

January 2017



Research Institute

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The Future of Monetary Policy

Introduction

Since 2008, central banks in leading advanced economies have undergone several fundamental transformative changes. Most importantly, in response to the extraordinarily challenging environment in the immediate aftermath of the global financial crisis, they saw their mandates extended from narrowly defined macroeconomic targets, notably price stability and employment, to include financial stability. Moreover, in order to achieve both the old and the new targets, central banks introduced an expanding number of previously untested “unconventional” policy instruments.

Given the substantial lag between the implementation of the post-2008 monetary policy measures and their impact on the economy, it is – even now – difficult to pass a final judgement on their success or failure. Notably, a series of economic and political shocks has impacted the global economy and financial markets since 2008, which renders a definite conclusion even more difficult. By providing a detailed account of monetary policies implemented across various countries, this Credit Suisse Research Institute report aims to draw several key conclusions and discusses some of the fundamental and operational challenges that central banks are likely to face in coming years. Looking beyond the short term, we also consider the future of digital currencies and their potential implications for monetary policy. A chapter dedicated to this topic was authored for our publication by David Yermack, Professor of Finance and Business Transformation at the New York University's Stern School of Business.

As we conclude in our report, the key issue for decision-makers globally remains to consider which fundamental direction monetary policy ought to take next. We anticipate one of the following two scenarios that may evolve in leading jurisdictions: a return to the pre-crisis “normal,” or an extension or amplification of recent policy trends, leading to a further blurring of the boundaries between monetary, regulatory and fiscal mandates. While the reality may turn out to be a mix of these scenarios, the implications for future economic and political development – and for financial markets in particular – will differ considerably depending on the path chosen. For this reason, we believe that the discussion of the future of monetary policy needs to be reinforced and hope that this report provides a useful input for future stakeholder considerations.

Urs Rohner
Chairman of the Board of Directors
Credit Suisse Group AG



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Normalization or new norms?

Since 2008, central banks in advanced economies have undergone transformative changes. To achieve their targets, central banks have adopted an ever-broader range of previously untested "unconventional" policy tools. This publication provides an assessment of central bank policies in major advanced economies since the financial crisis.

On the following pages, we discuss some of the fundamental as well as operational challenges that lie ahead, including the question whether central banks can return to the pre-crisis normal. In case of the alternative scenario, where they continue to maintain, or even add to their broader policy mandate, we explore the possible policy tools at hand.

Normalization scenario

Since 2008, central banks have changed their policy-making in dramatic ways, initially to prevent a major destabilization of the financial system in the immediate aftermath of the financial crisis, and thereafter to offset evolving deflation risks, which were due to private-sector deleveraging across the developed world as well as fiscal austerity and institutional weaknesses in the Eurozone.

In an effort to stimulate credit growth, consumption and investment, central banks introduced a unique series of policy measures that resulted in a manifold expansion of the size of their balance sheets. Over time, the asset structure of their balance sheets changed from government bills only to several types of bonds and equities, thereby arguably exerting a significant impact on asset prices. Moreover, stepping in for banks constrained by Basel III regulations, central banks have become prominent providers of assets through deposit facilities for sovereigns, financial institutions and shadow banks.

There is a broad consensus among experts that the innovative actions of central banks in response to the immediate crisis have contributed decisively to the stabilization of the financial system and thereby prevented a far deeper economic downturn from developing. There is much more controversy,

however, as to how successful these policies were in promoting the post-crisis economic recovery. Given the fact that the lags in the policy transmission mechanisms may have been longer than usual due to the depth and specifics of the crisis as well as other shocks that had an impact on the world economy in the post-2008 period, it may be too early to draw a final verdict. The acceleration of economic activity since mid-2016 in both advanced and developing countries suggests that the thesis of monetary policy ineffectiveness and continued "secular stagnation" stands a reasonable chance of being disproven. Momentum in labor markets seems to be improving in most countries and there are increasing signs that the prolonged weakness in corporate investment spending is giving way to slight acceleration.

Should this be the case, the chances would also increase that central banks will follow the US Federal Reserve (Fed) in gradually normalizing policy. This is the first scenario, which we discuss in the final chapter of this report. While instances of financial market turbulence could well occur in such a scenario – for example, as tighter dollar liquidity adds to pressure on dollar debtors in emerging countries or elsewhere – the overall outlook for investors would, in our view, be moderately positive. Although asset returns would likely be constrained by the high valuations that have resulted from the period of very expansionary policy, extremes should be avoidable. However, even in such a case, the question must be addressed as to how far policy normalization can go. This will depend on both the extent of the cyclical growth recovery and inflation, and on the likely "natural" or terminal equilibrium rate of interest. If the latter is comparatively low, central banks would potentially need to re-

sort to unconventional policy tools, should an economic downturn set in. The issue of which of the tools tested in past years would likely be effective at that point in time will thus remain highly pertinent.

Moreover, even in a scenario of policy normalization, central banks may have to change their operational modus due to the new regulatory environment. For example, as we explain below, central banks will inevitably have to maintain comparatively large balance sheets for extended periods of time, so that financial institutions can meet the liquidity requirements imposed by the Basel III regulatory framework. They are also likely to play an important role as market makers and market stabilizers for quite some time.

"New norms" scenario

In an alternative scenario, central bank policy normalization would be averted either for economic or political reasons, or a combination of both. Should the secular stagnation hypothesis be born out, pressures on central banks to maintain an easy stance would continue to intensify. A decision to, for example, move interest rates into more negative territory would loom earlier and thereby pose technical problems, while at the same time potentially exposing central banks to new popular pressures. Alternatively, or additionally, pressures could intensify in some countries to finance fiscal expansion measures through some form of "helicopter money," which we will discuss toward the end of this report.

Even in the absence of such an economic backdrop, the leeway for central banks to pursue independent policies that evolved in the pre-crisis period may be constrained by political intervention. As we point out below, this type of scenario poses certain stability risks for the Eurozone – and thereby for Switzerland – as different members of the common currency area are likely to have diverging views regarding the appropriate policy approach. In this case, conflicting views could express themselves in significant market stress. Arguably, international policy coordination would be (further) weakened in such a scenario.

Chapter 2 on page 7 of this report provides a short overview of the sources of growth and the evolving fragility in the global economy in the years before the financial crisis. It then recaps how central banks responded to the crisis with emergency and regulatory responses. Chapter 3 on page 11 provides a more detailed look at quantitative easing (QE) policies that have been applied by a number of key central banks in the aftermath of the crisis. Chapter 4 on page 18 assesses the impact of negative interest rate policies (NIRPs) that were applied by central banks outside the USA, often in conjunction with QE and Chapter 5 on page 26 looks at central bank's involvement in financial sector regulation.

The future

The final chapter of this report fleshes out some of the details and ramifications of the two most likely future scenarios described above. As noted, the challenges confronting central banks are likely to be considerable in either case and a return to the "good old days" of the Great Moderation (i.e. the period of decreased macroeconomic volatility experienced in the USA since the 1980s) seems rather unlikely. That central banks alone will be able to address the key macroeconomic or stability-related challenges would be surprising to say the least.

In either of these basic scenarios, and especially if the zero lower bound on interest rates is breached more permanently, innovations such as digital currencies and blockchain technology might gain prominence. How far central banks wish to go down this path will be determined by political considerations on the one hand, and by the banking sector's appetite to embrace financial technology advances on the other hand.



MARRINER S. ECCLES
FEDERAL RESERVE BANK OF NEW YORK

1936

The financial crisis and emergency policy tools

Following a surge in inflation in the late 1960s and 1970s, which was overcome in the following decade, the period prior to the 2008 crisis – often termed the “Great Moderation” – was characterized by low and rather stable inflation in advanced economies, with strong growth and high employment. The crisis came as a great surprise to most observers.

Historically, financial crises were considered a problem of the “periphery” countries, particularly emerging markets. Accordingly, central banks in key developed economies followed their respective mandates, including achieving price stability and/or full employment without any considerable regard for financial stability or economic growth. In this environment, short-term interest rates were the preferred – and seemingly highly effective – monetary policy instrument.

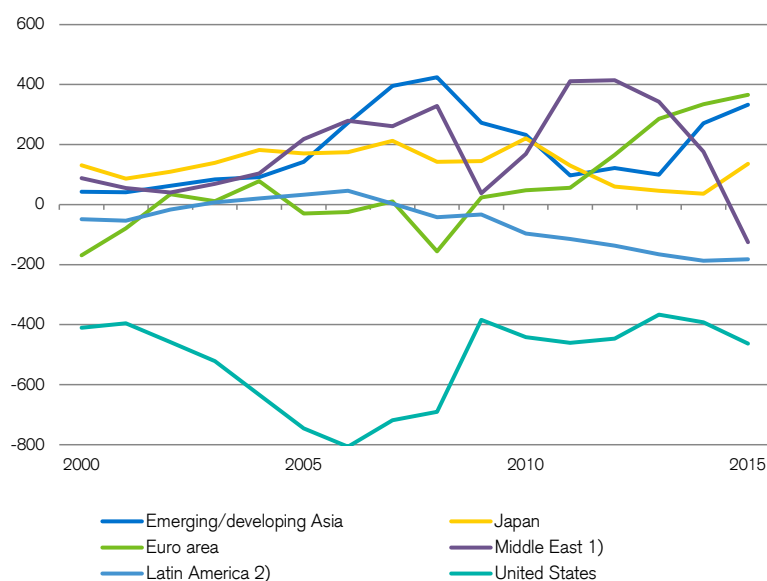
As is now widely recognized, domestic and international financial imbalances began to build up in the pre-crisis decade, resulting from a combination of supportive monetary conditions (and possibly overconfidence in simple mechanical monetary policy rules) and from rising debt levels in the banking as well as “shadow banking” sectors. Low and stable interest rates encouraged credit booms in several corners of the developed West – mortgages in the USA, Ireland and Spain and government debt in southern Europe.

There were four funding arteries between creditor nations and debtor nations, which mirrored the pattern of global current account imbalances (see [Figure 1](#)). Three involved the US dollar and ran from northern Europe, China and the Middle East to the USA. The fourth involved the common currency of Europe and ran from northern Europe to southern Europe (see [Figure 2](#)). These imbalances set the stage for the global transmission of the US financial shock that was triggered by the collapse of the credit-financed US housing bubble.

Figure 1

Global evolution of current account imbalances

In USD bn



1) Includes North Africa, Afghanistan, and Pakistan

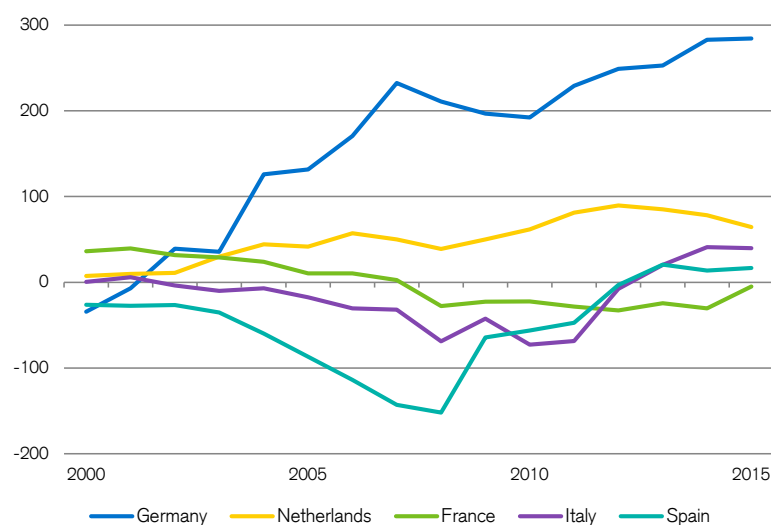
2) Includes Caribbean

Source: International Monetary Fund (IMF), Credit Suisse

Figure 2

Current account imbalances in the Eurozone

In EUR bn



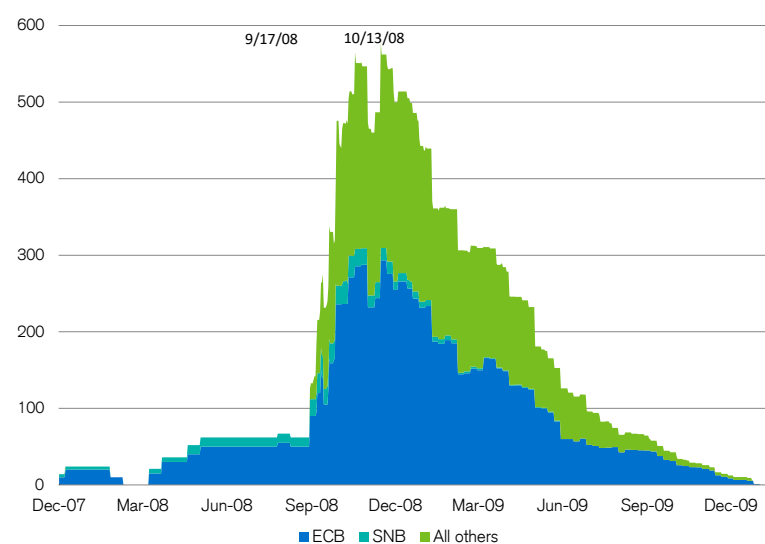
Source: International Monetary Fund (IMF), Credit Suisse

In response to the financial crisis, central banks boldly embraced the approach suggested by 19th century British economist Walter Bagehot to lend freely at a penalty rate against “good collateral.” Concretely, the Fed responded by opening the discount window to banks and by designing new liquidity facilities for shadow banks. Most important were the dollar swap lines that the Fed set up with the European Central Bank (ECB), the Bank of England (BoE), the Swiss National Bank (SNB) and the Bank of Japan (BoJ) to backstop the global Eurodollar market (Figure 2).

For the first time in history, the Fed became lender of last resort to the rest of the world and stepped in to safeguard the par exchange rate between onshore dollars and Eurodollars (Figure 3). Fiscal authorities stepped in as well, providing capital backstops to fix banks’ solvency problems. Against initial political resistance, the US fiscal authorities provided support to banks with the Troubled Asset Relief Program (TARP). In other countries, Switzerland included, the monetary and fiscal authorities also supported the financial system.

For the Eurozone, such tools were initially missing, which was a prime cause of the severity of the subsequent sovereign and banking crises. Effective emergency support measures were only devised three to four years after the global crisis erupted – as witnessed by the lag where the European Central Bank’s balance sheet expanded relative to those of other leading central banks (Figure 4).

Figure 3

Swap lines provided by the Fed during the crisis

Source: Federal Reserve, Credit Suisse

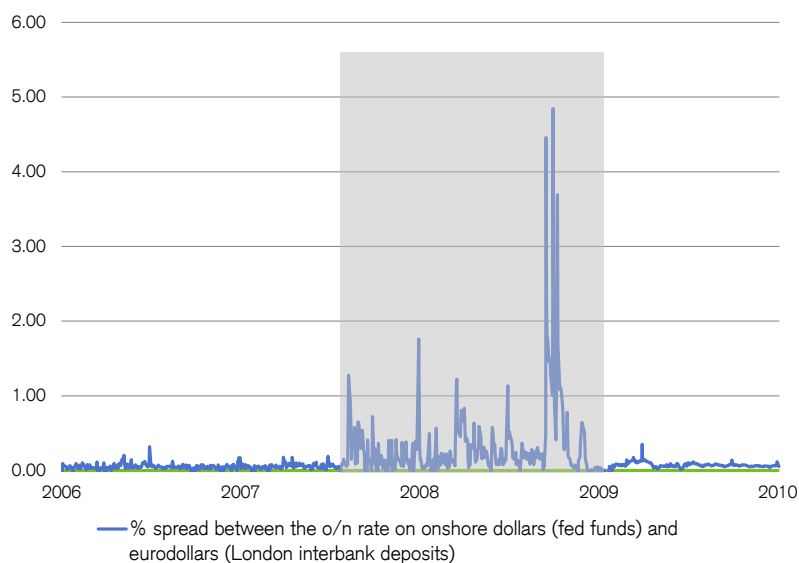
In the immediate aftermath of the crisis, the traditional tool of interest rates cuts did not show the hoped-for results and central banks started to innovate to get around the problem of the zero lower bound and the taboo of negative interest rates. The first of a series of monetary policy innovations was the so-called "forward guidance." This simple but powerful idea was that communicating that interest rates would stay at zero well into the future would flatten the yield curve and increase the appetite to borrow. The central banks' communication about future policy intentions influenced the markets' expectations about the size of future bill purchases, future injections of reserves and the future course of short-term interest rates. In turn, expectations about the future path of policy rates shaped the level of interest rates and the slope of the yield curve.

With some, but not sufficient success of the forward guidance approach, quantitative easing (QE) was introduced across mature economies. In theory, QE aims to stimulate growth through three channels. First, lower interest rates reduce debt servicing as borrowers refinance debt and improve their cash flows. Second, lower interest rates reduce discount rates and raise asset prices, boosting wealth, confidence and the propensity to spend. Third, lower interest rates should also spur the appetite to borrow, helped by asset managers' eagerness to lend the cash they accumulate from selling bonds to the central bank.

In fact, QE bears important similarities to traditional monetary policy, as both typically involve the purchase of government debt. In contrast to traditional monetary policy, which tends to operate in shorter maturities, central banks undertaking QE mostly purchase long-term bonds in large amounts. The primary aim of these purchases is to manipulate long-term interest rates directly, instead of manipulating short-term interest rates and shaping the market's expectation about future policy through communication. Reserves are created in this process as well, but are a by-product of policy rather than the means to an end.

Figure 4

Divergence between onshore and offshore Eurodollar rates

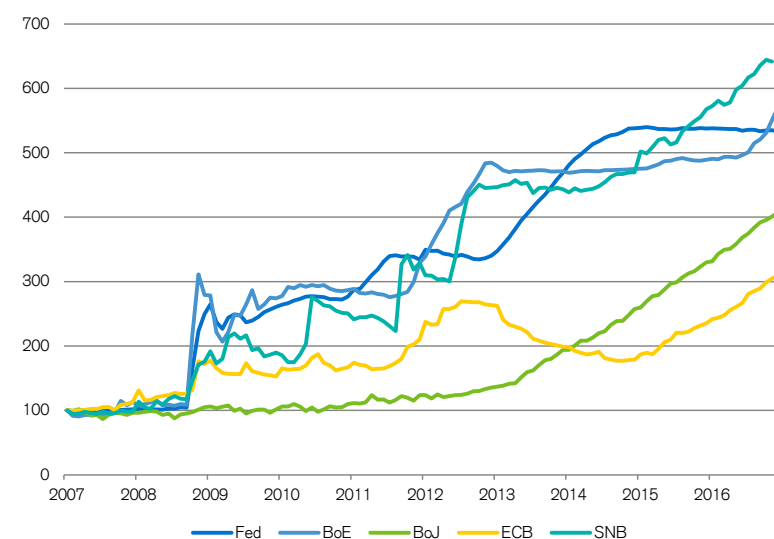


Source: Datastream, Credit Suisse

Figure 5

Evolution of central bank balance sheets

Local currency, indexed January 2007 = 100



Source: Datastream, Credit Suisse



The effects of quantitative easing

The quantitative easing approach was accepted gradually across the developed world and was implemented by all leading central banks to some degree. In assessing its effectiveness, it is important to factor in specific economic conditions in the respective countries and regions.

Federal Reserve

The Fed first began quantitative easing as early as November 2008 by announcing its planned purchases of USD 100 billion in direct obligations of government-sponsored enterprises (GSEs) and USD 500 billion in GSE mortgage-backed securities (MBS). The goal was to reduce the cost and availability of credit, and to support the housing market and financial market conditions in general. The quantitative easing (QE) decision came as a quick response to the crisis and an attempt to end the credit crunch. As the economy failed to recover, in March 2009, the Fed announced an increase of USD 750 billion in purchases of agency MBS and an increase of USD 100 billion in GSE debt, in addition to a USD 300 billion purchase of long-term Treasuries, citing the desire to promote price stability and economic recovery, and to stabilize financial markets and institutions. Despite the stimulus, bank lending continued to fall after a temporary stabilization in the second quarter of 2010.

With the unemployment rate still over 9% and a decline in credit, the Fed announced a new wave of QE on 3 November 2010 – which came to be known as QE2. The package included USD 600 billion of long-term Treasuries at a pace of purchasing USD 75 billion per month. While credit growth turned slightly positive, unemployment did not change much and investment growth remained weak. In September 2011, the Fed therefore announced its plan to buy USD 400 billion of Treasuries with maturities of 6–30 years and to sell USD 400 billion of short-term Treasuries with maturities of less than three years. Termed "Operation Twist," this debt-swap program aimed to lower long-term interest rates in order to help markets and credit conditions. In June 2012, the program was extended to continue through the end of the

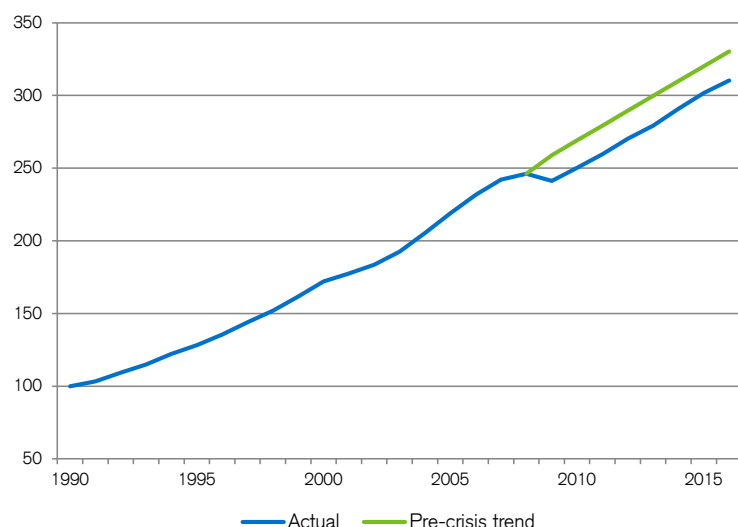
year. With the saving rate rising above 7% in 2012, spending growth close to zero, unemployment throughout the year circling around 8%, and investment decreasing, the Fed decided to boost the economy further by purchasing USD 40 billion per month of agency MBS in September and continuing the bond-swap in what marked the beginning of QE3. Just a couple of months later, an additional USD 45 billion per month of Treasuries were added to the package.

The savings rate was lower in 2013 (fluctuating around 5%) and lending started to pick up. Unemployment finally fell below 7% at the end of the year, and investment was growing. Owing to the improvements in the wider economy, the Fed decided to "taper" in December 2013 by reducing MBS purchases from USD 40 billion to USD 35 billion per month and Treasury bond purchases from USD 45 billion to USD 40 billion per month. On 29 October 2014, the QE program was ended as economic conditions were deemed to be sufficiently robust. To the surprise of many economists, inflation remained very "sticky" at around 2% in the initial years of the recession. It declined quite sharply in 2015, although the economy was expanding quite strongly by then, which caused the Fed to delay its first rate hike to the end of the year. In the meantime, however, inflation has essentially returned to the Fed's target level, prompting a shift toward more rate hikes. Considering the evolution of employment, the QE program should, in our view, be deemed a relative success.

Figure 1

Evolution of US nominal GDP

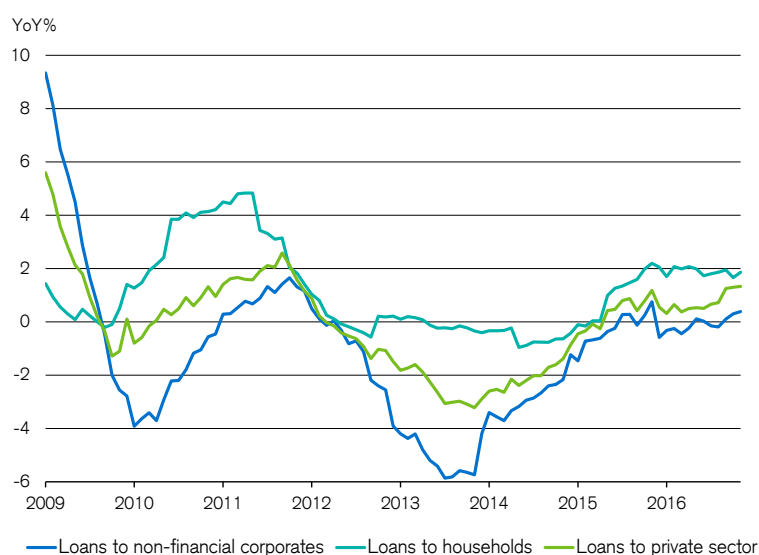
1990 = 100



Source: International Monetary Fund (IMF), Credit Suisse

Figure 2

Growth of bank lending in the Eurozone



Last data point: November 2016

Source: Bloomberg, Datastream, Credit Suisse / IDC

As Figure 1 shows, nominal Gross Domestic Product (GDP) growth in the USA has been on a similar track as in the pre-crisis period for some time, although the gap to the previous trend has not been closed. Looking ahead, it remains to be seen whether the considerable boost in asset prices as well as the build-up in corporate leverage that has occurred over the past years – arguably as a result of QE – will not pose future stability risks.

European Central Bank

The European Central Bank (ECB) began its fully fledged QE much later than the Fed due to institutional and political constraints. Starting in the 2008 crisis and until 2012, the ECB tried to mitigate the negative effects on the economy by limited and sporadic purchases of government bonds and covered bonds. In October 2014, the central bank launched a third covered bond program, followed by an asset-backed securities program in November with the aim of providing credit to the real economy, enhancing the transmission of monetary policy, and generating positive market spillovers. In March 2015, by adding public sector securities to its purchases, the ECB started full-blown QE and, in December, it even allowed debt instruments issued by regional and local euro area governments to be included in QE. From March 2015 to March 2016, the ECB's purchases averaged around EUR 60 billion worth of asset purchases per month. This was expanded to EUR 80 billion per month in April 2016, but will again be reduced to EUR 60 billion in March 2017. The intention is to continue with QE until at least December 2017.

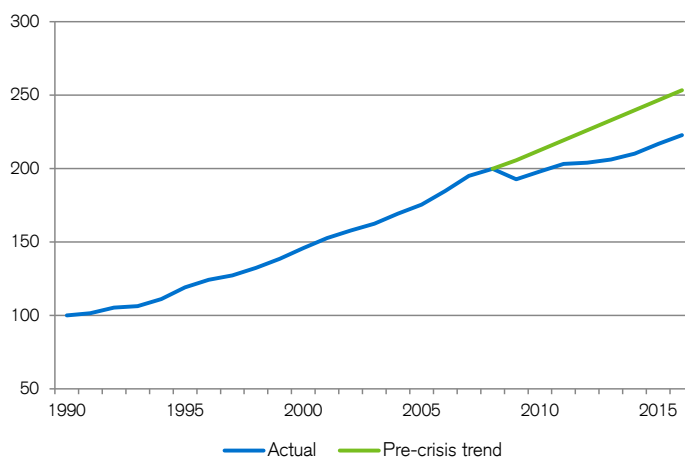
Given that banks play a far greater role in the creation of credit in the Eurozone than in the USA, the ECB also introduced various subsidized lending programs over the past few years (long-term refinancing operations, or LTROs). Moreover, it introduced negative deposit rates in 2015 to encourage banks to put cash balances to work (see below). Whether the combination of these policies has been a success remains to be decided given that their full implementation began much later than in the USA and there are considerable lags between policy innovations and economic responses. For example, credit growth in the Eurozone only began to recover in 2015 (Figure 2) after it was dragged down sharply by the region's crisis. Consumer spending also recovered with a lag and in some countries such as Italy and France, business sentiment only began to improve significantly in H2 2016.

Examining the trajectory of nominal GDP (Figures 3 and 4), we observe a flatter profile for the Eurozone than for the USA until now (see above). While the trajectory of German economic growth has been back at pre-crisis levels for some time and has even surpassed them, the overall profile is being held down by the Eurozone "periphery" as well as France. The weakness of the latter is not only partially due to an inherently lower effectiveness of QE in the Eurozone, but also due to the ongoing structural weaknesses in many economies. More specifically, persistent weaknesses in the banking system due to delayed consolidation and recapitalization has prevented QE from translating into stronger credit and economic growth.

Figure 3

Trajectory of nominal GDP in the Eurozone

1990 = 100



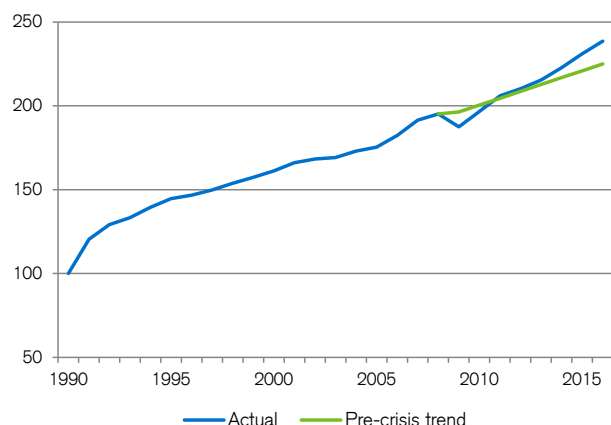
Source: International Monetary Fund (IMF), Credit Suisse

Figure 4

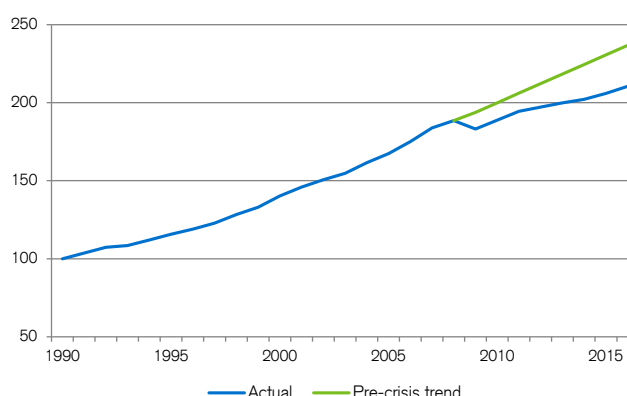
Trajectory of nominal GDP in the major Eurozone economies

1990 = 100

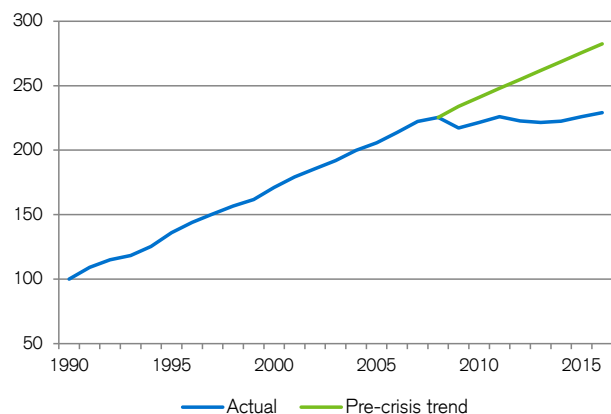
Germany



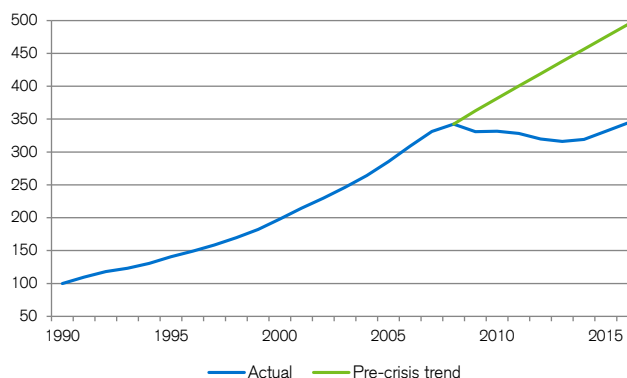
France



Italy



Spain



Source: International Monetary Fund (IMF), Credit Suisse

Given that the banking system is more important for financial intermediation in the Eurozone than are capital markets, this weakness in the transmission mechanism has weakened the monetary policy impulse. Wealth effects from QE are arguably also weaker than in the USA given that direct financial asset holdings of households are more limited. Conversely, while the devaluation of the euro resulting from the decline in interest rates associated with the various ECB policies has arguably been a more positive impulse than in the USA, weakness in key export markets such as China may have offset that effect since 2015.

Bank of England

In an attempt to reach its stated 2% inflation target and achieve sustained growth and employment, the BoE launched its quantitative easing program on 5 March 2009. It announced that it would purchase GBP 75 billion worth of assets within three months, financed by the creation of central bank reserves. In May and August, the BoE announced a further GBP 50 billion of purchases on each instance, before expanding the QE program with an additional GBP 25 billion in November. However, as the economy remained weak with a high unemployment rate by UK standards of close to 8%, the BoE decided to stimulate the economy in October 2011 with a further GBP 75 billion of asset purchases and added an additional GBP 100 billion throughout 2012.

As economic activity started to pick up in the following years, with a decrease in unemployment and an increase in spending, there were no more QE interventions until the Brexit vote in June 2016. Immediately thereafter, the BoE announced a purchase of GBP 10 billion worth of UK corporate bonds and an expansion of the asset purchase program by GBP 60 billion in government bonds financed by the issuance of central bank reserves. The BoE interventions can be judged to have been relatively successful, with unemployment back to pre-crisis levels. Given the sharp GBP depreciation since the Brexit vote, UK inflation is likely to overshoot the BoE target for some time to come (Figure 5).

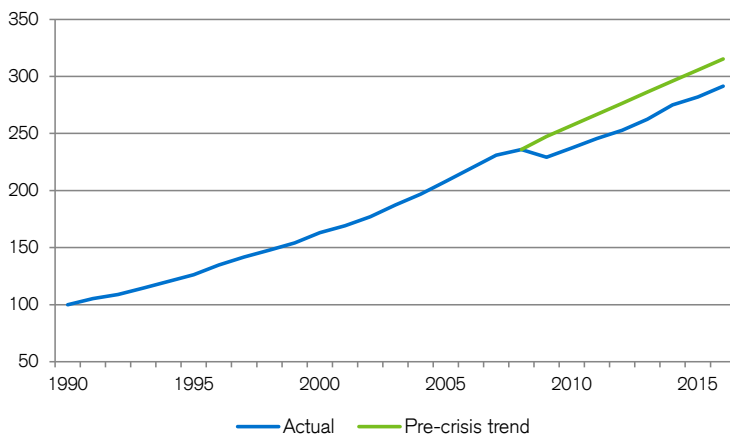
Bank of Japan

In April 2013, the Bank of Japan (BoJ) followed suit and also introduced QE, with the main goal of lifting inflation. In a country that had been struggling with deflation for a prolonged period even before the financial crisis, QE seemed well justified. The BoJ pledged to complete money market operations of JPY 60–70 trillion a year, purchase government bonds of JPY 50 trillion per year, and invest JPY 1 trillion in exchange-traded funds (ETFs) and JPY 30 billion in Japanese real estate investment trusts (J-REITs). With results far from what the central bank had hoped for, the BoJ raised the target for the increase in the monetary base in October 2014 to JPY 80 trillion per annum, the purchase of government bonds to JPY 80 trillion, and that of ETFs and J-REITs to JPY 3 trillion and JPY 90 billion, respectively.

Figure 5

Trajectory of nominal GDP in the UK

1990 = 100

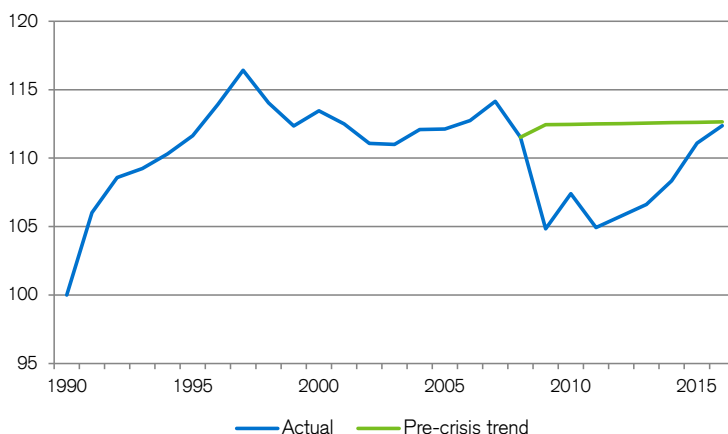


Source: International Monetary Fund (IMF), Credit Suisse

Figure 6

Trajectory of nominal GDP in Japan

1990 = 100



Source: International Monetary Fund (IMF), Credit Suisse

The approved assets for QE were expanded as well – ETFs that track the JPX-Nikkei Index 400 were now permissible for purchase by the BoJ. With inflation still well below target at the end of 2015, supplementary measures were introduced. In an effort to stimulate investment, the BoJ increased the riskiness of its balance sheet by starting a new ETF purchase program in addition to the existing one – JPY 300 billion worth of ETF-tracking stocks issued by firms that invest in physical and human capital. The BoJ also introduced negative deposit rates of – 0.1% in 2016 (see below). Even though its economy is currently no longer in deflation, Japan has not yet been able to convincingly achieve its goal of low and stable inflation. It remains to be seen whether an economy with a trend growth rate as low as that of Japan will be able to achieve a sustainably positive inflation rate. The GDP profile of Japan suggests, however, that a positive outcome should not be ruled out. As Figure 6 shows, the gap to the nominal GDP trend has closed and the trajectory may turn positive in the future.¹

Overall assessment

As the above cases indicate, QE was initially used to enhance the efficacy of rate cuts and liquidity operations during the crisis, then to underscore the commitment to forward guidance and finally as a tool in its own right with the aim of stimulating economic growth and inflation. QE was first fixed in terms of volumes and duration, and later became conditional on meeting growth and unemployment targets. In most cases, it was first aimed at the yields of government and government-guaranteed bonds. Later, some central banks (the ECB and the BoJ) broadened the targets to include bonds and equities. In the case of smaller central banks such as the Swiss, Swedish and Danish central banks, QE was the implicit result of pegging the home currency's exchange rate, which involved the purchase of large amounts of foreign bonds.

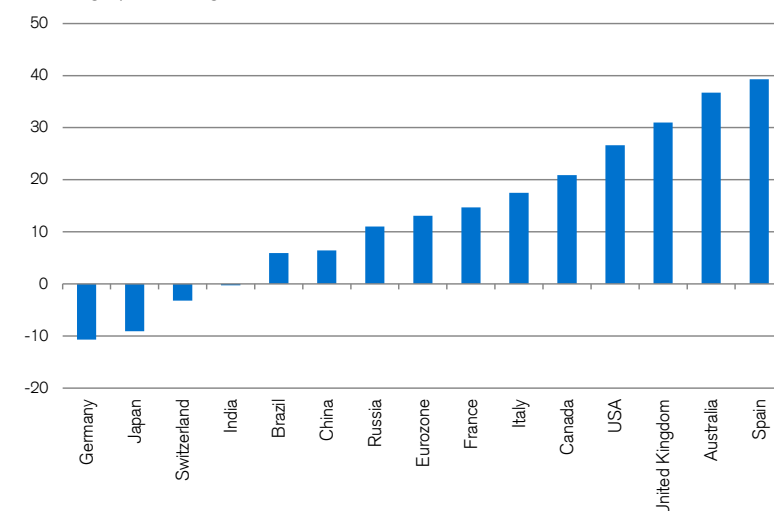
As all cases described above suggest, QE did help facilitate growth, although it is difficult to isolate the specific QE effects from others such as the natural "healing" of economies that typically occurs after economic or financial shocks, as well as from other impulses including moderate fiscal easing. It is also unclear which transmission mechanisms – e.g. lower debt service burdens, positive wealth effects or weaker currencies – were the most effective. The key drivers of economic growth, particularly investment spending and the bank credit mechanism, are likely to have been least affected

directly by QE programs. The former, i.e. investment spending, is known to be rather insensitive to interest rates, which tend to be most affected by QE. However, most economies where QE policies have been implemented did return to growth, albeit with considerable differences that were likely due to country- and region-specific differences. Most importantly, the headwinds that confronted policy-makers in the post-crisis years were exceptionally severe. Household debt had increased sharply in many advanced economies in the pre-crisis period (Figure 7) relative to expected incomes, setting off a prolonged deleveraging process (Figure 8).

Figure 7

Expansion of household debt pre-crisis

Percentage-point change in household debt/GDP ratio, Q1 2000* to Q4 2008



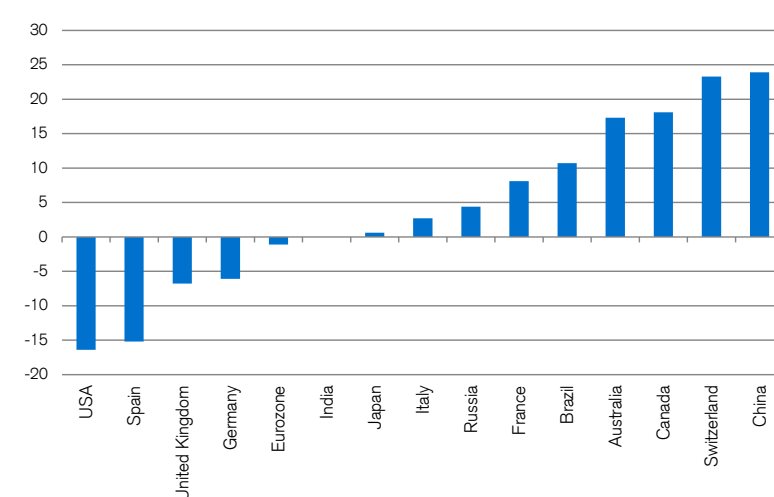
* For China: Q1 2006; for India: Q2 2007

Source: Bank for International Settlements (BIS), Credit Suisse

Figure 8

Household deleveraging post-crisis

Percentage-point change in household debt/GDP ratio, Q4 2008 to Q2 2016



Source: Bank for International Settlements (BIS), Credit Suisse

¹ The large setback in Japanese GDP since the crisis was, in contrast to the USA and the Eurozone not due to domestic financial stress but the result of the Fukushima nuclear disaster in 2011, a sharp tax hike in 2014 in combination with external shocks.

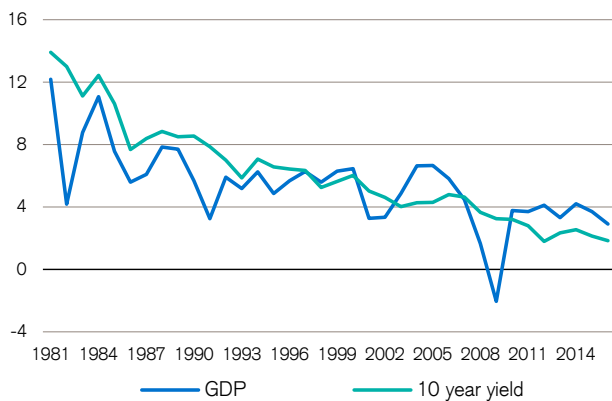
Meanwhile, fiscal policy was highly restrictive, except for very few instances such as the immediate post-crisis Obama fiscal boost. The deleveraging process was thus mainly supported by central banks trying to keep interest rates below growth rates (Figure 9). In the Eurozone periphery, in particular, this effort was undermined for a number of years owing to the widening of credit spreads (cf. chart for Italy) due to euro fragmentation fears.

Finally, central banks have been confronted by a combination of structural headwinds to growth including demographics and technological disruptions, which certainly did not make it easier to boost economic growth.

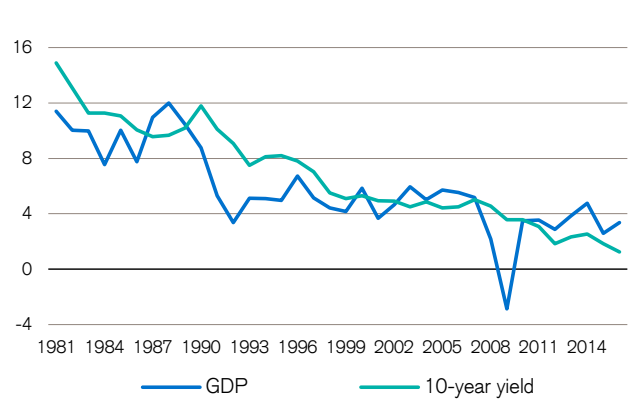
Figure 9

Gap between nominal growth and nominal interest rates in %

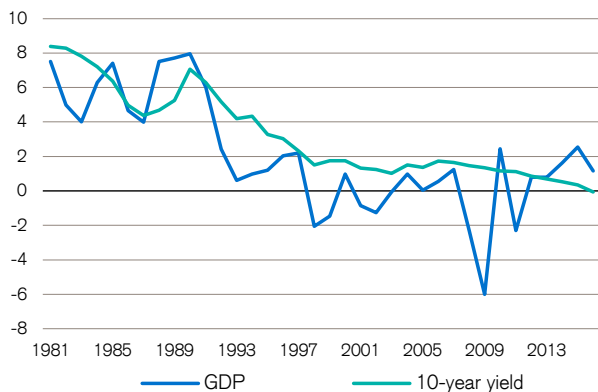
United States



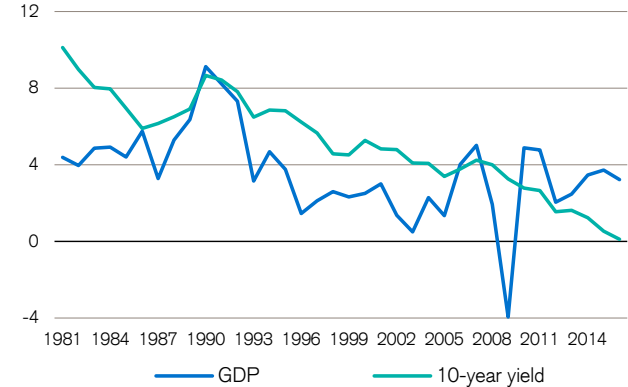
United Kingdom



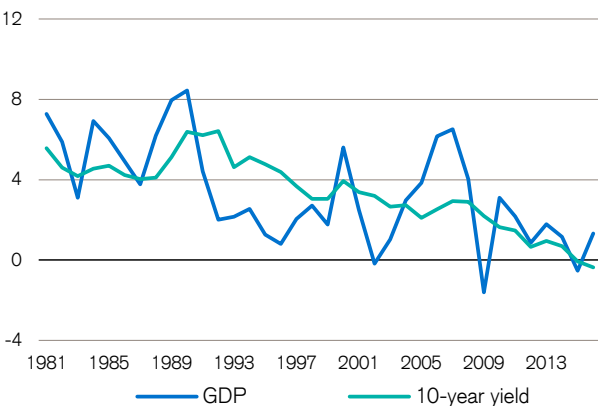
Japan



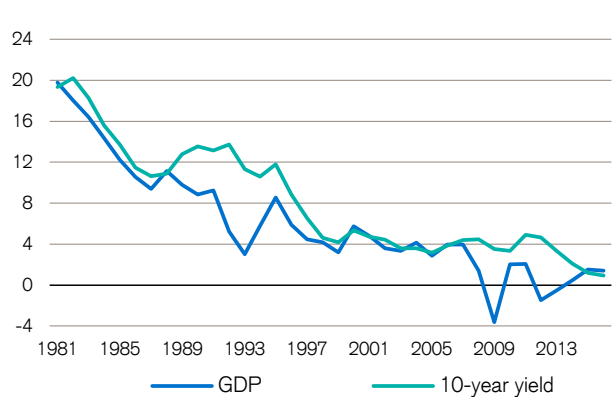
Germany



Switzerland



Italy



Last data point: 2016 (est.)
Source: Datastream, Credit Suisse



EUROPEAN CENTRAL BANK

EUROSYSTEM

The effects of negative interest rate policies

In an unprecedented move, a number of central banks of smaller European countries have taken their interest rates into negative territory in the past years, beginning with the Danish central bank temporarily lowering the certificates of deposit rate below zero between April 2012 and April 2014.

In the autumn of 2014, both Denmark and Sweden took deposit rates back into negative territory, and at the beginning of 2015, Denmark, Sweden and Switzerland also cut their target policy rates below zero². As [Figure 1](#) suggests, small economies that applied a negative interest rate policy (NIRP) typically, although not everywhere, intended to fend off "excessive" capital inflows and weaken their currencies. Simultaneously, in large economies – such as Japan and the Eurozone – NIRPs were typically regarded as a complement to the quantitative easing (QE) policies with the intention to stimulate credit creation and thereby boost growth while reducing deflation risks.

As was the case in our discussion of QE effects, assessing the specific effects of NIRPs is not simple, notably as the respective economies were affected by other positive (or negative) shocks at the same time as the NIRPs were implemented. Moreover, the NIRPs have not been in place for a long period of time and the extent of negativity of interest rates has been quite limited. We can nevertheless make some initial observations regarding their immediate effects.

NIRPs have translated into lower market interest rates

In order for an NIRP to have an effect on aggregate demand or the exchange rate, the lowering of rates from positive into negative territory would need to affect the interest rates determined in financial markets. [Figure 2](#) suggests that this was indeed clearly the case. In all countries shown, the 2-year swap rate (a market determined interest rate) has moved in sync with the respective central bank's policy rate. The relationship holds just as clearly whether the policy rate is in positive or negative territory.

Figure 1

Negative interest rate policies – timing and policy goals

Central bank	Date of announcement	Goal
Denmark	04/09/2012	Consequence of the reduction by the ECB of its policy rate by 25 bp.
Eurozone	05/06/2014	Provide additional monetary accommodation and support lending to the real economy.
Denmark	04/09/2014	Consequence of the reduction by the ECB of its policy rate by 10 bp.
Switzerland	18/12/2014	Negative rate makes it less attractive to hold CHF investments.
Sweden	12/02/2015	Support the upturn in underlying inflation.
Japan	29/01/2016	Maintain momentum toward achieving the price stability target of 2%.

Source: Various central bank policy statements, Credit Suisse

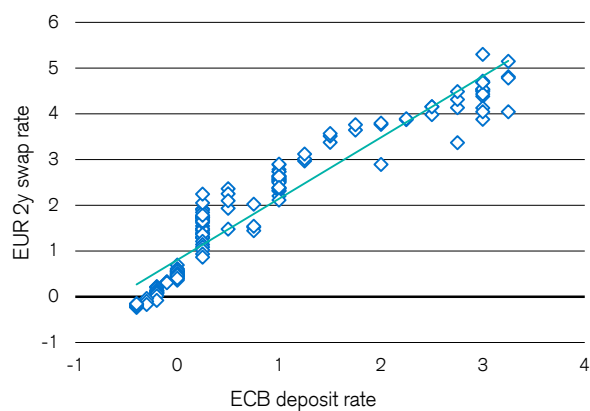
² These decisions were in fact not at all unprecedented: In 1972, the Swiss National Bank and the Swiss government had applied significant charges to foreign-held deposits in Switzerland in an effort to fend off Swiss franc strength. However, in contrast to the recent decisions, the bulk of deposits were exempted and lending rates never turned negative. Sweden introduced a negative deposit rate in July 2009 (until September 2010), but the amount of funds subject to the negative deposit rate was negligible.

Figure 2

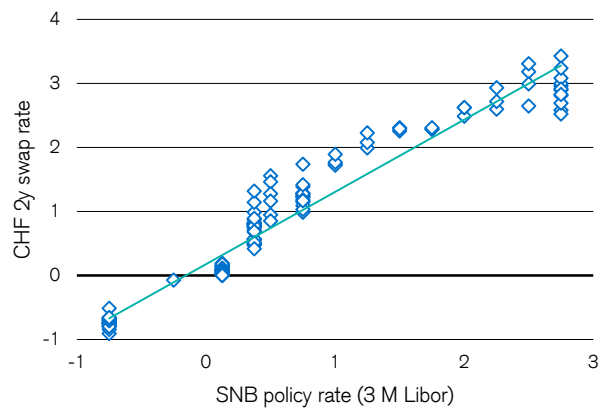
Market interest rates under positive and negative policy rates

2004–2016 in %

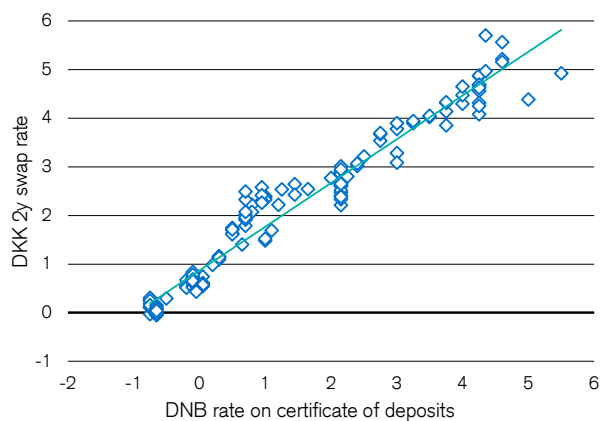
Eurozone



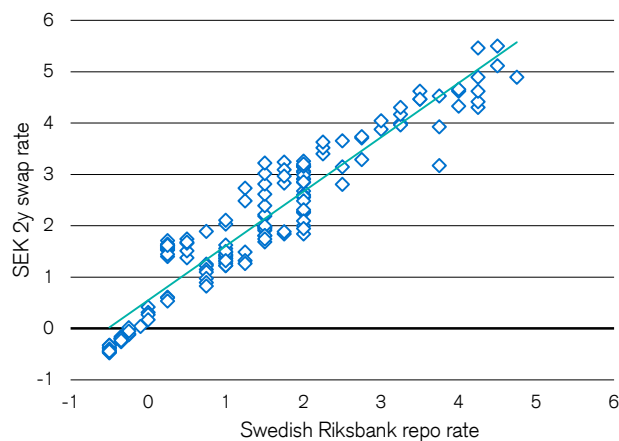
Switzerland



Denmark



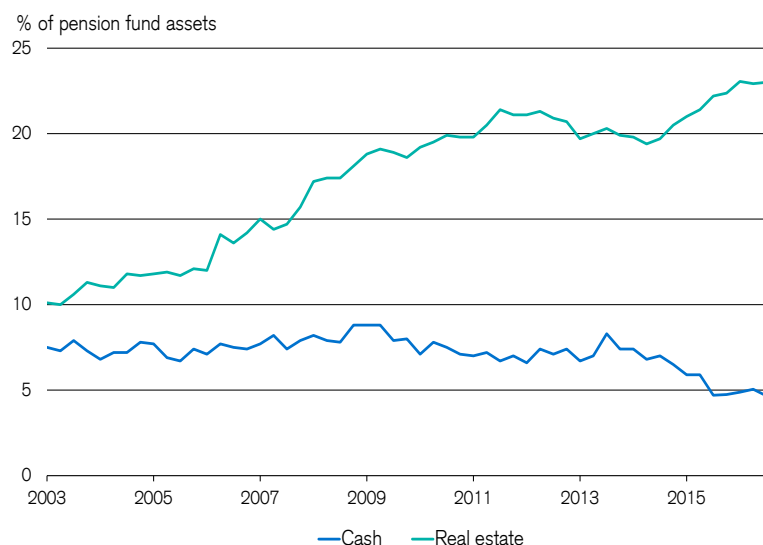
Sweden



Last data point: November 2016.
Source: Datastream, Credit Suisse

Figure 3

Asset allocation shift of Swiss pension funds into real estate in response to negative interest rates



Source: Credit Suisse

We have also examined a number of macroeconomic variables that are likely to be highly sensitive to interest rates, particularly credit growth, construction spending and house prices. In general, we have not observed a significant difference in patterns between countries with or without an NIRP. Nor do we observe a change of trend in countries as their policies moved from positive interest rates to negative rates. For example, consumer credit accelerated from 2015 to 2016 in Denmark, while slowing in Sweden during the same period. House prices surged in Sweden, grew strongly in Denmark and decelerated in Switzerland from 2015 to 2016, while construction slowed in Denmark and remained strong in Sweden. This suggests that country-specific cyclical factors other than NIRPs dominated the dynamics in these markets. In terms of investor behavior, we do note an interesting feature, however. Large institutional investors that are charged negative rates in Switzerland clearly shifted their asset allocations toward real estate investments as negative interest rates took hold (Figure 3).

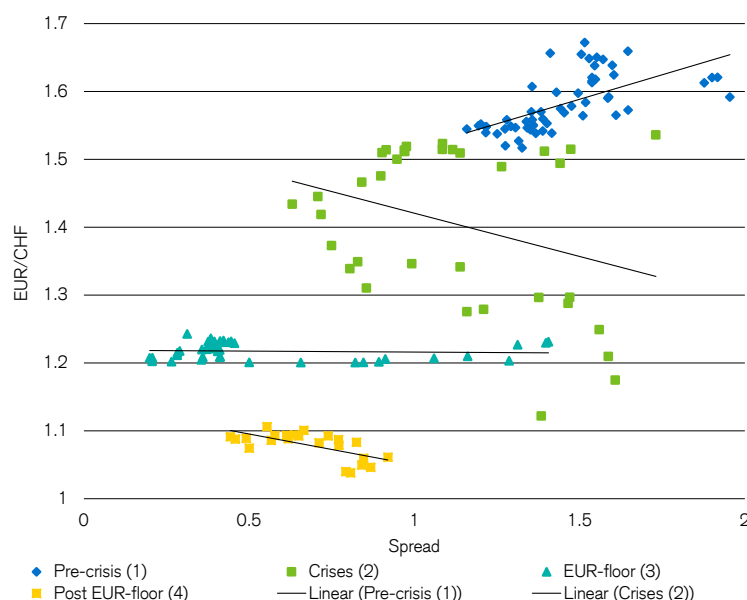
Surprisingly limited effects on exchange rates

One of the more interesting results of our analysis is that the central banks which implemented NIRPs to weaken their countries' currencies do not – at first glance – seem to have been successful in doing so. As Figure 4 shows, the EUR/CHF exchange rate was largely invariant to changes in the interest rate spread between the euro and the Swiss franc in the past 3–4 years. As Swiss interest rates declined relative to those in the euro area, the franc failed to depreciate. This is in contrast to previous periods in which a higher EUR-CHF spread weakened the franc. Once again, however, it is difficult to draw an exact conclusion as to the ultimate efficiency of the NIRP. After all, the franc might have appreciated even more without the SNB's NIRP. The likely reason for the lack of response of the EUR/CHF exchange rate to the NIRP is the continued safe-haven effect, which boosted the value of the franc. Moreover, the absolute interest rate spread may simply have been too narrow to have an effect. And, finally, markets may have assumed that the franc was to a large degree pegged to the euro even after the abandonment of the SNB's lower bound for EUR/CHF – which then led to an "anchoring" of the exchange rate at that level.

As has become apparent over the past two years, NIRPs have had to be complemented by continued SNB currency interventions due to the limited effect on the exchange rate (Figure 5). Not surprisingly, the chart also shows that a central bank which credibly commits to an exchange-rate target – in this case the central bank of Denmark – needs to intervene less to prevent currency appreciation even if its NIRP is less radical. Finally and

Figure 4

EUR/CHF and EUR-CHF interest rate spread



1) Jan. 2004 to Sep. 2008; 2) Oct. 2008 to Aug. 2011; 3) Sep. 2011 to Dec. 2014; 4) Jan. 2015 to Nov 2016

Source: Datastream, Credit Suisse

interestingly, our analysis shows that large central banks seem to be more successful in achieving their currency targets through interest rate policies (including NIRPs) than small central banks. It is notable that the BoJ, in particular, had far greater success in weakening the yen against the US dollar since it moved to unconventional policies, including negative interest rates, after the financial crisis (Figure 6). The same applies to the ECB.

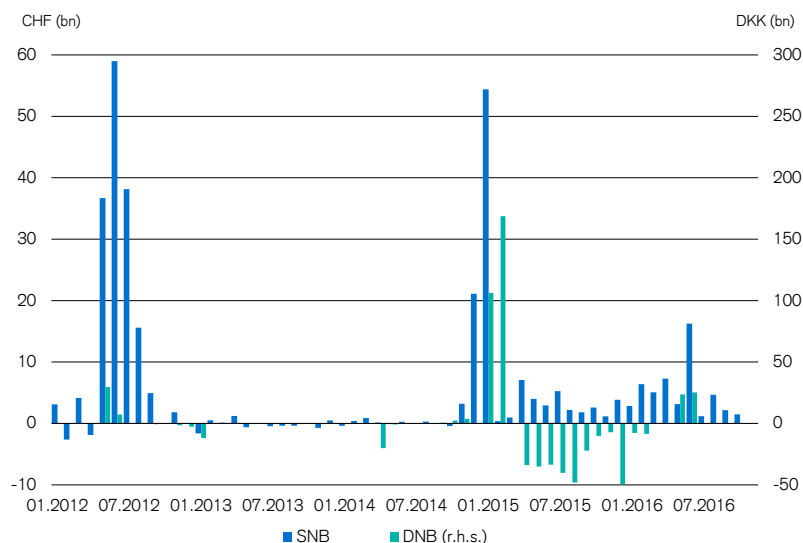
Contractionary effects of NIRPs?

The evidence presented above suggests that the effects of NIRPs are in principle no different from those of conventional interest rates policies. The question is, however, whether the negativity of rates may have some qualitatively different effects. The obvious Contractionary effect that could result from implementing an NIRP is a flight into cash.³ Given that nominal interest rates on cash are by definition zero, negative interest rates constitute an implicit subsidy on cash holdings.

Even so, as holding cash involves costs (e.g. storage costs) as well as risks (theft), slightly negative rates may not lead to a wholesale shift into cash. That said, taking interest rates into more negative territory is likely to lead to significant increases in cash holdings beyond levels that are optimal in terms of required transactions. Moreover, strongly negative rates would quite likely trigger a run on bank deposits, which would weaken banks and thereby undermine the expansionary intention of the NIRP.

Figure 5

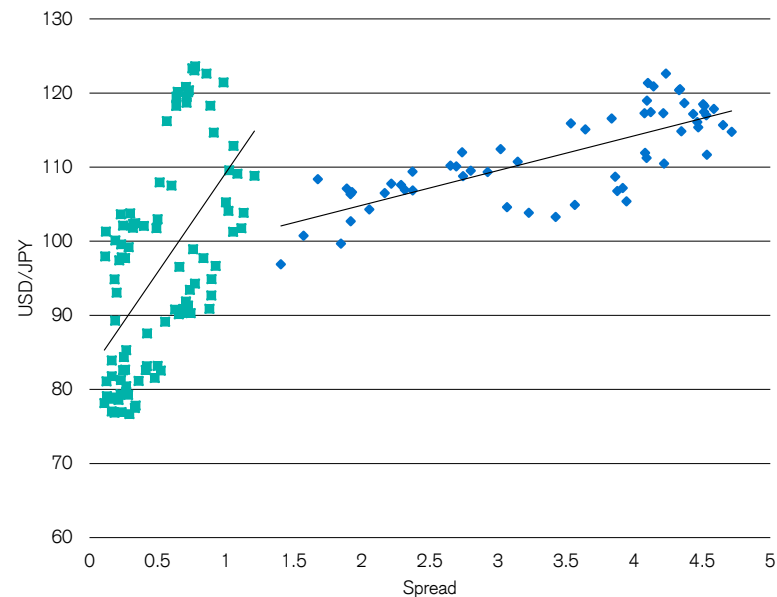
Foreign exchange interventions of the Swiss and Danish central banks



Source: Bloomberg, Credit Suisse

Figure 6

USD/JPY and USD-JPY spread before and after the financial crisis



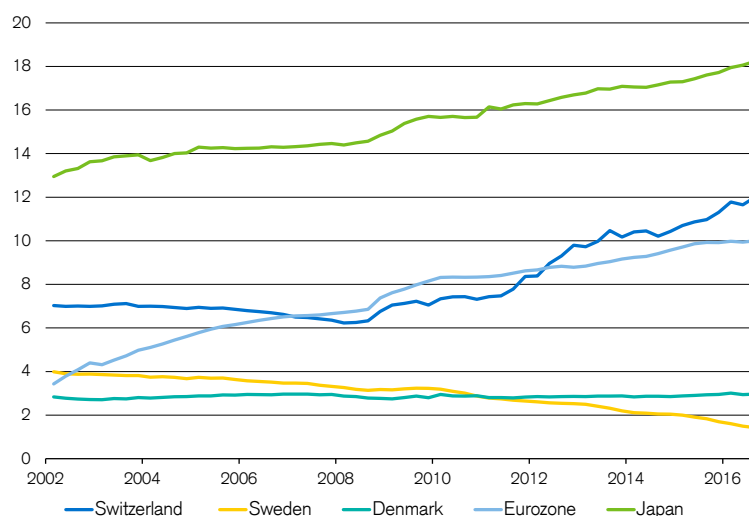
Source: Datastream, Credit Suisse

³ During the 1930s, when the British economist John Maynard Keynes developed his thesis of a liquidity trap, the introduction of negative interest rates was generally thought to be impossible because the interest elasticity of demand for cash was assumed to be extremely high. A negative interest rate would thus, it was assumed, lead to massive shifts into cash, further exacerbating the liquidity trap and thereby adding to deflationary pressures.

Figure 7

Cash in circulation

% of GDP



Source: Datastream, Credit Suisse

The evidence of the past years suggests that there has been an increase in the demand for cash in some countries as interest rates declined (Figure 7). In Switzerland, bank notes in circulation increased in the months that followed the introduction of the NIRP and the amount remains elevated in both a historical and international comparison. In Japan, cash holdings have also risen, but this trend was already in place before negative interest rates were introduced. Legal changes seem to have boosted holdings additionally along the way. In other economies such as Sweden, the trend has been toward lower cash holdings despite declining interest rates – as more efficient, electronic transaction technology outweighed the lower opportunity costs of holding cash.

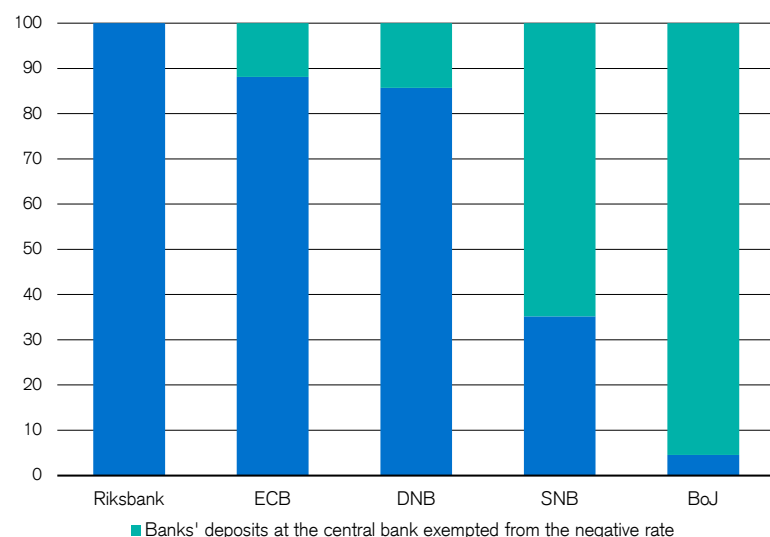
That said, the reason that the “flight into cash” has been quite limited is most likely due to the fact that commercial banks opted not to pass on the negative rates to retail depositors. This was enabled by exemptions from NIRPs granted by central banks to commercial banks on their deposits at central banks: in all NIRP economies except for Sweden, central banks charge negative interest rates only on a part of central bank deposits, but not on their entire balances. Figure 8 shows the share of deposits that are effectively exempted from NIRPs.

A second potentially contractionary effect of NIRPs relates to their potential effect on bank profitability, even when a flight to cash does not occur. The question is whether banks are able to maintain their profitability under NIRPs. Given banks’ inability to pass on negative rates to depositors, or if they cannot maintain bank lending rates at levels sufficient enough to safeguard a normal rate of profit, their ability to lend could decline. Taking interest rates into significantly negative territory could then lead to a contraction in bank lending and thus a slowing of economic growth, as well as higher deflation risks. Moreover, if banks’ balance sheets are weakened because of NIRPs, banks might switch from riskier assets (such as loans) into safer assets such as bonds and thereby exacerbate the credit crunch and economic downturn. Once again, these negative effects from NIRPs have not – to date – been observed in the respective countries.

Figure 8

Exemptions from NIRPs

% of all commercial banks’ deposits at the central bank



Source: Bloomberg, Credit Suisse

We have examined data on deposit rates, mortgage rates as well as small and medium enterprise (SME) loan rates for a sample of 11 Eurozone economies in periods just prior to the introduction of NIRPs (2013–2014) and since their introduction (2015 onward). Our data shows that deposit rates declined by an average of about 20 basis points between the two periods, mortgage and SME loan rates declined by about 100 basis points, and so margins on mortgages and SME loans declined by 80 basis points (Figure 9). We have also considered separately the evolution of margins on the liability and asset sides of bank balance sheets. We observe that banks' funding costs have generally increased (Figure 10) because rates offered to depositors did not, of course, decline relative to rates that have to be offered in the free markets (approximated by swaps). On the other hand, lending-rate margins have increased in a number of countries (Figure 11). This suggests that a limited contractionary effect from negative interest rates may have come into play.

A final potentially contractionary effect of NIRPs could occur if negative interest rates were to trigger a rise in savings rates rather than a decline. This is possible in theory, but as consumers have to date not been charged negative rates to any significant extent, if at all, it remains a theoretical risk.

Do NIRPs have a future?

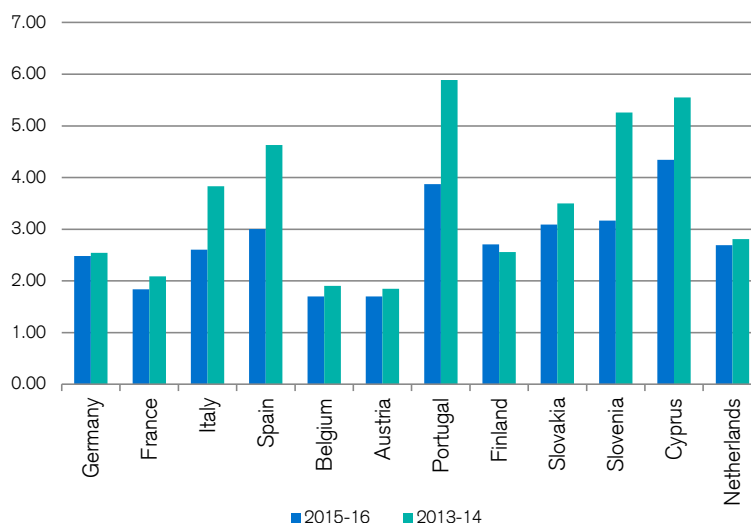
Our general conclusion is that NIRPs, at least so far, do not seem to have markedly different effects on the economy from those expected during periods of conventional policy easing, i.e. interest rate reductions within positive interest rate terrain. That said, the extent of NIRPs in terms of the level of (negative) rates and the breadth of the policies' application has been very limited so far.

The key question for the future is whether NIRPs could be applied more broadly should another economic downturn set in. Judging by current forecasts of the Federal Open Market Committee (FOMC), which sees the Fed funds rate peaking at about 3% in this cycle, the probability appears high that US interest rates would return to the zero level in a potential future downturn. Typical easing cycles see the Fed Funds rate dropping by 4% or even more.

The answer will ultimately depend on whether other policy tools will be at the disposal of central banks and whether these will prove more effective (a possible additional policy tool is so-called "helicopter money," which we discuss in the final chapter of this report.) The pursuit of QE in its current, non-fiscal form appears to be an inferior tool to NIRPs, the simple reason being that the acquisition of ever larger volumes of financial assets by central banks

Figure 9

Evolution of overall bank margins in NIRP economies*



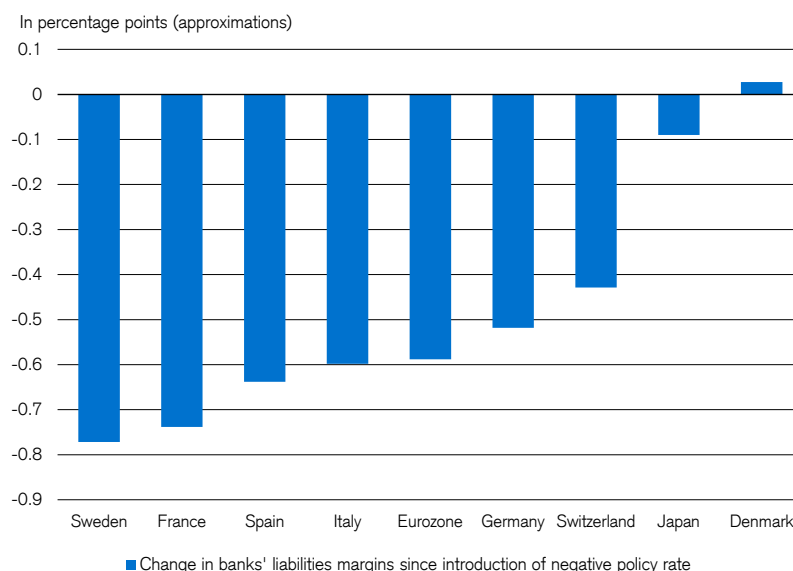
*Difference between average mortgage rates and rate on retail deposits

Last data point: October 2016

Source: Datastream, Credit Suisse

Figure 10

Evolution of bank liability margins*

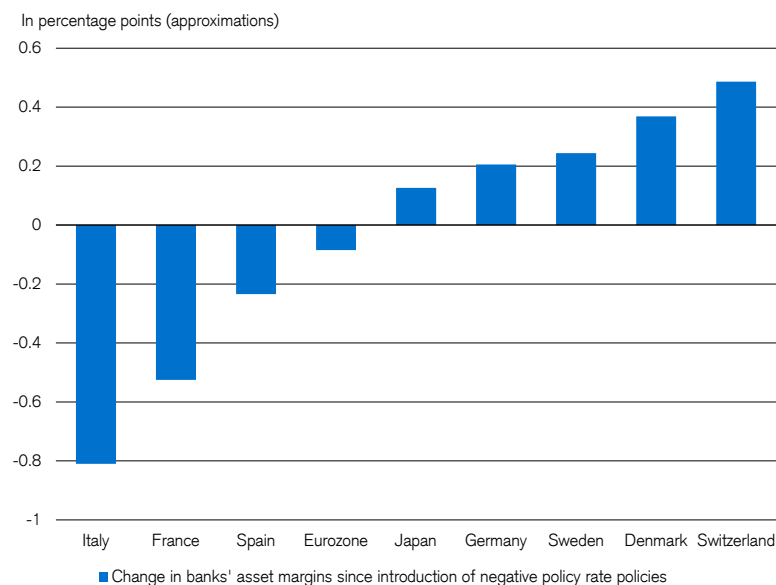


*Bank liability margins are approximated by the difference between savings rates and an average of 3 year swap rates.

Source: Datastream, Credit Suisse

Figure 11

Evolution of bank lending margins*



*Bank asset margins are approximated by the difference between 10 year mortgage rates and 10 year swap rates.

Source: Datastream, Credit Suisse

and their simultaneous removal from private markets would essentially amount to a drying up of financial markets.

In contrast, an extreme NIRP could be effective, provided that a flight into cash can be prevented, e.g. by charging holders of cash a fee on their holdings. Given that cash can be considered as a very short-dated government bond, such a charge would ensure that yields across the sovereign curve remain normal. Moreover, the banking system should be able to operate in such an environment, with banks passing on negative rates to depositors and maintaining their profit margins by maintaining lending rates at higher, albeit also negative rates.

Small economies trying to reduce pressure on their currencies may find negative rates easier to implement than letting their central bank balance sheets expand due to large purchases of foreign bonds. On the other hand, larger economies – notably the Eurozone and Japan – currently seem to be losing confidence in the effectiveness of negative rates in addressing the problems of slow economic growth and low inflation.



The impact of financial sector regulation

In addition to significantly expanding their set of policy tools in the post-crisis period, central banks were also active participants in the development of the financial sector regulatory framework. This section explores the central banks' changing role in markets and financial intermediation.

The Basel III regulatory framework has three implications for the future of central banking. First, central banks will not be able to reduce their balance sheets to pre-crisis levels in foreseeable future due to the liquidity requirements imposed by Basel III. The reason is that the vast central bank reserves created as by-products of QE now form an integral part of banks' liquidity portfolios (so-called high quality liquid assets, or HQLA portfolios). HQLAs can be reserves at central banks or bonds issued or guaranteed by highly rated sovereign governments. In an era of reduced bond-market liquidity, regulators prefer HQLA portfolios to include more reserves and fewer bonds. This means that central banks will have to maintain a large balance for the foreseeable future. Moreover, given the US dollar's role as the global reserve currency, and the widespread need for dollar liquidity by non-US banks globally, Basel III for the first time includes de-facto reserve requirements for the Eurodollar market. This means that foreign banks will have to keep a certain portion of their HQLA portfolios in reserves at the Fed. Thus, the Fed not only needs to maintain a large balance sheet to act as a depository for US banks' liquidity needs, but also for those of foreign banks.

Second, central banks are likely to be increasingly important providers of safe assets to a broader group of counterparties. Many of these are looking for alternatives to banks to place their cash balances. These dynamics are driven by Basel III as well because the new liquidity rules disincentivize banks from accepting certain types of short-term cash balances from institutional investors such as corporations, asset managers, other central banks, or money funds. But the liquidity services offered by commercial banks can only be substituted by

liquidity services offered by central banks. If central banks do not take the cash declined by banks, they would lose control over short-term interest rates. Thus, central banks have little choice but to become market makers in overnight liquidity – a role forced on them by Basel III and the objective of increasing financial stability.

Third, central banks are likely to play an increasing role as funding providers, not just in crisis times. The corollary to the fact that banks are being incentivized to turn away short-term cash balances from other market participants is that they have less funding available for arbitrage trades – where they borrow in one market segment and lend in another. With less arbitrage across money markets, long-held benchmark relationships between onshore and offshore money markets, and between Treasury, repo and swap curves are breaking down. The net effects have become increasingly apparent and may imply rising funding costs for governments and the private sector.

In the case of the Eurodollar market, for example, regulatory reforms alone have to date delivered the equivalent of six Fed rate hikes to those in need of dollars in the rest of the world, on top of the two rate hikes actually delivered by the Fed. The net result is that financial conditions in the rest of the world are far tighter than financial conditions in the USA. This is causing a build-up of pressure in emerging markets, in particular, and may, according to the Bank for International Settlements (BIS), be one of the headwinds that have hampered the post-crisis recovery of global trade. Unchecked, this could lead to increasing pressure to find funding currencies other than the US dollar.

Similar dynamics exist in sovereign debt markets where funding for governments is becoming more expensive relative to the path of interest rates projected by central banks. To control for these anomalies, central banks may well have to step in as lenders into various market segments – and in a way re-intermediate the balances they took in from cash investors.

Central banks as market-makers

Central banks that maintain large balance sheets take cash and also lend cash regularly so as to help the system to “police” relationships between various benchmark curves. In other words, central banks will have to take on some of the matched-book market-making responsibilities that banks used to fulfill, but now cannot due to restrictions imposed by Basel III. The central banks’ quest for financial stability has led to much smaller shares of commercial bank’s balance sheets being devoted to market-making and the policing of relationships between various benchmark curves. To the extent that the breakdown of these relationships keeps central banks from achieving their desired financial conditions, they will likely have to step in as intermediaries themselves.

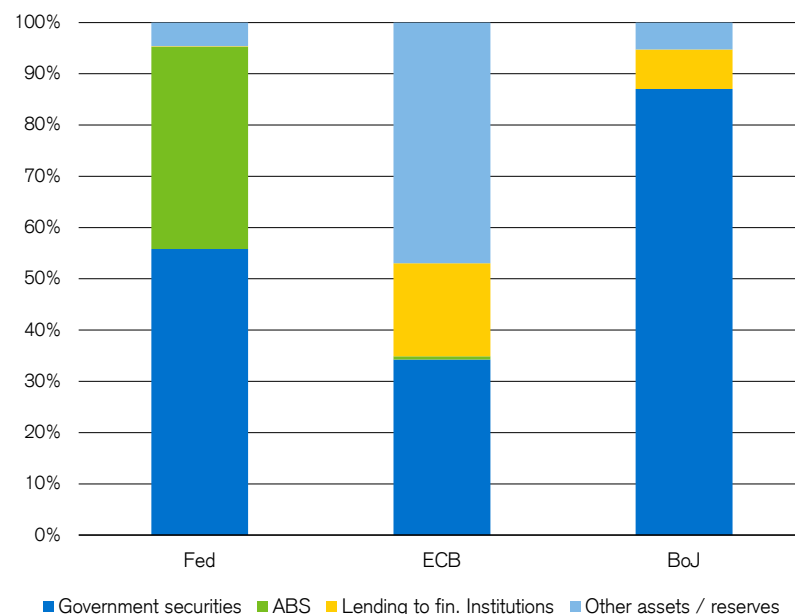
Ultimately, central banks are also likely to take on a greater role as market makers in capital markets. This role flows naturally from all the considerations listed above. If central banks’ balance sheets remain large, all the bonds purchased under QE could be used in the future to influence the slope of yield curves and size of credit spreads. Under QE, central banks made markets in order to flatten yield curves and compress credit spreads. In the future, when the challenge will not be a lack of demand for credit, but possibly too much demand for credit, central banks could do the opposite: sell bonds in order to steepen curves and widen credit spreads.

This responsibility will also flow from the central banks’ new mandate of maintaining financial stability. As we have observed immediately prior to the 2008 crisis, short-term interest rates may be sufficient to control growth and inflation, but they are certainly not sufficient to maintain financial stability.

While monetary policy will in part be constrained by the additional functions described in this chapter, it should be noted that the major central banks should still be able to exert significant influence over the macro economy, be it in their regular role as providers of marginal liquidity or in their crisis-prevention role as lenders of last resort. The key question in regard to the “regular” central banking function is rather to what extent political forces will aim to shape the functioning of central bank policy. Policy will naturally be strongly shaped by the evolution of the global and national economies as well as political trends in the respective regions and countries. Later in this report, we assess two possible scenarios.

Figure 1

Broad asset mix on central bank balance sheets



Last data point: Fed (4 Jan 2017), ECB (end-Dec. 2016); BoJ (end-Sep. 2016)

Source: Federal Reserve, Bank of Japan, European Central Bank, Credit Suisse



The future of digital currencies

In a well-known video from 1999, US economist Milton Friedman opined that “The one thing that’s missing, but that will soon be developed, is a reliable e-cash, a method whereby on the Internet you can transfer funds from A to B, without A knowing B or B knowing A.” Eight years after Bitcoin was launched by a still unknown data scientist using the name Satoshi Nakamoto, digital currencies continue to appear in new forms and attract attention from regulators concerned with financial stability.

Prof. David L. Yermack

The endurance of Bitcoin, which has remained technologically stable and spawned more than 700 imitator digital currencies, fulfills a dream long shared by economists and computer scientists for a decentralized algorithmic currency. Digital currencies accomplish exactly this peer-to-peer transfer of value and, if they grow significantly, they could well reduce the role of established financial stakeholders, including central banks. The main reason: a digital currency’s supply grows at a transparent, autonomous rate without intervention.

While Bitcoin is a technical success, the threat posed to financial stability by it and other digital currencies remains theoretical at best. The first part of this chapter discusses the current, modest position of digital currencies in the financial system and the risks to stability they may pose at some point. The second part provides a discussion of the novel architecture of digital currencies, featuring innovations known as blockchains and distributed ledgers. These innovations are being closely studied by financial intermediaries, as they seem to have the potential to revolutionize parts of the financial system in ways that make transactions quicker, cheaper, and far more secure. The third part briefly considers future applications of blockchains such as central bank digital currency.

Digital currencies and financial stability

When Satoshi Nakamoto launched Bitcoin in early 2009, he left little doubt about his motive of using an algorithmic currency to displace central banks as the guardians of financial stability. In an online posting, Nakamoto wrote: “The root problem with conventional currency is all the trust that’s required to make it work. The central bank must be trusted not

to debase the currency, but history is full of breaches of that trust.”

While Bitcoin and other digital currencies have grown more quickly and enjoyed more success than their creators likely imagined, they still have a tiny footprint in the marketplace and are probably many years away from the point at which they undermine the central banks’ monopoly in the creation of fiat money or threaten the stability of any nation’s financial system. In general, digital currencies could raise two types of concern about financial stability. First, digital currencies might prove more attractive to citizens than sovereign currency, driving the government’s money out of circulation and undermining monetary policy and the ability of the central bank to collect seigniorage. Second, even if digital currencies do not compete directly with sovereign currency, their payment platforms may prove unreliable or vulnerable to hacking, disrupting a niche channel of consumer payments in a way that creates economic problems.

To date, few governments have had to worry about direct competition from digital currency, although several like Russia and China have either banned these currencies for certain periods or restricted their use within the licensed banking and payment systems. The most public concern about a digital currency came from the government of Iceland in March 2014, when a new currency called Auroracoin was created expressly as a substitute for Iceland’s sovereign currency at a time when its banking system was reeling from the global financial crisis and capital controls limited external payments. However, the introduction of Auroracoin missed the target, as few citizens responded to the virtual “airdrop” that gave an initial stake in the currency to all holders of the national ID card.

At certain times of financial market turmoil, such as the day of the June 2016 Brexit vote in the UK, Bitcoin has appeared to behave as a hedge, rising in value at exactly the time when the pound and the euro were dropping (Figure 1). However, an analysis of cross-currency correlations currently shows very little systematic evidence of either positive or negative relations between Bitcoin values and the values of leading international currencies. Those instances when Bitcoin appears to have behaved as a hedge for sovereign currencies seem to be idiosyncratic as there are many more examples of days on which Bitcoin values were not affected by important market news that affected other currency values significantly.

The market for digital currencies today is quite small. The market capitalization of Bitcoin as of writing is USD 12.4 billion, and this figure represents 86% of the total for all the approximately 700 digital currencies that have been launched to date. The Bitcoin network processes about 175,000 transactions per day, representing a growth rate of about 50% over the prior year, but further increases beyond this point are unlikely due to a lengthy unresolved debate about how to scale up the network to handle more volume. At its limit, Bitcoin can handle a throughput of about seven transactions per second, a trivial amount compared to the capacity of major credit card companies and banks.

The failure of the Bitcoin community to agree upon a technical strategy for growth has exposed the weak nature of governance of digital currencies, which may be their fatal flaw. Bitcoin and other digital currencies typically operate on an open source basis, meaning that any user can propose an update to the code, including modifying binding constraints such as the size of a block of transactions on the blockchain archive. When a change to the code is floated, it can either be ignored or adopted by other network members and, if a majority agree to run the new code, a “fork” occurs and the old code is superseded. This structure suggests that digital currencies have pure democratic governance. However, they also lack leadership. Without a central authority with responsibility for initiating upgrades and building support for changes, the Bitcoin ecosystem has been unable to reach consensus on any one of a number of potential growth strategies. A major problem has been the collusive resistance of the “miners” who process Bitcoin transactions and face the obsolescence of their costly hardware investments if the network grows.

So far, the Bitcoin network that processes transactions has been invulnerable to hacking or sabotage, largely due to the incentive system that encourages miners to behave honestly while competing with one another for awards of seigniorage under a clever proof-of-work scheme used to validate transactions. However, a number of high-profile thefts have occurred of bitcoins stored in digital wallets on exchanges such as Mt Gox and BitFinex. Bitcoins are protected by a public and private key encryption system, but some custodians have underestimated the problems involved in safeguarding private keys from hackers.

Figure 1

Volume and prices of Bitcoins



Last data point: 10 January 2017

Source: Bitcoin, Credit Suisse

During 2015 and 2016, Ethereum emerged as the second most popular digital currency, but it was victimized by an anonymous hacker in May 2016, in connection with the launch of a “decentralized autonomous organization” (DAO) built upon algorithmic smart contracts. When a thief successfully drained some USD 50 million worth of Ethereum currency, known as ether, the community voted to negate the theft by essentially erasing several weeks of history on the network and re-starting transactions from the point just prior to the theft. This raised a number of serious governance concerns over the ability of the majority to “rewrite history” of the currency in response to an adverse event. A minority of users objected to the principle of this rewrite and refused to go along, essentially causing a schism in the Ethereum community leading to two rival versions of the ether currency. In the aftermath, the value of both fell significantly.

Regulators concerned about digital currencies should clearly focus on their technical vulnerabilities and the limitations of their governance. Since these instruments are still in their infancy, much more learning should occur in the next several years. One particularity of digital currencies that may amplify the costs of any failure is the tendency for their use to be concentrated in certain narrow geographic areas (such as the “Bitcoin Boulevard” in The Hague, Netherlands) and also among certain demographic groups, especially upscale younger males.

Blockchains and distributed ledgers

Digital currencies rely upon two recent innovations in data science, the blockchain and the distributed ledger, which were proposed by Stuart Haber and Scott Stornetta in the early 1990s. It is important to understand their fundamental characteristics, before assessing their value and future usability in replacing some of the existing structures.

A blockchain records data in a sequential archive. Haber and Stornetta proposed this structure for time-stamping the creation of intellectual property, such as music tracks or digital documents, in order to fix property rights with the creator before it could be copied by others. For security purposes, their design used hash functions – a type of cryptography that cannot be inverted to recover the original input. The authors proposed transforming each entry in their sequence into a hash code, which would then be combined with the raw data for the next entry and turned into another hash code, which would then be added to raw data for the subsequent entry, ad infinitum. An archive of records chained together in this form could authenticate the time of creation of any digital document

by allowing users to match the document’s hash code with the equivalent data embedded in the chain. Attempting to forge the information retroactively by changing a prior entry in the archive would cause changes in the sequence of all subsequent entries, since any minor alteration to the input of a hash function causes a significant change in its output that is trivial to observe.

A further component of Haber and Stornetta’s scheme called for publishing the sequence of records in a public forum, such as a newspaper, where data could be verified by any interested user. This strategy, now known as a distributed ledger, essentially crowd-sources the verification function classically played by auditors, and it is an essential component of the open blockchain structure introduced by Satoshi Nakamoto for Bitcoin. Implementing a distributed ledger in large markets requires grouping many transactions together into blocks so that the need for computer memory remains reasonable. Blocks are chained together in chronological order, because the header of each block contains a hash function reflecting the contents of the previous block, which itself includes a hash function derived from its predecessor, and so forth, all the way back to the first block in the chain.

Motivated by distrust of the financial establishment, Nakamoto introduced a blockchain design for Bitcoin with no sponsor or gatekeeper controlling the addition of new blocks. Instead, the update function is decentralized to all market participants in an ongoing competition catalyzed by the award of new bitcoins to the winner. In order to create a new block in the Bitcoin blockchain, the operator of a “node” on the network must bundle together transaction data, the hash code from the header of the prior block, the time stamp, and a further piece of data known as a “nonce.”⁴

Once the fastest (or luckiest) miner finds a nonce and successfully completes a block with the required hash, network members verify and acknowledge the new block and begin working on its successor. A winning hash can only be discovered through trial-and-error, a computationally costly “proof of work” process that deters hackers from attempting to update the blockchain with fraudulent data.

⁴ The nonce is a random number with the property that, when added to the other information in a block, it generates a hash with a certain number of leading zeroes.

Nakamoto observed that the award of new bitcoins to the first node discovering a rare hash “adds an incentive for nodes to support the network... [and] is analogous to gold miners expending resources to add gold to circulation,” thereby leading these network members to become known as miners.

The decentralized mining protocol for extending an open blockchain, sometimes referred to as “competitive bookkeeping,” has been incorporated into numerous other digital currencies and other public blockchain applications that permit open access for anyone, but require a method to discourage thieves and saboteurs. Along with sufficient incentives to obtain participation by miners, the protocol requires transparency of all blocks so that users have the opportunity to observe any data tampering that occurs. One clear weakness of the public blockchain model is the cost of the proof of work needed to update it, comprised of computer hardware and electricity. On the Bitcoin network, mining has become intensely competitive and analyses of the cost of mining generally assume that capacity is added up to the point where the marginal cost of mining new blocks (aggregated across all miners) equals the market value of the expected reward in new bitcoins.

The Bitcoin blockchain has proven to be stable through over seven years of continuous use, and its reliability has led many developers of blockchain products to propose free-riding upon the Bitcoin network through a strategy known as “colored coins.” To transfer an asset, such as a share of stock, one could initiate a bitcoin transfer from the seller to the buyer involving a trivial amount of bitcoins, such as 0.00001. Attached to this transaction in an additional data field could be a “token,” such as the share of stock. Miners would then bundle up the transaction into the next block, and the record of the bitcoin transfer would also serve as proof of transfer of the stock. While this strategy seems appealing because it saves development cost and takes advantage of Bitcoin’s reliability, it raises a number of legal and enforcement issues since the Bitcoin network was designed to transmit only bitcoins themselves and may not be suited to the special characteristics of other assets.

Refinements and appendages to blockchains are quickly emerging. A “permissioned” blockchain restricts updating privileges to a select group of authorized users who negotiate governance and control rights among themselves, in a process loosely resembling a partnership agreement. Permissioned blockchains offer clear advantages in security and privacy while potentially reducing costs of compliance with regulations such as “know your customer” money laundering regulation in the USA.

Many of the most prominent blockchain organizations, such as Hyperledger and R3CEV, have followed this model. In a “sidechain,” a sponsor can operate a private or permissioned ledger but periodically connect some aggregation of its transactions to an open, distributed ledger, or two private ledgers could exchange transaction data in both directions. Sidechains offer potential benefits such as the ability to accommodate overflow transaction volume that may exhaust the throughput capacity of the main blockchain. Other platforms, such as Ethereum incorporate many features of blockchains while adding additional functionality, such as a contracting language that allows users to establish contingencies for the transfer of assets and to reach out to an agreed-upon oracle to arbitrate disputes.

Blockchains and distributed ledgers represent a new way of archiving and validating data. Participants on the blockchain do not keep separate ledgers, but instead share a common ledger that they update jointly through a process of consensus. Transactions require input from the sender, the address of the recipient, and cryptographic validation by a third party such as a miner. Owing to the involvement of three actors who all must characterize the transaction identically, this method of data storage is sometimes referred to as “triple entry bookkeeping.” While users on the blockchain can take raw transaction data and use it to create traditional balance sheets and income statements, they have the flexibility to characterize transactions in any way they choose without being held hostage to the judgment of an auditor or to any particular reporting period.

Looking to the future

At the time of writing, numerous blockchain innovations are undergoing trials in both the private and public sectors. Major stock exchanges may soon use blockchain technology as part of their clearing and settlement processes, and governments may use blockchains to facilitate regulatory compliance and validate the identification and vital statistics of citizens. Many central banks are exploring the possibility of creating national blockchains to issue digital sovereign currency as a substitute for the coins and banknotes that have circulated for centuries. Central bank digital currency, if and when it occurs in the future, would represent an ironic twist on Nakamoto’s intentions, as his innovations might be co-opted by the very institutions they were designed to obliterate. At the same time they may provide a solution to the issue of flight to “traditional” cash should negative interest rate policies be applied more broadly.



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Outlook: Normalization or a new phase of fiscal dominance?

The previous chapters have focused on the development and use of specific monetary policy tools and their impact on economic outcomes. Such a technical view of monetary policy does not, however, suffice when trying to predict how central banking may evolve in the future.

Given that central banks are likely to retain their monopoly power over money creation even in a world of new transactions technologies (see the preceding section), the future of central banking will essentially remain determined by political processes. The key question to explore is to what extent central banks in various jurisdictions will retain their independence from the other branches of government, particularly the fiscal authorities. Of course, continued weak economic growth or popular resistance against particular policy tools such as negative interest rates can feed back into political pressure on central banks.

A paper co-authored by Zoltan Pozsar (a contributor to this publication) has explored the dynamic nature of the relationship between the monetary and fiscal authorities in the United States – we provide a brief summary below. With the ongoing shift in the US political landscape, the uncertainty over the direction this dynamic process will take is particularly high. The uncertainty is, in our view, even higher with regard to this relationship in the Eurozone, with possibly more extreme outcomes. The outcome of these processes will ultimately determine whether monetary policy will be able to return to a paradigm similar to the one prevailing in the pre-crisis period (our scenario of normalization) or whether the post-crisis central banking paradigm has been changed more permanently.

Dynamic relationship between the US monetary and fiscal authorities

The relationship between monetary and fiscal authorities in the USA has undergone a number of shifts, substantially influenced by the prevailing economic circumstances: it has been very close during periods of world war, deleveraging and deflation, and distant during peacetime, leveraging and inflation. In [Figure 1](#), we identify three types of relationship under the headings of “arranged marriage,” “divorce” and “estrangement.” During the first epoch (1913–1951), the dominant theme was fiscal activism and monetary subordination. The Fed spent most of this time being subordinate to and cooperative with Treasury and the Office of the President. Deficits were often monetized and rates on Treasuries were pegged.⁵

The low point of monetary independence in this era was the Employment Act of 1946, which gave the federal government, and not the Fed, the task of managing the economy. The Treasury-Fed Accord of 1951 marks the end of the epoch and the “emancipation” of the Fed. During the second epoch (1951–1978), the dominant theme was fiscal activism and monetary independence.

⁵ In 1942, in an effort to reduce the cost of financing World War II, the Fed began pegging the interest rate on Treasury bills at 3/8% and enforcing a ceiling of 2 ½% on the rate on long-term Treasury debt. The rate on bills was allowed to rise modestly in 1947, but the ceiling on bond yields was maintained for almost a decade until 1951.

Fiscal activism fell from favor gradually. The Humphrey-Hawkins Act of 1978 marks a milestone of a shift in power back toward monetary policy independence. During the third epoch (1978–2008), the dominant theme was fiscal passivism and monetary “supremacy.” Its hallmarks were the victory of Paul A. Volcker, Chairman of the Board of Governors of the Fed, over inflation, the supremacy of monetary policy as the primary tool to conduct economic policy and a much diminished role for fiscal policy. This epoch also marks the advent of the Great Moderation, including the buildup of credit excesses that led to the crisis, as described at the start of this publication.

Transitions from one epoch to another were at times driven by the electorate and at times by power struggles between the fiscal and monetary authorities. As an example of the former, President Roosevelt owed his election victory to popular discontent during the Great Depression. The Agricultural Adjustment Act of 1933 gave him the authority to devalue the dollar against gold, which effectively meant the end of the Federal Reserve’s independence. This was coupled with the monetary financing of deficits – fiscal-monetary cooperation with the explicit aim of reflating the economy. Congress often played the role of an arbiter determining whether fiscal or monetary authorities should have more authority, resulting in significant revisions to central bank acts (the Treasury-Fed Accord of 1951 and the Humphrey-Hawkins Act of 1978).

Going forward, we have yet to see what President Trump will mean for the Federal Reserve’s independence and fiscal-monetary relations. This will also depend on the extent to which fiscal stimulus is going to take center stage in policy-making, taking over the baton from monetary stimulus. Possibly of greater importance will be the stance of the Republican-dominated Congress, which is not only responsible for the confirmation of Fed Governors, but would also have to approve any change in legislation.⁶ At this point, it is unclear whether a majority could be found to make significant changes to legislation pertaining to Federal Reserve independence.

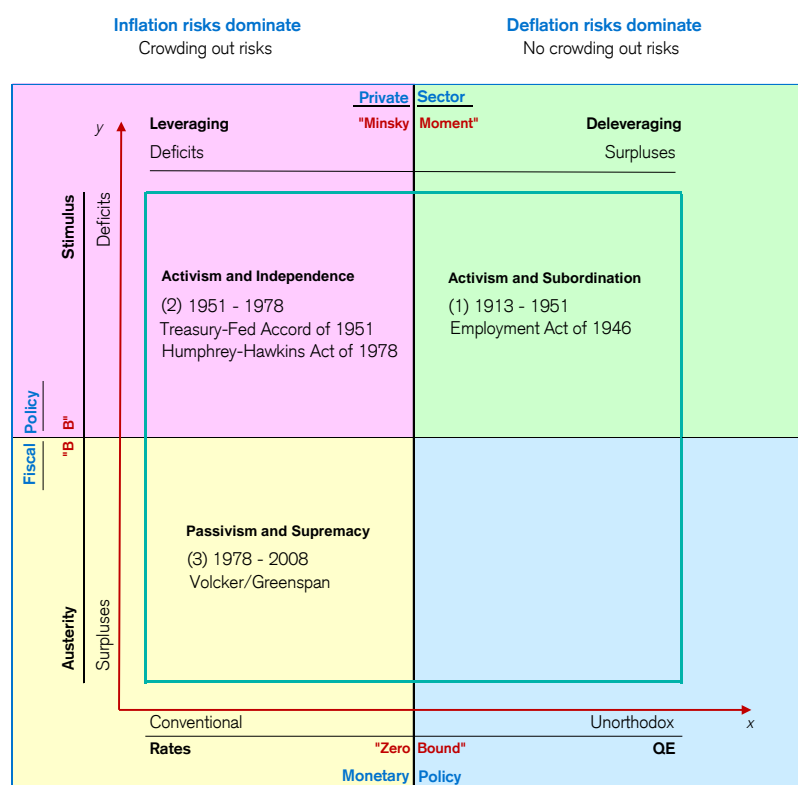
Dynamics of independence of other key central banks

Other central banks have gone through similar “life-cycles” as the US Fed. For example, the Bank of England gained full operational independence from HM Treasury only in 1998, with the requirement to pursue an inflation target set by the government. Recent critical comments directed at the BoE’s policies by Prime Minister Theresa May raised concerns that this independence may be in question,

but no legislative proposals have been forthcoming to date, nor do they seem likely to. In the case of the Bank of Japan, the degree of independence has also varied over time. During the 1930s, the BoJ, in full cooperation with the Ministry of Finance, underwrote the reflationary policies of Finance Minister Takahashi, which helped Japan avoid the Great Depression that had gripped the USA and Europe.

Figure 1

Dynamics of US monetary and fiscal cooperation



Source: McCulley and Pozsar (2012)

⁶ More precisely, it is the Senate that has the power to confirm or reject Fed Governors.

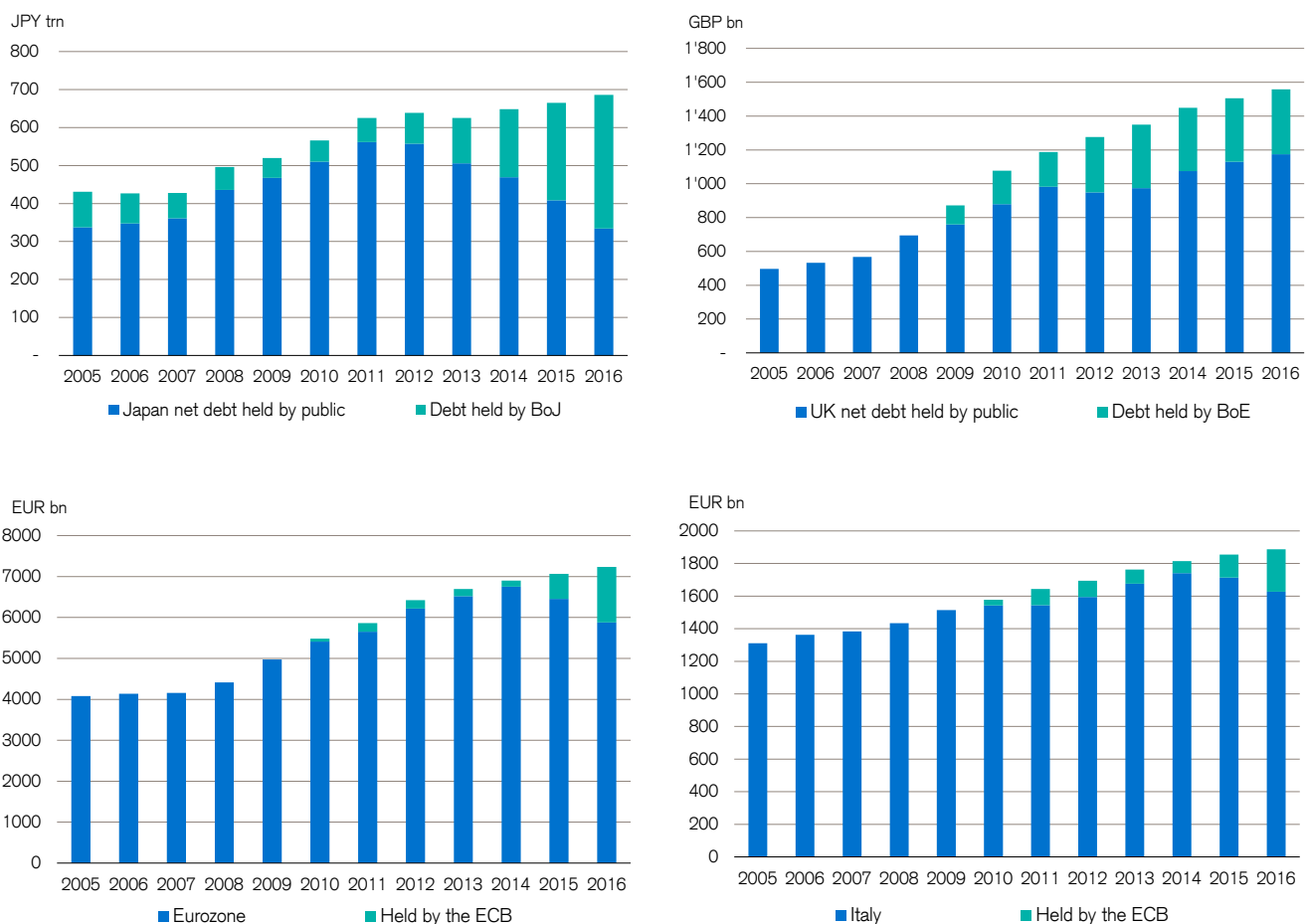
In the immediate post-War period, Japan suffered from hyperinflation, but the BoJ then established stronger control. Throughout the post-war period, the BoJ was an important tool for the government's industrial development strategy, in part by establishing credit growth targets for commercial banks. A revision of the Bank of Japan Act formally strengthened its independence in 1997, but cooperation between the BoJ and the government has intensified recently. With inflation rates still far below target, the central bank's large purchases of government bonds have not been in conflict with its independence, but this could change, naturally if inflation were to rise.

At this point, the BoJ already owns half of all net bonds (Figure 2) and the time is likely to come when it will want to decide whether to halt purchases, or even reverse them.

Finally, with regard to the status of the Swiss National Bank, the risks to its independence seem very limited. While populist demands for payouts of seigniorage to various special causes are voiced from time to time, the possibility of subjecting the SNB to the dictate of fiscal policy is highly remote for legal reasons, as well as its long tradition of independence. Moreover, in contrast to most developed economies, the fiscal position of the Swiss Federation remains very sound due to the constitutional requirement for fiscal balance approved by the Swiss voters in 2001.

Figure 2

Rising share of government debt owned by major central banks



Source: Bloomberg, Credit Suisse

Potential stress points for the ECB

Modelled largely on the German Bundesbank, the independence of the European Central Bank from fiscal authorities is one of the most clearly delineated. The European Treaties not only prohibit monetary financing of deficits, but also set an inflation target that is very low. Recent approval of the possibility of so-called Outright Monetary Transactions (OMT) which allow central bank support for governments, has in our view not significantly softened the prohibition of monetary financing because OMT is only possible under strong conditionality, i.e. in case a member country submits to an EU-sanctioned fiscal and economic restructuring program.

However, we do not believe that the ECB will be free of pressures going forward. In fact, pressure may be greater than that experienced by other central banks. The reason is that, in contrast to the other central banks, the balance sheets of the member central banks are not fully consolidated. There is, for example, no mutual liability for the sovereign assets accumulated by the individual central banks in the process of quantitative easing. Given that the exposure of the individual central banks to their sovereigns has increased markedly over the past years and will continue to rise as long as QE is underway, risks are on the rise.

At the same time, the exposure of "northern" central banks, particularly the Bundesbank, to "southern" central banks (the Target II balances, i.e. the real-time gross settlement (RTGS) system for the Eurozone, see [Figure 3](#)) has increased again in the course of the QE operations. While this

is in part a technical feature, in some sense it also reflects private sector capital flight from the south. A second stress point could thus arise if northern central banks showed a reluctance to continue providing financing to other member banks. The likely trigger for both these stresses (i.e. pressure on sovereign bonds in the periphery and worries over widening Target II balances) could well be when the ECB begins to wind down ("taper") its bond purchases.

Normalization or new norms?

The coming years will be decisive in relation to the future direction of central bank policy, depending on both economic and political developments, which are difficult to predict. We conclude this study by presenting two alternative future scenarios.

Scenario 1: Back to normal

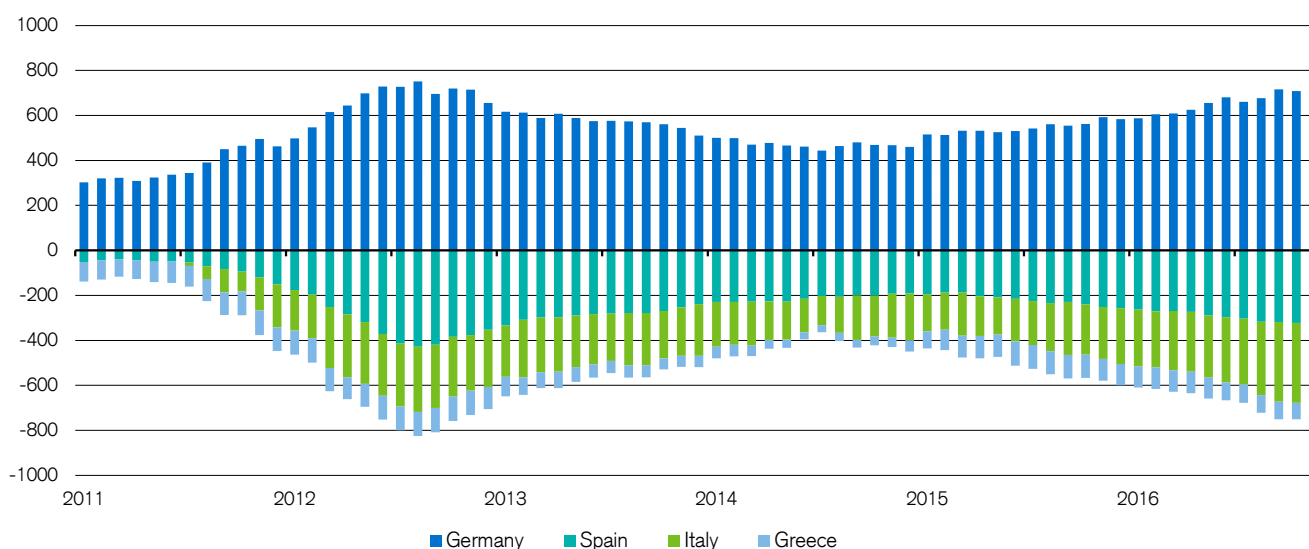
Our first scenario assumes that monetary policy will in essence return to an operational mode similar to that prevailing before the financial crisis. On the economic front, this scenario would include continued "healing" of the advanced economies, with moderate growth, the labor markets gradually returning to full employment and inflation rising toward the targets of central banks.

In terms of monetary policy operations, in this scenario, all central banks will eventually wind down their QE policies and likely raise their interest rates into positive territory. They should also, to a varying degree and pace, be able to reduce the size of their

Figure 3

Widening Target II imbalances

TARGET2 positions (EUR, bn)

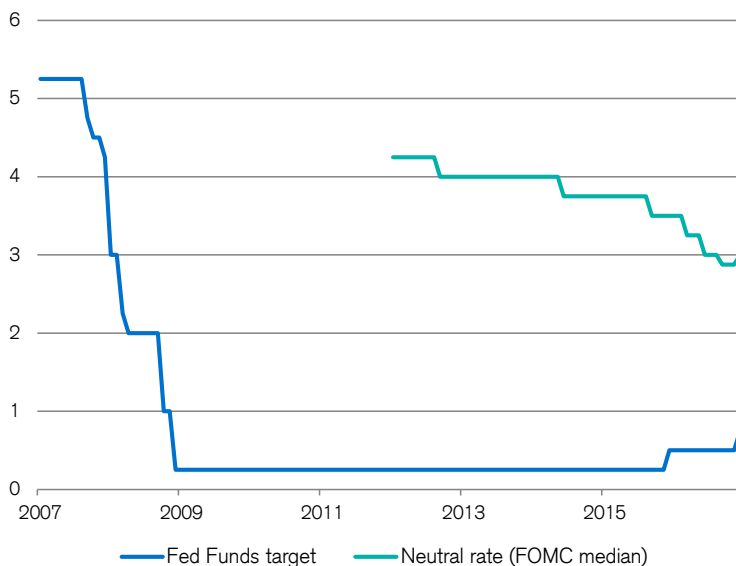


Source: European Central Bank, Credit Suisse

balance sheets. As a range of outcomes, we present the latest median projections for the Federal Funds rate by FOMC members as well as the actual Fed Funds rate (Figure 4). The real terminal (equilibrium, or natural) Fed Funds rate is assumed to be positive in this scenario (around 1%), which is lower than in the pre-crisis decades. We would also assume that the trajectories for interest rates will be similar in the UK, but lower in Japan, the Eurozone and Switzerland.

Figure 4

Fed Funds trajectories



Last data point: end-December 2016

Source: Bloomberg, Credit Suisse

In terms of financial market developments, this scenario entails low bond and moderate equity returns, both being constrained by fairly high valuations. Importantly, as long as another economic downturn does not materialize, severe financial market volatility should be avoided: normalization of monetary policy should ultimately instill confidence in markets. That said, phases of inflation overshoot and associated worries over faster policy normalization are likely to put added pressure on risk assets.

Of course, any scenario should consider the possibility of a future economic downturn. Depending on where interest rates are at the beginning of such a downturn, the question of what tools central banks will want to apply will arise once again. We would expect central banks to opt for a somewhat different mix of instruments than they have done in the past years. While asset purchases (QE) are likely to be introduced again, the trend will likely be more in the direction of NIRPs. To be effective, the exemptions from NIRPs may need to be more limited or rates more negative. In either case, the issue of the potential flight to cash will need to be dealt with.

Given that this scenario assumes reduced asset purchases, including of government bonds, and assuming that the financial position of governments has not by then improved substantially, this scenario anticipates the possibility of enhanced stress in bond markets of structurally weak economies. Two outcomes are then possible: either significant and credible fiscal reforms – potentially supported on a temporary basis by central bank bridge-financing (e.g. OMT as mentioned above) – or debt restructuring.

Scenario 2: Fiscal dominance

Although in theory, central banks may be able to preserve their independence regardless of economic conditions, we believe that the second scenario – that of fiscal dominance and a gradual loss of central bank independence – is more likely if economic recovery stalls and inflation remains stubbornly low.

In a first instance, one might imagine a continuation or intensification of "traditional" QE programs where governments issue bonds in the market that are subsequently bought by central banks. A more radical alternative would be a move to "helicopter money" where the central bank provides funds directly to the Treasury departments to fund expenditures, or even provides direct cash transfers to citizens. This scenario would also imply the effective cancellation of the sovereign bonds that central banks have accumulated (see next section).

It seems likely that economic activity would, at least initially, respond positively to such a policy shift. If the volume of central bank spending were to expand strongly, one would also expect inflation to pick up. Real interest rates would fall in a first instance, and asset prices might receive a boost. The key risk in this scenario is, however, that confidence in central banks would decline and long-term inflation expectations would rise – the yield curve would steepen. Given that trend growth of economies cannot be influenced markedly by either fiscal or monetary policy, the scenario would potentially result in stagflation. Risk assets would be bound to suffer in such a scenario. Moreover, exchange rate fluctuations would also likely increase as the degree of fiscal dominance and associated monetary expansion as well as inflation would likely differ strongly between countries and regions. For example, the flight into hard currencies such as the Swiss franc would likely intensify.

As noted above, fiscal dominance is an unlikely scenario for the Eurozone as the northern members are unlikely to fund added fiscal spending in the weaker member countries.

Helicopter money – better, worse or just the same?

In recent years, as economies seemed to fail to respond sufficiently to even unconventional monetary policies, the idea of resorting to "helicopter money" has emerged as a potential alternative or enhancement of QE. The idea of helicopter money is for the central bank to provide a one-time – or, in fact, repeated – infusion of cash into the economy by transferring funds to the fiscal authorities in return for a zero coupon infinite maturity bond. The government would be free to spend the cash for instance to cut taxes or to transfer directly to households. The concept goes back to Milton Friedman, who suggested that in a situation of seriously deficient aggregate demand, such an approach may be a powerful alternative to conventional monetary policy.

From a research perspective, the key question is whether helicopter money would be more or less effective than QE. The first point to make is that in a world with very low real yields on government bonds, their issuance is extremely cheap. Unless the central bank supplies reserves at yields which are even lower, helicopter money would not benefit the consolidated government balance. As senior economists at the Bank for International Settlement have pointed out, there are also flaws to the claim that helicopter money is fundamentally different from QE. The problem is essentially one of time inconsistency. Imagine a central bank (in a world of positive yields) that provides large sums of reserves to the fiscal authorities at zero interest. This

reduces the cost of fiscal expansion for the government and is thus more stimulative than typical QE. However, should economic growth pick up, the central bank will likely raise interest rates and will have to charge interest also on the additional reserves it issued by helicopter money. As a result, the stimulative effect of helicopter money relative to QE would be in principle reversed, even though it may temporarily have been effective.

The alternative is for the central bank to commit to provide reserves at zero interest indefinitely, essentially submitting to fiscal dominance (as previously discussed.) A profligate government would exploit this policy and inflation would inevitably rise, whereas a more sensible government may want to contain excess demand, for instance by raising taxes. It would then begin to run a surplus which would negate the need for helicopter money.

In summary, it appears to us that helicopter money is likely to be either time inconsistent, or would be no different from a temporary QE. An additional point to consider is that helicopter money as an approach faces legal hurdles in many jurisdictions, as direct financing of governments is often banned by law.



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