Monetary-Policy Strategies at the Zero Lower Bound on Interest Rates

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INTRODUCTION AND SUMMARY

The outbreak of the financial crisis in 2007-08 triggered a downturn on a scale unprecedented since the Great Depression of the 1930s. The downturn has resulted in substantial spare capacity in the economies, all things being equal putting a damper on inflation. Most central banks operate with an inflation target in their monetary-policy planning. In other words, inflation may be too high, but it can also be too low. In response to the slowdown, central banks have lowered their interest rates to near zero to prevent inflation from falling too far below target.

Since the rates of interest paid by central banks to private banks on their deposits cannot fall below zero, many countries have exhausted their possibilities for providing further stimulus to the economy through conventional monetary-policy measures. But the severity of the economic downturn means that a number of central banks have wanted to ease monetary policy further. In this respect, they have been constrained by the zero lower bound on interest rates. Therefore, they have resorted to unconventional measures to provide further monetary-policy stimulus to the economy – either by way of communicating their expectations of future monetary-policy interest rates or by way of purchase and sale of securities in financial markets.

The communication strategy exploits the fact that private-sector demand is influenced primarily by longer-term interest rates. By announcing that they expect to keep monetary-policy interest rates low, central banks may potentially reduce longer-term market rates. Over the past few years, this strategy has been adopted by the US Federal Reserve and Bank of Canada, among others.

As an alternative to communication, central banks may choose to intervene in the financial markets through quantitative easing, credit easing or liquidity support. Quantitative easing is the purchase of securities with long maturities. This serves to reduce interest rates on these securities and increase the liquidity of private investors. Through rebal-

ancing of private investors' portfolios of financial assets, this could lead to a broader-based fall in interest rates.

Credit easing typically aims to address the situation in selected markets. For example, markets in which risk premia have been pushed up to a level that is at odds with the central bank's assessment of underlying economic conditions. The difference between quantitative easing and credit easing is that the latter is sterilised, meaning that the total supply of liquidity does not increase. By providing liquidity support, the central bank enhances liquidity through new and extended credit facilities, thereby reducing the part of risk premium associated with liquidity risk.

The Federal Reserve, Fed, the European Central Bank, ECB, and the Bank of England, BoE, have all purchased securities in the financial markets. But these purchases have been highly different in nature. The Bank of England has opted for conventional quantitative easing, purchasing mainly government bonds. The aim of this programme has been to ease monetary policy more than would have been possible by lowering the monetary-policy interest rate, thereby achieving the BoE's inflation target of 2 per cent. Although inflation is currently relatively high in the UK, it was projected that inflation would fall below target, if the programme was not implemented.

The Federal Reserve has implemented both quantitative easing and credit easing in order to sustain the economic recovery and the functioning of key credit markets. The ECB's purchases, in the form of credit easing, have aimed to safeguard the effectiveness of the monetary-policy transmission mechanism primarily to ensure that the lowering of monetary-policy interest rates would pass through to market rates. In other words, the ECB's purchases are a complement to, rather than a substitute for, lowering of monetary-policy interest rates.

Empirical studies indicate that both the Federal Reserve and the Bank of England have been successful in reducing market rates through their purchase programmes. Few analyses have been conducted of the real economic impacts of these programmes, but preliminary findings suggest that they have worked as intended. The ECB's measures are believed to have helped to safeguard the effectiveness of the monetary-policy transmission mechanism, which is its criterion of success.

MONETARY POLICY AT THE ZERO LOWER BOUND ON INTEREST RATES

The practice of recent decades has been for central banks to use the interest rates at which private banks can borrow and deposit funds as their primary monetary-policy instrument. These interest rates govern the market rates paid by households and firms. As described in Box 1,

MONETARY-POLICY INTEREST RATES AND MARKET RATES[1] Box 1

In the money market, the central bank manages short-term money-market rates through its monetary-policy rate and related market operations.[2] The monetary-policy rate, I_t, can be divided into two components: the real interest rate, i_t, and expected inflation, π_t^e.[3] This division is significant, as real interest rates form the basis for the decisions of households and firms to save and invest. The real interest rate can be expressed as follows:

$$i_t = I_t - \pi_t^e. \tag{1}$$

Households and firms borrow and invest money in the financial markets at a nominal market rate, R_t, which is typically higher than the monetary-policy interest rate. The reason is that a risk premium, σ_t, reflecting *inter alia* credit and liquidity risks, is to be added to the "safe" monetary-policy interest rate. Credit and liquidity risks, etc. vary with the special characteristics of market segments, industries and individual firms.

Short-term real market rates, r_t, have the following relationship with monetary-policy interest rates and inflation expectations:

$$\begin{aligned} &R_t = I_t + \sigma_t \Rightarrow \\ &r_t = R_t - \pi_t^e = \left(I_t - \pi_t^{\,e}\right) + \sigma_t, \quad \text{or} \\ &r_t = i_t + \sigma_t. \end{aligned}$$

In addition, most households and firms base major economic decisions on interest rates that are fixed for an extended period of time. This especially applies to investment in housing and business capital, which is extensively financed by mortgage loans in Denmark.

According to the expectation hypothesis, long-term yields may be calculated as an average of the expected short-term interest rates over the relevant time horizon plus a term premium to compensate the lender for the uncertainty as to real interest rate developments over the given period. This uncertainty increases with the length of the time horizon. Consequently, the term premium is typically higher, the longer interest rates are locked. Hence, a fixed real market rate for the following periods, r_t^k, may be revalued as follows:

$$\begin{aligned} r_t^k &= \sum_{j=0}^{k} r_{t,t+j}^e + \tau_t^j \Leftrightarrow \\ r_t^k &= \sum_{j=0}^{k} \left(i_{t+j}^e + \sigma_{t+j}^e\right) + \tau_t^k, \end{aligned} \tag{2}$$

where τ_t^k is the term premium for locking interest rates for k periods of time. Consequently, equation (2) expresses that real long-term market rates are comprised of investor expectations of the sum of future monetary-policy real interest rates and risk premia over the investment horizon with the addition of a term premium.

Over recent decades, the usual practice has been for monetary-policy interest rates to be the primary monetary-policy tool of central banks; monetary-policy interest rates are used to manage short-term market rates and thereby longer-term market rates in accordance with the relationship expressed in equation (2).

[1] This presentation is based on Amano and Shukayev (2010).

[2] This is a simplified approach. It is assumed that only one monetary-policy interest rate exists. In practice, Danmarks Nationalbank – like most other central banks – uses several monetary-policy interest rates. These rates and their interaction with market rates in the Danish money market are described in detail in Danmarks Nationalbank (2009).

[3] We adhere to the common practice in that the subscript is a time indication, while a superscript, *e*, denotes expectations formed at a point in time *t*. For simplicity, we leave out the time indication in the main text below.

long-term market rates comprise expectations of future monetary-policy rates, to which should be added risk premia, depending on the characteristics of the specific asset (covering e.g. liquidity and estimated default rate) and a term premium.

The central bank interest-rate instrument has the inherent limitation that the nominal interest rates which the central bank pays to private banks on deposits cannot fall below zero; otherwise, the individual bank would achieve a better return by simply holding cash than by depositing it with the central bank. This limitation is known as the *zero lower bound on interest rates*.[1]

The zero bound is rarely a problem; in normal cycles, inflation hovers at around 2 per cent, to which should be added a positive real return, cf. equation (1) in Box 1. This means that the central bank has the scope to vary nominal monetary-policy interest rates without getting too close to zero.

But in a severe recession, especially one accompanied by major financial tensions, even a monetary-policy rate close to zero could, in certain circumstances, result in excessively high market rates. In that case, the central bank needs to resort to tools other than monetary-policy interest rates.

Real interest rates are the rates determining the financial transactions of households and firms. If we compare equations (1) and (2) in Box 1, it is clear that even if the nominal monetary-policy interest rate *I* is pushed as close to zero as possible, the real interest rate on monetary-policy instruments, *i*, may be reduced further, if the central bank can contribute to increasing the expected rate of inflation, π^e .

The central bank may also influence long-term market rates, cf. equation (2) in Box 1. Long-term money-market rates depend on private sector expectations of future monetary-policy interest rates. Consequently, the central bank may influence long-term money-market rates by signalling its forward-looking intentions for monetary-policy rates. If the central bank is able to send a credible signal that it will keep interest rates at an unchanged low level for an extended period of time, bond yields will naturally fall, and inflation expectations could potentially rise. This will lead to lower and potentially negative *real interest rates*. In an economy with a floating exchange rate, other things being equal, this will cause the exchange rate to depreciate, thereby further stimulating the economy. But if many countries signal

[1] In practice, the rate of interest paid on deposits at central banks may become moderately negative, as deposits offer a number of advantages over cash that the banks are willing to pay for. In this article, we disregard this factor and the effective lower bound on interest rates is referred to as the zero bound on interest rates.

low interest rates, they will not all achieve depreciation at the same time.

Alternatively, the central bank may influence term and risk premia by purchasing and selling securities or through special credit facilities. Below, four different strategies are reviewed for reducing market rates when monetary-policy interest rates are at their lower bound: communication, quantitative easing, credit easing and liquidity support.

COMMUNICATION

At the zero bound, several central banks have communicated their expectations of future developments in monetary-policy interest rates. For example, the Bank of Canada announced from April 2009 that it expected to keep interest rates unchanged at 0.25 per cent until the end of the 2nd quarter of 2010, conditional on economic conditions. In June 2010, it raised interest rates. In March 2001, the Bank of Japan committed to keeping interest rates low (0 per cent) until inflation turned positive.

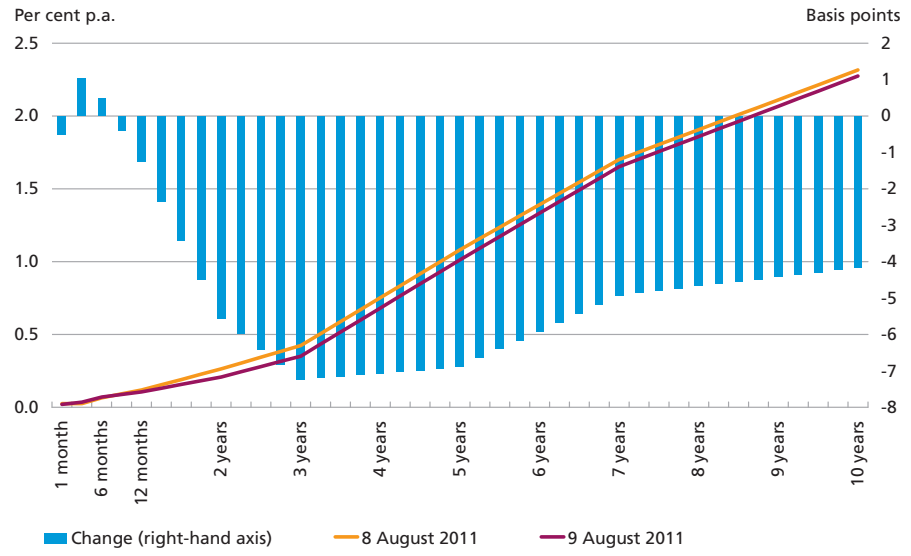
On 9 August 2011, the Federal Reserve announced that it was likely to keep interest rates unchanged between 0-0.25 per cent until mid-2013. Previously, the Federal Reserve had announced that it was likely to keep interest rates low for an *extended period*. The yield curve, reflecting the sum of expectations of future monetary-policy interest rates, I, the term premium, τ, and risk premia, σ, parallel-shifted downwards following the announcement, cf. Chart 1. However, it should be noted that the effect was relatively modest.

Central bank communication faces a particular challenge when monetary-policy interest rates are close to the zero lower bound. On the one hand, the central bank wants to keep interest rates low for an extended period to influence longer-term interest rates through communication. On the other hand, the central bank wants the flexibility to be able to raise interest rates before the announced time if required by macroeconomic factors.

Internally in the Federal Open Market Committee, FOMC, it has been debated to what extent the Federal Reserve should commit to keeping monetary-policy interest rates low. At the meeting on 9 August 2011, three FOMC members preferred not to communicate a specific date for when the Fed expected to raise interest rates. Another member, Evans (2011), advocated that the Federal Reserve should commit to keeping interest rates unchanged until the unemployment rate had been reduced to 7 per cent.

By committing to keeping interest rates unchanged for an extended period, the Fed risks that this communication will be perceived by the

US YIELD CURVE AROUND THE TIME OF THE FOMC ANNOUNCEMENT Chart 1



Note: The yield curve is a linear interpolation between individual points. Basis points are percentage points scaled up by a factor of 100.
Source: Reuters EcoWin.

market as a commitment rather than a conditional expectation. This means that the Fed could lose credibility if it fails to deliver on the expectation. Previous experience shows that the market seems to respond to both information from the central bank and other macroeconomic information, cf. Moessner and Nelson (2008). They conclude that central bank communication should not be interpreted as a commitment, but rather as a conditional expectation.

During recent years, a few central banks have begun to routinely publish their expectations of monetary-policy interest rates for the coming 2-3 years (interest-rate paths). This applies e.g. to New Zealand, Norway and Sweden, all of which have explicit inflation targets. By publishing an interest-rate path, the respective central banks seek to strengthen the private sector's understanding of the central bank's reaction function. A better understanding may help to improve the effectiveness of monetary policy, cf. e.g. Woodford (2005). The Federal Reserve does not publish interest-rate paths. However, since 2003, the Fed has explicitly signalled its forward-looking intentions in the press releases published after each FOMC meeting, thereby following the general trend of greater openness in policy-making.

However, interest-rate expectations may be difficult for central banks to communicate. For example, Sveriges Riksbank had difficulty "managing" market expectations in 2009. Although the market shared its

growth and inflation estimates, market expectations of monetary-policy interest rates were significantly higher than those of Sveriges Riksbank. Svensson (2010) explained this phenomenon by saying that, at a de facto zero rate, the market knows that interest rates cannot fall any lower. But there is a positive probability that interest rates will rise before Sveriges Riksbank expects them to do so. Consequently, average interest-rate expectations are higher than projected by the bank.

Liquidity trap and deflation

The communication strategy poses a particular risk if inflation has turned into deflation (generally falling prices); in that case, the economy may be caught in a *liquidity trap* where real interest rates are positive despite nominal interest rates of zero. This situation is described in more detail in Box 2.

Bullard (2010) discusses the particular challenges of central banks when faced with a liquidity trap. In that situation, he does not find the communication strategy appropriate. If the bank signals that it will keep interest rates very low for an extended period, this underpins the expectations of private players that the economy is in a regime of low interest rates and falling prices. Therefore, prospects of low nominal interest rates for an extended period do no contribute to reducing real interest rates; instead, the economy will be trapped in the inappropriate situation with declining prices. These have been the characteristics of Japan's economy in recent years, cf. Box 2.

DOES THE LIQUIDITY TRAP BIND AT THE ZERO LOWER BOUND ON INTEREST RATES? Box 2

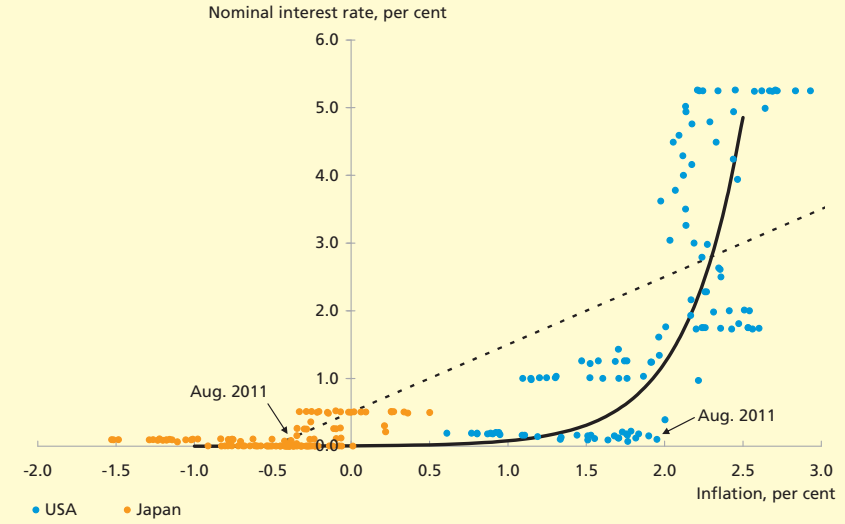
The special economic circumstances of the zero bound on interest rates imply the risk of falling into a *liquidity trap*, cf. the analysis in Benhabib et al. (2001). A liquidity trap occurs when the nominal interest rate is close to zero, while prices have stagnated or are even falling (deflation). In this situation, the central bank has lost not only its monetary-policy interest rate as an economic policy tool; deflation will also dampen economic growth and maintain the economy in an unhealthy state.

The state outlined, with interest rates close to zero and falling prices, closely mirrors developments in Japan over the past decade, cf. Chart 2. The yellow circles of the chart show inflation and nominal interest rate developments on a month-by-month basis from January 2002 to August 2011. It appears that the nominal interest rate has been moving between 0 and 0.5 per cent, while the rate of inflation has been primarily negative, with annual price falls of up to 1.5 per cent.

US interest rate and inflation developments over the same period are illustrated in Chart 2 with blue circles. US developments are in stark contrast to Japan – the annual rate of inflation is mainly running between 1.5 and 3 per cent and never falls below 0.6 per cent, while short-term interest rates clearly increase in step with inflation rates.

CONTINUED Box 2

INTERESTRATES AND INFLATION IN THE USA AND JAPAN Chart 2



Note: Monthly observations for the period January 2002 to August 2011. The dashed line shows the Fisher equation for a fixed real interest rate of 0.5 per cent. The full line illustrates a stylised interest-rate reaction function based on Bullard (2010).
Source: OECD and Bullard (2010).

The relationship between the two widely different situations in Japan and the USA can be explained by combining three economic relationships:

1. The fact that the return on an asset can be divided into a real interest rate and an expected rate of inflation, cf. equation (1) in Box 1. This relationship, also known as the Fisher equation, is illustrated in Chart 2 by the dashed line. For purposes of simplicity, we have assumed a constant real return of 0.5 per cent a year, cf. Bullard (2010).[1]
2. The zero lower bound on interest rates which is clearly illustrated by the chart.
3. The assumption that the central bank intends to pursue an *active interest-rate policy*, a fundamental principle of the inflation target regimes widely used as a monetary-policy strategy over recent decades, cf. Danmarks Nationalbank (2009, Chapter 1). According to this principle, the central bank is to respond by raising its monetary-policy interest rate even more if the rate of inflation is estimated to exceed the central bank's inflation target over a medium-term horizon.[2] This causes the real interest rate to rise, cf. equation (1) in Box 1, which, in turn, dampens economic activity and stops the expected increase in inflation.

The central bank's active monetary policy is illustrated in Chart 2 by a graph with a gradient greater than one – this captures that the central bank responds to fluctuations in inflation expectations with an interest-rate response greater than one-to-one. This monetary-policy response function is illustrated in Chart 2 by the full line where the slope is steeper than the slope for normal inflation levels.

The combination of relationships 1 and 3, in normal cycles, is illustrated by the cross between the dashed line and the full line in the upper right-hand corner of Chart 2.

CONTINUED Box 2

Here, the rate of inflation matches the central bank's target and the private agents' inflation expectations. This means that we have reached a long-term economic equilibrium; in normal cycles, the economy will fluctuate around this equilibrium.

But an important consequence of relationship 2, the zero lower bound on interest rates, is that the principle for active monetary policy cannot apply at all inflation levels. When inflation is sufficiently low, the central bank's interest-rate response will necessarily be lower than one; otherwise, it would fall below its zero bound, which is not possible. This relationship is illustrated in Chart 2 in that the interest-rate response function (the full line) bends and becomes horizontal for low inflation levels. In this case, monetary policy has become *passive*: It has lost its stabilising influence, which the private economic agents must also be expected to realise. This results in another kind of economic equilibrium, i.e. the cross between the two lines in the lower left-hand corner of the chart. In this case, the rate of inflation also matches that expected by the economic players and the central bank is unable to impact the rate of inflation through its monetary-policy rate. This situation is known as a liquidity trap.

[1] The actual real interest rate may show considerable fluctuations over time. In general, the real return on "safe" securities has been low during recent decades and especially during the illustrated period since 2002, which has been affected by several negative shocks to the global economy.

[2] This principle is also known as the Taylor principle after Taylor (1993 and 1999), cf. the extensive analysis in Woodford (2003).

According to Bullard, quantitative easing would be a far stronger instrument for creating positive inflation expectations in this situation. This would stimulate economic activity and bring the economy back to the desired equilibrium with moderately positive inflation rates. The central bank will again be able to use its official interest rates as an active instrument for economic stabilisation.

QUANTITATIVE EASING, CREDIT EASING AND LIQUIDITY SUPPORT

As an alternative to reducing expectations of future monetary-policy interest rates, central banks may seek to reduce the term premium, τ. One way of doing so is to purchase long-term securities, thereby increasing overall demand for these securities. This will push prices up and interest rates down. When the central bank does not otherwise intervene in the market, it also increases the liquidity of the investors from which it purchases securities.

Investors typically want to reinvest this liquidity in assets broadly similar to their previous assets. This extends the increased demand to a larger group of assets, sharing the characteristics of the securities initially purchased by the central bank. This effect of unsterilised purchases is known as the *portfolio balance effect*, cf. Joyce et al. (2011), reducing the term premium of a broad class of assets. This type of intervention is

known as *quantitative easing*.[1] Such intervention typically also impacts risk premia, σ, not least for the types of assets purchased by the central bank.

Central banks can also make targeted purchases of securities in special segments of the financial markets in which risk premia, σ, have been pushed up to a level that is at odds with the bank's assessment of underlying economic conditions. The purchases boost the overall demand for these securities, thereby reducing risk premia. The liquidity impact of the purchases is sterilised by the central bank's sale of securities in more efficient markets for a similar amount. Such interventions are referred to as *credit easing,* as they ease credit conditions without affecting the total supply of liquidity.[2]

Central banks may also seek to reduce risk premia during periods of crisis or stress in the financial markets. For example through a number of measures to ensure that solvent banks have access to the necessary liquidity when the money market freezes. During the financial crisis, liquidity in the financial markets has been challenged. This has increased the significance of the part of the risk premium associated with liquidity risk. Through new and extended credit facilities, central banks can improve liquidity, thereby reducing risk premia through a reduction of liquidity risk. Such measures are referred to as *liquidity support*.[3]

Quantitative easing, credit easing and liquidity support are all measures reserved for particularly difficult economic conditions. The reason is that they could lead to a situation where the return on financial assets does not reflect their actual risks, thereby distorting the incentives of investors to make excessively risky investments. When the economy normalises, these measures may be withdrawn immediately. Moreover, their impact on the economy is more uncertain than the effect of conventional adjustments of monetary-policy interest rates.

In practice, the strategies are interrelated

Asset purchases by central banks create increased demand for the selected types of assets. To the extent that the market regards the assets as risky, the purchases will reduce the risk premium – resulting in credit easing. If the central bank does not sterilise its purchases by selling a

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1 The concepts of quantitative easing and credit easing are used extensively in the literature of recent years, often with different meanings. In this article, we follow the terminology of the Bank of Canada (2009).

2 Note that the meaning of sterilisation is based on the assumption that the portfolio balance channel is active. When central banks engage in securities transactions with private banks, these are assumed subsequently to trade in the market to rebalance their portfolios with the associated implications for interest and exchange rates.

3 See Dam and Risbjerg (2009) for a review of liquidity support measures in Denmark and the euro area during the crisis.

similar amount of other securities, it increases the cash balance of the investors from which it purchases securities – resulting in quantitative easing. Unsterilised purchases of securities that are not regarded as "safe" constitute quantitative easing as well as credit easing.

The portfolio balance effect mentioned earlier also entails that assets sharing a number of characteristics with the ones purchased by the central bank are most affected. Therefore, the risk premium of these is especially reduced, while securities that are less similar are impacted through the broader term premium.

In addition to influencing long-term money-market rates through the term premium, quantitative easing typically also has a *signalling effect*. The reason is that, by engaging in quantitative easing, the central bank signals that it wants to reduce interest rates more than is possible through adjustment of monetary-policy interest rates. This underpins that the bank does not plan to raise interest rate in the foreseeable future. This signal will serve to keep market rates down and prevent inflation expectations from falling, which could lead to higher real interest rates. This, in turn, strengthens private demand. In other words, the signalling effect links the purchase strategies with the communication strategy.

Where assets are purchased directly by the banks, their reserves will also increase. This will enhance their lending capacity, which may have a beneficial impact on private demand through the *bank lending channel*, cf. Drejer at al. (2011).

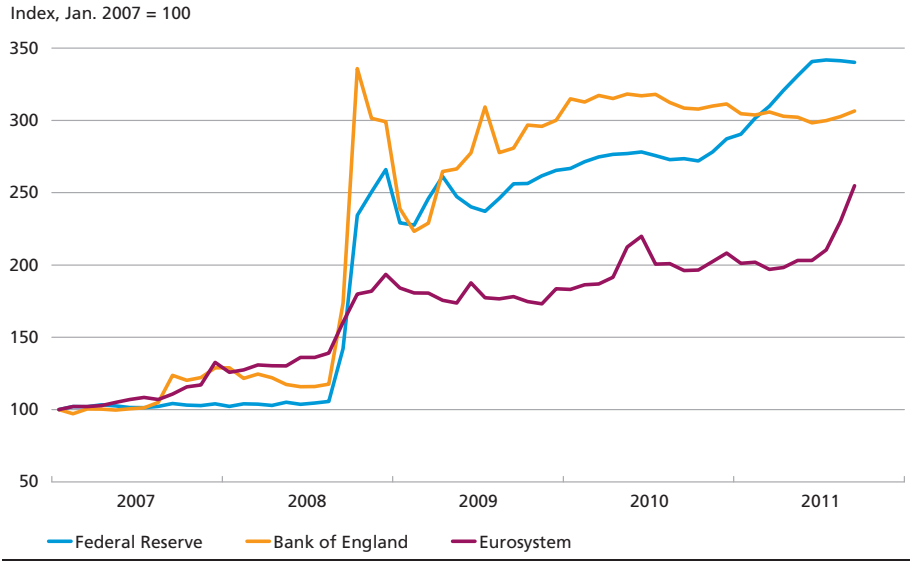
QUANTITATIVE EASING AND CREDIT EASING DURING THE CRISIS

The Federal Reserve, the Bank of England and the ECB have all reduced their monetary-policy interest rates to near zero. Moreover, they have used both quantitative easing and credit easing to reduce risk and term premia for market rates. As a result, central bank balance sheets have increased, cf. Chart 3. In addition to asset purchases, the central banks have also been acting as *lenders of last resort* by expanding lending to banks.

USA

The Federal Reserve, Fed, has implemented purchase programmes on several occasions, entailing both quantitative easing and credit easing. On 25 November 2008, the Fed announced its first purchase programme: the purchase of up to 600 billion dollars worth of mortgage bonds and Mortgage-Backed Securities, MBS, issued or guaranteed by the government-sponsored enterprises Freddie Mac and Fannie Mae. The Fed also

CENTRAL BANK BALANCE SHEETS Chart 3



Note: The Eurosystem comprises the ECB and the national central banks of the euro area member states.
Source: Reuters EcoWin.

launched a new facility, *Term Asset-Backed Securities Loan Facility,* TALF, with a limit of 200 billion dollars. The aim of expanding the Fed's collateral basis to include Asset-Backed Securities, ABS, based on new loans to small firms, student loans, car loans and credit-card loans, was to support this segment of the ABS market, which – according to the Fed – did not function. On 18 March 2009, the Fed announced plans to increase purchases of mortgage bonds and MBS by a further 850 billion dollars. These measures may be seen as credit easing, as they aimed to reduce the market risk premium. As the purchases were not sterilised, they also contained a quantitative element.

Moreover, on 18 March 2009, the Fed announced quantitative easing in the form of purchases worth 300 billion dollars of US government bonds, dubbed QE1, with a view to improving financial conditions in the economy. On 3 November 2010, the Fed announced plans to launch the purchase of US government bonds worth 600 billion dollars, dubbed QE2. The reason stated for this purchase, as opposed to previous purchases, was a poorer macroeconomic outlook and the wish to ensure that inflation was consistent with the Fed's mandate. Purchases would focus on 3-10-year government bonds.

On 21 September 2011, the Fed announced that it would increase the average maturity of the portfolio of government bonds. Specifically, the Fed would sell government bonds with a maturity of less than 3 years worth 400 billion dollars and reinvest the proceeds in government bonds

with a maturity of 6-30 years. Again, the aim was to reduce the term premium in order to sustain the economic upswing. These purchases fall outside this article's distinction between quantitative easing and credit easing, as the purchases are sterilised, but not targeted at specific credit markets. The purchases increase the duration of the Fed's portfolio of government bonds and will change the slope of the yield curve. On the day of the announcement, the 30-year government bond yield was reduced by 0.2 percentage points, while the 2-year government bond yield increased by 0.03 percentage points.

UK

The Bank of England's asset purchases have constituted quantitative easing. The BoE has mainly purchased UK government bonds. The purchase programme was launched on 5 March 2009, with the BoE's announcement of a 75 billion pound purchase. Although inflation has been relatively high over recent years, the BoE expected it to fall below the 2 per cent target in the mid-term due to weak capacity pressures. The BoE has subsequently increased the purchase programme. Most recently, on 6 October 2011, it was increased by 75 billion pounds to a total of 275 billion pounds. The reason stated for subsequent purchases has been weak inflation expectations.

The euro area

The rationale for the ECB's asset purchases has been to safeguard the monetary-policy transmission mechanism. In other words, the purchases have been in the form of credit easing. During the period from July 2009 to the end of June 2010, the ECB purchased covered bonds worth 60 billion euro. At the Governing Council meeting on 6 October 2011, it was decided to resume the purchase programme with a planned purchase worth 40 billion euro during the period from November 2011 until the end of October 2012. Moreover, through its Securities Markets Programme, SMP, launched on 10 May 2010, the ECB has had the opportunity to purchase private and government debt in markets that, according to the ECB, are dysfunctional. As at 2 December 2011, the ECB had purchased debt worth 206.9 billion euro. The liquidity impact has been sterilised.

EVALUATION OF THE PROGRAMMES

Empirical studies indicate that both the Federal Reserve and the Bank of England have been successful in reducing market rates through quantitative easing. Chung (2011) assesses that the Federal Reserve's purchases

in 2009 reduced 10-year government bond yields by approximately 0.50 percentage points. Based on a number of studies of the impact of quantitative easing on the yield curve, Williams (2011) argues that QE2 has reduced the yield curve by 0.15-0.20 percentage points.

According to Williams (2011) a reduction in monetary-policy interest rates of 0.75 percentage points is typically reflected in a fall of 0.15-0.20 percentage points in yields on long-term government securities, although the relationship between short-term and long-term interest rates is uncertain and depends on the situation. Chung (2011) assesses that the purchases already made and planned are equivalent to a reduction in short-term interest rates of 3 full percentage points. The total impact of QE1 and QE2 is a significant reduction of monetary-policy interest rates. It should be noted, however, that the yield on government securities is hardly the primary rate determining the demand of households and firms. But quantitative easing has affected the general level of interest rates in the economy, cf. the discussion above.

Joyce et al. (2011) find that the UK purchase programme has reduced yields on medium-term and long-term government bonds by about 1 percentage point. The impact on other market rates is more uncertain. The effect on private-sector wealth is also uncertain, but the programme is assumed to have increased household financial wealth by around 16 per cent. This masks the overall impact of higher prices of government and corporate bonds and higher equity prices.

Due to the crisis, the usual estimates of the interest-rate impact on the real economy cannot be applied directly. Few analyses exist of the real economic effects of the programmes. Chung et al. (2011) have conducted a model-based analysis of the economic impact of quantitative easing since 2008. They find that unemployment in 2012 is expected to be 1.5 percentage points lower than it would otherwise have been. Moreover, the easing has prevented deflation. According to estimates by the forecasting and consulting firm Macroeconomic Advisors, QE2 only caused the gross domestic product, GDP, to increase by 0.4 per cent and unemployment to fall by 0.2 percentage points, cf. Wen (2011).

Joyce et al. (2011) have estimated the impacts of the Bank of England's quantitative easing on GDP and inflation. They find that the programme has increased GDP by 1.5-2 per cent, while inflation, measured by the annual rate of increase in the Consumer Price Index, CPI, has been 0.75-1.5 percentage points higher than it would otherwise have been. The impact on inflation is roughly equivalent to what is achievable from a reduction of the monetary-policy interest rate by 1.5-3 percentage points.

In the euro area, the motivation for special monetary-policy measures has not been to boost demand, but to ensure the functioning of the

monetary-policy transmission mechanism during the crisis. The measures are found to have had the desired effect, cf. ECB (2011). It is also stressed, however, that the special measures need to be phased out at an appropriate time. Otherwise, they could distort the incentive for financial market players and delay the necessary balance sheet adjustments.

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