



SPEECH

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■ Monetary policy with a zero interest rate

The Riksbank conducts a policy of flexible inflation targeting, which aims to stabilise inflation around the inflation target and also to stabilise the real economy. To achieve this, the Riksbank sets the repo rate and publishes a forecast for the repo rate in the years ahead. The repo rate and the expectations of future repo rates that arise from the repo rate path affect market interest rates, which in turn affect aggregate demand and inflation. During the financial crisis, the functioning of the financial markets has deteriorated and the transmission mechanism from the repo rate path to inflation and the real economy has weakened. In order to improve the functioning of the financial markets and strengthen the link between the repo rate path, market rates, inflation and the real economy, the Riksbank has taken a number of special measures.¹

Although the discussion of monetary policy often focuses on the repo rate and the repo rate path, it is important to realise that it is the *real* interest rate and the *real* repo rate path that mainly affect aggregate demand, not nominal interest rates. The real interest rate is the nominal interest rate minus expected inflation. When the Riksbank cuts the repo rate the real repo rate also normally falls as inflation expectations are normally sluggish. In a situation with very weak aggregate demand, a low level of resource utilisation and low inflation a low and perhaps even a negative real interest rate is required to stimulate the real economy and thus, as far as possible, stabilise inflation around the inflation target and resource utilisation around a normal level. The Riksbank cannot, however, cut the repo rate more than to zero. But even if the repo rate is set at zero, the real interest rate may be too high to have the desired stimulation effect on the real economy. In such a situation monetary policy faces a binding *zero lower bound for the interest rate*. The major question is then how monetary policy should be conducted, to avoid a binding zero lower bound and to escape from such a situation by using means other than lowering the interest rate.

Why is it not possible to reduce the nominal interest rate below zero? The reason is that money in the form of banknotes and coins yields a zero interest rate. If the interest rates for various accounts and securities such as Treasury bills and bonds were to become negative, households, firms and authorities would prefer to retain cash in the form of banknotes instead of lending it or depositing it. With a zero interest rate, households, firms and authorities become indifferent about the choice of whether to hold securities such as treasury bills and bonds or to hold

¹ For more information on these measures, see www.riksbank.se

■ cash.² A so-called open market operation in which the central bank increases the monetary base and thus liquidity by buying treasury bills and bonds and paying with cash, then becomes ineffective in the sense that the interest rate is still zero and the only thing that happens is that households, firms and authorities hold more cash and fewer Treasury bills and bonds. A situation with a zero interest rate is therefore also called a *liquidity trap*.

The issue of monetary policy when the interest rate is zero has become topical again. Since the autumn of last year, the outlook for the global economy has deteriorated further. At the same time as forecasts for inflation and growth have been revised downwards, policy rates have been lowered and are now approaching zero in several countries. In December last year, the Federal Reserve, for example, cut its policy rate to an interval between 0–0.25 per cent, while in Japan the policy rate is 0.1 per cent and in Switzerland 0.5 per cent.

Inflation throughout the world is also falling rapidly. It is possible that the level of inflation can become negative and that we will thus see deflation in some countries. Deflation for a short period is not a major problem. We even had this in Sweden a few years ago. But if deflation is prolonged, and especially if inflation expectations fall and deflation expectations arise, the situation can become very problematic. The combination of very low policy rates, a weak real economy and the risk of deflation has thus revived the debate about how monetary policy can and should be conducted in the event of a zero interest rate bound.

In the 1990s, Japan experienced a long period with a zero interest rate, deflation and, compared with previous decades, weak real economic development. The experience gained in Japan has stimulated extensive discussion and a great deal of research at universities and central banks on monetary policy in connection with a zero interest rate bound. At Princeton University, Ben Bernanke, Paul Krugman and I conducted research on this subject.³ The Japanese experience and the research conducted on monetary policy with a zero interest rate are now topical again.

For Sweden, a scenario with deflation and a zero interest rate is as yet not particularly likely. However, at the Riksbank we must of course be prepared for all eventualities and consider what measures would be possible and appropriate in such a situation. We must also think about how we can minimise the risk of ending up in such a situation. Many observers criticised the Japanese central bank for having reacted far too slowly and for being too cautious about testing various methods to escape from their liquidity trap. I believe that we at the Riksbank should be prepared with analyses and measures at an early stage. Today I will therefore address the problem that a situation with a zero interest rate represents and the possible alternative solutions. I will, among other things, discuss a price level target and a method that in my research I have called the “Foolproof Way” of escaping from a liquidity trap. Finally, I summarise how effective the alternatives may be and how they can be selected depending on how serious the situation with a zero lower bound for the interest rate is deemed to be.

In a situation with a zero lower bound for the interest rate, fiscal policy acquires a very important role. How effectively an expansionary fiscal policy can stimulate

² This applies when the amount of cash held does not fall below the level needed for transaction purposes.

³ See Svensson, Lars E.O. (2003), “Escaping from a Liquidity Trap and Deflation: The Foolproof Way and Others,” *Journal of Economic Perspectives* 17(4), 145-166, for literature references and a review of this research. My own contribution to this research can be found on my website, www.princeton.edu/svensson.

the real economy is, however, dependent on a number of factors, for example the degree of Ricardian equivalence – that is the extent to which a reduction in public saving gives rise to increased private saving. The initial size of the national debt, the structure of public expenditure and the distribution between expenditure increases and tax reductions in the national budget may also be decisive for the impact of fiscal policy on the real economy. Here, however, I only discuss monetary policy alternatives in the event of a zero interest rate.

The problem: Real interest rate too high

I have already said that, in the case of a binding zero lower bound for the interest rate, the real interest rate is too high compared to the level appropriate to stabilise inflation around the inflation target and at the same time stabilise the real economy. To be precise, it is the *real market rate*, that is the market rate met by households and firms minus expected inflation, that is too high. The market rate exceeds the repo rate with a spread that is determined by various risk and liquidity premia. This spread is now unusually large due to the financial crisis. This means that the market rates are positive even if the repo rate is zero.

With some simplification, the real market rate can be specified as:

$$\begin{aligned}\text{Real market rate} &= \text{Nominal market rate} - \text{expected inflation} \\ &= \text{Repo rate} + \text{spread} - \text{expected inflation}.\end{aligned}$$

Even if the repo rate is reduced to zero, the real market rate can be too high, because the spread is large and/or because the expected inflation is low.⁴

The real market interest rate can thus be lowered, if the spread can be reduced. The measures implemented by the central banks and other authorities in various countries to improve the functioning of the financial markets, what Ben Bernanke calls "credit easing",⁵ can reduce the spread and thus contribute to a lower market rate. However, even if the various spreads are still larger than normal, it is, quantitatively probably only a rather moderate reduction of the real market rate that is possible in this way. The really substantial effect on the real market rate can instead be achieved if inflation expectations can be raised.

It is particularly dangerous if, instead, expectations of deflation arise, that is expectations of negative inflation. The real interest rate may then become far too high. A nightmare for central banks is a downward spiral, in which a too high real interest rate slows down the economy and leads to increasing deflation and expectations of decreasing inflation, which in turn lead to a still higher real interest rate that slows down the real economy even more and leads to even greater deflation.

With a zero lower bound it is therefore important for the central banks to affect and raise inflation expectations in some way. How this should be done is the real problem with a zero lower bound for the interest rate bound and a liquidity trap. It may even be necessary to raise inflation expectations above the inflation target for a while in order to achieve a sufficiently low real interest rate. This means that

⁴ The appendix to this speech shows, in a simple so-called new-Keynesian model, how the output gap depends on expectations regarding the repo rate path, the spreads, the future price level and the path for the natural interest rate; see equations (6) and (7).

⁵ See Bernanke, Ben (2009), "The crisis and the policy response", speech at the Stamp Lecture, London School of Economics, January 13, 2009, www.federalreserve.gov.

■ the central bank must get people to believe that it will knowingly and deliberately strive to exceed the inflation target. How can a central bank that normally strives to create low inflation expectations and meet the inflation target promise, with any credibility, that it will exceed the inflation target in the future?⁶

When we discuss and evaluate various policy alternatives for monetary policy in a liquidity trap, we should thus start from the most important criteria for assessing their effectiveness – how effective alternatives will be in affecting inflation expectations.

The solution: Affect inflation expectations

A credible inflation target

An established and credible inflation target above zero and a transparent monetary policy will help to ensure that inflation expectations do not fall too low and to reduce the risk of expectations of deflation arising. The Riksbank has a major advantage in this respect in that we already have a well-established inflation target. By publishing well-founded forecasts for inflation, the real economy and the repo rate, the central bank can affect expectations of inflation and future repo rates. Even if the real economy becomes weak and inflation low or even negative in the short term, the central bank can, with a good and convincing analysis, present forecasts in which inflation returns to the inflation target and the real economy stabilises. This means, all in all, that the central bank's forecasts and scenarios constitute central tools in the effort to influence inflation expectations. Central banks that already have well-established numerical inflation targets may therefore find it easier to hold up inflation expectations and create credibility for their policy. In countries that do not have a numerical inflation target it may be good to introduce such a target in a situation with a binding zero lower bound for the interest rate, although it would of course have been better to already have the inflation target established and credible before ending up in such a situation.

Inflation targets do, however, have a disadvantage. Following a period of unwelcome low inflation below the inflation target, inflation targeting entails, as it is usually applied, that the central bank subsequently seeks to maintain a level of inflation in line with the target. The central bank does not thus attempt to compensate for the previously low inflation with a period of inflation above the target. If firms and households consequently believe that inflation will be very low in the short term and thereafter equal to the inflation target, then the average expectations in the slightly longer term will still be low and under the target. In such circumstances, with a zero interest rate, the real interest rate may still be too high even if the inflation target is credible in the longer term. One way to avoid this disadvantage is instead to have a so-called price level target, or what may also be referred to as "average inflation targeting".

⁶ As Paul Krugman put it in his insightful Brookings essay – how will the central bank "credibly promise to be irresponsible". Krugman, Paul R. (1998). "It's Baaack: Japan's Slump and the Return of the Liquidity Trap". *Brookings Papers on Economic Activity* 49, 137-206.

■ *A credible price level target*

A price level target in the form of a path for the price level, in which the rate of increase in the price level is given by the inflation target, has several advantages compared with a standard inflation target in a situation with a zero interest rate. Unlike an inflation target, a price level target has a “memory” in the sense that lower inflation or deflation during a period of time whereby prices fall below the target path will be compensated for by a correspondingly higher inflation in a later period to attain the price level target path once again. If the price level target is credible, the long-term inflation expectations will be stable, even if low inflation or deflation is expected in the short term. If prices have already fallen below the price level target, a credible price level target will lead to short-term expectations of inflation rising above the long-term average. With an unchanged nominal rate the real interest rate will then fall and the real economy will be stimulated. A credible price level target will thus entail an inherent automatic stabilisation in a situation with a zero interest rate.⁷ A price-level target can be seen as an average inflation target for a longer period of time, for instance five years.⁸

In a case where there is a risk that inflation will be too low, or even negative, for a couple of years it may be appropriate, in order to avoid the disadvantage with a standard inflation target that I mentioned above, to tighten the inflation target and temporarily interpret it as a target of 2 per cent for average inflation over the next five years, for example. This would mean that the central bank would then compensate for low inflation during the first years with higher inflation in the subsequent years so that the five-year average is on target. The Australian central bank, the Reserve Bank of Australia, actually formulates its target in this way: “[T]he appropriate target for monetary policy is to achieve an inflation rate of 2–3 per cent on average over the cycle”.⁹ If the central bank by means of convincing analyses and forecasts can gain credibility for such a temporary price level target – a temporary average inflation target – the price level target's inherent stabilisation of the real economy could then be used.¹⁰

Observe inflation and price level expectations – the exchange rate as an indicator

As expectations of the future inflation rate and the price level are so important to the development of the real interest rate in the event of a binding zero lower bound for the interest rate, it becomes even more important to observe and measure these expectations. There are several ways for a central bank to observe expectations of the future price level. The Riksbank, for example, commissions Prospera to conduct quarterly surveys about expectations for inflation one, two

⁷ For a few years beginning in 1931 the Riksbank had a price level target, after leaving the gold standard. To date, the Riksbank is the only central bank in the world to have had an explicit price level target. See Berg, Claes, och Jonung, Lars (1999), “Pioneering price level targeting: The Swedish experience 1931-1937,” *Journal of Monetary Economics* 43(3), 525-551.

⁸ See Nessén, M. and Vestin, D. (2005). “Average inflation targeting”. *Journal of Money, Credit, and Banking*. v. 37, iss. 5, pp. 837-63.

⁹ www.rba.gov.au.

¹⁰ A well-argued proposal on a combination, a hybrid, between a price level target and an inflation target is presented in Giavazzi, F and Mishkin, F. S. “An Evaluation of Swedish Monetary Policy 1995-2005”. (2006/07:RFR1), www.riksdagen.se.

■ and five years ahead. Inflation expectations can also be estimated by comparing market rates for nominal and indexed bonds. In this way, the central bank can observe whether measures taken to influence inflation expectations are having any effect.

When the interest rate is zero the exchange rate becomes an interesting indicator of expectations of the future price level. According to the interest rate parity condition, the current exchange rate is determined by the expected future exchange rate, current and expected future interest rate differentials between domestic and foreign interest rates and expected future currency risk premia. The future exchange rate depends on future price level, the future real exchange rate and future foreign price level. For exchange rates and price levels expressed in logarithms we can specify the following relation:

$$\begin{aligned} \text{Current exchange rate} &= \text{Expected future (exchange rate - interest rate differential + foreign} \\ &\quad \text{exchange risk premium)} \\ &= \text{Expected future (price level + real exchange rate - foreign price level} \\ &\quad \text{- interest rate differential + foreign exchange risk} \\ &\quad \text{premium)} \end{aligned}$$

With an expected future domestic interest rate that is zero or low, future interest rate differentials and foreign exchange risk premia for a small open economy are largely exogenous and given. At a reasonably long horizon, the expected future real exchange rate is given by a neutral real equilibrium rate and is largely exogenous for a small economy. The expected future foreign price level is also exogenous for a small open economy. Consequently, under these conditions, the expected future price level is practically the only endogenous variable that affects the current exchange rate. With this reasoning, the current exchange rate, all other things being equal, becomes a direct indicator of the expected future price level. By observing the exchange rate, the central bank can thus observe expectations of the future price level. Higher inflation expectations and thereby a higher expected future price level lead then to a depreciation of the currency today, all else being equal. A measure that raises expectations of future inflation and the future price level should thus show up in a depreciated currency. A strengthening of the currency may therefore be ominous and interpreted as a sign that inflation expectations are falling.¹¹

The exchange rate as a policy instrument – "The Foolproof Way" to escape a liquidity trap

The direct link between the current exchange rate and the expected future price level first leads, as mentioned, to the insight that the current exchange rate depends on the expected future price level and can be used as an indicator of the latter. But the link also leads to the idea that cause and effect can be reversed. Instead of the expected future price level determining the current exchange rate, the current exchange rate can determine the expected future price level. To be more precise, the exchange rate can be used as a policy instrument when it is no longer possible to lower the interest rate because it is already zero. Unlike the policy rate, the exchange rate has no upper or lower limit, as Bennett McCallum

¹¹ See equations (8) and (9) and more details in the appendix to this speech.

pointed out early in the discussion of Japan's liquidity trap.¹² When the real economy and inflation can no longer be stimulated by cutting the policy rate, it is still possible to achieve the same stimulation by using the exchange rate as a policy instrument and depreciating the currency.

This is the background to my proposal of a "Foolproof Way" for a small open economy to escape from a liquidity trap.¹³ The Foolproof Way consists of the following three parts:

- (1) A price level target is introduced in the form of a path as I described earlier. In the event that unwelcome low inflation or deflation has already arisen, the price level target can be set correspondingly higher than the current price level.
- (2) An exchange rate target that is consistent with the price level target is announced and the exchange rate is pegged to this exchange rate target until the price level target is attained. If, for example, the price level is to be raised by 10 per cent, the exchange rate target is set so that the currency depreciates by 10 per cent.
- (3) When the price level target has been attained, the currency is allowed to float and monetary policy returns to normal, either with the old inflation target or with the continued use of a price level target if this is deemed to be advantageous in the longer term.

It is easy for the central bank to implement part (2) and keep the exchange rate at a given level when the currency is strong and would appreciate if it were allowed to float. Initial doubts among the market participants and the risk of this method failing means that it would appear to be a good deal to buy domestic currency cheaply and then sell it at a higher price when the method fails. This would lead to a high demand for the domestic currency. The central bank, however, could sell as much domestic currency as it likes and would only see its foreign exchange reserves increase correspondingly. A large foreign exchange reserve and monetary base might be considered inflationary, but higher inflation and inflation expectations are exactly what the central bank wants in this situation.

The difficult thing, in contrast, is to maintain a fixed exchange rate when the currency is weak and would depreciate if it was allowed to float, as was the case of the speculative attacks the Swedish krona was subjected to during the fixed exchange rate regime in the early 1990s. In such a situation, the central bank would have to buy the domestic currency and pay with foreign exchange reserves, which are finite and would eventually run out. When the market realises that there is a difference between maintaining a fixed exchange rate when the currency is strong and when it is weak, the high demand for the domestic currency will cease and the foreign exchange reserves will return to a more normal level.

This method is a very drastic action. It shows that the central bank really means business and lends credibility to the price level target. It may therefore affect

¹² McCallum, B. (2000), "Theoretical analysis regarding a zero lower bound on interest rates". *Journal of Money, Credit, and Banking*. v. 32, 870-904.

¹³ See Svensson, Lars E.O. (2001), "The Zero Bound in an Open Economy: A Foolproof Way of Escaping from a Liquidity Trap," *Monetary and Economic Studies* 19(S-1), February, 277-312; Svensson, Lars E.O. (2003), "Escaping from a Liquidity Trap and Deflation: The Foolproof Way and Others," *Journal of Economic Perspectives*, 17(4) 145-166.

■ expectations of the future price level much more than any other measure. The method is verifiable as it consists of action and not just talk, and its logic is very clear. Raised inflation expectations would reduce the real interest rate, stimulate the real economy and increase inflation, and the price level would move upwards towards the price level target. The real economy would also be stimulated directly by the fact that exporting and import-competing sectors would be affected positively by the short-term real depreciation that would arise due to the short-term sluggishness of the price level. As the price level moves up towards the price level target, the real exchange rate will, however, return to its neutral level.

Does this method represent a competitive devaluation? The answer is that this is no more of a competitive devaluation than any other form of monetary policy expansion. Note that if the zero lower bound for the interest rate did not exist, the central bank could reduce the real interest rate by reducing the nominal rate. This nominal rate reduction would lead to a depreciation of the currency. The currency depreciation in part (2) achieves the same currency depreciation directly instead of indirectly via a reduction of the nominal interest rate. The method is thus no more of a competitive devaluation than a reduction of the nominal interest rate would be, if such a reduction were possible. It is quite simply a method that entails a certain degree of monetary policy expansion, but by using means other than the policy rate. Every measure that managed to increase expectations of the future price level would in fact also automatically lead to a weakening of the currency. Using the exchange rate as a policy instrument should therefore not be seen as more controversial than using any other method that leads to expectations of a higher future price level.

Is this method to the disadvantage of other countries? The method is to the advantage or disadvantage of other countries depending on whether a normal monetary policy expansion, an interest rate cut, is to the advantage or disadvantage of other countries. The effects of a small, open economy's monetary policy on other countries is normally limited, and the net effect depends on a number of circumstances. Monetary policy is normally conducted in each country without regard to such effects. The impact that a currency depreciation or a monetary expansion in a larger country has on the trade balance of other countries depends on both income and substitution effects. The former is positive due to the greater output and the greater demand for foreign imports, while the latter is negative due to changes in the real exchange rate and the terms of trade. Depending on the initial position, the positive income effect can be quite substantial. However, as the income and substitution effects normally have different signs it can be expected that the net effect is normally fairly small. This is supported by simulation studies.¹⁴

Today, however, we have a situation in which the two largest economies in the world, the US and Japan, both have a zero interest rate. If the authorities in these countries want to stimulate the real economy by lowering the real interest rate further by creating higher inflation expectations, they clearly cannot do this by depreciating their currencies against each other at the same time. They will instead have to create such expectations by other methods. If one of the countries manages to raise expectations of its future price level it will be sufficient in principle, however, for the other country to keep the exchange rate constant for its expected future price level to also rise. Roosevelt's decision to allow the dollar to depreciate by 40 per cent against gold during the depression in the

¹⁴ Coenen, G. and Wieland, V. (2003). "The Zero-Interest-Rate Bound and the Role of the Exchange Rate for Monetary Policy in Japan" *Journal of Monetary Economics* 50, 1071–1101.

■ 1930's can be mentioned as an example of a currency depreciation carried out with the express purpose of raising the price level in the country.¹⁵

"Quantitative easing": Ineffective if it is not expected to be permanent

Why not just increase the money supply in order to create expectations of a higher future price level? As long as the interest rate is zero then households and firms, as we have already seen, are indifferent about the choice between money and securities such as Treasury bills or bonds. An increased supply of money will then have no effect other than households and firms holding more money and fewer bills and bonds. However, at some time in the future the economy will return to normal, the interest rate will be positive and households and firms will no longer be indifferent when choosing between money and these securities. Somewhat simplified, we can say that the money supply will once again become approximately proportional to the price level. A larger money supply in the future will lead, all else being equal, to a higher price level in the future. If the central bank could thus credibly commit to a *permanent* and lasting increase in the money supply, the expected future price level would rise. The problem here is, however, that there is no way for the central bank to make a credible commitment to a larger money supply in the future. There is nothing to prevent the central bank from renegeing on such a commitment and reducing the money supply in the future in order to reduce future inflation and keep it in line with the inflation target.¹⁶

Experience from Japan's period of "quantitative easing" also shows that the extreme expansion of approximately 70 per cent of the monetary base between March 2001 and March 2006 did not noticeably affect expectations of inflation and the future price level.¹⁷ For example, the yen did not depreciate as it should otherwise have done. Firms and households clearly believed that the expansion of the monetary base was temporary and not permanent, which subsequently proved to be true. The monetary base fell back to normal levels when the interest rate was later raised to above zero.

Other measures

A number of other measures for addressing a situation with a zero interest rate have been proposed. Even if short-term interest rates are zero or close to zero, bond rates at longer maturities may still be positive. If the central bank therefore buys long-term bonds it may perhaps be able to squeeze down the long-term interest rates somewhat, which should stimulate the real economy. The central bank can also promise to keep the policy rate at zero for a prolonged period in

¹⁵ Bernanke, Ben (2002), "Deflation: Making Sure 'It' Doesn't Happen Here", speech 21 November at the National Economists Club, Washington, D.C., www.federalreserve.gov.

¹⁶ As Paul Krugman put it in his insightful Brookings essay – how will the central bank "credibly promise to be irresponsible". Krugman, Paul R. (1998). "It's Baaack: Japan's Slump and the Return of the Liquidity Trap". *Brookings Papers on Economic Activity* 49, 137-206.

¹⁷ Quantitative easing and credit easing are not the same thing. The first method entails deliberately increasing the monetary base and having a quantitative target for this. The monetary base can then be seen as supply-determined by the central bank. The second method consists of providing new loan opportunities for the banks in order to improve the functioning of the financial markets and reduce spreads. This method also results in an increase in the monetary base, but this can be seen as demand-determined by the banks. See Bernanke, Ben (2009), "The crisis and the policy response", speech at the Stamp Lecture, London School of Economics, 13 January, www.federalreserve.gov, for further discussion.

order to create expectations of lower future interest rates and a more expansionary monetary policy in the future. This should also stimulate the real economy. Personally, I believe that the stimulation that the central bank can achieve in this way is very moderate, perhaps a few tens of basis points on the real interest rate in the best case. By influencing inflation expectations more directly, the real interest rate can be reduced by several percentage points.

Monetary policy alternatives with a zero interest rate bound: Concluding comments

As both Japan and the United States now have a zero interest rate and several other countries are now cutting their interest rates close to zero, it is natural that monetary policy with a zero interest rate should be increasingly a subject for discussion and debate. The most recent Monetary Policy Report contains an article on monetary policy with a zero interest rate, and there is also an alternative scenario in Chapter 2 assuming weaker real economic development and a repo rate path that is at zero during part of the forecast period. Although it is not particularly likely that we in Sweden will be subjected to a strongly binding zero lower bound for the interest rate, it is wise to be prepared for this eventuality and to have carefully considered the monetary policy alternatives that would then be available, and which of these would be appropriate, depending on how serious the zero lower bound was.

A zero lower bound on the interest rate means that the real interest rate is still too high to sufficiently stimulate the real economy, despite the policy rate being cut to zero. It is the real market rate that is important in the real economy, and this corresponds to the policy rate plus a spread arising due to various risk and liquidity premia, minus expected inflation. Although the policy rate is zero, nominal market rates are positive as a result of the spread. The various measures taken by central banks and other public authorities during the financial crisis to ensure that the financial markets function more efficiently and that the spreads decline thus fulfil a function that is at least as important, even if the repo rate is at zero. It is reasonable to suppose, however, that their stimulating effect is much smaller than the effect a central bank can achieve with measures that focus on inflation expectations.

The major danger with a zero lower bound for the interest rate is that inflation expectations will be too low and even negative, and that the real interest rate will thus become too high. It is thus necessary to keep watch on inflation expectations, to counteract expectations of falling inflation, and preferably to create expectations of higher inflation. In this type of situation it may be desirable to create expectations that actually exceed the inflation target.

The Riksbank's current regime, with a credible inflation target and the publication of forecasts, including their motivation, for inflation, the real economy and the repo rate, provides a very good base for maintaining confidence in monetary policy, for upholding inflation expectations and preventing them from falling too low, or even from falling unchecked.

If, contrary to expectations, this should not prove sufficient, and inflation expectations were to threaten to become too low, it is possible that tightening the inflation target, in the form of a temporary target for prices, might work better. This type of temporary price target could be introduced in the form of an average inflation target, so that inflation over the coming five years should on

■ average be 2 per cent. If inflation then falls below 2 per cent during a period of time, it must be kept above 2 per cent during a period of time to ensure the average will be 2 per cent. With a well-motivated average inflation target it may be easier to justify this monetary policy and to create confidence in allowing inflation to exceed 2 per cent during a period of time in order to provide a sufficiently low real interest rate.

If not even this, contrary to expectations, were to prove sufficient and inflation expectations were to remain low and impossible to influence, or were to change to lasting expectations of deflation, then a possible last resort is my suggestion of a foolproof way of getting out of a liquidity trap. This method entails a price level target where the currency is depreciated and the exchange rate held at a temporary exchange rate target until the price level target has been attained. This dramatic method is most efficient in creating expectations of a higher future price level and could provide sufficient stimulation to the real economy. I consider it very unlikely that this method would be needed in Sweden, but I believe it is good that it is available as a last resort. On the other hand, “quantitative easing” in the form used in Japan, that is, a temporary targeted increase in the banks’ reserves with the central bank, would probably be completely ineffective.

There are probably many in the central bank world who are hesitant about openly discussing the advantages and disadvantages of monetary policy in a zero interest rate situation and the unconventional methods that are available. Many would perhaps even prefer to exclude some of the alternatives without any particular justification. With a zero lower bound for the interest rate the central bank’s credibility and its possibilities to affect inflation expectations are even more important than usual. I myself am convinced that the central bank’s credibility can best be served by an open and transparent discussion of all of the available alternatives. This discussion should be held in good time before any of these alternatives may be needed, but in the hope that none of them will be needed. With a broad understanding that forceful measures are available, and with a readiness by the central bank to resort to these methods if the situation should so require, the general public and the market need not fear that the central bank will lose control of the situation and of inflation expectations in a situation with a zero interest rate.

■ Appendix

How the current output gap is determined at the zero lower bound

In a simple so-called New Keynesian model it is possible to show how the current output gap is determined at the zero lower bound.¹⁸ The (log) production, y_t , in period t (where a period represents one quarter) depends positively on expected future (log) production, $y_{t+1|t}$ (the output in period $t+1$ which is expected in period t), negatively on the difference between the real market rate, \tilde{r}_t , and the time preference, ρ_t , and other determinants. This can be written as

$$y_t = y_{t+1|t} - \sigma(\tilde{r}_t - \rho_t) + \text{other determinants}, \quad (1)$$

where σ is a positive constant, the intertemporal elasticity of substitution. The so-called Fisher equation shows the relationship between real market rates, nominal market rates, \tilde{i}_t , and expected inflation, $\pi_{t+1|t}$,

$$\tilde{r}_t \equiv \tilde{i}_t - \pi_{t+1|t} \equiv \tilde{i}_t - (p_{t+1|t} - p_t),$$

where π_t is inflation in period t and p_t is the (log) price level in period t . (Log) potential output in period t , \bar{y}_t , and the Wicksellian neutral real rate, \bar{r}_t , are related as follows

$$\bar{y}_t = \bar{y}_{t+1|t} - \sigma(\bar{r}_t - \rho_t) + \text{other determinants}. \quad (2)$$

The output gap, x_t , is equal to the difference between output and potential output, $x_t \equiv y_t - \bar{y}_t$. Subtracting equation (2) from equation (1) then gives

$$x_t = x_{t+1|t} - \sigma(\tilde{r}_t - \bar{r}_t). \quad (3)$$

That is, the output gap in period t depends positively on the expected future output gap and negatively on the interest rate gap between the real market rate and the real neutral rate.

We can solve equation (3) forward to the future period $t+T$ when the economy has come out of the liquidity trap. Then the current output gap, given by (3), can be expressed as follows:

¹⁸ For a more detailed derivation and detailed discussion, see Svensson, Lars E.O., (2006), "Monetary Policy and Japan's Liquidity Trap", working paper, www.princeton.edu/svensson.

$$\begin{aligned}
 x_t &= x_{t+T|t} - \sigma \sum_{\tau=0}^{T-1} (\tilde{r}_{t+\tau|t} - \bar{r}_{t+\tau|t}) \\
 &= x_{t+T|t} - \sigma \sum_{\tau=0}^{T-1} (\tilde{i}_{t+\tau|t} - \pi_{t+\tau+1|t} - \bar{r}_{t+\tau|t}) \\
 &= x_{t+T|t} - \sigma \sum_{\tau=0}^{T-1} \tilde{i}_{t+\tau|t} + \sigma \sum_{\tau=0}^{T-1} \pi_{t+\tau+1|t} + \sigma \sum_{\tau=0}^{T-1} \bar{r}_{t+\tau|t} \\
 &= x_{t+T|t} - \sigma \sum_{\tau=0}^{T-1} \tilde{i}_{t+\tau|t} + \sigma (p_{t+T|t} - p_t) + \sigma \sum_{\tau=0}^{T-1} \bar{r}_{t+\tau|t}, \tag{4}
 \end{aligned}$$

where $x_{t+T|t}$ denotes the level of the output gap in period $t+T$ that is expected in period t and where the Fisher equation is used. Accumulated inflation is then equal to the total change in the price level between periods t and $t+T$. The nominal market rate is equal to the policy rate, i_t , plus a positive spread due to various risk and liquidity premia, δ_t ,

$$\tilde{i}_t = i_t + \delta_t. \tag{5}$$

If we substitute (5) into (4), we see that the current output gap depends on the expected future output gap, policy rate path, total increase in the price level, expected spreads and neutral interest rate path according to

$$x_t = x_{t+T|t} - \sigma \sum_{\tau=0}^{T-1} i_{t+\tau|t} - \sigma \sum_{\tau=0}^{T-1} \delta_{t+\tau|t} + \sigma (p_{t+T|t} - p_t) + \sigma \sum_{\tau=0}^{T-1} \bar{r}_{t+\tau|t} \tag{6}$$

Let us assume now that the problem is that there is a recession in period t , that is, the output gap is negative ($x_t < 0$). Let us also assume that the interest rate is expected to be zero up to and including period $t-T-1$ (so that $i_{t+\tau|t} \approx 0$ for $\tau = 0, 1, \dots, T-1$). Let us also assume that the expected future output gap when the liquidity trap is over is around zero. Then the expression of the current output gap given by equation (6) can be reduced to

$$x_t \approx - \sigma \sum_{\tau=0}^{T-1} \delta_{t+\tau|t} + \sigma (p_{t+T|t} - p_t) + \sigma \sum_{\tau=0}^{T-1} \bar{r}_{t+\tau|t} < 0. \tag{7}$$

The first term on the right hand side is thus expected future spreads. The higher these are, the more negative the output gap is. Different measures to improve the functioning of the financial markets, "credit easing", which reduce the spreads thus contribute to reducing the recession. The final term is the expected neutral real interest rate path, which is largely given exogenously. There thus remains the middle term, namely total expected inflation up to period $t+T$. The prevailing price level, p_t , is sticky in the short run. There thus remains the expected future price level, $p_{t+T|t}$. Equation (7) thus shows how expectations of future prices affect the current output gap and how a higher expected future price level stimulates the real economy and reduces the recession today.

■ ***How the current exchange rate depends on the expected future price level***

According to the interest rate parity condition, the (log) exchange rate, s_t , depends on the expected future exchange rate, the interest rate differential between the domestic interest rate and the foreign interest rate, $i_t - i_t^*$, where i_t^* is the foreign interest rate (here, for the sake of simplicity, we do not distinguish between the policy rate and the market rate), and by an exchange rate risk premium, θ_t , as follows:

$$s_t = s_{t+1|t} - (i_t - i_t^*) + \theta_t.$$

By solving this equation forwards to period $t+T$ one obtains

$$s_t = s_{t+T|t} - \sum_{\tau=0}^{T-1} (i_{t+\tau|t} - i_{t+\tau|t}^*) + \sum_{\tau=0}^{T-1} \theta_{t+\tau|t}. \quad (8)$$

In addition, the future exchange rate, the domestic price level, the foreign (log) price level, p_{t+T}^* , and the real (log) exchange rate, q_{t+T} , are related according to

$$s_{t+T} \equiv p_{t+T} + q_{t+T} - p_{t+T}^*. \quad (9)$$

If this relationship is used in equation (8) and if we assume that the domestic interest rate is expected to approximately equal zero up to period $t+T-1$, the current exchange rate is determined according to

$$s_t \approx p_{t+T|t} + q_{t+T|t} - p_{t+T|t}^* + \sum_{\tau=0}^{T-1} i_{t+\tau|t}^* + \sum_{\tau=0}^{T-1} \theta_{t+\tau|t}, \quad (10)$$

The expected future real exchange rate can be assumed to be equal to a real equilibrium rate and can be regarded as exogenous. Foreign price levels, foreign interest rates and exchange rate risk premia can also be regarded as exogenous. Then, under these circumstances, the only endogenous variable affecting the prevailing exchange rate will be the expected future price level, $p_{t+T|t}$.