". On 13 October 2000 the Policy Board of the BoJ made an attempt to clarify the definition of price stability for Japan "as an environment where economic agents including households and firms can make decisions regarding such economic activity as consumption and investment without being concerned about the fluctuation of the general price level". The BoJ has recently justified its unwillingness to provide a quantitative definition of price stability on the ground that the recent situation in Japan is characterised by exceptional economic conditions and unusual price developments.

Central Banks that have provided a quantitative definition of price stability (the euro area and Switzerland):

For the <u>euro area</u>, the Governing Council of the ECB announced the quantitative definition of price stability on 13 October 1998 as: "Price stability shall be defined as a year-on-year increase in the Harmonised Index of Consumer Prices (HICP) for the euro area of below 2%". The ECB clarified that the use of the world "increase" excludes deflation from the definition and that moreover the lack of an explicit lower bound in the definition reflects the acknowledgement of the existence of an unknown (but likely small positive) and possibly time varying measurement bias in the HICP.[5] Price stability has therefore been defined in the form of a range for allowable inflation rates.

In <u>Switzerland</u>, the Swiss National Bank has provided an explicit quantitative definition of price stability, which is fully equivalent to that of the ECB. It has defined price stability as an increase in the CPI for Switzerland of less than 2%.

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[3] See Greenspan, A. (1994), Statement before the Subcommittee on Economic Growth and Credit Formulation of the Committee on Banking, Finance, and Urban Affairs, U.S. House of Representatives, February 22, 1994.

[4] "[…] *the Federal Reserve can be quite explicit about its ultimate objectives – price stability and the maximum sustainable growth in output that is fostered when prices are stable. By price stability, however, I do not refer to a single number as measured by a particular price index. In fact, it has become increasingly difficult to pin down the notion of what constitutes a stable general price level*". […]. "*For all these conceptual uncertainties and measurement problems, a specific numerical inflation target would represent an unhelpful and false precision. Rather price stability is best thought as an environment in which inflation is so low and stable over time that it does not materially enter into the decisions of households and firms.*" Remarks by Chairman A. Greenspan "transparency in monetary policy" at the Federal Reserve Bank of St. Louis, Economic Policy Conference, October 11, 2001.

[5] See ECB (1999), "The stability-oriented monetary policy strategy of the Eurosystem," ECB Monthly Bulletin, January 1999. See also W. Duisenberg (2001): "*The ECB's monetary policy strategy and the quantitative definition of price stability*", letter of the President of the ECB to the Chairperson of the Committee on Economic and Monetary Affairs, Mrs. Christa Randzio-Plath, 13 December 2001, and W. Duisenberg (2001): "*The ECB's quantitative definition of price stability and its comparison with such definitions or inflation targets applied in other large economic areas*", letter of the President of the ECB to the Chairperson of the Committee on Economic and Monetary Affairs, Mrs. Christa Randzio-Plath, 16 October 2001, www.ecb.int.

Table 1: Inflation targets or definitions of price stability in selected industrial countries

COUNTRY	INDICATOR	NUMERICAL VALUE DEFINITION/TARGET	EX-ANTE HORIZON [*]	ACCOUNTABILITY (EX POST) [*]
1. Europe:				
Euro area	HICP	Below 2% (since 1999) Definition of price stability	Medium term (not sole focus on inflation forecasts; prominent role for monetary developments, which exhibit a medium-term relation with prices)	Medium term
Memo item: Euro area countries prior to 1999 [3]				
Finland	CPI	(about) 2 % Objective for 1998	Focus on two years ahead inflation forecast	
France	CPI	Not exceeding 2% Objective for 1998		Inflation in the year concerned
Germany	Not specified	2% before 1997 1.5 – 2% for 1998 "inflation norm"	Annual monetary target	Monetary developments in the year concerned
Italy	CPI	Not exceeding 2% Objective for 1998		
Spain	CPI	3.5%-4% (Jan. 95-96:Q1) 3%-3.25 % (96:Q1-97:Q1) below 3% during 1997 below 2.5%-2.75% for late 1997 2% for 1998		Inflation in the year concerned
European countries not in the euro area:				
Norway	CPI Focus on core inflation	2½% with a fluctuation margin of ±1% Target	Main focus on 2 years ahead inflation forecast	Timeless with escape clauses [2]
Sweden	CPI	2% with a fluctuation margin of ±1% (Jan.95-now) Target	Main focus on 1 to 2 years ahead inflation forecast with possibility of extending horizon	Escape clauses [2]
Switzerland	CPI	Below 2% Definition of price stability	Medium term with a focus on three years ahead inflation forecast	Medium term
United Kingdom	RPIX (Retail Price Index excluding mortgage interest payments)	1%-4% (Oct. 92-June 97) 2.5 % [1] , (June 97-now) Target	Medium term (with a focus on two years ahead inflation forecasts)	Timeless with escape clauses [2]
2. Other OECD countries:				
Australia	CPI	2 – 3%, (Jan. 1993-now)	Medium term	On average over the

COUNTRY	INDICATOR	NUMERICAL VALUE DEFINITION/TARGET	EX-ANTE HORIZON [*]	ACCOUNTABILITY (EX POST) [*]
		Target		business cycle
Canada	CPI Focus on CPI excluding food energy, and the effect of indirect taxes	Midpoint 2%-4% (Feb. 91-end-1992). Midpoint 1.5%-3.5% (end-92-mid 1994). Midpoint 1%-3% (Dec. 1993 (revised)-Feb 2001; then renewed, and valid up to end-2006). Target	Medium term with focus on six to eight quarters ahead	
Japan	CPI	No numerical value [5] Qualitative definition of price stability	[6]	
New Zealand	CPI (excluding credit services)	3%-5%, range target (Mar. 90-Dec. 90) 2.5%-4.5%, range target (Dec. 90-Dec. 91) 1.5%–3.5% (Dec. 91-Dec. 92) 0%-2% (Dec. 92-Dec 96) 0%-3% (Dec. 96-Nov. 2002) 1%-3% (Nov. 2002-now) Target	Medium term (prior to Nov. 2002: main focus on 6 to 8 quarters ahead inflation forecast)	Medium term (future CPI between 1-3% on average over the medium term)
United States	Not specified Focus on several inflation measures	No numerical value [4] Qualitative definition of price stability		

Notes to Table 1: (*) Ex ante horizon: the horizon over which the central bank will seek to pursue its objective or re-establish it after a shock has occurred. Accountability ex post: the time period over which the central bank is to be held accountable. (1) If inflation as measured by the RPIX is more than one percentage point above or below the target of 2.5%, the Governor of the Bank of England needs to write an Open Letter of explanation to the Chancellor. (2) Timeless horizon implies that, in principle, the inflation target has to be maintained at all times. Escape clauses: when explicit contingencies under which a temporary deviation from price stability can be allowed are provided. (3) When adopting the broad economic policy guidelines in July 1995 the Ecofin indicated that a value of 2% would be the maximum rate of inflation compatible with price stability. This was reconfirmed in the 1998 guidelines. (4) The Chairman of the US Fed, Alan Greenspan, stated that "price stability obtains when people do not consider inflation a factor in their decisions". (5) The BoJ has defined price stability "as an environment where economic agents including households and firms can make decisions regarding such economic activity as consumption and investment without being concerned about the fluctuation of the general price level". (6) On 19 March 2001 the BoJ announced that it will continue its policy of quantitative easing "until the CPI registers stably a zero percent or an increase year on year".

Central banks that specified inflation targets (all remaining non-euro area countries shown in Table 1).

Following the practice initiated by New Zealand in 1990, over the last decade a large number of countries have announced explicit inflation targets in the form of point targets or ranges, in the context of a general

process of reform of their monetary policy framework.[6] It should be noted that in many cases initially a clear distinction was made between the "inflation targets" and the ultimate price stability objective. In the context of the gradual process of disinflation in many countries at the beginning of the 1990s, the former was seen as instrumental for achieving the latter. As many countries have reached and announced very low inflation targets in the meantime, these are nowadays seen more as an operational definition of the ultimate objective of price stability.[7]

Starting from non-European countries, in <u>Canada</u> an agreement between the central bank and the finance ministry sets price stability as the principal objective for monetary policy. To implement this objective, the agreement specifies a target range for CPI inflation of 1 to 3% with a focus on the midpoint of the range. In <u>Australia</u>, the central bank has set an inflation target with a range of 2 - 3% for the CPI, which applies to the average inflation rate over a business cycle. In <u>New Zealand,</u> the numerical inflation target is set jointly by the Minister of Finance and the Governor of the central bank in the context of the Policy Target Agreement (PTA). The new PTA signed in November 2002 requires the Reserve Bank of New Zealand to keep future CPI inflation in the range 1 - 3% on average over the medium term (the target was previously set at 0-3% since 1996).

Turning to European (non euro area) countries, in the <u>United Kingdom</u> the Chancellor has mandated the Bank of England to pursue a point target for RPIX inflation of 2.5%.[8] This point target has remained unchanged since 1997. In <u>Norway</u>, the target for CPI inflation is set at 2.5% with a fluctuation margin (or tolerance band) of ±1%. Finally, in <u>Sweden</u> a point target for CPI inflation of 2% with a fluctuation margin of ±1% has been adopted.

Table 1 also reports (when made explicit) the horizon for the conduct of monetary policy, trying to make a distinction between an ex ante dimension (i.e. the time frame over which the central bank will seek to pursue its objective in a forward-looking manner) and the ex post dimension (i.e. the horizon over which the central bank wishes/is to be held accountable).[9] Broadly speaking all central banks recognise that, due to the occurrence of unforeseeable shocks and the existence of significant lags in the transmission of monetary policy impulses, it would be impossible to keep inflation at the desired level all times or to bring it back to the desired level in a very short time. Moreover, it is widely recognised that a gradual response of monetary policy to some specific shocks (mainly of a cost-push nature) is required in order to avoid imparting an unnecessarily high volatility in output and interest rates.

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[6] For a detailed review of the experiences with inflation targeting see Bernanke, S.B., T. Laubach, F.S. Mishkin and A.S. Posen (1999), "Inflation Targeting: Lessons from the International Experience," Princeton University Press, Princeton.

[7] Clearly, in countries (such as some Eastern Europe or Latin America countries, not reviewed in this paper) where relatively high inflation targets are announced, the distinction between the definition of price stability and the inflation target is more relevant.

[8] If inflation as measured by the RPIX is more than one percentage point above or below this target, the Governor of the Bank of England needs to write an open letter of explanation to the Chancellor. It should be noted that owing to differences in statistical methodologies and in the coverage of expenditure items, RPIX inflation has historically tended to be higher (by more than half a percentage point on average over the past decade) than HICP inflation in the UK.

[9] Given that not all countries have made an explicit distinction in this respect, our attributions in the table should be taken with particular caution.

In terms of ex ante horizon some central banks that have adopted an explicit inflation targeting approach have announced a specific fixed horizon driving the conduct of their decisions. Such horizons vary in a range from 1 to 3 years ahead and often correspond to the horizons of the official published forecasts of the central banks. It should be mentioned that more recently a tendency towards de-emphasising the fixed horizon in favour of a 'medium term' notion can be noted among inflation targeting central banks. The medium term notion has been adopted by the ECB, the Bank of Australia and more recently by the Reserve Bank of New Zealand (RBNZ).[10]

Only a few central banks have made explicit their 'ex post' horizon (or horizon for accountability). The Bank of England and Norges Bank and the RBNZ prior to the new Policy Targets Agreement (PTA) view their horizon as being timeless, implying that in principle the inflation target has to be maintained at all times. In these cases normally a number of escape clauses are provided, i.e. explicit contingencies under which temporary deviations from the target can be allowed (these normally relate to a number of cost-push unexpected shocks). The ECB and the RBNZ have adopted a medium term horizon. The Bank of Australia refers to the average inflation developments over the business cycle.[11]

3.   Ranges or point objectives: rationales

As discussed in the preceding section, the specific features of the announced quantitative objectives for inflation developments vary somewhat across countries, including ranges of various size, ranges with an explicit focus on the range's mid-point, point targets with fluctuations bands or point targets. In this section we review some possible motivations for these different choices that have been proposed either by central banks, academic experts or observers.

Generally, central banks that have adopted ranges have emphasised the existence of *uncertainty* related to future inflation developments and the *imperfect controllability* of inflation. The advantage of a range, in this respect, would be that it conveys to the public the important message that the control of inflation is inherently imperfect and therefore it avoids giving the impression that monetary policy is equipped to (or might attempt to) fine-tune price developments with a high degree of precision. The size of the range may thus convey information about the central bank's assessment of the uncertainty surrounding the effects of its policies. In this respect, the motivations behind the choice of a range are similar and related to those behind the choice of a medium-term perspective in the conduct of monetary policy, as described in the

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[10]   For example, in New Zealand, the new PTA has officially extended the horizon from the previous 6 to 8 quarters ahead to the "medium term". Recently the Bank of England has also referred to the notion of the medium term several times in its recent press releases on interest rates decisions. For example, on 6 February 2003 the MPC stated: "[…]. *In order to keep inflation on track to meet the target over the medium term, the Committee judged that it was necessary to reduce interest rates by 0.25%*". The recent literature has emphasised the potential problems which may arise with the adoption of a fixed (and relatively short-term) horizon, e.g. in relation with the possibility of the emergence of asset price bubbles and episodes of financial crises.

[11]   It should be noted that the use of the word 'average' in the case of both Australia and New Zealand ("future CPI …on average over the medium term") might seem to imply a price level target with drift. However, it is not straightforward (particularly in the case of New Zealand where the word 'future' is included) to what extent ex-post deviations of the expected inflation from the policy target are bygones or not. If they are not corrected, the cumulative long-run effects on the price level of these short run deviations may drive the CPI far away from the drift.

previous section. In an uncertain environment, a range objective may also be seen as preferable to a point objective for credibility purposes. Over relatively short periods of time, deviations from any point objective may be substantial with potential negative effects on the credibility of the central bank, while a range enhances the likelihood that inflation developments will be very frequently within the established objective.

This latter view is not, however, uncontroversial. Bernanke et al. (1999, op. cit.) argue that missing a range (which may inevitably happen from time to time) may be perceived by the public as a more serious policy failure than missing a point (which happens continuously and inevitably).[12] Moreover, with a range in place the public may focus excessively on whether inflation is just inside or just outside of the range, rather than on the magnitude of the deviations from the mid-point. All this may increase pressure on the central bank to act vigorously to keep inflation within the range, which may create problems of instrument instability and excessive volatility in the real economy, particularly if the horizon is short.[13] In this sense a trade-off may exist between the choice of the size of the range and the length of the horizon for the conduct of monetary policy. Moreover, careful communication may be needed on the part of the central bank to avoid the impression that the bounds of the range are seen as implying "hard edges", i.e. threshold values which trigger actions in a quasi-automatic fashion.[14]

Orphanides and Wieland (2000) point out that the presence of a range target invariably suggests a non-linearity in the policy response of central banks. Given that under the conventional linear-quadratic framework used in the analysis of optimal monetary policy, optimal policy is linear and invariant to the presence of (additive) uncertainty, the presence of a range must imply a departure from the standard framework. With this in mind, they offer two possible motivations for the adoption of a range and explore their implications for optimal monetary policy. First, they assume a zone-quadratic objective for the central bank, that is, a loss function which assigns quadratic loss to inflation outside the target zone and, implicitly, a near zero loss for inflation outcomes within the zone. Secondly, they explore the possibility of non-linearities in the short-run inflation-output trade-off, namely, the assumption that inflation is relatively stable for a range of output gaps and only increases or decreases when the output gap falls outside this range. Under both types of non-linearities, and under the assumption that the central bank assigns at least some weight to output stabilisation, monetary policy will be relatively unresponsive to inflation (and more responsive to output developments) when inflation is within the range inflation

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[12] Similar points have been made by Svensson on various occasions, see e.g. Svensson, L.E.O. (2001), " Independent Review of the Operation of Monetary Policy in New Zealand: Report to the Minister of Finance," www.princeton.edu/~svensson. More recently he pointed out that a relatively narrow interval (say 1% wide) would avoid the main drawbacks of ranges.

[13] Bernanke et al. (1999), op. cit., quote the case of New Zealand as an example in this regard and argue that these problems played a role in the country's decision to finally widen the range objective in 1996, from 0-2% to 0-3%.

[14] These motivations appear to be behind the choice of the Bank of Canada to emphasise the mid-point of its range, as apparent from the following quote: "[…] *Monetary policy will therefore be directed to moving inflation to the target midpoint over a six- to eight-quarter horizon. In this way, policy aims at keeping the trend of inflation at the 2 per cent target midpoint. The target range of ±1% around the target midpoint thus encompasses the outcomes for inflation that are likely to occur most of the time. This range should be interpreted as a reflection of the short-run uncertainty of outcomes stemming from unpredictable shocks and not as a measure of the indifference of the Bank as to the outcome*". See "Renewal of the Inflation-Control Target – Background Information", Bank of Canada, May 2001, www.bankofcanada.ca.

objective. However, the size of the zone of relative inaction to inflation developments depends crucially on the degree of uncertainty the central bank faces (relative to the size of the range). In particular, the higher is uncertainty the lower is the zone of inaction and in the limit optimal policy will collapse to the standard linear-quadratic case (which implies no inaction zone).

Another reason that is often quoted as a motivation for the choice of a range (rather than a point) inflation objective is the need to preserve *flexibility* in the management of monetary policy. There are two levels of arguments in this regard.

First, it is argued that a range also reflects a concern by central bank for macroeconomic stabilisation, in particular for avoiding excessive output and employment fluctuations when responding to threats to price stability.[15] In this respect, there is clearly a link between the choice of a range and the horizon for the conduct of monetary policy (see Section 2 above) and a trade-off may exist between the size of the range and the length of the horizon adopted for the conduct of monetary policy. Moreover, a range may also be thought to give more leeway to the central bank to pursue objectives other than inflation, such as output growth, in case its mandate includes multiple objectives with no priority given to price stability.[16]

Second, it has been argued that a range might be seen as preferable if there is the possibility that the optimal inflation rate for the economy might vary (gradually and moderately) over time. There may be several reasons for this. For example, structural shocks (such as a permanent rise in productivity growth) may increase the equilibrium level of the real interest rate of the economy, permitting to balance the costs of inflation with the benefits (such as those deriving from the existence of a zero lower bound in nominal interest rates) at a permanently lower inflation rate.[17] Similarly, changes in statistical measurement methods may permit to reduce the measurement bias in observed inflation and thereby the implicit focal point within the inflation objective. In these cases, a range objective could at least theoretically accommodate mild variations in the optimal inflation rate without requiring a change or frequent changes in the inflation objective.

The two lines of argumentation above also illustrate the possibility that the higher flexibility given by a range target (relative to a point) may leave open the possibility (or raise the suspicion) of an excessive degree of discretion in the conduct of monetary policy. In this respect, the trade-off existing for the society between the benefit from granting the policy maker some flexibility in the conduct of its policy

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[15] See Bernanke et al. (1999), op. cit., pp. 291-293.

[16] In this respect, Fed officials have sometimes referred to the fact that a numerical objective for inflation would unduly constrain the Fed in view of its dual mandate of price stability and long-term output growth; e.g. see the remarks by Governor D.L. Khon (2003), "Comments on Marvin Goodfriend's 'Inflation targeting in the United States'" at the National Bureau of Economic Research Conference on Inflation Targeting, Florida, January 25, 2003. In this respect, the focus of the Fed on price stability with no quantitative specification of the inflation objective, may be thought at as implying a range for allowable inflation outcomes of relatively broad size. This argument is not, however, used by central banks with a mandate which assigns price stability an overriding role.

[17] Another example could be the need of responding in an appropriate manner to episodes of asset price bubbles or financial instability, which may require in some cases a prolonged deviation from any point target inflation rate, in order to ensure that the target is met over a longer-run prospective.

and the need to limit its discretion has been recently formalised by Athey, Atkenson, and Kehoe (2002).[18] In their model, monetary authorities have private information on the state of the economy determining the optimal inflation rate or target, which remains unknown to the public. The problem of the society is to find a well-designed rule which gives monetary policy the flexibility to react to its private information, but at the same time is able to guard against the standard time inconsistency problem arising from the temptation to stimulate the economy by creating unexpected inflation (à la Barro-Gordon). They find that the optimal rule is simply achieved by legislating an inflation cap that specifies the highest allowable inflation rate. The optimal inflation cap (or degree of discretion) is decreasing in the severity of the time inconsistency problem.

Last but not least, a crucial aspect that is referred to in the discussion on ranges and point objectives concerns the *signalling properties* of the announced target. The capability of tightly anchoring inflation expectations is in fact a crucial motivation for the announcement of a quantitative objective for inflation in the first place. In this respect, it is often claimed that the signalling properties of a point target are superior to those of a range. A single number is easier to communicate, may be remembered more easily and, especially, it provides a more precise focal point for the expectation formation mechanism of agents in the economy and for co-ordinating their actions.[19]

Orphanides and Williams (2003) analyse the effect of the announcement of an explicit numerical inflation target in a model in which agents have imperfect knowledge about the structure of the economy and rely on adaptive learning to continuously update their beliefs regarding the dynamic structure of the economy based on incoming data.[20] In such a framework, effective communication of an explicit inflation target (and strong emphasis on the primacy of price stability objective) by the central bank can help focus inflation expectations and thereby reduce the costs associated with imperfect knowledge, thus yielding superior economic performance.

While clearly the above argument suggest that the adoption of a relatively broad range might result in lower capability of anchoring inflation expectations relative to a point target, it is less obvious what difference a relatively small size range (such as those announced by the central banks reviewed above in Section 2) would make. It seems therefore useful to investigate empirically whether there are any systematic differences in countries' ability of anchoring inflation expectations and whether these

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[18] See Athey, S., Atkenson, A. and P.J. Kehoe (2002), "The Optimal Degree of Discretion in Monetary Policy," Federal Reserve Bank of Minneapolis, Working Paper, November 2002.

[19] For instance Svensson (2001), commenting on the ECB's definition of price stability, claims: "*A range provides a less precise anchor for inflation expectations. There is a big difference between inflation expectations of 2% and 0%. For instance, wage negotiation differences are often about a few tenths of a percent, and the starting point for the negotiations (expected inflation plus expected productivity growth) are important*". See Svensson, L.E.O. (2001), "The Fed Does Not Provide the Solution to the Eurosystem's Problems", Briefing paper for the Committee of Economic and Monetary Affairs (ECON) of the European Parliament for the quarterly dialogue with the President of the European Central Bank, www.princeton.edu/~svensson.

[20] See A. Orphanides and J.C. Williams (2003), "Imperfect Knowledge, Inflation Expectations and Monetary Policy", paper prepared for the NBER Conference on Inflation Targeting, January 23-25, 2003, mimeo.

differences can be related to the specific characteristics of their announced objectives.[21] We turn to this issue in the next section.

4. Evidence on long-term inflation expectations in selected countries

Exhibiting well-anchored long-term inflation expectations is commonly seen as a desirable feature in any monetary policy framework. Well-anchored expectations would reflect that the public regards the central bank and the overall policy framework as deserving a high degree of credibility for achieving its inflation objective. By contrast, in a low credibility environment, the presence of significant fluctuations in inflation expectations would tend to hamper the smooth functioning of monetary policy.

In practice, in a given monetary policy framework, long-term inflation expectations are usually considered to be well anchored if they exhibit limited variability around an intended level. However, assessing this in practice might not always be a straightforward endeavour.[22] Two types of difficulties in this respect are relevant: those related to uncertainty about the level at which the central bank intends to settle long-term expectations and those related to gauging a threshold for volatility in observed long-term expectations which would seem compatible with well-anchored expectations.

Regarding the first issue, two sources of uncertainty should be highlighted. First, even if the central bank announces an intended level of inflation, the public may believe that such objective could be changed in the future. For instance, the central bank might be interested in performing a one-off change in the level of desired inflation (e.g. the quest for low inflation in the 1980s and part of the 1990s in many industrial countries). In this case, the above description of well-anchored expectations as stable long-term expectations would usually not apply and it might even be reversed: a credible disinflationary process would be characterised by rapidly changing expectations toward the new equilibrium level. Second, uncertainty in the level at which the central bank intends to anchor expectations may also arise in a *stationary* environment if the central bank's strategy does not include a quantitative announcement of the inflation objective or definition of price stability or if there is a quantitative announcement which leaves some room for variability in the intended level of future inflation. In this respect, the evidence presented in the following attempts to gauge the implications of different types of quantitative announcement (or the lack thereof) for the ability to anchor long-term inflation expectations by the central bank. An obvious caveat to this approach is the fact that the stability of inflation expectations depends on the overall monetary policy framework and not only on the presence of a quantitative announcement for the inflation objective or its specific features.

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[21] Quite obviously the ability to anchor inflation expectations depends on all the features of the monetary policy frameworks, including the way of conduct of monetary policy, their credibility and effectiveness in the communication with the public, so results are not certain a priori.

[22] In the case of the euro area, the ECB monitors regularly inflation expectations in the euro area through a number of indicators, including indicators derived from financial assets, consumer surveys and surveys of professional forecasters. The ECB conducts its own survey of professional forecasters at a quarterly frequency (e.g. described in ECB Monthly Bulletin, November 2002). For comparability purposes at an international level this note makes use primarily of measures of long-term inflation expectations reported by *Consensus Forecasts*.

A second problem that complicates the analysis of central bank's credibility relates to the possibility that measures of inflation expectations may exhibit some intrinsic volatility independently of the credibility gained by the central bank. Such volatility may result from measurement problems (e.g. due to changes in the sample of experts that provide input if expectations are measured through a survey of professional forecasters or due to shifts in the inflation or liquidity risk premia if they are measured from relative yield of inflation-indexed bonds). Given the uncertainty surrounding such measurement problems, a natural way to assess this volatility in a given country is by its relative performance with respect to best performing countries or economic areas.

As regards the implications of a low level of credibility of the central bank to keep future inflation close to a given level, recent studies (e.g. Erceg and Levin (2001)[23] and Orphanides and Williams (2002)[24]) have shown that as the degree of uncertainty faced by the public regarding the long-term inflation objective of the central bank increases, the degree of persistence in inflation could increase substantially, so that shocks to current inflation could have visible effects on long-term inflation expectations. This suggests that under a low degree of credibility of the central bank inflation expectations would exhibit (in addition to relatively large volatility) positive correlation between changes in short-term inflation expectations (which reflect shocks to inflation) and long-term inflation expectations.

Against this background, long-term inflation expectations in the context of a stable monetary policy framework could be considered to be well anchored if they exhibit at least two features: First, a low level of volatility around a given level (which should be compatible with the point or range target in the case where the central bank makes a quantitative announcement of the inflation objective). Second, a low degree of correlation between movements in realised inflation and short-term inflation expectations on the one hand and long-term inflation expectations on the other. These two criteria to assess the stability of inflation expectations are examined in the next two sub-sections. For this, we examine long-term inflation expectations proxied by the measures provided by Consensus Forecasts in the period 1990-2002 in a number of industrial countries (namely, Australia, New Zealand, the U.K., Canada, the U.S., Switzerland, Sweden and the euro area.[25] (See Annex I for a description of the data).

4.1   The level and volatility of long-term inflation expectations

This section highlights in the first place the patterns in the level and volatility of long-term inflation expectation from the early 1990s until 2002 in the countries considered, except that for some countries only shorter periods of observations are available (exact data availability is indicated in Table 3 and

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[23]   "Imperfect credibility and inflation persistence", C. Erceg and A. Levin, mimeo, Board of Governors of the Federal Reserve System, June 2001.

[24]   "Imperfect Knowledge, inflation expectations and monetary policy", A. Orphanides and J. Williams, mimeo, Board of Governors of the Federal Reserve System, May 2002.

[25]   In addition, patterns in long-term inflation expectations in some of euro area countries –namely, France, Germany, Italy, the Netherlands and Spain- are examined, with particular emphasis on the period 1990-1998. Obviously, any inference on these countries for the period starting in January 1999 should be made with caution, as at that time euro area countries relinquished the independent monetary policies, which makes their experience not comparable with those of countries with an independent monetary policy.

Annexes I and II). For this, Table 2 presents summary statistics with average long-term inflation expectations in a number of sub-periods; in addition, Annex II shows in Displays 1 to 14 a more comprehensive set of indicators and Charts with inflation expectations developments in each of the considered countries.

As regards the patterns in the level of inflation expectations across economic areas, and focusing primarily in the period after the disinflationary process was completed in most countries, the following conclusions may be extracted. For the U.S., where the central bank does not announce a quantitative objective for inflation, the level of expectations seems to have stabilised around an inflation rate of 2.5%. In the case of Japan it should be noted that the level of expectations broadly converges (although with significant variability, as discussed below) to a rate slightly below 1%, indicating that markets consistently believe that mild deflation will eventually come to an end. For central banks with an explicit quantitative announcement of their primary objective, it is noted from Displays 1-14 that in the majority of cases where either a point or a fully symmetric range is used as the format of the objective, that inflation expectations have converged to that point or mid-point in the range. This is indeed the case for the U.K., Sweden (where a focal point is a feature of the objective), Australia (where a symmetric range is used) and to a large extent also Canada (focal point). In the case of the euro area, Display 1 indicates that measures of inflation expectations (five years ahead in the case of the ECB Survey of Professional Forecasters and between 6 and 10 years ahead in the case of Consensus Forecasts) were close to the 2% mark at the start of Stage Three of EMU, declined somewhat in 2000 and have drifted slightly upwards since then, to remain stable at about 1.8 to 1.9%.

As regards the trends in the volatility of inflation expectations across economic areas, Table 2 and the charts and tables in Annex II show that all countries except one experienced a clear reduction in the volatility of long-term expectations starting in the early 1990s. The only exception to these broad trends is the case of Japan, where volatility of inflation expectations did not fall.[26]

The parallel decline in the volatility of long-term inflation expectations over the 1990s is confirmed in the tables within Displays 1 to 14 for all countries considered except the case of Japan, which is analysed separately. This evolution is reflected in particular in the decline in the coefficient of variation of long-term inflation expectations in all countries except Japan. When the earliest sample (1990-1994) is considered, countries' coefficients of variation of long term inflation are in the range of 0.07 (for the U.S.) to 0.19 (Canada). By contrast, when the most recent sample (1999-2002) is considered, these figures are in the range of 0.03 (U.S. and Sweden) to 0.10 (New Zealand and Switzerland).

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[26] In order to avoid the difficulties in gauging the quality of the inflation expectations anchor in a context of disinflation, the analysis focuses mainly on the period after the disinflationary movement (i.e. 1995-2002).

Table 2*: Summary statistics on long-term inflation expectations

		1990-1994	1995-1998	1999-2002
EURO AREA	Average long-term inflation expectations	3.13	2.32	1.82
	Standard deviation of inflation expectations	0.18	0.27	0.09
	Coefficient of variation of inflation expectations	0.06	0.12	0.05
	Standard deviation of realised inflation	-	0.60	0.63
Memo items: euro area countries:				
FRANCE	Average long-term inflation expectations	2.96	2.18	1.63
	Standard deviation of inflation expectations	0.28	0.23	0.09
	Coefficient of variation of inflation expectations	0.10	0.11	0.05
	Standard deviation of realised inflation	0.61	0.65	0.62
GERMANY	Average long-term inflation expectations	2.69	2.21	1.80
	Standard deviation of inflation expectations	0.11	0.15	0.11
	Coefficient of variation of inflation expectations	0.04	0.07	0.06
	Standard deviation of realised inflation	1.78	0.48	0.81
ITALY	Average long-term inflation expectations	3.94	2.43	1.66
	Standard deviation of inflation expectations	0.52	0.58	0.11
	Coefficient of variation of inflation expectations	0.13	0.24	0.06
	Standard deviation of realised inflation	0.87	1.39	0.51
NETHERLANDS	Average long-term inflation expectations	-	1.78	1.86
	Standard deviation of inflation expectations	-	0.10	0.19
	Coefficient of variation of inflation expectations	-	0.06	0.10
	Standard deviation of realised inflation	-	0.33	1.04
SPAIN	Average long-term inflation expectations	-	2.61	2.33
	Standard deviation of inflation expectations	-	0.38	0.21
	Coefficient of variation of inflation expectations	-	0.15	0.09
	Standard deviation of realised inflation	-	1.25	0.56
SWITZERLAND	Average long-term inflation expectations	-	-	1.63
	Standard deviation of inflation expectations	-	-	0.16
	Coefficient of variation of inflation expectations	-	-	0.10
	Standard deviation of realised inflation	-	-	0.41
SWEDEN	Average long-term inflation expectations	-	2.43	1.96
	Average absolute deviation of expectations from target	-	0.18	0.04
	Standard deviation of inflation expectations	-	0.47	0.05
	Coefficient of variation of inflation expectations	-	0.20	0.03
	Standard deviation of realised inflation	-	1.36	0.95
U.K.	Average long-term inflation expectations	3.86	2.98	2.33
	Average absolute deviation of expectations from target	-	0.50	0.18
	Standard deviation of inflation expectations	0.36	0.38	0.10
	Coefficient of variation of inflation expectations	0.09	0.13	0.04
	Standard deviation of realised inflation	2.28	0.66	0.89

Table 2**(continued): Summary statistics on long-term inflation expectations

		1990-1994	1995-1998	1999-2002
AUSTRALIA	Average long-term inflation expectations	4.03	2.99	2.48
	Average absolute deviation of expectations from point target	-	0.27	0.05
	Standard deviation of inflation expectations	0.63	0.44	0.07
	Coefficient of variation of inflation expectations	0.16	0.15	0.03
	Standard deviation of realised inflation	1.28	1.91	1.73
CANADA	Average long-term inflation expectations	2.99	1.89	1.99
	Average absolute deviation of expectations from point target	0.18	0.19	0.06
	Standard deviation of inflation expectations	0.58	0.25	0.10
	Coefficient of variation of inflation expectations	0.19	0.13	0.05
	Standard deviation of realised inflation	2.21	0.54	0.62
JAPAN	Average long-term inflation expectations	2.14	1.50	0.88
	Standard deviation of inflation expectations	0.43	0.44	0.34
	Coefficient of variation of inflation expectations	0.20	0.29	0.39
	Standard deviation of realised inflation	1.09	0.97	0.35
NEW ZEALAND	Average long-term inflation expectations	-	1.78	1.86
	Average absolute deviation of expectations from point target	-	0.50	0.36
	Standard deviation of inflation expectations	-	0.10	0.19
	Coefficient of variation of inflation expectations	-	0.06	0.10
	Standard deviation of realised inflation	-	1.02	1.38
U.S.	Average long-term inflation expectations	3.84	3.00	2.56
	Standard deviation of inflation expectations	0.26	0.25	0.07
	Coefficient of variation of inflation expectations	0.07	0.08	0.03
	Standard deviation of realised inflation	0.66	0.63	0.85

(*) Source: Consensus Forecasts. Long term inflation expectations reflects survey evidence relating surveyed experts' views on inflation rates in a period between six and ten years ahead. For the euro area, data are constructed by aggregating series from the five euro area countries listed under *memo items* in the Table, representing more than 80% of the euro area household consumption in all periods considered. Annex I provides background information on data sources and elaboration.

(**) For Australia the first year considered is 1991.

Similarly, when the ratio of the standard deviation of long-term inflation expectations to the standard deviation of realised inflation is considered, all countries are found to have experienced a gradual and considerable decline in that ratio: Whereas for the earliest sample 1990-1994 the ratio was in the range of 6.2% to 59.8%, in the most recent sample 1999-2002 the range of the ratio was between 4% and 38.1%.

In summary, Table 2 and Displays 1 to 14 in Annex II show that the downward trend in long-term inflation expectations did tend to be levelled-off in all countries at some point in the second half of the 1990s. From this point, they also tended to exhibit lower volatility. The exception to this trend is the case of Japan. As shown in the table in Display 12, long-term inflation expectations in Japan declined on average somewhat over the 1990s. But their volatility has seen only a limited decline, as reflected in the relatively small declines in the standard deviation and the coefficient of variation between the earliest sample 1990-1994 and the most recent sample 1999-2002. Furthermore, the average change (in absolute

terms and relative to the previous observation)[27] in long-term expectations increased from 0.33 in the earliest sample (1990-1994) to 0.5 percentage point in second sample (1995-1998) to remain at that level in the latest one (1999-2002), as shown in the table within Display 12. By contrast, for all other countries considered, this same statistic saw a decline or remained broadly unchanged over the 1990s. In particular, for all countries excepting Japan this measure of volatility of expectations was in the range of 0.04 (U.S) to 0.33 (Australia) percentage point in the period 1990-1994, while in the period 1999-2002 the respective range was from 0.05 (Australia) to 0.13 (Switzerland) percentage point.

Overall, looking at the various indicators and with particular reference to the period 1999-2002, the variability of inflation expectations has been very low in Australia, Canada, the euro area, Sweden, the UK and the US, with little perceivable differences in performance among these countries[28]. Interestingly, these countries adopted different frameworks to anchor inflation expectations: a point target in the case of Sweden and the UK, a range in the case of Australia and Canada, a range definition of price stability in the euro area, and no explicit quantitative reference in the case of the U.S.

In the same period, inflation expectations were slightly less well-anchored, according to most indicators, in New Zealand and Switzerland, although volatility of expectations in this countries remained at relatively low levels.[29]

All in all, although it is difficult to extract strong conclusions from this evidence, the previous discussion suggests that the announcement of quantitative references in terms of point targets or ranges for inflation is not a necessary condition (e.g. U.S.) for good performance at anchoring inflation expectations.

In order to more rigorously compare the degree of volatility in inflation expectations across different features of the inflation objectives, Table 4 reports the results of a simple panel-data regression of the form:

$$\frac{(E\pi^J{}_{t+10} - \frac{1}{T^J}\sum_{t=1}^{T^J} E\pi^J{}_{t+10})^2}{(\frac{1}{T^J}\sum_{t=1}^{T^J} E\pi^J{}_{t+10})^2} = \alpha + \sum_I \beta^I \cdot Dummy_t{}^J(I) + \varepsilon^i{}_t \tag{1}$$

where I, J and t index announcement strategies, countries and time periods respectively. T^J is the total number of periods in which country J is observed. The term in the left-hand-side in (1) is a function of long-term inflation expectations. The term *Dummy(I)* in the right-hand-side is an indicator variable reflecting the type of implemented strategy (I) relating the announcement of a quantitative target in a given country (J) and year (t) , as reflected in Table 1, although in many cases it is not straightforward to

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[27] Consensus long-term expectations are reported biannually, as explained in Annex I of this note.

[28] For euro area countries, the tables in Displays 3 to 7 indicate a considerable decline in both the level and the volatility of long term expectations in the period 1999-2002 compared to the longer periods including previous years, particularly in France and Italy, while less so in Spain and the Netherlands.

[29] In the case of Switzerland, results appear to be particularly affected by one observation in 1999, which may of course represent an outlier.

assign precisely central bank strategies in this respect to a given regime. A baseline classification of countries' or areas' strategies in the observed years in line with Table 1 is shown in Table 3 below.

Table 3: Baseline classification of countries' strategy announcement of inflation objective

No explicit announcement	France (1990-1997) Netherlands (1995-1998) Japan (1990-2002)	Italy (1990-1998) U.S. (1990-2002) U.K. (1990-1991)
Quantitative definition of price stability (no explicit lower bound)	euro area (1999-2002) France (1998)	Switzerland (2000-2002)
Target range	Australia (1995-2002) Spain (1995-1996)	New Zealand (1995-2002) U.K. (1992-1997)
Explicit point target	U.K. (1997-2002) Sweden (1995-2002) Switzerland (1999)	Canada (1990-2002) Germany (1990-1998) Spain (1997-1998)

Obviously, any classification of announcement strategies in narrowly defined categories, as attempted in Table 3, entails some degree of oversimplification, and therefore alternative classification criteria to the borderline cases have also been used in the empirical analysis. [30]

The results of the panel estimates are reported in Table 4 below. The term "No explicit announcement" (which corresponds to the constant term in the regression) captures measured volatility in expectations in countries that did not implement a quantitative definition of the inflation objective. The other coefficients reported in Table 4 correspond to the *difference* in measured volatility in the other categories, relative to the degree of volatility in countries that did not announce a target.

Overall the results in Table 4 appear to indicate that the precise features of the quantitative announcement seem to have limited effects on the performance at anchoring long-term expectations.[31]

Table 4 also suggests that the announcement of a quantitative objective has tended to contribute to reducing volatility in long-term expectations. At the same time, volatility of expectations in the U.S., where no quantitative objective was announced, turned out smaller than in the control group. Obviously, these results should be seen with caution, as the analysis is limited by the size of the sample and potential endogeneity bias in the estimates.

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[30] In this respect, it would seem particularly difficult to classify the announcement strategies of Germany in 1990-1998 and Switzerland before 2000 in any of the narrow categories in Table 3, given the then prevailing focus on monetary targeting in these countries. For reasons of simplicity, these countries in those years are classified as implementing a point target in the baseline case.

[31] This appears to be robust also for alternative classifications to the baseline case. In particular, the finding that announcing a point target does not seem to significantly improve the performance in anchoring long-term inflation expectations is somewhat strengthened in alternative regressions where Germany (1990-1998) and Switzerland (1998-1999) are classified as "no explicit announcement".

Table 4♦ : Volatility of long-term inflation expectations: announcement strategies

	1995-2002	
	Coefficient	t-value
No explicit announcement (excluding Japan and US)	0.046	3.57
Quantitative definition of price stability	-0.031	-1.98*
Target range	-0.030	-1.65
Point target	-0.029	-1.56
Japan	0.119	5.48**
US	-0.036	-1.64
R-squared	0.239	
No. observations	217	

(♦) Reports results of estimating equation (1):

The coefficient for "no explicit announcement (excluding Japan and U.S.) corresponds to "α" in equation (1) (i.e. the constant term). The remaining coefficients correspond to the terms "β(I)" in equation (1).

The terms (*) (**) indicate that the coefficient is statistically significant at (5%-level)(1%-level) respectively.

Table 5 shows similar estimates across economic areas as opposed to across different types of announcements.[32]

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[32] It should be noted that in this case a constant term is not included and thus all coefficients reflect absolute volatility of expectations in each economic area.

Table 5*: Volatility of long-term inflation expectations: economic regions

	Coefficient	t-value	p-value
euro area (1999-2002)	0.016	0.580	0.563
Memo items: euro area countries (1995-1998)			
France	0.034	1.220	0.226
Germany	0.015	0.544	0.587
Italy	0.071	4.030	0.000
Netherlands	0.003	0.391	0.696
Spain	0.017	0.122	0.903
Other European countries			
Sweden	0.032	1.610	0.109
Switzerland	0.007	0.285	0.776
U.K.	0.025	1.260	0.208
Other OECD countries			
Australia	0.020	1.030	0.303
Canada	0.009	0.454	0.651
New Zealand	0.007	0.349	0.728
Japan	0.165	8.350	0.000
U.S.	0.010	0.510	0.611
R-squared		0.2764	
No. observations		169	

(*) Reports results from estimating the following equation:

$$(E\pi^J_{t+10} - \frac{1}{T^J}\sum_{t=1}^{T^J} E\pi^J_{t+10})^2 /(\frac{1}{T^J}\sum_{t=1}^{T^J} E\pi^J_{t+10})^2 = \sum_J \beta^J \cdot Dummy_t^J(J) + \varepsilon^J_t$$

where in this case J indicates an economic region and no 'regimes' or announcement strategies considered.

p-values are defined conventionally as the probability that the t-statistic is equal to zero, thus indicating a level of significance of 5% (1%) if the p-value is equal to 0.05 (0.01, respectively).

Results in Table 5 indicate that the dummy variables that proxy the volatility of long-term inflation expectations appear significant only in few countries.

4.2 Co-movement of short-term and long-term inflation expectations

If a central bank is successful at anchoring long-term inflation expectations, it would be expected that current shocks to inflation would have no visible effect on long-term expected inflation, since over a number of years (say 6 to 10 years ahead) the effects of the shock would be expected to unwind gradually and inflation to converge close to the *steady-state* rate. A simple approach to examine if in an economy current shocks have no visible impact on long-term expectations would be to test whether revisions in long-term expectations are correlated with revisions in short-term expectations. To perform this test, the following regression can be implemented:

$$\Delta E\pi^{J}{}_{t+10} = \sum_{I} \beta^{I} \cdot \Delta E\pi^{J}{}_{t+1} \cdot Dummy_{t}{}^{J}(I) + \varepsilon^{J}{}_{t} \tag{2}$$

where as for equation (1) *I* and *J* index announcement strategies and countries respectively. The term in the left-hand-side in (2) is the change in long-term inflation expectations in period *t* with respect to the previous observation. The term *Dummy(I)* in the right-hand-side is an indicator variable reflecting the type of implemented strategy (*I*) relating the announcement of a quantitative target in a given country (*J*) and year (*t*). The correlation between short term and long term revisions in regime *I* is measured by the coefficient β^{I}.

Table 6 shows the results of estimating equation (2) in a panel of countries which are classified in terms of their type of quantitative announcement of the inflation objective (or the lack thereof), as outlined in Table 3. All coefficients in Table 6 correspond to variables defined as the product of *dummy* variables indicating each of the categories or "regimes" in Table 3 in each economic region and changes in short term inflation expectations in the same region and year.

Overall, Table 6 suggests that, with very few exceptions, the differences in the degree of correlation between revisions in short-term versus long-term expectations across types of announcements of a quantitative objective (including the absence of announcement) seems very limited.

It is clear that any interpretation of this evidence should be made with a high degree of caution, in particular since the size of the sample is not large and the regression leaves out a large number of important factors (including the fact that in the period 1995-1996 the downward trend movement in inflation and inflation expectations was still taking place to some extent in many of the countries considered).

Table 6♦: Co-movement of short-term and long-term inflation forecasts: announcement strategies

	1995-2002	
	Coefficient	t-value
No explicit announcement (excluding Japan and US)	0.103	0.89
Japan	0.323	1.94*
US	0.111	0.45
Quantitative definition of price stability	0.047	0.29
Target range	0.015	0.11
Point target	0.079	0.57
R-squared	0.109	
No. observations	211	

(♦) Reports results of estimating equation (2): All reported coefficients correspond to the terms "β^{I}" in equation (2) (i.e. the coefficients associated to the interaction term with the product of observed changes in short-term inflation expectations in that country and a regime dummy associated to the central bank in that country). Short-term inflation expectations refer to 1-year ahead survey-based measures from Consensus Forecasts, as described in Annex I. Finally the symbol (*) denotes coefficient statistically significant at 5%-level.

Table 7 reports the results of performing the equivalent of regression in equation (2) for a panel of countries instead of *regimes* (i.e. types of announcement of a quantitative objective).[33] From Table 7, countries with the smallest estimated correlation between revisions in short-term and long-term forecasts are Germany, New Zealand, The Netherlands, Australia, France and Italy.

Overall, although no strong implications may be extracted from this evidence, the regression results in Tables 6 and 7 also confirm the claim that the precise form of the announced quantitative inflation objective (i.e. a target, a range or an explicit upper bound) does not appear to have a strong impact on the central bank's performance at anchoring expectations.

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[33] See note to Table 7 for details.

Table 7[*]: co-movement of short-term and long-term inflation forecasts: countries

	1995-2002		
	Coefficient	t-value	p-value
Euro area (1999-2002)	0.075	0.313	0.754
Memo item: euro area countries (1995-1998)			
France	0.166	0.631	0.529
Germany	-0.038	-0.174	0.862
Italy	0.117	0.787	0.432
Netherlands	0.091	0.578	0.564
Spain	0.432	2.680	0.008
Other European countries			
Sweden	0.180	1.740	0.083
Switzerland	0.307	1.570	0.117
U.K.	0.194	0.693	0.489
Other OECD countries			
U.S.	0.216	0.975	0.331
Canada	0.116	0.637	0.525
Japan	0.427	3.540	0.001
Australia	0.123	1.610	0.110
New Zealand	0.020	0.176	0.861
Constant	-0.038	-2.280	0.024
R-squared		0.135	
No. observations		211	

(*) Reports results from estimating the following equation, where in this case J indicates an economic region and no 'regimes' or announcement strategies considered.

$$\Delta E \pi^{J}_{t+10} = \beta^{J} \cdot \Delta E \pi^{J}_{t+1} + \varepsilon^{J}_{t}$$

Short-term inflation expectations refer to 1-year ahead survey-based measures from Consensus Forecasts, as described in Annex I. p-values are defined conventionally as the probability that the t-statistic is equal to zero, thus indicating a level of significance of 5% (1%) if the p-value is equal to 0.05 (0.01, respectively).

5. Summary and conclusions

This paper reviewed the literature concerned with the trade-offs involved in choosing different formats for framing the specification of central banks' primary objective. In addition, it compared the developments in the level and volatility of inflation expectations in the euro area and a sample of industrial countries.

As regards the rationales for different formats, the available literature suggests that a range format has the relative advantage of signalling more clearly that price developments are surrounded by large uncertainty and are only imperfectly controllable, particularly at short horizons. Moreover, a range may give more flexibility to accommodate the uncertainty in the estimate of, and possible moderate variations. in the optimal inflation rate. By contrast, point targets have the relative advantage of providing a clear focal point for firmly anchoring inflation expectations.

As regards the patterns in the level of inflation expectations across countries and economic areas, it is noted that in the majority of cases where either a point or a symmetric range is used as the format of the objective, it is observed that inflation expectations have converged to that point or mid-point in the range. In the case of the euro area, measures of inflation expectations were slightly below 2% since the start of Stage III of EMU.

As regards the patterns found in the volatility of inflation expectations, although no strong conclusions may be extracted from evidence based on relatively short samples, the overall evidence shows that long-term inflation expectations are well anchored in the large majority of countries considered. This is indicated by both a low and generally decreasing volatility of expectations and a low and a generally decreasing degree of correlation between revisions in short-term and long-term inflation expectations. Moreover, the specific features of the inflation objectives do not appear to have a visible effect on the performance at anchoring inflation expectations. In particular, there does not seem to be evidence that the announcement of a quantitative objective in the form of a point or of a range for admissible inflation rates makes any appreciable difference. With regard to the two countries in our review where no numerical value for the inflation objective was announced, the United States and Japan, inflation expectations appear to be well anchored in the former but not in the latter. This may suggest that the track record by the central bank to consistently deliver a given inflation rate is a crucial factor for the anchoring long term inflation expectations.

Annex I: Data and definition of reported statistics

<u>**Consensus Forecasts**</u>

All the forecasts on inflation used in this paper were drawn from Consensus Forecasts and Asia-Pacific Consensus Forecasts. Consensus Economics, founded in 1989, is the world's leading international economic survey organisation and polls more than 600 economists each month to obtain their forecasts and views. These surveys cover estimates for the principal macroeconomic variables (including growth, inflation, interest rates and exchange rates) in over 70 countries. The forecasts are compiled into a series of publications, among which there are Consensus Forecasts and Asia-Pacific Consensus Forecasts. All the series on short term inflation expectations (i.e. the annual rate of inflation expected to prevail in the following year relative to the survey) and long term inflation expectations (i.e. annual rate of inflation expected to prevail between 6 and 10 years ahead) were drawn from Consensus Forecast, with the exception of those for Australia and New Zealand from December 1994, for which we consulted Asia-Pacific Consensus Forecast. Short-term inflation expectations are available on a monthly basis, while long-term ones are biannual (issues: April and October of each year). Short-term inflation expectations are available from December 1989, while long-term ones from April 1990, at least for some countries. In particular, for the regions included in our analysis, long-term inflation forecasts are available from April 1990 for the following regions: U.S., Japan, Germany, Italy, France, U.K., Italy, and Canada. Australia's series begins in April 1991. Finally, data for Spain, Sweden, New Zealand, and The Netherlands are available from April 1995, while for Switzerland the first estimates date April 1998.

As regards the construction of the series of long-term inflation expectations for the euro area previously to the start of Stage III of EMU, , this series, results from averaging inflation expectations of Germany, France, and Italy from April 1990 up to October 1994 (the weights being, respectively, 0.414847, 0.295488, and 0.2896665), and of Germany, France, Italy, Spain, and The Netherlands from April 1995 to October 2002 (weights: 0.334115, 0.237984, 0.233294, 0.127784, 0.066823), based on Consensus Forecasts information for these countries.

In addition, for each of the economic regions considered, the following statistics are reported for a number of overlapping periods (see the tables in Displays 1-14).

Average long-term inflation expectations: Reports the average release from Consensus expectations.

Average absolute deviation of inflation expectations from point target. Reports the average of the absolute value of deviations from observed Consensus long-term expectations to the point inflation target, when applicable. For comparability, it is also computed for countries which do not have strictly a point target but where a point reference might be extracted (e.g. the mid point in an announced range for inflation objective).

Standard deviation of inflation expectations: As a measure of the volatility of inflation expectations, it reports the standard deviation of Consensus long-term inflation expectations.

Coefficient of variation of inflation expectations: To take into account that volatility measured by the standard deviation may be clouded by the level of inflation, it reports the ratio of the standard deviation over the average of inflation expectations (which is always positive in the sample).

Standard deviation of realised inflation: reports the standard deviation of headline inflation. The precise underlying consumer price index is reported in footnotes to the Tables. To facilitate comparability, observations of headline inflation used to calculate this statistic correspond to the exact same month when Consensus inflation expectations are reported (thus each statistic reports the exact same number of observations for the coefficient of variation of realised and expected inflation).

Average absolute period-on-period change in expectations. As an alternative measure of variability of inflation expectations, it reports the average absolute value of the change in Consensus long-term inflation expectations relative to the previous release.

Ratio of the standard deviation of expectations over the standard deviation of realised inflation: This ratio reports the relative volatility of long-term inflation expectations and realised inflation. This is done to take into account that a fraction of the volatility in long-term expectations could reflect the volatility in headline inflation emanating from the characteristics of the price index (e.g. as regards statistical properties –like the treatment given to durable goods or mortgage payments- or related to structural features of the economy -related to the size or degree of openness of the economic region).

## Annex II: Developments in long-term inflation expectations in a sample of industrial countries[34]

Display 1: euro area

EURO AREA	1990-1994	1995-1998	1999-2002
Average long-term inflation expectations	3.13	2.32	1.82
Average absolute deviation of expectations from 1.5%	-	-	-
Standard deviation of inflation expectations	0.18	0.27	0.09
Coefficient of variation of inflation expectations	0.06	0.12	0.05
Standard deviation of realised inflation	-	0.60	0.63
Average absolute period-on-period change in expectations	0.11	0.13	0.09
Stand.dev.of expectation over stand.dev.of realised inflation	-	44.83	13.48

Euro Area : Expected and realised inflation

Legend:
- HICP inflation (y-o-y rate of change)
- Long-term inflation expectations (Consensus Forecasts)
- Upper bound of definition of price stability ("year-on-year increase in HICP below 2%")

Stage III of EMU

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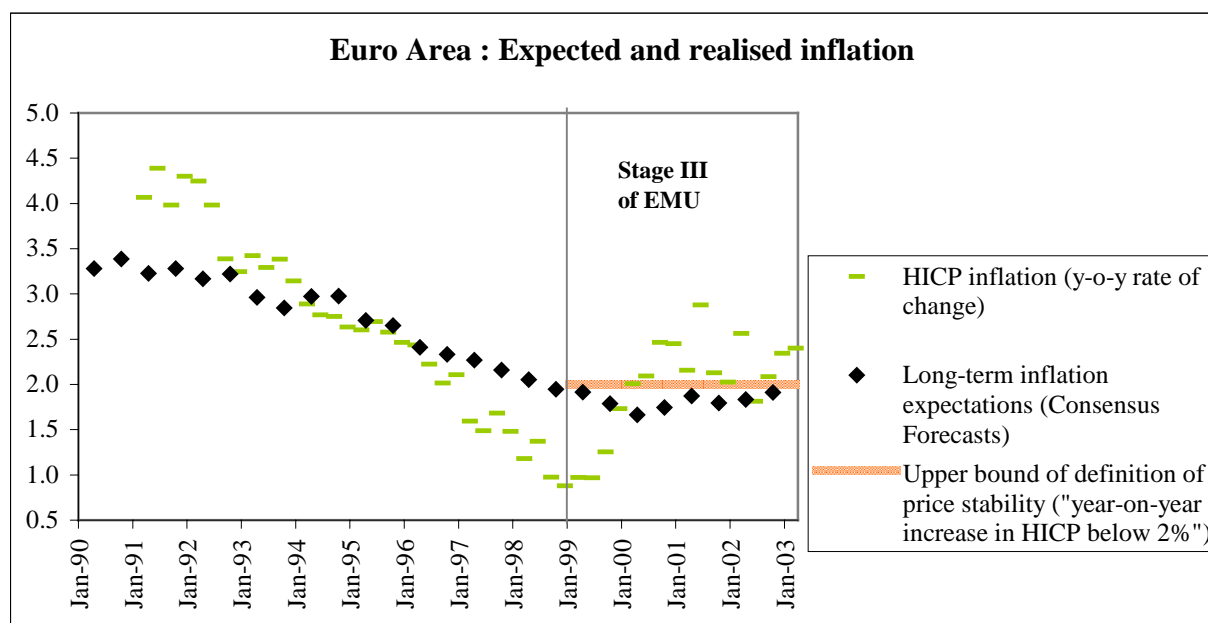
[34] For all charts and tables in the displays in this Annex, 'Inflation expectations' refers always to long-term inflation expectations from Consensus Forecasts. See Annex I for details on the construction of the long-term inflation expectations series for the case of the euro area and definition of the reported statistics. For the case of the euro area, inflation expectations 5 years ahead are reported from the ECB Survey of Professional Forecasters. 'Realised inflation' refers to Eurostat's HICP inflation for the euro area, to RPI inflation in the case of the U.K. and to CPI inflation in all other cases, as reflected in each of the displays under the chart's legend.
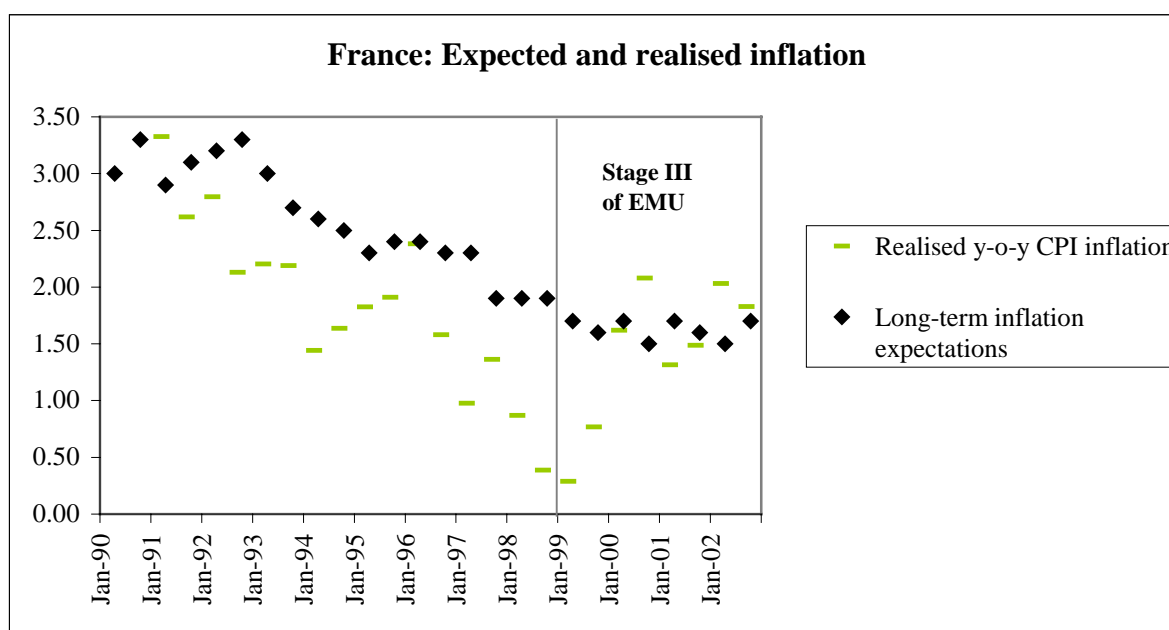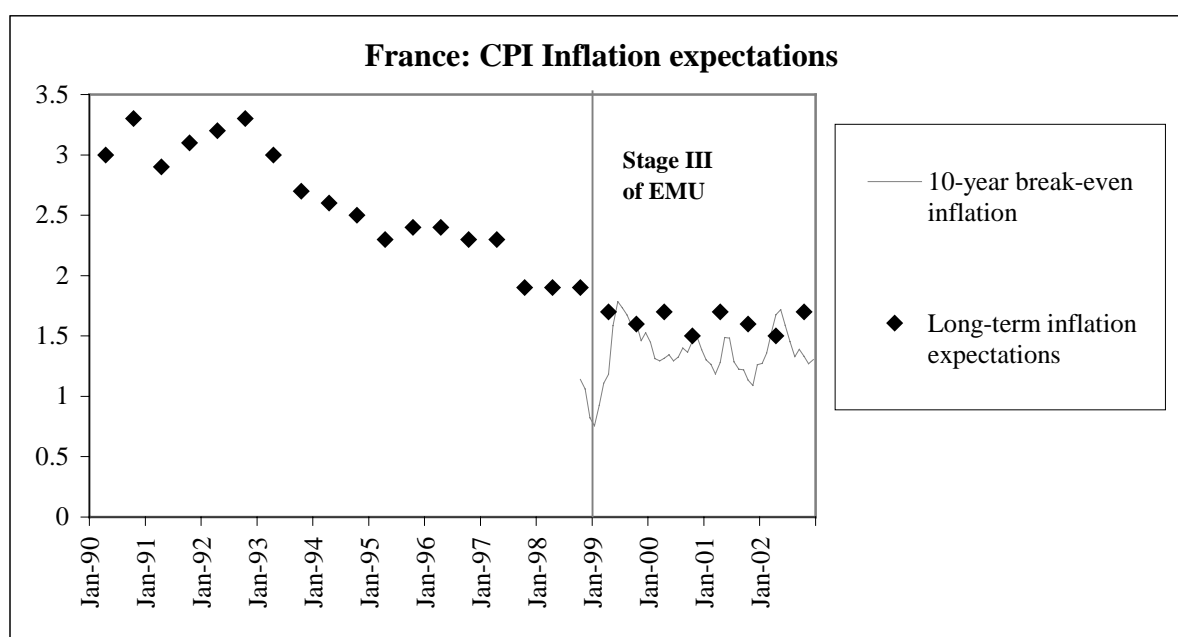
Euro area: inflation expectations
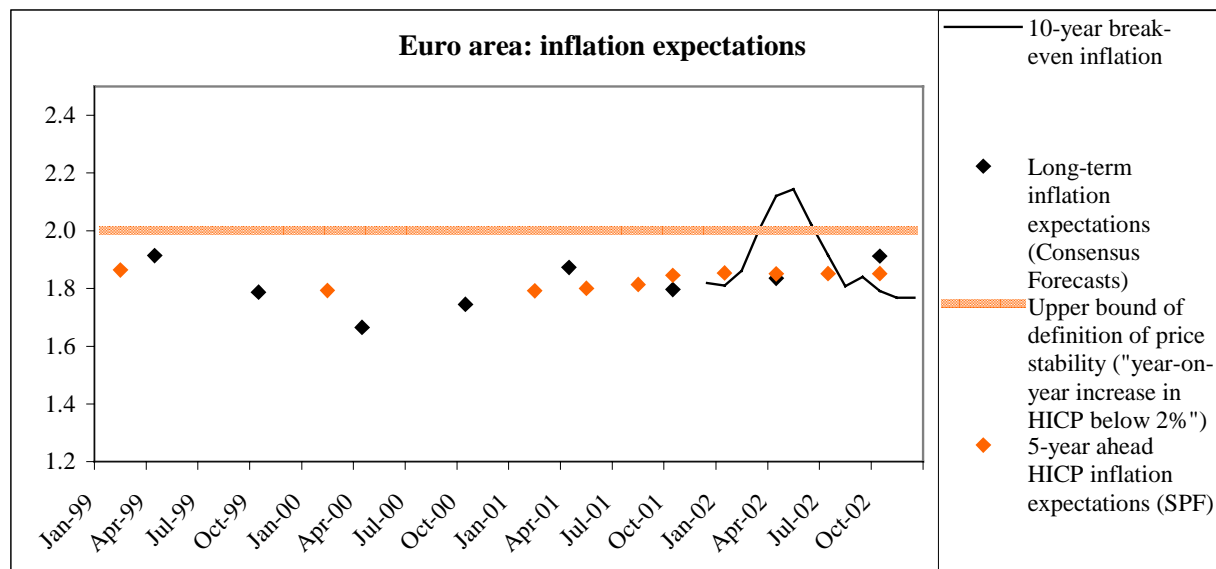
(*) Expected annual inflation 5-years-ahead are from ECB's Survey of Professional Forecasters, (see e.g. ECB Monthly Bulletin May 2003).

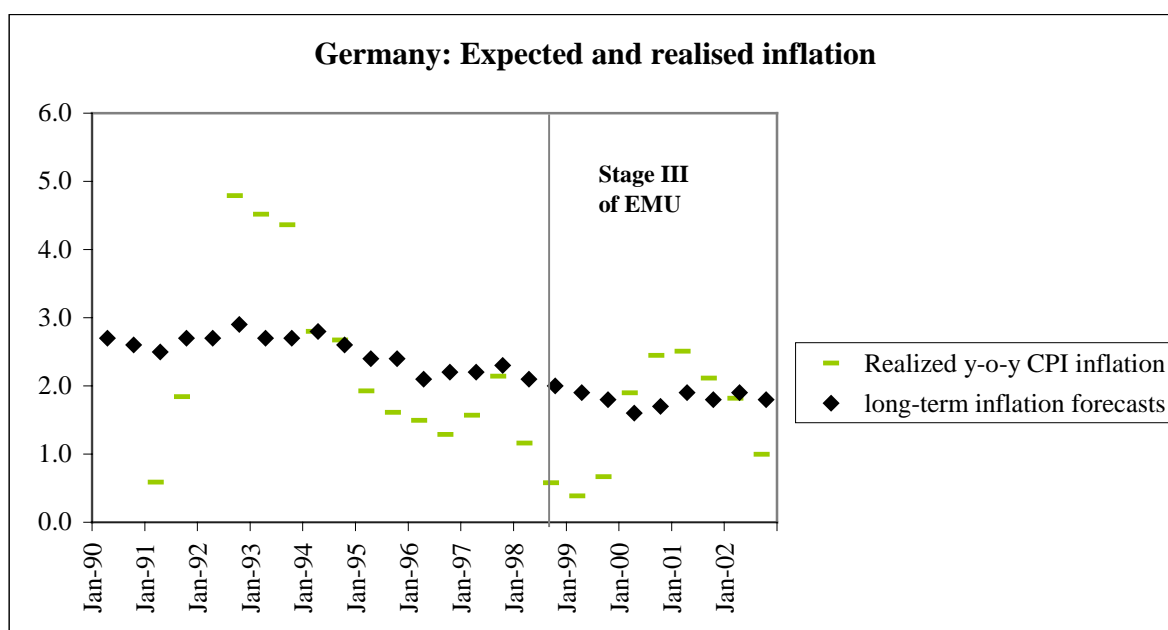**Display 2: France**

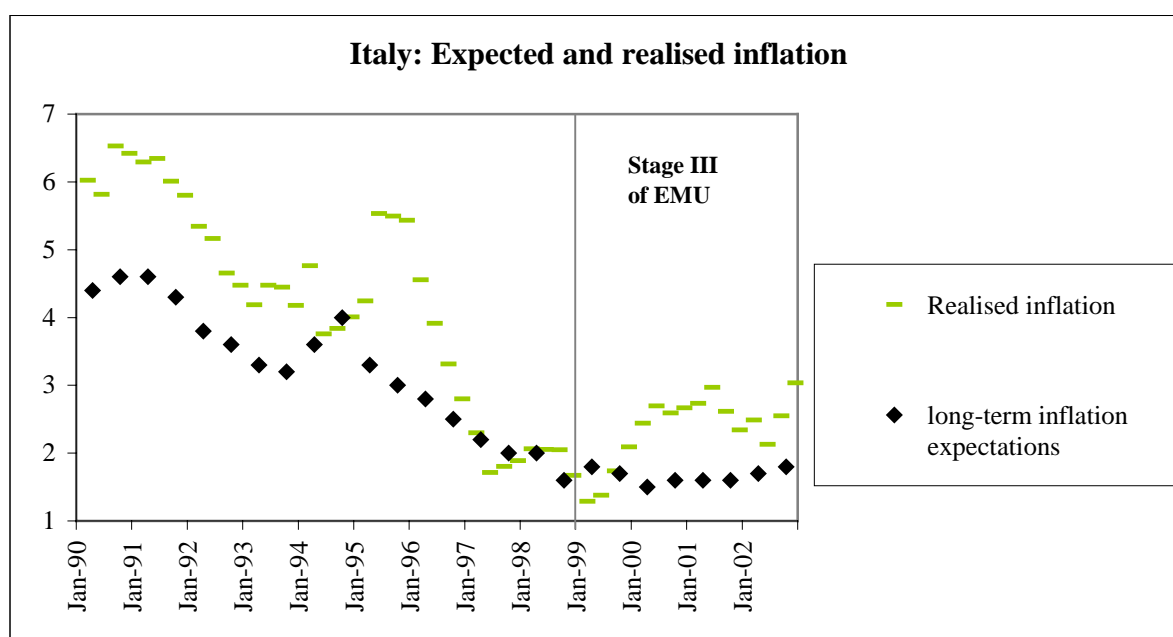| FRANCE	1990-1994	1995-1998	1999-2002
Average long-term inflation expectations	2.96	2.18	1.63
Average absolute deviation of expectations from point target	-	-	-
Standard deviation of inflation expectations	0.28	0.23	0.09
Coefficient of variation of inflation expectations	0.10	0.11	0.05
Standard deviation of realised inflation	0.61	0.65	0.62
Average absolute period-on-period change in expectations	0.21	0.10	0.15
Stand.dev.of expectation over stand.dev.of realised inflation	46.29	35.82	14.18

France: CPI Inflation expectations

France: Expected and realised inflation

Display 3: Germany

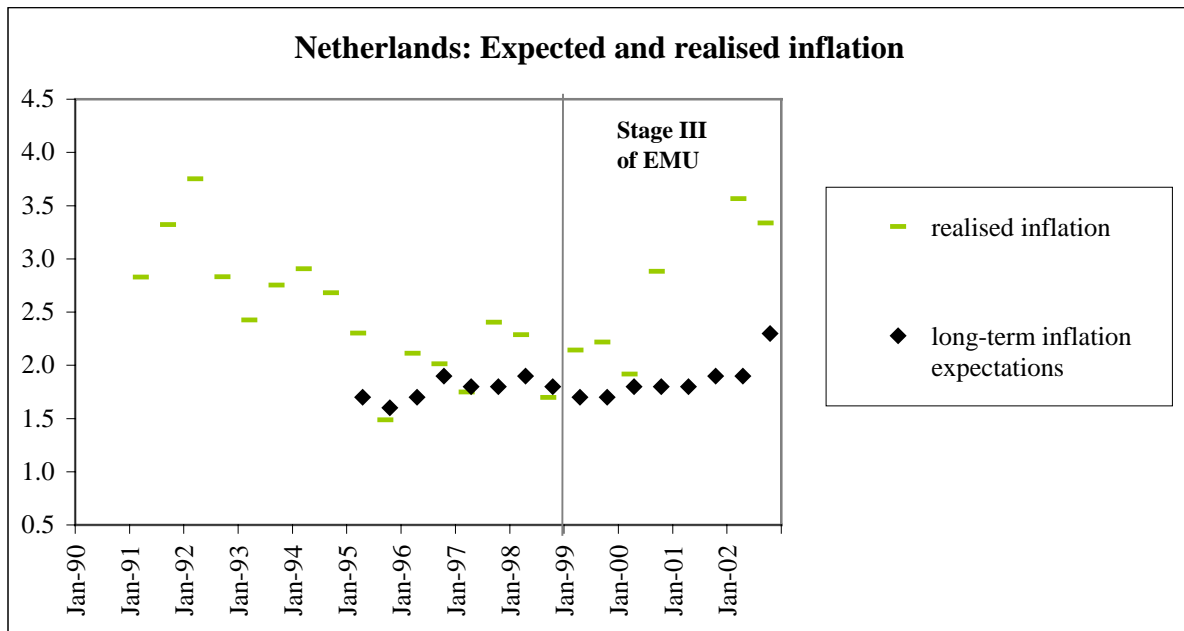| GERMANY	1990-1994	1995-1998	1999-2002
Average long-term inflation expectations	2.69	2.21	1.80
Average absolute deviation of expectations from point target	-	-	-
Standard deviation of inflation expectations	0.11	0.15	0.11
Coefficient of variation of inflation expectations	0.04	0.07	0.06
Standard deviation of realised inflation	1.78	0.48	0.81
Average absolute period-on-period change in expectations	0.13	0.13	0.13
Stand.dev.of expectation over stand.dev.of realised inflation	6.19	30.35	13.12

Germany: Expected and realised inflation

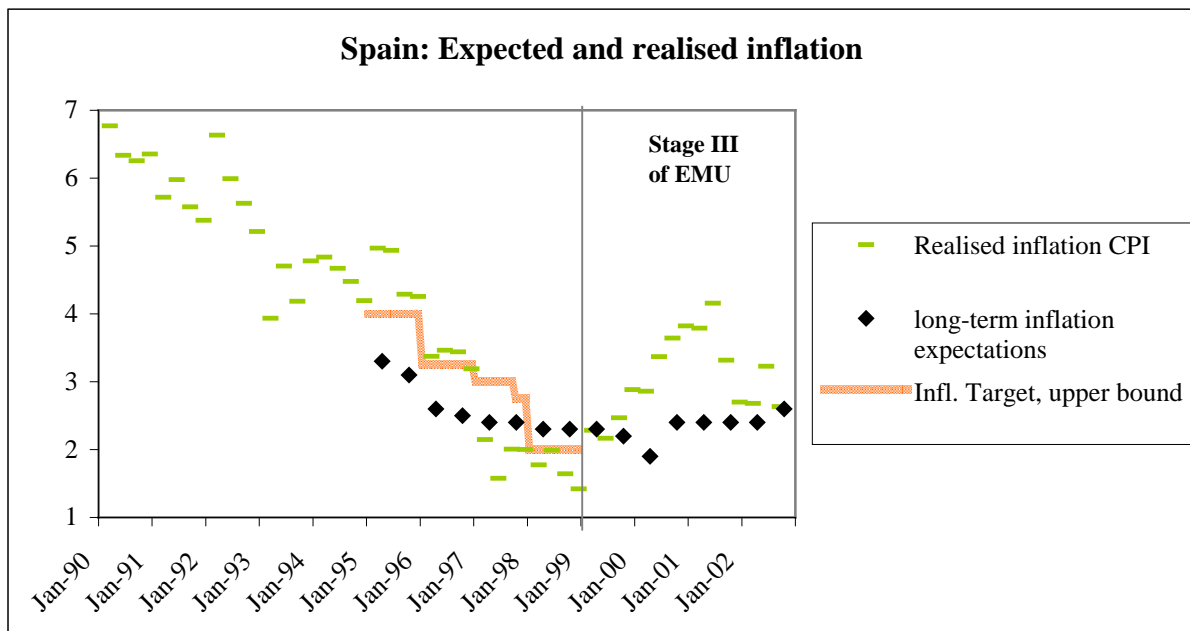| ITALY	1990-1994	1995-1998	1999-2002
Average long-term inflation expectations	3.94	2.43	1.66
Average absolute deviation of expectations from point target	-	-	-
Standard deviation of inflation expectations	0.52	0.58	0.11
Coefficient of variation of inflation expectations	0.13	0.24	0.06
Standard deviation of realised inflation	0.87	1.39	0.51
Average absolute period-on-period change in expectations	0.27	0.30	0.10
Stand.dev.of expectation over stand.dev.of realised inflation	59.80	41.45	20.77

Italy: Expected and realised inflation

Display 5: Netherlands

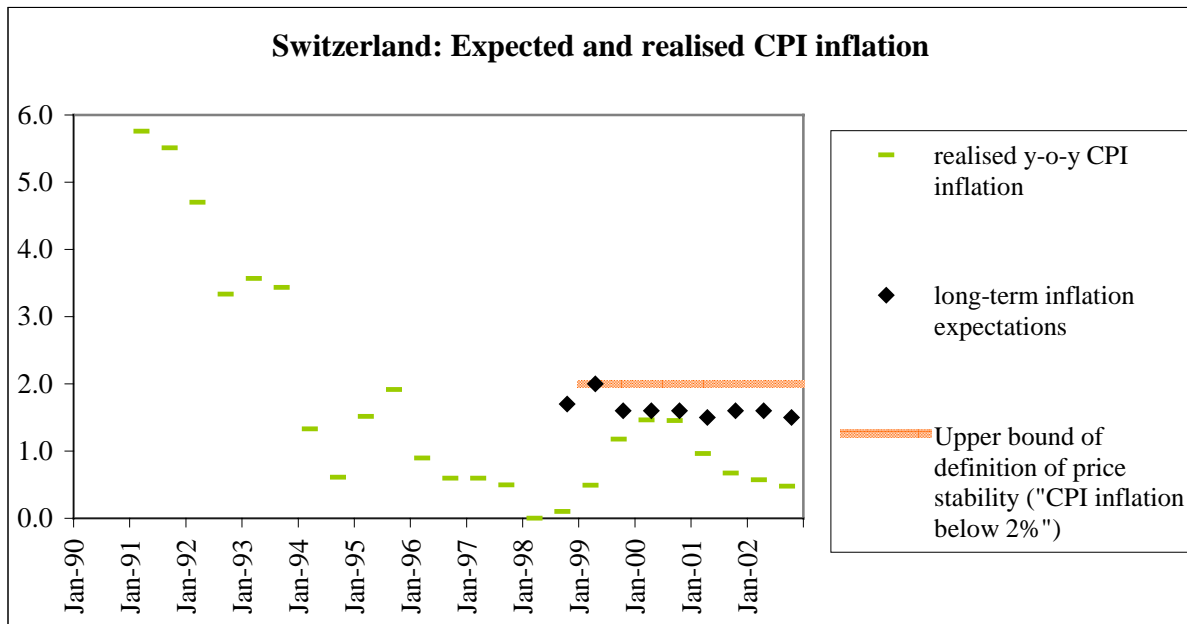| THE NETHERLANDS	1995-1998	1999-2002
Average long-term inflation expectations	1.78	1.86
Average absolute deviation of expectations from point target	-	-
Standard deviation of inflation expectations	0.10	0.19
Coefficient of variation of inflation expectations	0.06	0.10
Standard deviation of realised inflation	0.33	1.04
Average absolute period-on-period change in expectations	0.30	0.09
Stand.dev.of expectation over stand.dev.of realised inflation	31.26	18.42

Netherlands: Expected and realised inflation

Display 6: Spain

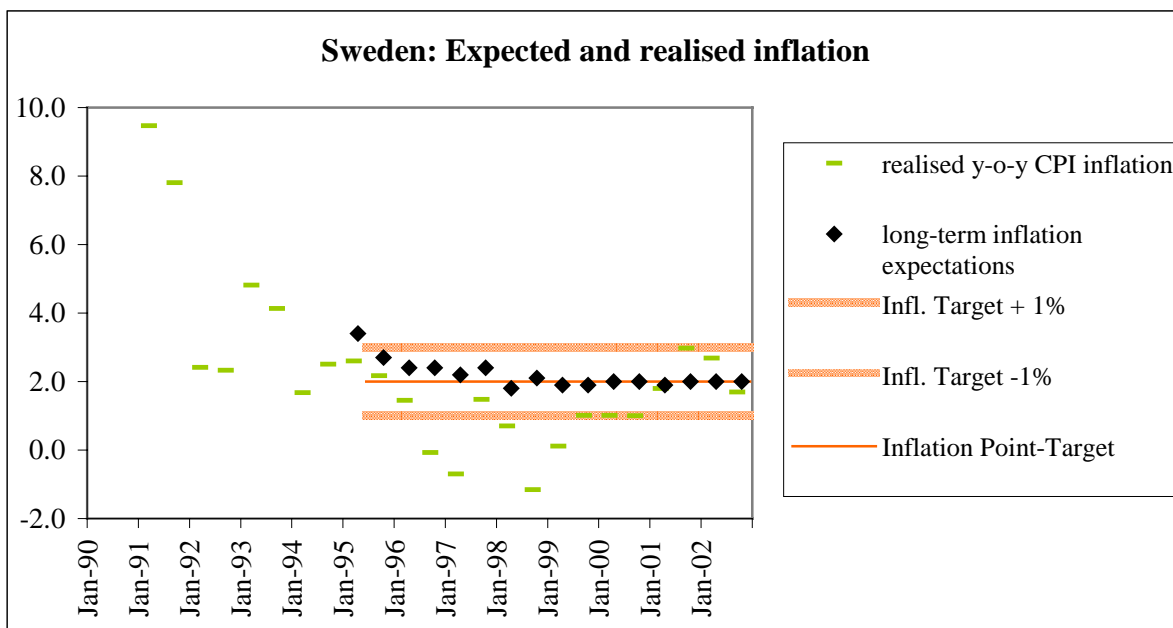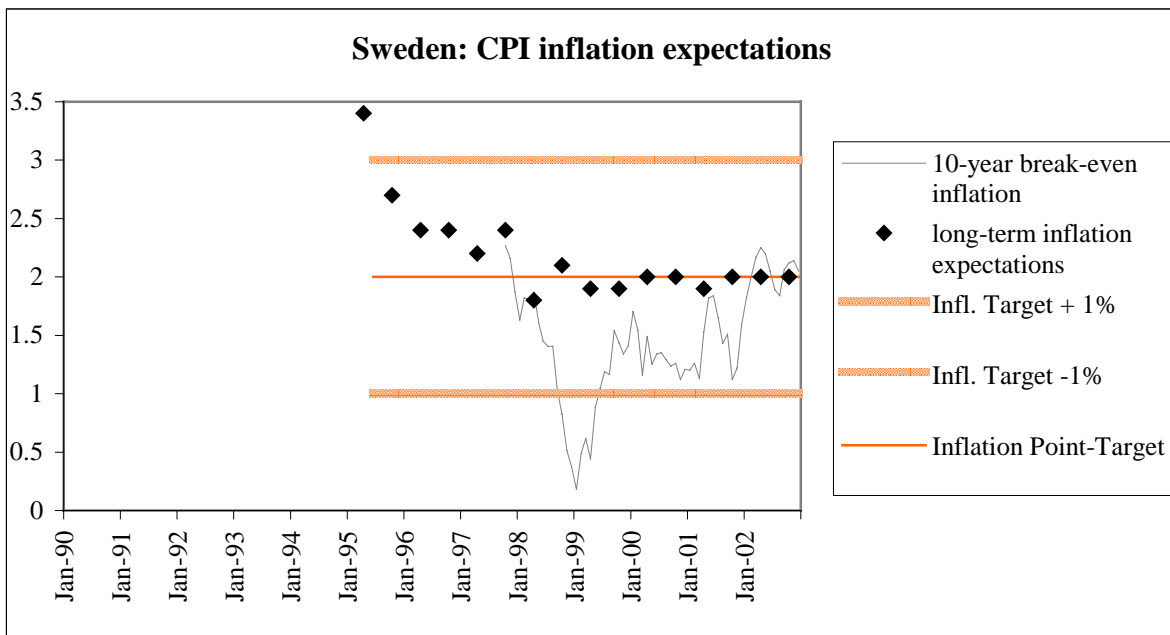| SPAIN	1995-1998	1999-2002
Average long-term inflation expectations	2.61	2.33
Average absolute deviation of expectations from point target	-	-
Standard deviation of inflation expectations	0.38	0.21
Coefficient of variation of inflation expectations	0.15	0.09
Standard deviation of realised inflation	1.25	0.56
Average absolute period-on-period change in expectations	0.14	0.14
Stand.dev.of expectation over stand.dev.of realised inflation	30.43	36.80

Spain: Expected and realised inflation

Stage III of EMU

Realised inflation CPI

long-term inflation expectations

Infl. Target, upper bound

Display 7: Switzerland

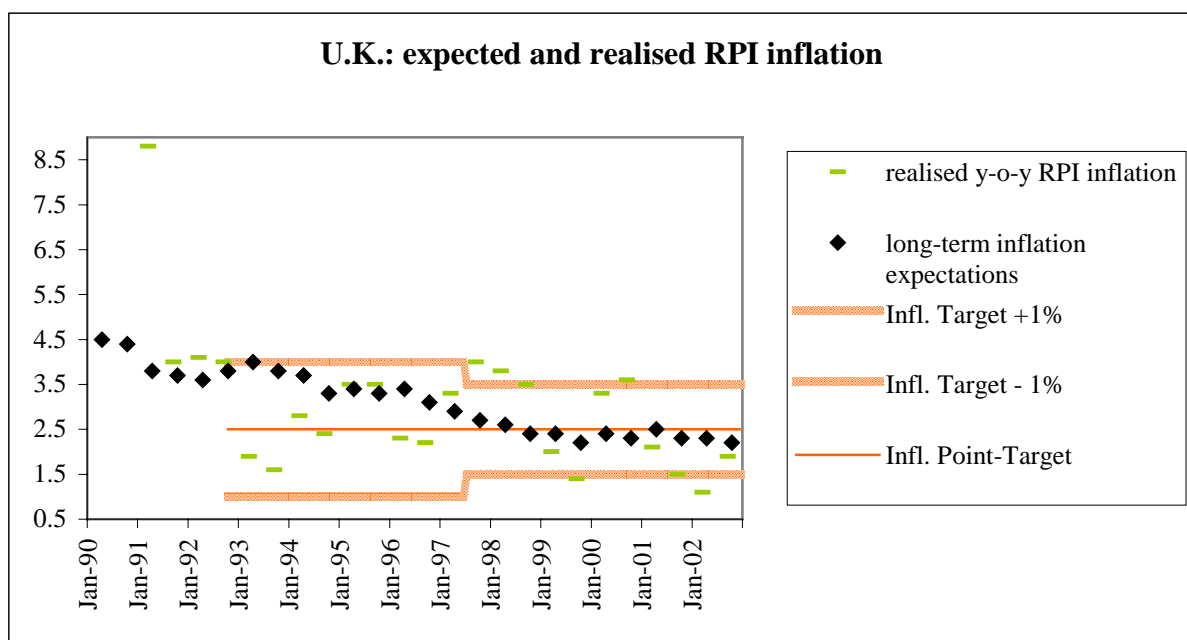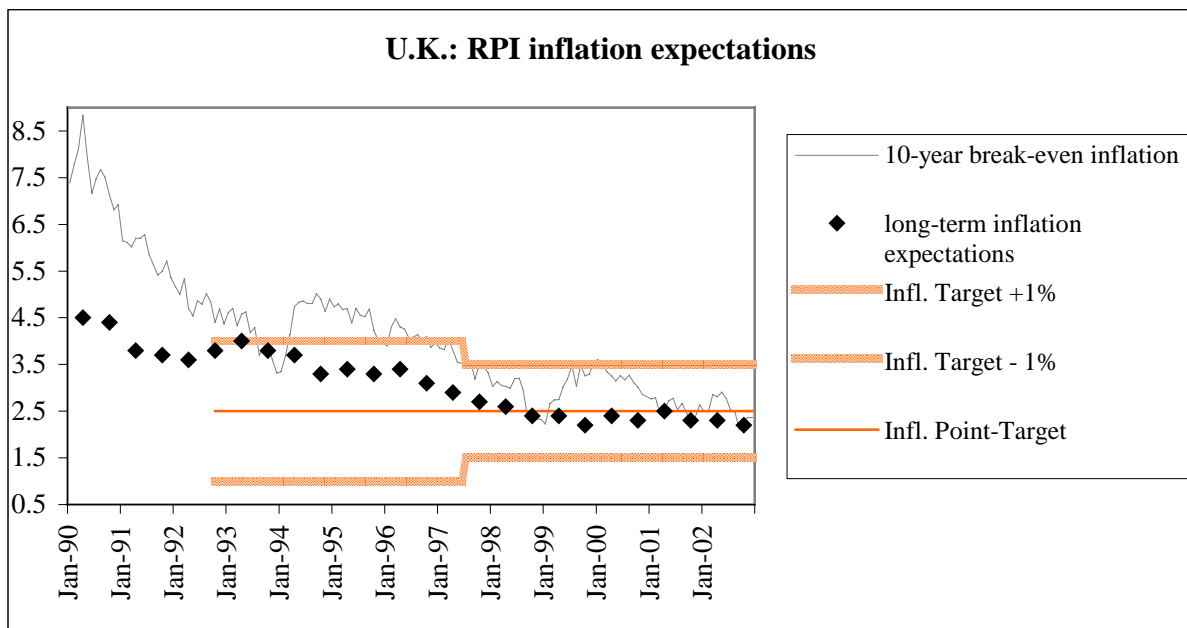| SWITZERLAND	1999-2002
Average long-term inflation expectations	1.63
Average absolute deviation of expectations from point target	-
Standard deviation of inflation expectations	0.16
Coefficient of variation of inflation expectations	0.10
Standard deviation of realised inflation	0.41
Average absolute period-on-period change in expectations	0.13
Stand.dev.of expectation over stand.dev.of realised inflation	38.13

Switzerland: Expected and realised CPI inflation

Legend:
- realised y-o-y CPI inflation
- ◆ long-term inflation expectations
- Upper bound of definition of price stability ("CPI inflation below 2%")

Display 8: Sweden

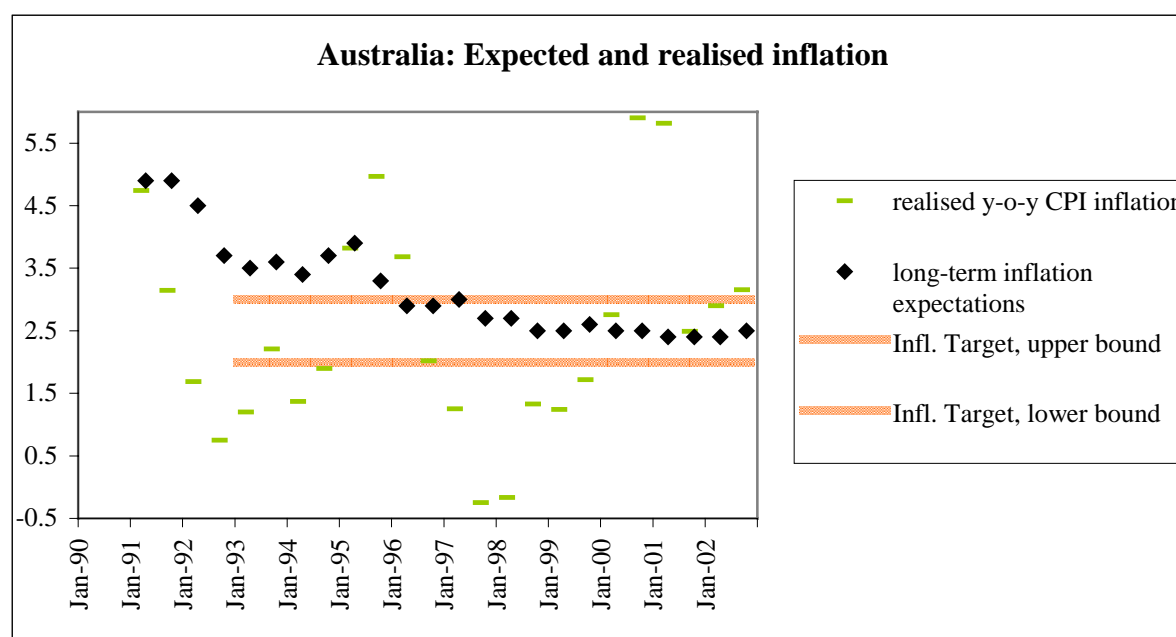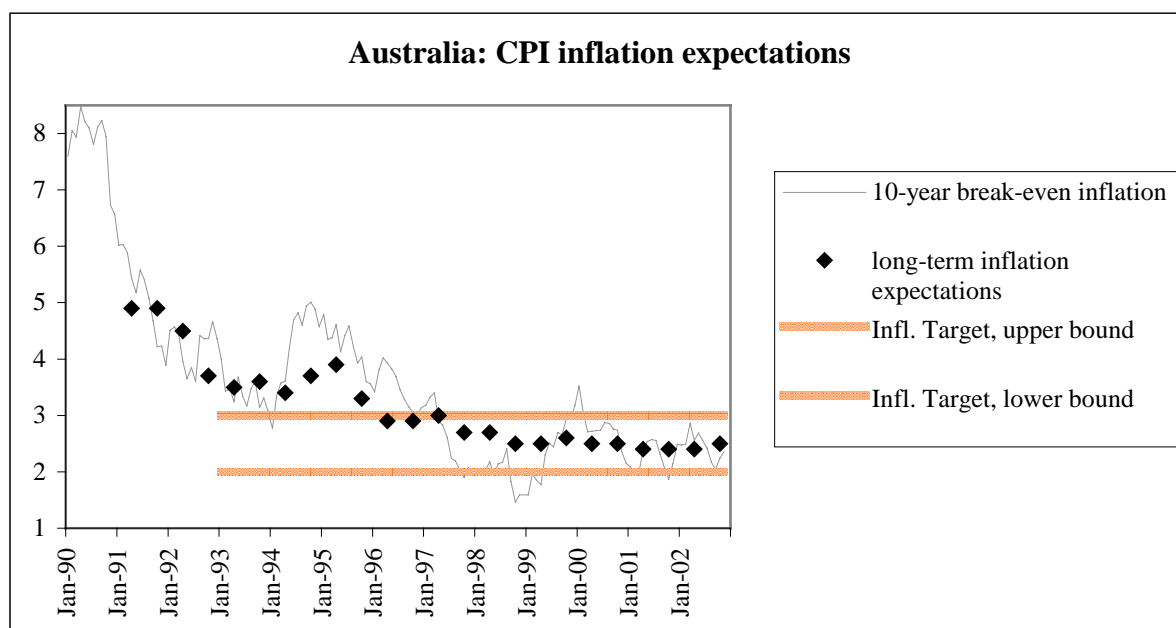| SWEDEN	1995-1998	1999-2002
Average long-term inflation expectations	2.43	1.96
Average absolute deviation of expectations from point target	0.18	0.04
Standard deviation of inflation expectations	0.47	0.05
Coefficient of variation of inflation expectations	0.20	0.03
Standard deviation of realised inflation	1.36	0.95
Average absolute period-on-period change in expectations	0.33	0.06
Stand.dev.of expectation over stand.dev.of realised inflation	34.97	5.44

Sweden: CPI inflation expectations

Sweden: Expected and realised inflation

Display 9: U.K.

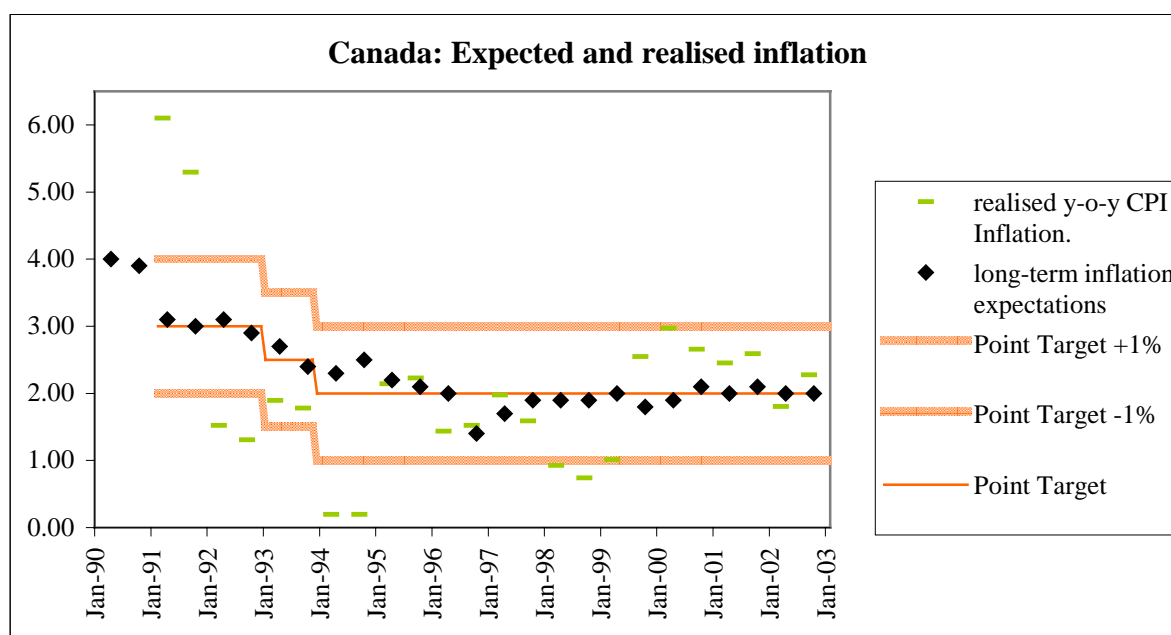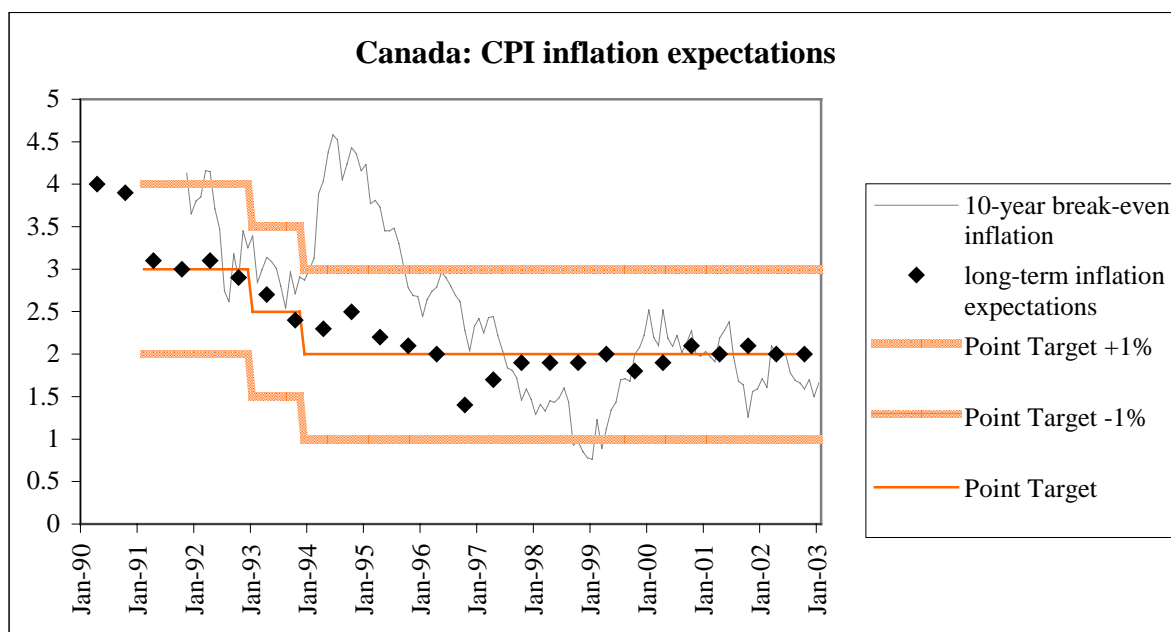| U.K.	1990-1994	1995-1998	1999-2002
Average long-term inflation expectations	3.86	2.98	2.33
Average absolute deviation of expectations from point target	-	0.50	0.18
Standard deviation of inflation expectations	0.36	0.38	0.10
Coefficient of variation of inflation expectations	0.09	0.13	0.04
Standard deviation of realised inflation	2.28	0.66	0.89
Average absolute period-on-period change in expectations	0.24	0.16	0.13
Stand.dev.of expectation over stand.dev.of realised inflation	15.75	58.17	11.58

U.K.: RPI inflation expectations

Legend: 10-year break-even inflation; long-term inflation expectations; Infl. Target +1%; Infl. Target - 1%; Infl. Point-Target

U.K.: expected and realised RPI inflation

Legend: realised y-o-y RPI inflation; long-term inflation expectations; Infl. Target +1%; Infl. Target - 1%; Infl. Point-Target

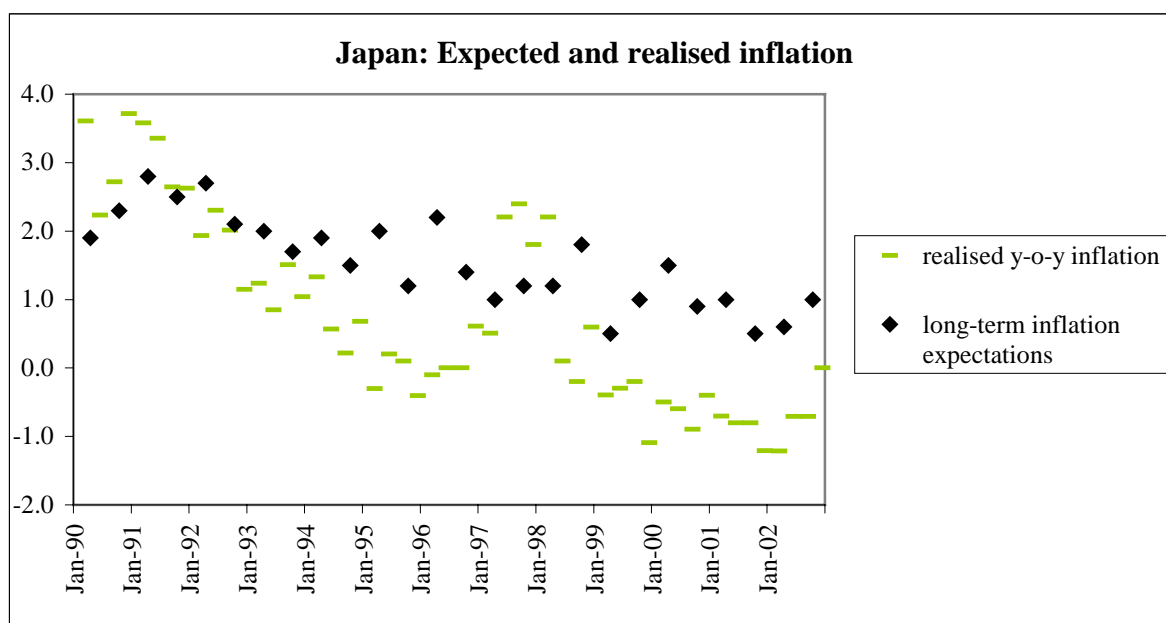| AUSTRALIA	1991-1994	1994-1998	1999-2002
Average long-term inflation expectations	4.03	2.99	2.48
Average absolute deviation of expectations from point target	-	0.27	0.05
Standard deviation of inflation expectations	0.63	0.44	0.07
Coefficient of variation of inflation expectations	0.16	0.15	0.03
Standard deviation of realised inflation	1.28	1.91	1.73
Average absolute period-on-period change in expectations	0.33	0.23	0.05
Stand.dev.of expectation over stand.dev.of realised inflation	49.55	22.92	4.09

Australia: CPI inflation expectations

Australia: Expected and realised inflation

Display 11: Canada

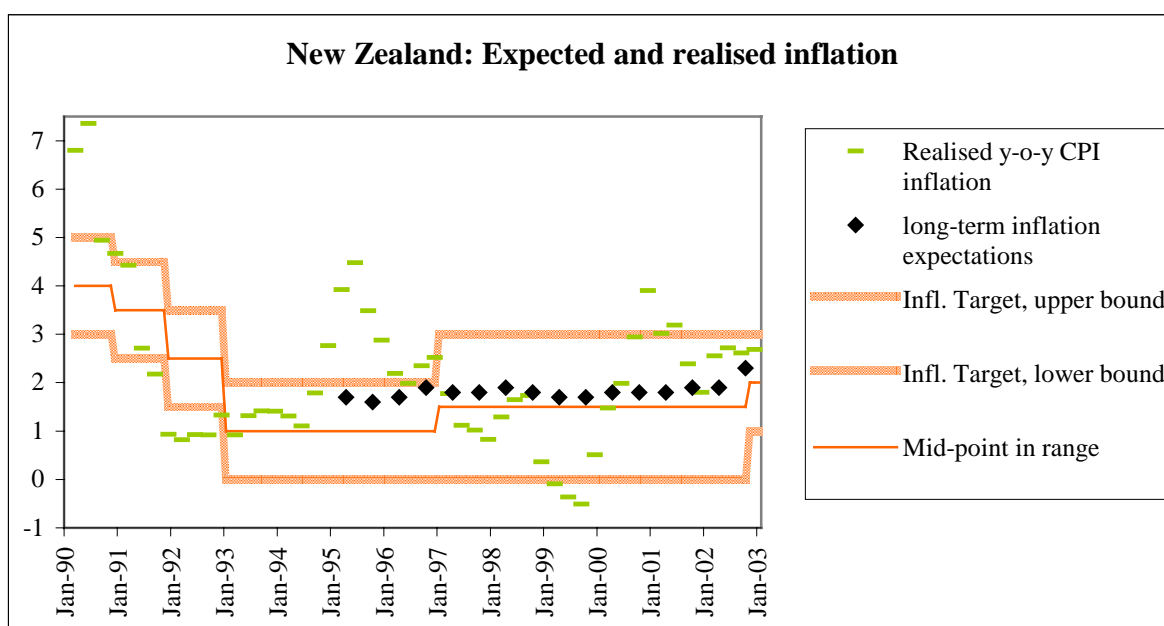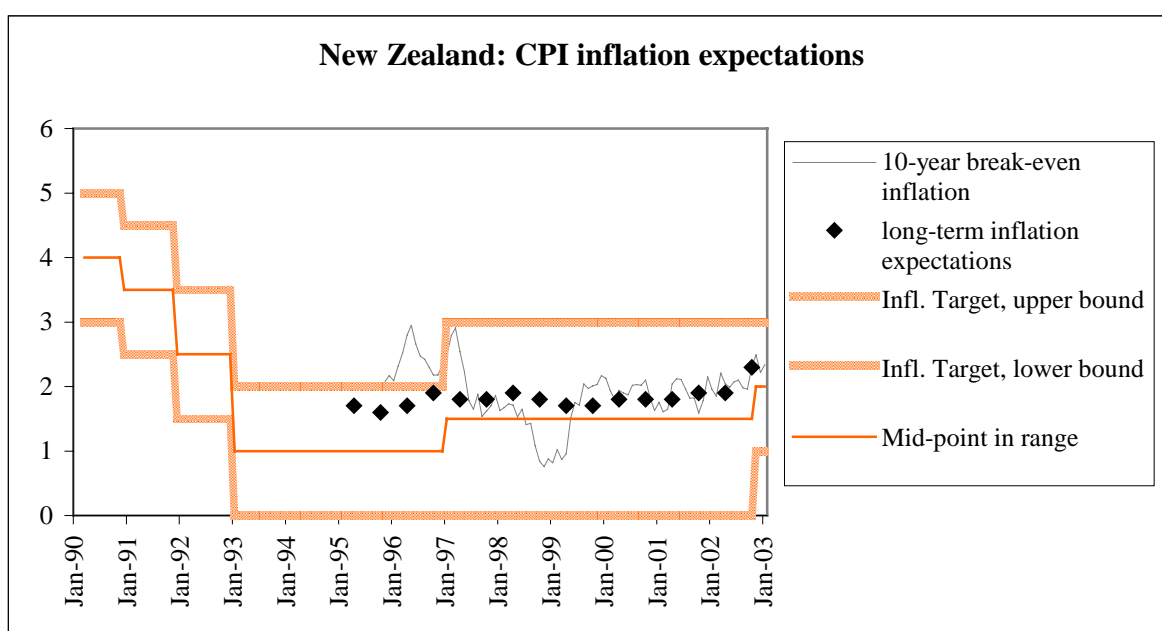| CANADA	1990-1994	1995-1998	1999-2002
Average long-term inflation expectations	2.99	1.89	1.99
Average absolute deviation of expectations from point target	0.18	0.19	0.06
Standard deviation of inflation expectations	0.58	0.25	0.10
Coefficient of variation of inflation expectations	0.19	0.13	0.05
Standard deviation of realised inflation	2.21	0.54	0.62
Average absolute period-on-period change in expectations	0.25	0.20	0.11
Stand.dev.of expectation over stand.dev.of realised inflation	26.21	45.78	16.09

Canada: CPI inflation expectations

Canada: Expected and realised inflation

| JAPAN	1990-1994	1995-1998	1999-2002
Average long-term inflation expectations	2.14	1.50	0.88
Average absolute deviation of expectations from point target	-	-	-
Standard deviation of inflation expectations	0.43	0.44	0.34
Coefficient of variation of inflation expectations	0.20	0.29	0.39
Standard deviation of realised inflation	1.09	0.97	0.35
Average absolute period-on-period change in expectations	0.33	0.54	0.50
Stand.dev.of expectation over stand.dev.of realised inflation	39.27	45.34	96.03

Display 12: Japan

Japan: Expected and realised inflation

- realised y-o-y inflation
- ◆ long-term inflation expectations

NEW ZEALAND	1995-1998	1999-2002
Average long-term inflation expectations	1.78	1.86
Average absolute deviation of expectations from mid-point range	0.50	0.36
Standard deviation of inflation expectations	0.10	0.19
Coefficient of variation of inflation expectations	0.06	0.10
Standard deviation of realised inflation	1.02	1.38
Average absolute period-on-period change in expectations	0.10	0.09
Stand.dev.of expectation over stand.dev.of realised inflation	10.16	13.91

New Zealand: CPI inflation expectations

New Zealand: Expected and realised inflation

Display 14: U.S.

U.S.	1990-1994	1995-1998	1999-2002
Average long-term inflation expectations	3.84	3.00	2.56
Average absolute deviation of expectations from point target	-	-	-
Standard deviation of inflation expectations	0.26	0.25	0.07
Coefficient of variation of inflation expectations	0.07	0.08	0.03
Standard deviation of realised inflation	0.66	0.63	0.85
Average absolute period-on-period change in expectations	0.04	0.13	0.08
Stand.dev.of expectation over stand.dev.of realised inflation	39.26	39.87	8.72

U.S.: CPI inflation expectations

U.S.: Expected and realised inflation
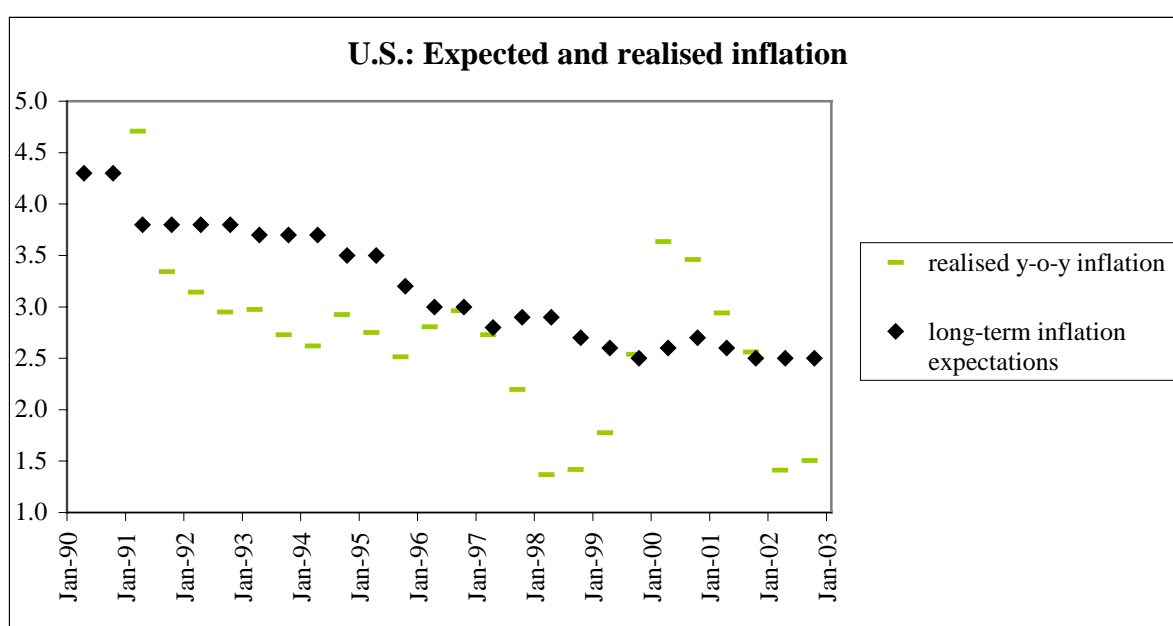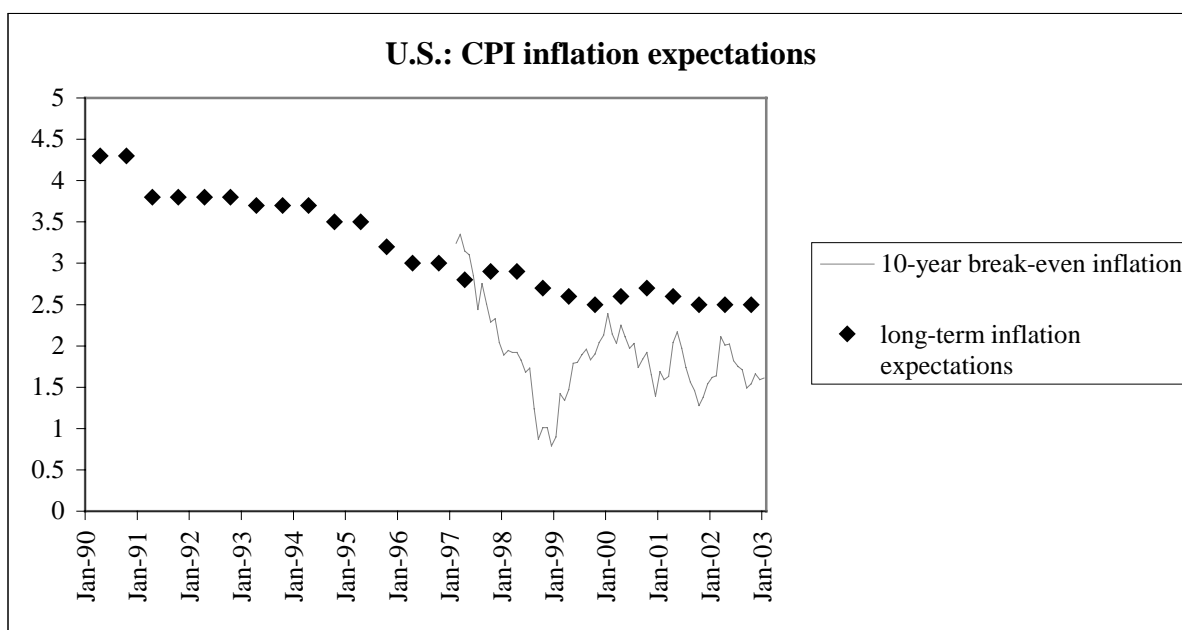
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