Inflation targets and intervals – an overview of the issues

Mikael Apel and Carl Andreas Claussen*
The authors work in the Monetary Policy Department of the Riksbank

In this article, we analyse the advantages and disadvantages of different ways of formulating inflation targets that involve an interval. We first review the international debate of ten to fifteen years ago on how an inflation target should best be designed. We then discuss the arguments in the current Swedish debate in light of this. One central conclusion is that if the inflation target is credible, monetary policy can be flexible and consider factors other than inflation – such as output and employment – even without an interval. A 'tolerance band' can open for more flexibility if it increases the credibility of the inflation target, but it could also reduce flexibility if it creates more inflation uncertainty or if ending up outside the interval is very costly. A 'target range' entails a major change to the monetary policy framework. It would allow the central bank to aim at different levels for inflation at different times. But as inflation expectations may become less firmly anchored, economic fluctuations may become greater.

1 There are different types of inflation targets

Almost all of the OECD's 35 member countries can be characterised as inflation targeters. They either conduct their own inflation targeting policy, or they are members of the euro area where the European Central Bank (ECB) conducts inflation targeting.[1] Monetary policy in many emerging market economies, such as Ghana, Indonesia and the Philippines, is also based on an inflation target. In total, there are currently about sixty countries that use a quantified target for inflation in one way or another.[2]

Inflation targets can be designed in different ways. They can be what is known as *point targets* where the inflation target is specified in terms of a single number, or they can be so-called *target ranges* where the target is specified in terms of an interval. As it is difficult to attain a point target exactly, point targets are often complemented with a *tolerance band*. The tolerance band specifies which deviations from the point target can be considered 'acceptable' in normal times.

1.1 The difference between a tolerance band and a target range

The difference between a tolerance band and a target range is illustrated in Figure 1. The figure shows CPIF inflation since 2006, an inflation target of 2 per cent and two possible intervals: a tolerance band of ±1 percentage point around the target, and a target range from 1 to 3 per cent. The important difference between the two intervals is how the central bank regards the desirable level of inflation in the period ahead. The tolerance band refers

* We would like to thank Claes Berg, Gabriela Guibourg, Ulf Söderström and Anders Vredin for valuable comments and suggestions. The opinions expressed in this article are our own and should not be regarded as the Riksbank's view.

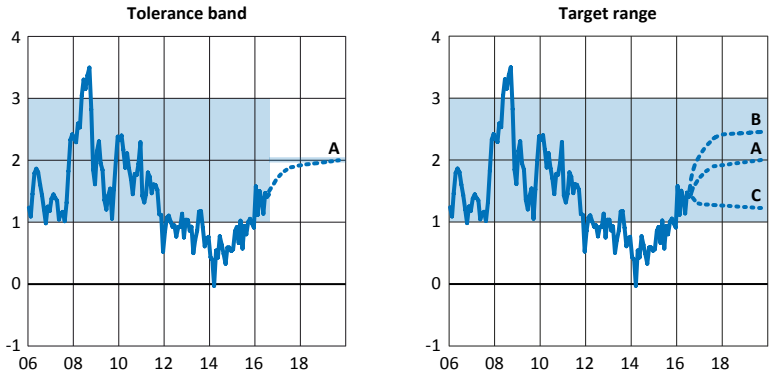
1 The only exception is Denmark, whose currency is pegged to the euro. A difference between the euro countries and regular inflation-targeting countries is that the ECB's inflation target applies to average inflation across the euro area. This means that inflation in individual countries can vary.

2 A list of central banks' inflation targets for 2016 can be found at www.centralbanknews.info.

to inflation outcomes. In this sense it is backward-looking, but it may also affect current monetary policy and thereby also future inflation. Most importantly, with a point target and a tolerance band, the central bank always aims at bringing inflation back to the point target, as in path A.

With a target range it is different. Then there is no requirement for the central bank to always bring inflation back to the middle of the interval. The central bank can, in principle, aim for any level within the interval, for example as in paths A, B or C.

Figure 1. Tolerance band versus target range
Inflation and inflation forecasts



Note. The broken line represents fictitious forecasts.
Sources: Statistics Sweden and the Riksbank

1.2 Point target with tolerance band is the most common in practice

It is most common for central banks to have a point target and a tolerance band.[3] This is the case in Chile, the Czech Republic and Hungary, for example. However, a number of countries only have a point target. This is the case in Norway, Sweden, and the United States, for example. The Riksbank had a tolerance band up to 2010. A few countries have a target range, for example Australia and Israel. Switzerland, where the aim is for inflation "to be below 2 per cent", can also be included here as zero can be regarded as the lower bound (as a negative rate of price increase is not inflation but deflation).

There are also several countries whose inflation targets are harder to characterise. These include Colombia and New Zealand, which both have formal target ranges but also have the expressed ambition of bringing inflation close to the midpoint of the range – implying that it also has the characteristics of a point target.[4] In the euro area, inflation must be below 2 per cent which, like Switzerland, could be interpreted as a target range of zero to 2 per cent. But the wording of the target specifies that inflation is to be "close to 2 per cent", which indicates an ambition to be closer to the upper limit of the interval. The United Kingdom is often included among the countries which only have a point target.[5] At the same time, the United Kingdom is one of the relatively few countries where a sufficiently large deviation from target has concrete consequences. If inflation deviates from target by more than one percentage point, the Governor of the Bank of England must write an open letter to the Government and explain why this has happened.[6] Thus, according to the definition above, this arrangement

3 A complete list of different countries' targets can be found in Table A1 in Appendix 1.
4 See, for example, Lewis and MacDermott (2016) for a historical review of New Zealand's inflation target. The aim for future inflation to be held "near the 2 percent target midpoint" was added in September 2012.
5 See, for example, Hammond (2012).
6 The clarification of the inflation target that the Riksbank presented in conjunction with the appointment of the Executive Board in 1999 is somewhat reminiscent. See Heikensten (1999).

has the characteristics of a tolerance band, even if the Bank of England seems to prefer not to use this term.[7]

2 The debate about point targets vs. intervals

So, which type of inflation target is to be preferred? About ten to fifteen years ago, there was a quite intensive international discussion on how an inflation target should best be designed. One central issue concerned whether the target should be a point target or an interval.[8] But it was not always clear whether the interval discussed was a tolerance band or a target range: was it the target *in itself* that should be a point or an interval, or was it that a point target should be surrounded by a tolerance band? Below, we go through the arguments presented. Even today these arguments provide a fairly complete view of the advantages and disadvantages of the various targets.

The review may also be useful for the recent debate in Sweden. The discussion here has focused on whether the Riksbank should (re)introduce some type of interval. But neither here has there been complete clarity as to whether the interval under discussion is a tolerance band or a target range.[9] We will return to the Swedish debate later in the article.

2.1 Intervals that are supposed to illustrate uncertainty and the impossibility of fine-tuning

An argument in the earlier international debate that must be interpreted as referring to a tolerance band is that the interval should reflect inflation uncertainty and the fact that the central bank cannot perfectly control inflation. The interval would illustrate that actual inflation may differ from the target. The aim of this type of interval would be for the central bank to avoid giving the impression that monetary policy can fine-tune inflation with a high degree of precision. The size of the interval would provide information on the central bank's assessment of the normal level of uncertainty about shocks and about the effects of monetary policy. The interval would show what variation in inflation that could reasonably be expected over time.

Some argued that uncertainty could better be illustrated in other ways, for example by the uncertainty band around the central bank's forecasts, such as, for example, those in the Riksbank's Monetary Policy Reports (the so-called "fan charts").[10] Uncertainty can also be illustrated by alternative scenarios. Some also argued that economic agents already understand that a point target will never be exactly fulfilled, and that deviations will always exist. A tolerance band would therefore be unnecessary, according to this point of view.

However, it cannot be ruled out that a tolerance band is a more pedagogical way of illustrating this uncertainty and that economic agents would gain a better understanding of the uncertainty if there was an interval. A tolerance band may then make moderate deviations from the point target less dramatic, as inflation would still be within the tolerance band. In contrast, if there is no tolerance band the same deviations could be perceived as a clear miss of the target and could thereby reduce the confidence in the central bank and

7 For example, Charles Bean (2003), former Chief Economist and member of the Bank of England's Monetary Policy Committee, has explained that: "It is worth stressing that the Open Letter is part of the arrangements for public accountability, not an elaboration of the target into a de facto 1.5%-3.5% tolerance band. Sending an Open Letter is not therefore to be seen as a sign that we have 'failed', rather it is a trigger for a public explanation as to why the deviation has occurred."

8 See, for example, Bernanke et al. (1999), Mishkin (2000), Castelnuovo, Nicoletti-Altimari and Rodríguez Palenzuela (2003) and Meyer (2004).

9 See, for example, Österholm (2016) for one interpretation of the debate. The advantages and disadvantages of various intervals were discussed in a Riksbank Study in September. The study was intended to form the basis of a broad and open discussion of the issue (Sveriges Riksbank, 2016b). The study also looked at alternative target variables. See also Jansson (2015).

10 For example, Bernanke et al. write (1999), p. 321: "[I]n 1995, the Bank of England switched […] to a point target, and it has used the Inflation Report and other channels to communicate the inherent uncertainties in the control of inflation to the public, rather than leaving those uncertainties to be inferred from the target range." For an example of uncertainty bands, see Figure 1:3 in the Monetary Policy Report, September 2016. This interval is intended to show the probability of various outcomes over various forecast horizons, and is based on the Riksbank's historical forecasting errors.

the inflation target. In that (hypothetical) case, a tolerance band could facilitate the central bank's communication and contribute to confidence in the point target.

But there is also a downside. If the aim of the tolerance interval is unclear, it might be interpreted as a target range and thereby create more uncertainty regarding the inflation target, see section 2.2.

Furthermore, when inflation falls outside the interval, it may be perceived as much more alarming and a serious failure of policy. The negative effect on confidence may be greater than without the interval.[11] This could, in turn, lead to a non-linear monetary policy reaction pattern where the central bank reacts relatively weakly to a shock causing inflation to stay just inside the interval, but strongly to a marginally greater shock causing inflation to move to just outside the interval. The result could be a stop-go policy that increases uncertainty and contributes to greater macroeconomic fluctuations.[12]

It is important that the interval (tolerance band) is well-adapted

It is of course important that a tolerance band is well-adapted. Inflation should be within the band most of the time, but it should not be so wide that inflation always will lie within it. Neither should it be too narrow. The tolerance band around the Riksbank's inflation target until 2010 was not well-adapted. When that band – which was specified as ±1 percentage point around 2 per cent CPI inflation – was removed, inflation had been outside the band just as often as it had been inside. The memorandum published when the band was removed noted the following: "There is considerable understanding for the fact that inflation commonly deviates from the target and that the deviations are sometimes larger than 1 percentage point. Inflation can thus be outside of the tolerance band without threatening the credibility of the inflation target. Such deviations have proved to be a natural part of monetary policy."[13] Thus, at this time the Riksbank assessed that a point target was sufficient and that the tolerance band was superfluous.

2.2 Intervals that show which levels of inflation the central bank can target

Another argument that was raised was that an interval could allow monetary policy to take more account of factors such as resource utilisation, which is to say monetary policy could be more flexible with an interval than without.[14] Another argument for flexibility has (re) emerged in the discussion after the financial crisis, namely the argument that monetary policy should counteract the accumulation of financial imbalances.[15] People arguing that an interval will increase flexibility may have a target range in mind. With a target range the central bank can choose to aim for different inflation levels at different times. Alternatively, they may be thinking of a tolerance band that opens for longer periods of deviations from target.

However, it is not clear exactly why flexibility would increase with an interval. An intuitive interpretation is that the central bank would not need to bring inflation back as rapidly to a given point target. In other words, the central bank – according to this way of thinking – would not have to be so much of an "inflation nutter", as the previous Governor of the Bank of England, Mervyn King, has put it. If monetary policy is strictly aimed at minimising target deviations in all situations, the real economy will vary more. In this sense, monetary policy may become more flexible with an interval. We will discuss this argument later in the article.

11 Bernanke et al. (1999) state, for example, that "the damage to credibility of missing a target range entirely is greater than that of missing a target point" (p. 32).
12 See, for example, Mishkin (2008).
13 Sveriges Riksbank (2010).
14 See, for example, Bernanke et al. (1999) and Castelnuovo, Nicoletti-Altimari and Rodríguez Palenzuela (2003).
15 See, for example, Banerjee, Cecchetti and Hofmann (2013) and Blanchard, Dell'Ariccia and Mauro (2013).

Another argument for a target range is that the 'optimal' inflation rate varies over time, and that there therefore is reason to aim at different levels of inflation at different times. An example referred to in the international debate ten to fifteen years ago was that structural factors could raise the real equilibrium interest rate.[16] The cost of permanently low inflation would then be lower as the risk of reaching the lower bound for the nominal interest would be lower. When the advantages and disadvantages are weighed up, it could be optimal to permanently aim at a lower inflation level than before.

The situation today is of course the opposite. The real equilibrium interest rate is unusually low and the risk of reaching the lower bound for the interest rate is high. The implication is then that the central bank should aim for the upper part of a target range.

But if the motivation for a target range is to be able to adjust for changes in the optimal rate of inflation, it seems more reasonable to discuss and evaluate the appropriate level of a point target. After inflation targeting was introduced at the start of the 1990s, inflation of around 2 per cent became more or less a standard inflation target in industrialised countries. This worked well for a long time. It was not until recent years that this level came under question to any great extent. Due to the reasons we mention above, many debaters have now advocated raising the central banks' inflation target to 3 or 4 per cent.[17]

It is more difficult to anchor expectations with a target range

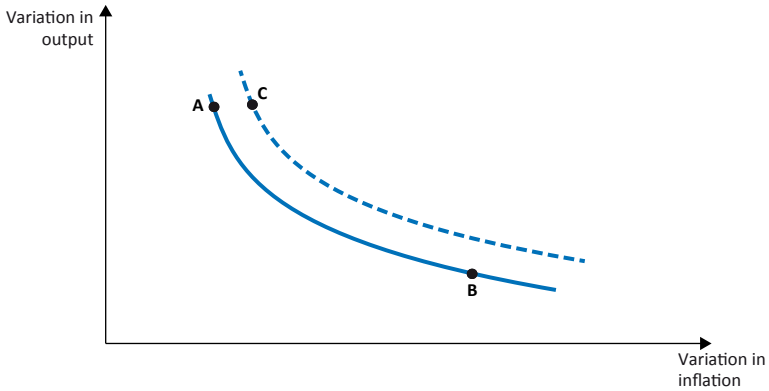
A central bank that utilises a target range to occasionally change the point target may experience detrimental movements in inflation expectations. It is more difficult to anchor inflation expectations with a target range than with a point target.[18] A specific figure is easier to communicate, easier to remember, and forms a more precise benchmark for price and wage formation; it forms a firmer nominal anchor. When inflation expectations vary more, wage growth will also vary more. That will in turn lead to larger variations in inflation, and so on. This is a common and central argument against a target range.

If inflation expectations are poorly anchored, real economic stabilisation becomes difficult and there will be larger fluctuations in economic activity. To see why, suppose that a negative demand shock causes inflation to fall to the bottom of the target range. If that causes inflation expectations to fall, the real interest rate increases. The higher real rate reinforces the original shock and weakens the economy further, as it is the real interest rate that affects companies and households' investment and consumption decisions. In a corresponding way, a positive shock to demand can make inflation and inflation expectations rise towards the upper bound of the interval. This lowers the real interest rate and contributes towards further increasing demand. Thus, the result of weaker anchoring of inflation expectations is larger economic fluctuations.

The argument can be illustrated using Figure 2.

16 See Castelnuovo, Nicoletti-Altimari and Rodríguez Palenzuela (2003).
17 See, for example, Ball (2014), Krugman (2014) and De Grauwe and Ji (2016). In the latest review of the monetary policy framework which the Bank of Canada publishes every five years, for example, an increase in the target was one of the areas examined. However, its conclusion was to maintain the target of 2 per cent. See Bank of Canada (2016).
18 See, for example, Svensson (2001).

Figure 2. Taylor curve with and without anchored expectations



The curves in the diagram are called Taylor curves and illustrate the alternatives facing a central bank that trades off stabilising inflation against stabilising the real economy.[19] If the central bank prioritises stabilising the real economy relatively more than inflation it will choose an alternative on the lower right of the Taylor curve, for instance point B. That alternative entails relatively little variation in the real economy (or output). A central bank that prioritises stabilising inflation relative to output will chose an alternative on the upper left of the curve, for instance point A where the real economy varies more and inflation less. The lower solid Taylor curve shows the alternatives that are available when inflation is well anchored at one point – the "efficient frontier". Points to the left of the efficient frontier, with lower variation in inflation and the real economy, are not attainable.

As we explained above, economic stabilisation becomes more difficult and economic fluctuations increase when inflation expectations are not anchored at one point, but vary across an interval. This is illustrated in Figure 2, where the Taylor curve that applies if the central bank has a target interval, the dotted line, lies to the right of the efficient Taylor curve that applies with a credible point target.

Figure 2 also illustrates that monetary policy can be flexible and stabilise inflation *and* the real economy without a target range. Given that the point target is credible, the central bank can choose any point on the effective Taylor curve, for example point B.[20] There is nothing to be gained by introducing a target range as the corresponding Taylor curve lies above the efficient frontier. For every given variation in the real economy, the variation in inflation will be greater with a target range than with a point target (compare points A and C).

It is of course difficult to say how much the Taylor curves would differ in practice. Inflation expectations may very well be reasonably well-anchored even with the target ranges that central banks commonly use today (1-2 percentage points). With such a narrow target range there is not much room for targeting different levels of inflation at different times. Narrow ranges may therefore in fact correspond closely to point targets.

There are very few empirical studies that compare how well central banks with a point target anchor long-term inflation expectations relative to central banks with a target range. The few studies that exist indicate that there is not any major difference between the two.[21] One explanation could be that central banks in countries with formal target ranges in practice tend to aim at the midpoint of the interval and, in that sense, act as if they had a point target.[22]

19 The Taylor curve is named after the US economist John Taylor, who first drew attention to this connection (see Taylor, 1979).
20 However, not even with a point target is it possible to go arbitrarily far to the right. The more the participants in the economy believe that the central bank only cares about stabilising the real economy and ignores inflation, the looser the nominal anchor becomes.
21 See Castelnuovo, Nicoletti-Altimari and Rodríguez Palenzuela (2003).
22 Svensson (2010) argues that the differences between different types of inflation target "does not seem to matter in practice. A central bank with a target range seems to aim for the middle of the range".

Analysts who weigh the arguments mostly conclude that a point target is preferable to a target range.[23] We may also note that in the real world point targets (with or without tolerance bands) are significantly more common than target ranges.[24]

3 There are few formal studies of intervals

Most of what is written about tolerance bands and target ranges is based on intuitive arguments and anecdotal evidence. There are very few formal theoretical and empirical studies. In Appendix 2, we review some of the theoretical studies.

Although few, the formal studies provide some important insights. One is that the central bank will have an incentive to react to changes in inflation even when it is inside the interval. Thus, it does not necessarily remain completely passive until inflation moves outside the interval. The reason is that there is uncertainty. The larger the uncertainty, the larger is the risk that inflation will move outside the interval. The central bank can reduce this risk by keeping inflation close to the middle of the interval.

Another insight is that it matters whether the interval has 'hard' or 'soft' edges. Hard edges means that it is very costly to be outside the interval and that this cost increases sharply with the deviation. An example could be when it is considered to be particularly alarming and negative for confidence in the central bank if inflation strays outside a fairly broad interval. Soft edges means that the cost for moving outside the interval increases with the size of the deviation, but the increase is fairly small. If the interval has hard edges, the central bank will work significantly more actively to hold inflation close to the middle of the interval than if the interval had soft edges.

In summary, the academic literature on intervals is very limited and mainly descriptive rather than normative. It analyses what happens if there is an interval of some sort, not whether the point target *should* be surrounded or replaced by an interval. In standard monetary policy theory, there is no interval and no compelling reasons for having one.

4 The current Swedish debate

As we noted above, there is an ongoing discussion on whether the Riksbank should reintroduce some kind of interval. Some argue that an interval would facilitate the Riksbank's communication by reminding people that monetary policy cannot fine-tune inflation. Others go further and suggest that an interval could increase the choices and the flexibility of monetary policy. In particular, some seem to believe that the Riksbank could conduct a less expansionary policy today if there was an interval.

We will devote the rest of this article to the Swedish debate and review the arguments made more closely. When possible, we will refer back to what we have gone through so far.

Would an interval – a tolerance band or a target range – have opened for a different monetary policy than the one that the Riksbank has actually conducted? Will a tolerance band open for a different policy in the period ahead? To answer these questions, it is natural to start by examining the conditions under which monetary policy operates today, with a point target of 2 per cent and no interval.

4.1 Monetary policy can be flexible without an interval

The Riksbank uses forecasts for inflation and other relevant variables when it determines monetary policy. The reason is that monetary policy works with a time lag: the policy conducted today cannot affect inflation and the real economy today. Different monetary policy alternatives lead to different forecasts. The Executive Board selects the monetary

23 For example, Bernanke et al. (1999), Meyer (2003) and Mishkin (2000, 2008).
24 See Table A1 in Appendix 1.

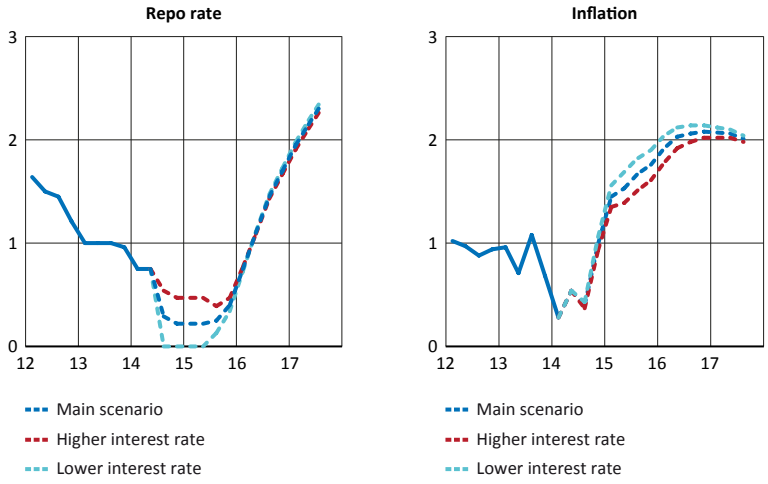
policy alternative that gives forecasts with the best possible balance between the objectives for monetary policy. The approach is described as follows:

"In connection with every monetary policy decision, the Executive Board makes an assessment of the repo-rate path needed, and any potential supplementary measures necessary, for monetary policy to be well-balanced. It is thus normally a question of finding an appropriate balance between stabilising inflation around the inflation target and stabilising the real economy." (Sveriges Riksbank, 2016a, p. 2)

This means that normally there are many alternatives even if there is no interval. The Riksbank can choose to place great emphasis on bringing inflation back to the inflation target quickly or it can be more flexible and allow it to take a little longer. Allowing it to take a little longer may, for example, be justified if a rapid tightening aimed at bringing inflation quickly to target is considered to seriously weaken the real economy.

Figure 3 shows some of the alternatives the Riksbank had in July 2014. The Riksbank then chose the dark blue main scenario. The policy rate was not cut as much as in the scenario that would bring inflation back to target faster ("lower interest rate"). The Riksbank justified its choice by arguing that the low level of interest rates had already contributed towards households' debts as a proportion of their incomes increasing relatively quickly: "An even lower repo rate will strengthen this tendency, thus increasing the risk of the economy developing in an unsustainable way in the long run." (Press release no. 14, 2014)

Figure 3. The Riksbank's alternative scenarios for the repo rate, July 2014



Sources: Statistics Sweden and the Riksbank

4.2 … but confidence in the inflation target must not be undermined

However, the existence of alternatives does not mean that the Riksbank can choose *any* monetary policy. One condition that has to hold is that the selected monetary policy does not risk undermining confidence in the inflation target. This usually means that monetary policy must not make economic agents stop expecting that inflation will reach the point target. The central bank can therefore only choose a monetary policy that brings inflation back to the point target. It cannot choose an alternative where inflation and inflation expectations will be stabilised at a lower (or higher) level, or where it rise or fall according to some trend.

Which alternatives are available is, of course, a question of judgement. It is not something that simply follows from a model or calculations. The key question is how long inflation can deviate from the inflation target without undermining confidence in the point target. If this period is judged to be brief, there are few policy alternatives. In this case, the

central bank must try to quickly bring inflation back on target. If the period is judged to be long, there are more alternatives and the central bank can allow it to take longer before inflation is brought back to target. We will return to the Riksbank's more recent assessments below.

4.3 A fixed horizon can limit flexibility

The number of policy alternatives may be limited if there is a fixed and explicit horizon within which inflation shall return to the point target. For example, with a fixed horizon of two years it would not be possible to select the alternative with a higher interest rate in Figure 3, where it takes more than two years for inflation to reach the target.

One way to mitigate the effect of a fixed horizon and increase the number of alternatives could be to introduce a tolerance band. The band would show which level of inflation would be acceptable at the fixed horizon. As long as inflation reaches the target later on, it would only have to be within the interval at the horizon.

But a combination of a fixed time horizon and a tolerance band appears to be unnecessarily complicated. A simpler way to eliminate the problems of the fixed horizon would be to remove the fixed horizon.

The Riksbank has reasoned as follows regarding the horizon:

"There is no general answer to the question of how quickly the Riksbank aims to bring the inflation rate back to 2 per cent if it deviates from the target. A rapid return may in some situations have undesirable effects on production and employment, while a slow return may have a negative effect on confidence in the inflation target. The Riksbank's ambition has generally been to adjust monetary policy so that inflation is expected to be fairly close to the target in two years' time." (Sveriges Riksbank 2016a, p. 2.)

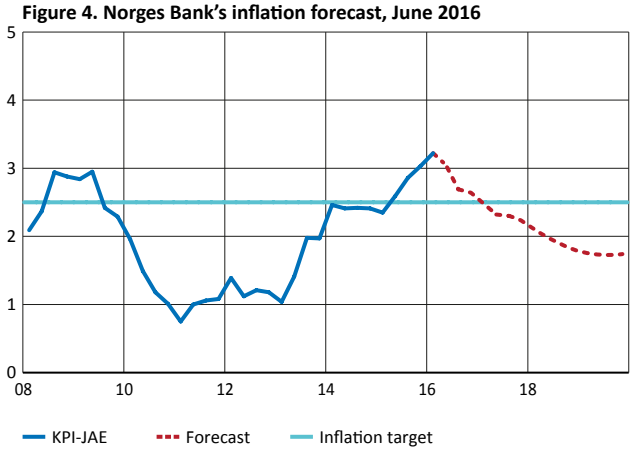
The wording "generally" and "fairly close to the target" shows that the two-year horizon is not considered to be fixed.

One circumstance that could potentially complicate matters is that central banks, including the Riksbank, only publish forecasts for two to three years ahead. If it is considered problematic to publish inflation forecasts that do not reach the point target within the forecast horizon, this may limit the available alternatives. It seems that the solution to this problem would be to publish forecasts that stretch further ahead in time.

However, here it may be relevant to mention that Norges Bank on several occasions has published forecasts that do not reach the target within their three-year forecast horizons. As far as we know, this has not damaged confidence in the inflation target in Norway, nor created any other problems. Figure 4 shows Norges Bank's inflation forecast in the Monetary Policy Report no. 2, 2016.[25] Three years ahead, the inflation forecast falls below target by about 0.75 percentage points. This does not seem to have significantly impacted confidence in the inflation target. Inflation expectations five years ahead lay at 2.45 per cent at this point, which is only marginally below the target of 2.5 per cent.

25 Monetary Policy Report with financial stability assessment 2/16, p. 23.

Figure 4. Norges Bank's inflation forecast, June 2016



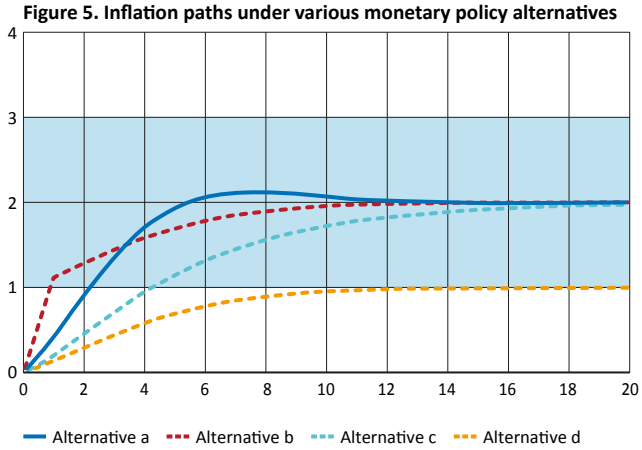
Source: Monetary Policy Report with financial stability assessment 2/16

In the rest of this article we assume that there is no fixed horizon for when inflation is supposed to reach the point target. The only condition is that monetary policy should not risk undermining confidence in the inflation target.

5 Does a tolerance band increase monetary policy's room for manoeuvre?

We can use Figure 5 as a starting point when we analyse whether the central bank will have more alternatives to choose from – its room for manoeuvre will increase – with a tolerance band.

Figure 5. Inflation paths under various monetary policy alternatives



Note. The horizontal axis shows the number of quarters. The paths are fictitious examples produced by changing the parameters of the monetary policy rule in an otherwise identical quantified new-Keynesian model.

In the diagram, we have drawn four hypothetical inflation paths and a tolerance band of +/-1 percentage point around the point target of 2 per cent. In three of the paths, paths *a*, *b* and *c*, inflation stabilises at the inflation target, but at different horizons. In path *d*, inflation stabilises at 1 per cent, that is, at the lower limit of the tolerance band.

Alternatives *a*, *b* and *c* can be chosen regardless of whether the central bank has a tolerance band or not. However, alternative *d* cannot be chosen when the central bank has a point target of 2 per cent. This illustrates that the central bank would not automatically have more alternatives if a tolerance band were to be introduced. All monetary policy alternatives that bring inflation back to the point target can be chosen both with and without a tolerance

band. No monetary policy alternative that does not bring inflation back to the point target can be selected as long as the central bank has a point target, regardless of whether there is a tolerance band or not.

5.1 A tolerance band can increase the room for manoeuvre if it increases confidence in the point target

As we discussed above, it has been argued that deviations from a point target could be seen as less serious if there is a tolerance band than if there is only a point target. If this is the case, it may imply that there are more monetary policy alternatives to choose from if there is a tolerance band than if there is not. We can illustrate this in Figure 5. Assume that with no tolerance band, confidence in the inflation target risks being undermined if inflation deviates from the *point target* for more than one year. Assume too that, with a point target *and* a tolerance band, confidence in the inflation target risks being undermined if inflation deviates from the *tolerance band* for more than one year. In this case, only alternative *a* could be chosen with a point target and no interval, while alternatives *a*, *b* and *c* could be chosen if the point target was surrounded by a tolerance band. In this example, a tolerance band would provide greater room for manoeuvre for monetary policy.

5.2 … but can also reduce the room for manoeuvre if it has 'hard edges'

However, we can also construct examples where there would be *fewer* alternatives to choose from with a tolerance band. Assume that the tolerance band has 'hard edges', which is to say that the central bank sees it as very costly if inflation moves outside the interval (as we discussed above).[26] Assume too that a central bank with a tolerance band with hard edges in practice will choose the monetary policy alternative that most quickly takes inflation back to the interval. In Figure 5, this would mean that alternative *b* would be the only real alternative. Thus, in this example the tolerance band would give fewer alternatives to choose from (if alternative *b* and at least one of alternatives *a* or *c* would be feasible without a tolerance band).

As we noted above, a tolerance band with hard edges could also affect which alternatives could be selected when inflation is *inside* the tolerance band. The reason is that the risk of moving outside the interval is greater if inflation is close to the edge of the interval than if it is closer to the point target. The central bank would therefore be keener on getting inflation back to the point target quickly when there is a tolerance band with hard edges than if there is no interval.[27]

Considering the review in this section, we can draw the following conclusions:

Monetary policy can be flexible even without a tolerance band. Only if the tolerance band strengthens the confidence in the point target can a tolerance band increase monetary policy's room for manoeuvre. If the tolerance band creates more uncertainty regarding future inflation or has 'hard edges', the room for manoeuvre may instead decrease.

A tolerance band does not *per se* increase the room for manoevre for monetary policy. Thus, it is not obvious that monetary policy would have been different in recent years if there had been a tolerance band, or that it will become different if a tolerance band is introduced. But neither can it be ruled out. Thus, if one argues that a tolerance band would indeed increase the scope for flexibility, as some debaters seem to do, one has to be prepared to explain exactly why one thinks this would be the case.

26 See also the reasoning in Appendix 2 and Figure A2.

27 Bernanke et al. (1999), Mishkin and Schmidt-Hebbel (2002) and Mishkin (2003) argue that the tolerance band's edges may start to "live a life of their own" and become harder than intended. Monetary policy may then become suboptimal in the way we describe here. As we have noted in Appendix 2, Medina and Valdés (2002) show how an interval with hard edges can give such effects.

6 A target range is a bigger change

With a target range, the central bank can choose any policy alternative that keeps inflation within the range. If we assume that the interval of +/- 1 percentage points in Figure 5 constitutes a target range, all alternatives in the figure – including *d* – can be chosen.

Introducing a target range would be a significantly bigger step than introducing a tolerance band, and the consequences could be much more sweeping.

It is not entirely clear whether any debater has actually advocated that the Riksbank should have a target range. However, it has often been suggested that monetary policy should target a rate of inflation lower than 2 per cent. The argument has been that factors such as globalisation and digitisation have made it very difficult, if not impossible, to bring inflation up to 2 per cent.[28]

A reasonable interpretation of this is that people argue for greater freedom of choice, such that the inflation target can be adjusted to different circumstances. As we noted above, one justification for a target range in the earlier international debate was that there may be reason to aim at different levels of inflation in different periods. Alternatively, people argue that the *point target* of 2 per cent should be lowered. However, the consequences of lowering the point target or introducing a target range and aiming at the lower part of the interval are similar in a number of important ways.

From a short-term perspective, it might be reasonable to think that the Riksbank could conduct a less expansionary policy if it were to target a lower inflation rate, either under the framework of a target range or by lowering the inflation target.[29] However, this would only be temporary. When expectations adjust, monetary policy will be the same even if the inflation target is lowered from 2 or 1 per cent. It is the real interest rate that matters, and this rate will eventually be the same on average because inflation and nominal interest rates will both become proportionally lower when the target is lower.

Furthermore, if the problem is that monetary policy is too expansionary at the moment – that is to say a basically short-term problem – it seems fairly drastic to undertake such a large change as introducing a target range or lowering the target. For reasons of continuity and credibility the monetary policy framework should not be amended all too often and we would probably have to live with such a change for a long time.

6.1 Targeting lower inflation may reduce the future room for manoeuvre

Problems could arise in the long run if the Riksbank were to aim for lower inflation, and inflation expectations permanently became 1 per cent, for example. The main problem is that it becomes more difficult to stimulate the economy in the future when economic activity is weak or inflation is below target. When inflation is low on average, the average policy rate is also low. This reduces scope for cutting the policy rate, as it will hit its lower bound more frequently. When average inflation is low, it is therefore more difficult to achieve the really low or even negative real interest rates that are sometimes needed.

Therefore, if low nominal interest rates in general are a source of concern, it would be better to increase average inflation. This is the reason why people in the international debate have proposed that the central banks' inflation targets should be raised.

28 See, for example, Mitelman (2013).

29 However, it is not self-evident that this means that the nominal interest rate can be raised. If inflation expectations fall, the real interest rate will rise and monetary policy will thereby become less expansionary even with an unchanged nominal policy rate.

6.2 If inflation varies more, expectations may be more difficult to anchor

One specific problem regarding a target range is, as we explained above, that it may make it more difficult to anchor expectations. This is quite natural if the target range is indeed utilised as a target range, that is, if the central bank actually aims at different levels of inflation at different times. This would be like having the central bank change the point target every now and then. Most analysts argue that the mere point of having an inflation target is that, once a level has been decided, this level is maintained so that it can act as a stable and credible benchmark for price and wage formation.

Poorly-anchored inflation expectations may make it difficult for monetary policy to stabilise the real economy. Instead, fluctuations risk becoming larger in the way we have described above.

A number of complications are thus inherent in a target range. It would be a big change in the monetary policy framework and it risks making inflation and inflation expectations stick at a low level. That may in turn make it more difficult to conduct a sufficiently expansionary monetary policy later on. In the long run, a target range could make inflation expectations overall less firmly anchored and the fluctuations in the economy larger. Thus, people that argue for a target range should provide support for why the (supposed) advantages should more than balance out the disadvantages.

7 If monetary policy can be flexible without an interval – why such an expansionary policy today?

If monetary policy can be flexible and take the real economy and financial stability concerns into account, why is it then that the Riksbank has pursued what many consider a very expansionary policy?

The Riksbank has justified its policy by arguing that inflation had undershot the target so long that there was a risk that the economic agents would start to doubt whether the Riksbank had the ambition and capacity to actually meet the inflation target. The inflation target that has been the nominal anchor for economic agents for more than twenty years could loosen. The Riksbank therefore gradually saw it as more and more important to get inflation to rise towards the target.

Figure 6 illustrates that these concerns were justified. From 2010 until the start of 2014, long-term inflation expectations (measured as the median value among money market participants) were firmly anchored at 2 per cent. But in 2014, expectations started to fall. Actual inflation, measured as both the CPI and the CPIF, had then long been below target and showed no sign of rising. The Riksbank deemed that a more expansionary monetary policy was needed to bring up inflation. This reasoning has characterised monetary policy over the last years. Both actual inflation and inflation expectations have risen, but it is still seems an open question whether they are again anchored at the target.

Figure 6. Long-term inflation expectations
Inflation expectations 5 years, median money market participants

Source: Prospera

One argument that has been made against the recent monetary policy of the Riksbank and for the introduction of a tolerance band, is that the Riksbank has been altogether too strongly tied to the point target of 2 per cent as such. If an interval had been present, it is argued, the Riksbank could have chosen a higher interest rate path and would not have had to bring inflation back to the point target so quickly.[30]

But this is not an accurate description of the motives behind the Riksbank's actions. The expansionary policy has been based on the assessment that confidence in the inflation target was becoming undermined, not on a short-term desire to meet the inflation target under any circumstances and at any price.[31]

At the same time, as we have noted above, it is a question of judgement as to how large room for manoeuvre there actually is in any given situation. It cannot be ruled out that the Riksbank has underestimated the confidence in the inflation target and hence also its room for manoeuvre. Debaters that think this is the case should of course focus on presenting arguments that support this view.

8 Conclusion

Inflation targets can be designed in different ways. Internationally it is common to have point targets, with or without a tolerance band. But there are also examples where the inflation target is formulated in terms of an interval, a 'target range'. The Riksbank's inflation target is defined solely as a point target. Before 2010 the Riksbank's point target was also surrounded by a tolerance band. Recently, it has been argued that the Riksbank should (re)introduce some sort of interval.

Ten to fifteen years ago, there was an international debate on the advantages and disadvantages of having an interval. In this article, we have reviewed the arguments in this debate and interpreted the current Swedish discussion in the light of them. One central conclusion is that monetary policy can be flexible even without an interval. A tolerance band might increase flexibility if it increases the credibility of the inflation target. However, it could also reduce flexibility if it increases inflation uncertainty or if moving outside the interval is very costly. A target range entails a major change to the current monetary policy framework. It would allow the central bank to aim at different levels for inflation. But as inflation expectations become less firmly anchored, economic fluctuations may increase.

30 See, for example, Jonung (2015), who also argues that the interval should be broader than the one removed in 2010, amounting to +/–2 percentage points.
31 See, for example, Flodén (2015).

References

Banerjee, Ryan, Stephen Cecchetti and Boris Hofmann (1993), "Flexible Inflation Targeting: Performance and Challenges", in "Is Inflation Targeting Dead? Central Banking After the Crisis", Edited by Lucrezia Reichlin and Richard Baldwin, Centre for Economic Policy Research.

Bernanke, Ben S., Thomas Laubach, Frederic S. Mishkin and Adam S. Posen (1999), *Inflation Targeting – Lessons from the International Experience*, Princeton University Press.

Blanchard, Olivier, Giovanni Dell'Ariccia and Paolo Mauro (2013), "Rethinking Macro Policy II: Getting Granular", Staff Discussion Note 03, International Monetary Fund.

Castelnuovo, Efrem, Sergio Nicoletti-Altimari and Diego Rodríguez Palenzuela (2003), "Definition of Price Stability, Range and Point Inflation Targets: The Anchoring of Long-Term Inflation Expectations", Background Study for the Evaluation of the ECB's Monetary Policy Strategy, Working Paper No. 273, European Central Bank.

De Grauwe, Paul and Yuemei Ji (2016), "Inflation Targets and the Zero Lower Bound in a Behavioral Macroeconomic Model", Discussion Paper No. 11320, Centre for Economic Policy Research.

Flodén, Martin (2015), "Sweden Needs its Inflation Target," speech, 13 October at Fores, Stockholm.

Hammond, Gill (2012), *State of the Art of Inflation Targeting*, Handbook – No. 29, Centre for Central Banking Studies, Bank of England.

Heikensten, Lars, (1999), "The Riksbank's Inflation Target – Clarifications and Evaluation", *Sveriges Riksbank Quarterly Review, No. 1*.

Jansson, Per (2015), "Time to Improve the Inflation Target?", speech, 3 December at Handelsbanken: Stockholm.

Jonung, Lars (2015), "Professor varnar för låga räntan" [Professor warns of low interest rate], interview in Svenska Dagbladet by Louise Andrén Meiton, November 18th.

Krugman, P. (2014), "Inflation Targets Reconsidered," Essay presented at the ECB Sintra conference, May.

Lewis, Michelle and C. John McDermott (2016), "New Zealand's Experience with Changing its Inflation Target and the Impact on Inflation Expectations", Discussion Paper No. 07, Reserve Bank of New Zealand.

Medina, Juan Pablo and Rodrigo O. Valdés (2002), "Optimal Monetary Policy Rules under Inflation Range Targeting", in *Monetary Policy: Rules and Transmission Mechanisms,* Series on Central Banking, Analysis, and Economic Policies, vol. 4, eds. Loayza N. and K. Schmidt-Hebbel, Central Bank of Chile, pp. 95-115.

Meyer, Laurence H. (2004), "Practical Problems and Obstacles to Inflation Targeting", *Federal Reserve Bank of St. Louis Review, July/August 2004*, Vol. 86, No. 4, pp. 151-60.

Mishkin, Frederic S. (2000), "Issues in Inflation Targeting", in *Price Stability and the Long-Run Target for Monetary Policy*, Proceedings of a seminar held by the Bank of Canada, June 2000.

Mishkin, Frederic S. (2008), "Comfort Zones, Shmumfort Zones", speech, March 27th, The Sandridge Lecture of the Virginia Association of Economists and the H Parker Willis Lecture of Washington and Lee University, Lexington, Virginia, Board of Governors of the US Federal Reserve System.

Mishkin, Frederic S. and Klaus Schmidt-Hebbel (2002), "One Decade of Inflation Targeting in the World: What Do We Know and What Do We Need to Know?", in *Inflation Targeting: Design, Performance, Challenges*, eds. Loayza N. and R. Soto, Central Bank of Chile, pp. 117-219.

Mishkin, Frederic S. and Niklas J. Westelius (2008), "Inflation Band Targeting and Optimal Inflation Contracts", *Journal of Money Credit and Banking*, Vol. 40, No. 4, pp. 557-582.

Mitelman, H. (2013), "Dags sänka inflationsmålet [Time to reduce the inflation target]", commentary, *Dagens Industri*, December 4th.

Orphanides, Athanasios and Volker Wieland (2000), “Inflation Zone Targeting”, *European Economic Review*, Vol. 44, No. 7, pp. 1351-1387.

Rogoff, Kenneth (1985), “The Optimal Degree of Commitment to an Intermediate Monetary Target”, *Quarterly Journal of Economics*, Vol. 100, No. 4, pp. 1169-1189.

Svensson, Lars E.O. (2001), “The Fed Does Not Provide the Solution to the Eurosystem’s Problems”, Briefing Paper for the Committee on Economic and Monetary Affairs (ECON) of the European Parliament, May.

Svensson, Lars E.O. (2010), “Inflation Targeting”, Chapter 22 in *Handbook of Monetary Economics* Volume 3B, eds. Freidman, B. M. and M. Woodford, Elsevier and North-Holland: San Diego and Amsterdam.

Sveriges Riksbank (2010), “The Riksbank Removes the Tolerance Interval from its Specified Monetary Policy Target”, Memorandum, Basis for Decision 31 May 2010, available at http://www.riksbank.se/Upload/Dokument_riksbank/Kat_publicerat/ Pressmeddelanden/2010/nr27_beslutsunderlag.pdf.

Sveriges Riksbank (2016a), “Monetary Policy Report, July”.

Sveriges Riksbank (2016b), “The Riksbank’s Inflation Target – Target Variable and Interval”, *Riksbank Studies*, September.

Taylor, John B., (1979), “Estimation and Control of a Macroeconomic Model with Rational Expectations”, *Econometrica*, Vol. 47, No. 5, pp. 1267-1286.

Walsh, Carl E. (1995), “Optimal Contracts for Central Bankers”, *American Economic Review*, Vol. 85, No.1, pp. 150-167.

Österholm, Pär (2016), “Flexibelt mål kan ge problem” [Flexible target may lead to problems], SvD Debatt, September 12th.

Appendix 1 – Inflation targets in various countries

Table A1. Type of inflation target in various countries

Type of inflation target	Countries or currency areas
Point target	Albania, Argentina, Bangladesh, Belarus, China, Georgia, Iceland, India, Japan, Kyrgyzstan, Malawi, Mongolia, Mozambique, Norway, Pakistan, Russia, Samoa, South Korea, Sweden, Ukraine, United Kingdom, United States, Vietnam, Zambia
Point target with tolerance band	Armenia, Brazil, Canada, Chile, Colombia, Costa Rica, Czech Republic, Dominican Republic, Ghana, Guatemala, Hungary, Indonesia, Kenya, Mexico, Moldavia, New Zealand, Paraguay, Peru, Philippines, Poland, Romania, Serbia, Thailand, Turkey, Uganda, West African Economic and Monetary Union
Target range	Australia, Azerbaijan, Botswana, the euro area*, Israel, Jamaica, Kazakhstan, Nigeria, South Africa, Sri Lanka, Switzerland*

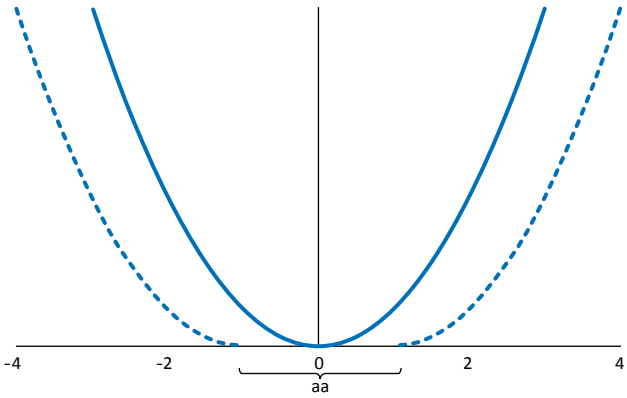
Note. *Inflation must be below 2 per cent (but close to 2 per cent in the euro area's case).
Sources: www.centralbanknews.info and central banks' websites.

Appendix 2 – The academic literature on intervals

There are very few formal theoretical and empirical studies of tolerance bands and target ranges.

One example is Orphanides and Wieland (2000). They investigate conceivable arguments for why central banks specify the inflation target as an interval and not as a point. Among other things, they analyse a case where the central bank's loss function (a concept described in more detail below) is entirely horizontal at zero in a certain interval, which is to say that limited deviations from the middle of the interval are not considered costly.[32] The loss function may then look like the broken curve in Figure A1, in which aa is the horizontal interval. For comparison, the unbroken curve shows a conventional loss function.

Figure A1. Loss function with and without interval



The loss function can be described as follows. The central bank's task is, at each point in time t, to find an interest rate path $\{r_{t+\tau}\}_{\tau=0}^{\infty}$ that minimises the intertemporal loss function

(1) $$L_t = E[\Sigma_{\tau=0}^{\infty} l(x_{t+\tau})],$$

where

(2) $$l(x_t) = (\pi_t - \bar{\pi})^2 + \lambda y_t^2.$$

$l(x_t)$ is the loss function at each point in time t, π_t is inflation, $\bar{\pi}$ the inflation target and y_t the output gap or resource utilisation. Thus, the loss function is the sum of (squared) deviations, partly for inflation from the inflation target, partly for the output gap from the normal value (zero).

The solid curve in Figure A1 shows the first term in (2), which is to say the 'loss', or cost, that arises when inflation deviates from a point target.

Suppose instead that the loss function is the following:

(3) $$l(x_t) = \begin{cases} (\pi_t - \bar{\pi}_L)^2 + \lambda y_t^2 & \text{if } \pi_t \in (-\infty, \bar{\pi}_L) \\ \lambda y_t^2 & \text{if } \pi_t \in (\bar{\pi}_L, \bar{\pi}_H) \\ (\pi_t - \bar{\pi}_H)^2 + \lambda y_t^2 & \text{if } \pi_t \in (\bar{\pi}_H, \infty) \end{cases}$$

32 Another case analysed is that in which the short-term Phillips curve is horizontal in one segment, which is to say that inflation does not react to changes in resource utilisation as long as the latter is sufficiently close to its normal level.

There is no loss if inflation is larger than $\bar{\pi}_L$ but smaller than $\bar{\pi}_H$, and the central bank can then focus on stabilising the output gap. The broken curve in Figure A1 shows a loss function as in (3), where the interval aa represents the interval between $\bar{\pi}_L$ and $\bar{\pi}_H$.

Orphanides and Wieland represents how the broken loss function implies a monetary policy reaction function with what they call a "zone of inaction" where the central bank reacts less to inflation (and more to resource utilisation). They interpret this zone as the central bank's "interval".

Among other things, they find that the size of the zone of inaction greatly depends on uncertainty, which is to say the size and frequency of shocks to the economy. The greater uncertainty, the smaller zone of inaction. The reason is that the risk that inflation will move beyond the interval aa increases when uncertainty increases. By attempting to keep inflation close to the middle of aa, the central bank can reduce this risk. So even small changes in inflation deviations from the middle of the interval cause the central bank to react. When uncertainty increases, monetary policy reacts more to inflation deviations and the zone of inaction becomes smaller.

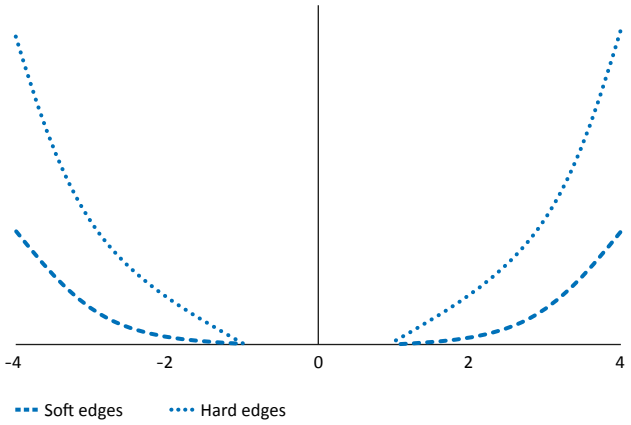
Notice that the zone of inaction is something different to the interval aa in Figure A1, even if the latter, of course, affects the size of the former. Orphanides and Wieland's zone of inaction can be seen as the optimal monetary policy in a model where the central bank has a loss function like the broken curve. With a conventional unbroken curve there would be no zone of inaction.[33]

A more natural approach is therefore to consider the interval aa in Figure A1, rather than the zone of inaction, as the central bank's "interval". The interpretation of Orphanides and Wieland's model then becomes as follows. The Government or Parliament has assigned the central bank the loss function represented by the broken line in Figure A1 with an interval aa within which inflation is expected to remain. Compared with a conventional loss function and as expected, monetary policy will not react as much when inflation deviates from the middle of the interval (except in the case where uncertainty is very high).

Medina and Valdés (2002) analyse the implications of different loss functions using a similar model, but their 'interval' refers to and is specified in terms of the central bank's loss function. They distinguish two types of target ranges: those with "hard edges" and those with "soft edges". Hard edges means that it is very costly to be outside the interval and that this cost increases sharply with the size of the deviation. An example could be that it is considered to be particularly alarming and negative for confidence in the central bank if inflation strays beyond a fairly broad interval – in the manner we have described above. Soft edges means that the cost for moving outside the interval certainly increases with the size of the deviation, but the increase is fairly small. Figure A2 shows a loss function with hard edges and one with soft edges, in which costs arise when inflation deviates from the target range, but at different rates.

33 However, one exception concerns the second case that Orphanides and Wieland analyse using a partial horizontal short-term Phillips curve.

Figure A2. Loss functions with hard and soft edges



Medina and Valdés find that there are no zones of total inaction as regards inflation. Monetary policy must always react to shocks, even when inflation is well inside the interval.

An interval with soft edges can make monetary policy less aggressive than it would have been with a point target. More specifically, interest rate fluctuations become smaller in their model. But they also find that, if the loss function has very hard edges – that is, if deviations from the target range are considered to be highly undesirable – monetary policy can actually become more aggressive than in the case of a point target. Put differently, the central bank may, in such a case, become more of an "inflation nutter". Of course, with a point target, all deviations from target are unwanted, but, compared with the case in which a deviation from an interval is considered to be extremely costly, monetary policy nevertheless reacts less.

Mishkin and Westelius' (2008) analysis has a slightly different starting point. They start from the Barro and Gordon (1983) model where inflation becomes too high as there is a constant temptation to conduct an excessively expansionary monetary policy.

In the model, the Government wants unemployment to be below its natural equilibrium and it also places excessive emphasis on stabilising unemployment. This results in two biases: an inflation bias with excessively high inflation and a stabilisation bias that means that fluctuations in inflation are higher (and fluctuations in unemployment lower) than optimal. In the earlier literature, two solutions have been suggested to eliminate these biases. Either a central bank governor is appointed who is "conservative" in the sense that he or she prefers lower inflation and has a lower weight on fluctuations in unemployment than society in general has (Rogoff, 1985). Or a contract is prepared that entails that the central bank governor is 'punished' in various ways if inflation becomes too high and if fluctuations in inflation become large (Walsh, 1995). Both of these solutions are linked with practical problems and would be difficult to implement.

Mishkin and Westelius argue that one alternative to both of these solutions would be for the central bank to be assigned the task of holding inflation within an interval in which it is associated with some form of cost for the bank if inflation moves beyond the interval. Such an interval could solve the time inconsistency problem in a simpler way than appointing a "conservative" central bank governor or preparing a contract with the management of the central bank. [34]

34 It is worth noting that, even if Mishkin and Westelius call their interval 'band target' or 'target range', it seems to differ from the definition of target range we use in this article. For example, in their analysis, it is the outcome of inflation outside the interval that triggers sanctions. In this sense, the interval instead corresponds to what we have called a tolerance band. Mishkin and Westelius also take up the Bank of England as an example. As we have noted above, the Bank of England has a point target of 2 per cent and it could be argued that it also has a tolerance band of ±1 percentage point. However, the Bank of England's target is not categorised as a target range.

Studies that attempt to draw normative conclusions by comparing the development in different countries with different targets are even rarer. In the main text, we mention Castelnuovo, Nicoletti-Altimari and Rodríguez Palenzuela (2003). They study how well central banks with a point target or target range, respectively, manage to anchor long-term inflation expectations. They find no major difference between the types of inflation target in this respect.