Do Long-Term Bonds Offer a Higher Return than Short-Term Bonds?

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INTRODUCTION AND SUMMARY

Since the autumn of 2008, the difference between long- and short-term interest rates has been large by historical standards. Thus, the difference between German 10-year and 1-year government bond yields has been almost 2.5 percentage points, cf. Chart 1. This is significantly more than the average historical yield spread, which makes it tempting to buy long-term rather than short-term bonds or to fund short and invest long. Furthermore, some market participants apparently consider the risk to be limited. Long-term bonds, however, are far more price-sensitive than short-term bonds and are associated with higher *interest-rate risk*. If interest rates pick up from the current low levels, long-term bonds may offer a lower return than short-term bonds.

The decision to assume interest-rate risk depends on a variety of factors, the most important being the investor's risk appetite and interest-rate expectations. The risk appetite is to some extent bound up with the investment purpose and horizon. Pension funds, for instance, have long-term liabilities, which can be hedged by buying long-term bonds. For them, the risk associated with buying long-term bonds is lower than for an ordinary wealth investor without long-term liabilities. This article focuses on an ordinary wealth investor who has to choose between investing in short- or long-term bonds.

The first part of the article analyses the connection between return and interest-rate risk in the period 1975-2010 in Germany and the USA. The analysis shows that long-term bonds have on average yielded a higher return than short-term bonds, so that it pays off to assume interest-rate risk. This means that the investor has received compensation – a risk premium – for buying long-term bonds. However, the excess return varies widely over time since it is difficult to predict how the interest rates and the yield curve will develop and since the risk premium is not constant.

The historical relations between return and interest-rate risk can be taken as a guideline for investors and macroeconomic projections. In

GERMAN 1- AND 10-YEAR GOVERNMENT BOND YIELDS   Chart 1
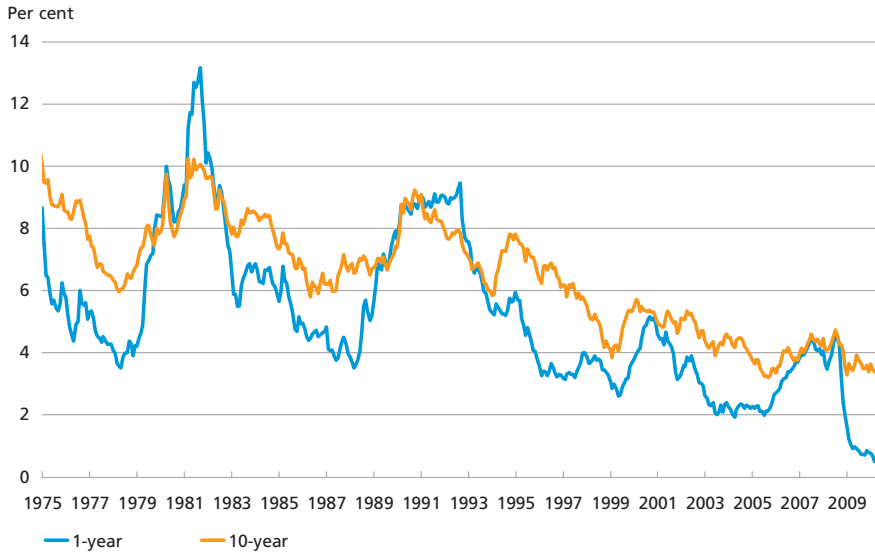
Note: The most recent observations are from 30 April 2010.
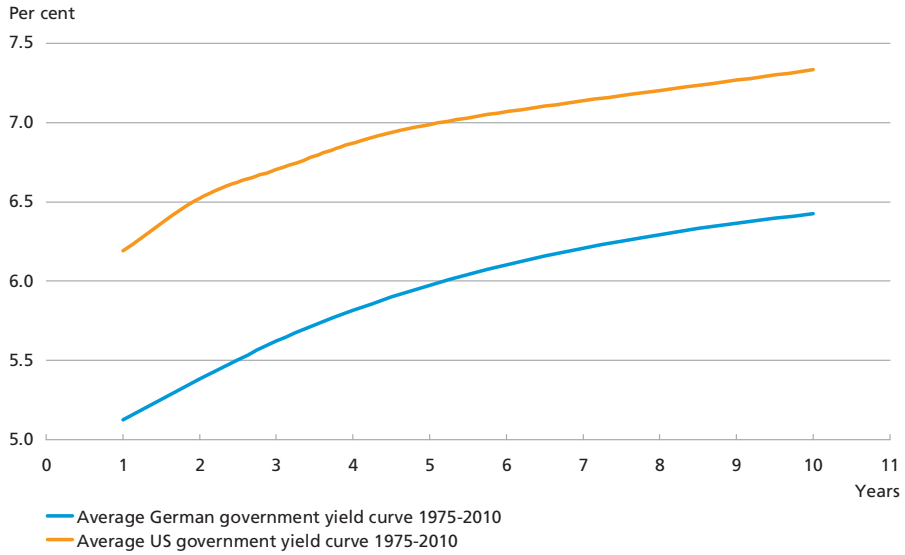Source: Reuters EcoWin.

such projections, interest rates are of crucial importance to e.g. economic growth and fiscal sustainability. However, caution is advised when applying historical observations to predictions of future developments. Interest rates could take a different path than indicated by historical experience, especially in the current situation with very low short-term interest rates as a consequence of unconventional monetary policy measures. It is important that the individual investors act on the basis of the present situation and their own expectations of interest rates once monetary policy is normalised. The second part of the article describes the relation between the current yield curve, investors' interest-rate expectations and the *expected* excess return on assuming interest-rate risk.

HISTORICAL RETURN ON SHORT- AND LONG-TERM BONDS

Yield curves in the USA and Germany have on average had positive slopes since the 1970s, cf. Chart 2. The difference between 1- and 10-year yields has since 1975 averaged 1.3 percentage points in Germany and 1.1 percentage points in the USA. This yield spread mainly reflects that investors require a risk premium for the increased risk associated with long-term bonds. The slope may also reflect investors' interest-rate expectations. It is difficult to separate the two, as both risk premiums and interest-rate expectations vary over time.

AVERAGE GERMAN AND US GOVERNMENT YIELD CURVE   Chart 2

Per cent

Average German government yield curve 1975-2010
Average US government yield curve 1975-2010

Source: Reuters EcoWin.

In order to assess the return on a bond, it is necessary to apply the total return. This is composed of coupon payments and capital gains or losses due, for instance, to changes in the general level of interest rates.

The price of a long-term bond is more sensitive to shifts in the level of interest rates than the price of a short-term bond, cf. Box 1. Therefore, long-term bonds are associated with a higher risk. This risk can be expressed as the volatility of the return.

During the period 1975–2010, total returns in Germany and the USA have been rising in step with volatility, cf. Chart 4. Thus, increasing the interest-rate risk has resulted in excess returns. The excess return can be viewed as a measure of the realised risk premium, meaning the extra return that the investor has obtained for buying long-term bonds. The excess return has been rising with the interest-rate risk, but the increase has decelerated. Thus, the relative gain from increasing the interest-rate risk is highest at the short end.

Excess returns have varied widely since 1975. The period can roughly be divided into two parts. In *the first period*, 1975-85 in the USA and 1975-95 in Germany, assuming interest-rate risk resulted in no or little gain, cf. Chart 5. In *the second period*, from 1985 in the USA and 1995 in Germany until today, there was a gain. However, there are substantial variations even within these two periods.

The excess returns seen over the past 15-25 years have been unusual by historical standards. Viewed over even longer horizons, the excess re-

RETURN AND RISK ASSOCIATED WITH BUYING LONG-TERM BONDS	Box 1

The total return on a bond depends on the coupon rate and changes in the market price of the bond.

The *coupon rate* is the nominal interest rate of the bond. If the coupon rate does not equal the effective market rate, the price of the bond will not be at par. The price will approach par value as the time of maturity approaches. This type of value adjustment is called maturity reduction or mathematical price adjustment and is often considered part of the interest income.

The *price* of a bond is affected by yield changes. If yields rise, the price will fall and vice versa. The price sensitivity to yield changes is often measured by the *duration* of the bond. Duration expresses how much the price of the bond changes in percentage terms when yields change by 1 percentage point. The higher the duration, the greater the sensitivity to yield changes. Long-term bonds have a higher duration than short-term bonds.

The risk of a bond is not determined by sensitivity to yield changes alone, but also by the movements in yields. The risk can be measured as volatility in the bond return. Volatility expresses the size of the fluctuations to be expected in return over a given horizon. As a consequence of greater price sensitivity, long-term bonds are more volatile, cf. Chart 3, even though long yields are often more stable than short yields.

| DISTRIBUTION OF MONTHLY TOTAL RETURN FOR GERMAN GOVERNMENT BONDS, 1975-2010	Chart 3
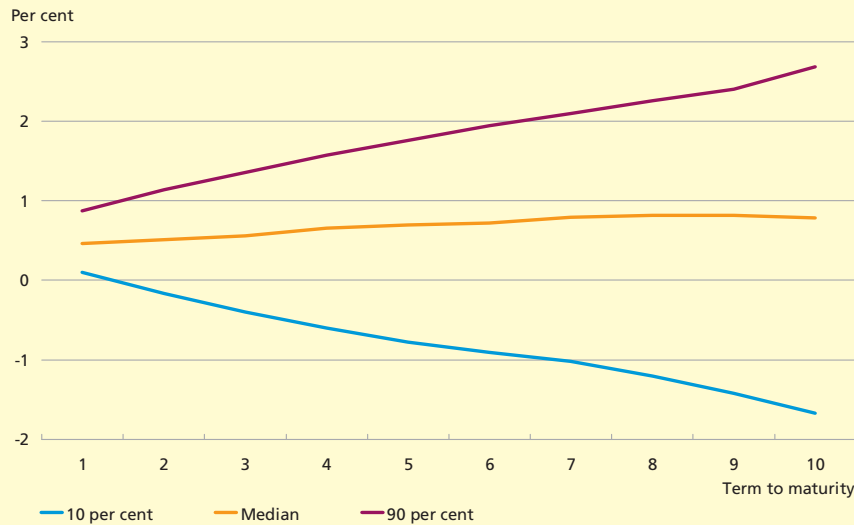
Source: Reuters EcoWin.

turn has been limited. Dimson et al. (2002) shows that in Germany, the excess return was negative during the first half of the 20th century, while it was only slightly positive in the USA.

Although the excess return has been positive on average in recent years, this will not necessarily be the case going forward. A large number

AVERAGE 12-MONTH TOTAL RETURN AND VOLATILITY OF GOVERNMENT
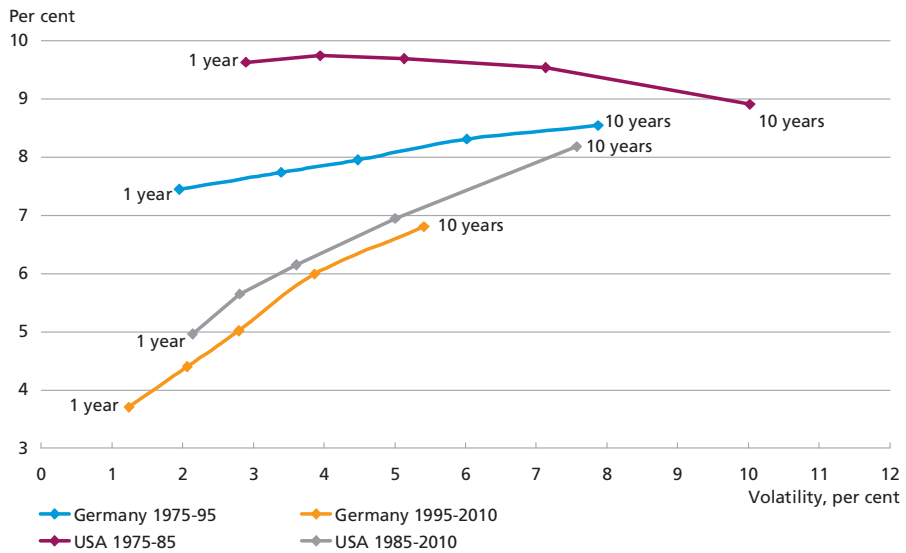BONDS, 1975-2010   Chart 4
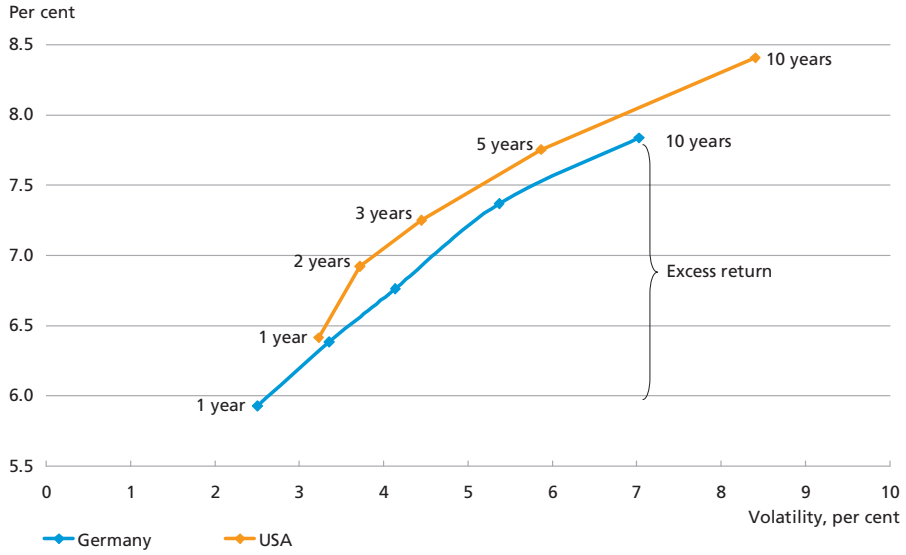
Note: Volatility is calculated as the standard deviation of the annual total returns and expresses the size of the fluctua-
       tions to be expected in the return on a 1-year horizon. Total return in the USA from September 2005 is approxi-
       mated using the method described in Babcock (1984).
Source: Reuters EcoWin and Global Financial Data.

AVERAGE 12-MONTH TOTAL RETURN AND VOLATILITY OF GOVERNMENT
BONDS IN SUB-PERIODS SINCE 1975   Chart 5

Note: Volatility is calculated as the standard deviation of the annual total returns and expresses the size of the fluctua-
       tions to be expected in the return on a 1-year horizon. Total return in the USA from September 2005 is approxi-
       mated using the method described in Babcock (1984).
Source: Reuters EcoWin and Global Financial Data.

of factors can affect interest rates and lead to significant fluctuations, including changes in monetary policy, inflation and growth. The periodic variations in excess returns mean that it is crucial to compare own interest-rate expectations with the current yield curve.

THE CURRENT YIELD CURVE AND EXCESS RETURNS

Currently, 1- and 2-year yields in Germany (as at 26 May 2010) stand at 0.3 per cent and 0.5 per cent, respectively, cf. Chart 6. By investing in a 2-year bond rather than a 1-year bond, the investor can thus obtain an excess yield of 0.2 per cent in the first year. The excess yield in the second year remains uncertain, though – unless the 1-year yield one year ahead is locked in today. This corresponds to investing in a 2-year bond providing the same security. Without risk aversion, capital market equilibrium requires that the expected return on 1-year and 2-year bonds is the same. The expected return will be the same if the yield on the 1-year bond is expected to have risen by 0.3 percentage point to 0.6 per cent in a year, cf. Chart 6. For the investor, such an increase in yields would result in a price loss on the 2-year bond of 0.2 per cent in the first year, and thus a total return of 0.3 per cent, corresponding to the return on a 1-year bond, cf. Box 2.

The 1-year yield one year ahead observed today is called the *forward rate*. The forward rate indicates the future development in interest rates

YIELD CURVE IN GERMANY, 26 MAY 2010	Chart 6
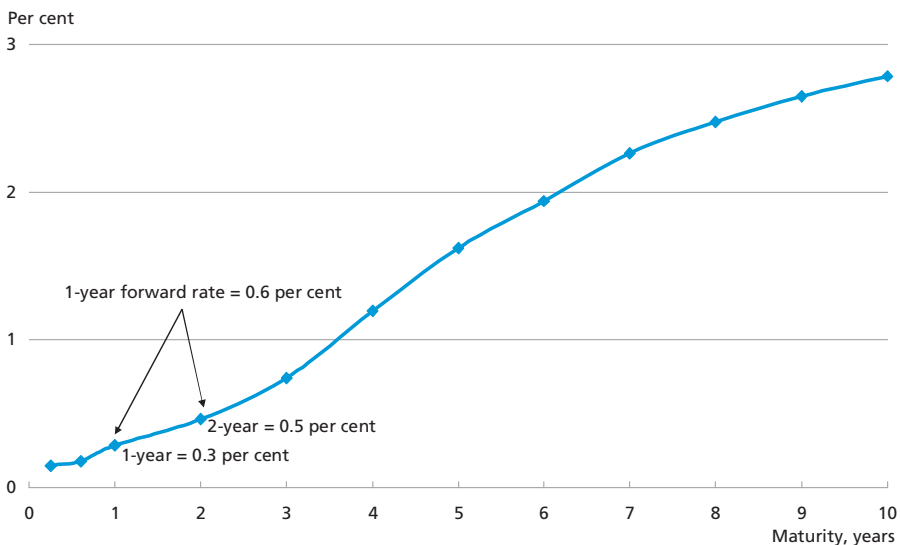
Source: Bloomberg.

DECOMPOSITION OF THE RETURN INTO YIELD AND VALUE
ADJUSTMENTS IF THE FORWARD RATE IS REALISED   Box 2

The rates equalling the return on two bond investments are called forward rates. Forward rates are defined on the basis of an equilibrium argument: an investment in a 2-year bond must offer the same expected return as an investment in for instance a 1-year bond and subsequently a new 1-year bond in a year:

(1) $(1+r_2)^2 = (1+r_1)*(1+fr_{1,1})$, where
                r_2 is the yield on a 2-year bond[1],
                r_1 is the yield on a 1-year bond
                $fr_{1,1}$ is the 1-year forward rate one year ahead

The German 2-year government bond yield was 0.5 per cent on 26 May 2010, cf. Chart 6, while the 1-year government bond yield was 0.3 per cent. (1) gives:

$(1+0.5/100)^2=(1+0.3/100)*(1+fr_{1,1}/100) \Rightarrow fr_{1,1}= 0.6$ per cent

The 1-year forward rate one year ahead must therefore be 0.6 per cent to equalise the return on the two bond investments.

If the forward rate is realised, there will be a capital loss on the 2-year bond in one year as a consequence of the yield increase, cf. Table 1. In two years, this capital loss will be offset by a corresponding capital gain. The total excess return from assuming interest-rate risk is zero, if the forward rate is realised.

EXAMPLE OF INVESTMENT OF KR. 100 WHEN THE FORWARD RATE IS
REALISED   Table 1

Kr.	1-year bond	2-year bond
After the first year		
Yield	0.3	0.5
Value adjustment	0.0	-0.2
Return	0.3	0.3
Gain on interest-rate risk	*0.0*	
After the second year		
Yield	0.6	0.5
Value adjustment	0.0	0.2
Return	0.6	0.6
Gain on interest-rate risk	*0.0*	

Note: The interest payment after year 1 is assumed to be invested at the 1-year yield one year ahead. Rounded figures.

[1]   The zero-coupon yield is applied. This is the yield on a bond with only one payment due at maturity.

which results in the capital loss on a long-term bond – in this example a 2-year bond – precisely offsetting the excess return relative to a 1-year bond. More generally, forward rates are equilibrium rates, ensuring the same return on all maturities. Forward rates can be deduced on the basis of the current yield curve. The presence of a risk premium means that

one should be cautious to use them as an exact expression of the market's interest-rate expectations.

An interest-rate increase that exceeds the forward rate results in a loss – and vice versa

Forward rates play a central role for an investor who is considering investing in a longer-term bond. If the investor in the example outlined above finds that forward rates are high relative his own interest-rate expectations, there will be an *expected* gain from buying a 2-year bond today. This reflects an expectation that the actual 1-year yield in one year is lower than the forward rate.

Such an investment can be viewed as a deliberate bet on the future development in interest rates. By buying a 2-year bond, the investor locks in the 1-year yield one year ahead at 0.6 per cent. If the realised 1-year yield in one year is lower, the investor will gain. If it is higher, the investor will suffer a loss.

The expected gain from the bet should be weighed against the increased risk associated with long-term bonds. In this case, the risk is that the 1-year yield one year ahead will have risen to more than 0.6 per cent.

**WHY DO EXCESS RETURNS VARY?**

The historical fluctuations in excess returns in Chart 5 can be examined more closely by looking at the variation in the relationship between forward rates and realised rates. For most of the period, realised rates have been lower than forward rates, cf. Chart 7. In continuation of the above example, investments in 2-year bonds have therefore during long periods yielded a higher return than 1-year bonds.

It is expected that realised rates will deviate from forward rates.

Due to the risk premium, a *positive* difference is expected, on average, between the forward rate and the realised spot rate. This reflects the compensation required by the investor for assuming the risk associated with long-term bonds. This is supported by the observations in Chart 7. However, it is difficult to calculate the precise risk premium, as it seems to vary over time. The variations have in some periods accounted for a large share of the aggregate fluctuations in yields, cf. Cook and Hahn (1990). The periods during which the difference is negative can probably not be explained by the changes in the risk premium. Here investors' interest-rate expectations matter.

In Chart 7, interest-rate expectations are based on the information available to the market one year before the realised rate was observed. During the year, new information about for instance macroeconomic data and

1-YEAR FORWARD RATE AND SPOT RATE ONE YEAR LATER IN THE USA   Chart 7
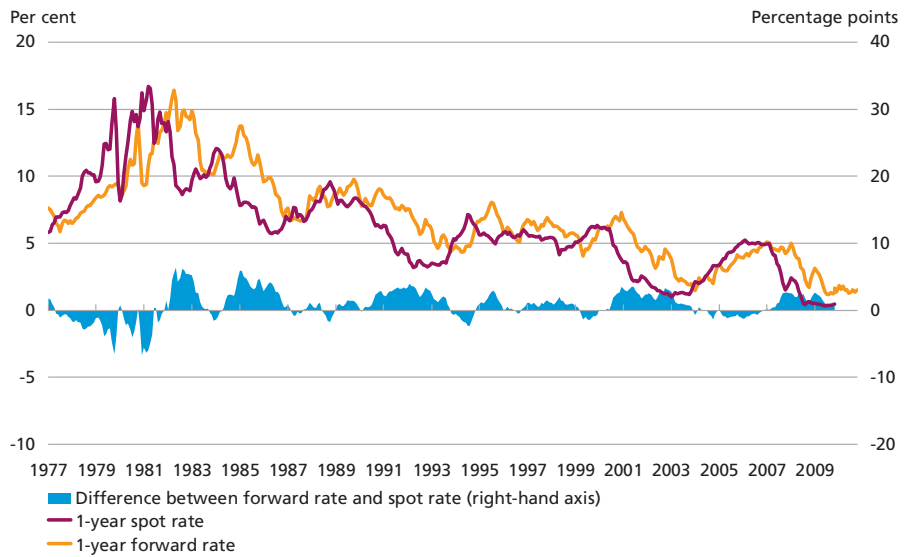
Note: The relationship between the 1-year forward rate and the realised spot rate one year later determines when
        buying a 2-year bond rather than a 1-year bond offers a gain. When the forward rate is higher than the spot
        rate, buying a 2-year bond is profitable.
Source: Reuters EcoWin.

changes in the risk premium is incorporated. For this reason, too, realised rates are expected to deviate from forward rates. Economic developments, monetary policy, external shocks to the economy, credit risk, liquidity etc. are all factors that have contributed to the deviations between realised rates and forward rates in recent years. These factors are very difficult to predict and take into account in interest-rate expectations.

However, the difference shows a certain pattern. In periods with falling interest rates, the forward rate appears to be higher than the realised rate. In these periods, the interest-rate risk will often result in a gain. Conversely, the forward rate is typically lower than the realised rate in periods when interest rates are rising. The systematic deviations may in part be due to sluggishness in investors' interest-rate expectations.

Sluggishness in interest-rate expectations

Due to sluggishness, long-term rates do not adjust sufficiently quickly to changes in short-term rates, cf. Froot (1989). This can for instance be illustrated by many investors not having expected the massive and pro-longed declines in short-term government yields as a consequence of the crisis in the US subprime mortgage market. At the end of the day, the crisis had serious spill-over effects on all financial markets and led to historically accommodative monetary policies. This underlines that it is difficult to predict monetary-policy interest rates, especially over a

longer-term horizon. The market is typically not able to predict changes beyond a few months, cf. Gürkaynak et al. (2006).

Predictability has probably increased since the mid-1990s in step with the Federal Reserve, for instance, having become more transparent. This means that the market is better prepared to predict changes in monetary-policy interest rates, cf. Poole et al. (2002). This is expected to reduce deviations between forward rates and realised rates and could explain why deviations since the mid-1990s seem to have diminished somewhat, cf. Chart 7. The low level of interest rates is probably also a contributory factor.

Monetary policy also affects investors' inflation expectations. A change in inflation expectations results in an adjustment in the required nominal rate to maintain the real value. At times, it has been difficult to predict inflation. During and after the oil crisis in the late 1970s and the early 1980s, investors underestimated actual inflation, cf. Chart 8. During that period, interest-rate risk led to losses. In the following years, there was a tendency towards excess returns during the periods when inflation was lower than expected, and losses in periods with unexpectedly high inflation. The difference between expected and actual inflation was considerable again in 2008-09 in continuation of the crisis in the financial markets with an unexpectedly sharp drop in inflation. During these years, interest-rate risk resulted in excess returns.

EXPECTED AND REALISED INFLATION IN THE USA   Chart 8
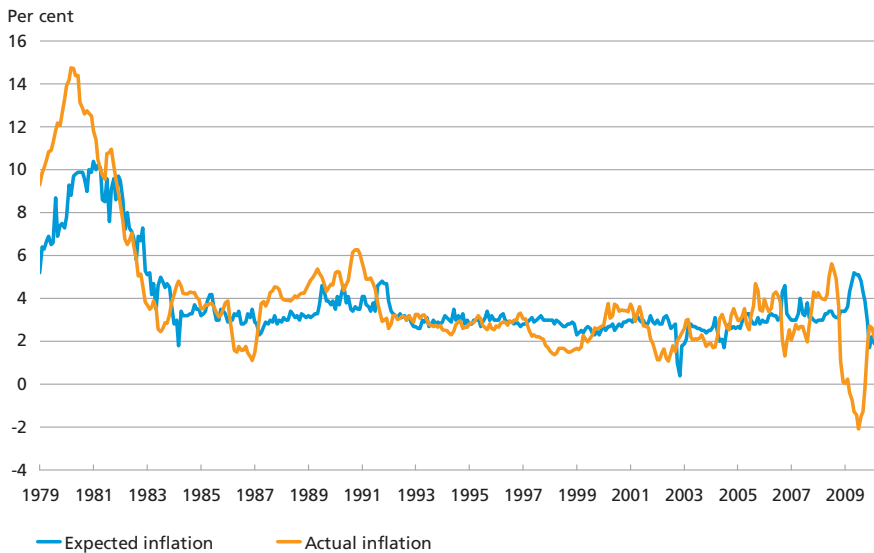
Note: Expected inflation is based on the University of Michigan Inflation Expectation measure.
Source: Reuters EcoWin and Federal Reserve Bank of St. Louis.

CONCLUDING REMARKS

Interest rates will rise – when and by how much remains uncertain. This could cause long-term bonds to yield a lower return than short-term bonds for a period. Developments in Japan show that it can be difficult to predict when and by how much interest rates will rise. In the past 15 years, assuming interest-rate risk has almost continuously resulted in an excess return in Japan, as forward rates have generally been higher than spot rates, cf. Chart 9.

Monetary policy is currently very accommodative amid low interest rates across most of the world. Bond purchases by central banks, historically low monetary-policy interest rates and extraordinary liquidity supply have had a strong impact on both the level of interest rates and the slope of the yield curve. Once monetary policy is normalised, the pace and pattern of adjustment in the level of interest rates and the slope of the yield curve may change unexpectedly, but the effect remains uncertain, cf. Kohn (2010). If the level of interest rates or the slope of the yield curve increases more than expected by the market, this could lead to price losses that may force investors to assume less interest-rate risk and close down positions. There is therefore a risk that interest-rate increases will be self-reinforcing, cf. BIS (2010). In such a situation, it is less important to the individual investor that there will be a gain on average over a long period, if the investor is not capable of absorbing potential losses on long-term bonds.

1-YEAR FORWARD RATE AND SPOT RATE ONE YEAR LATER IN JAPAN   Chart 9
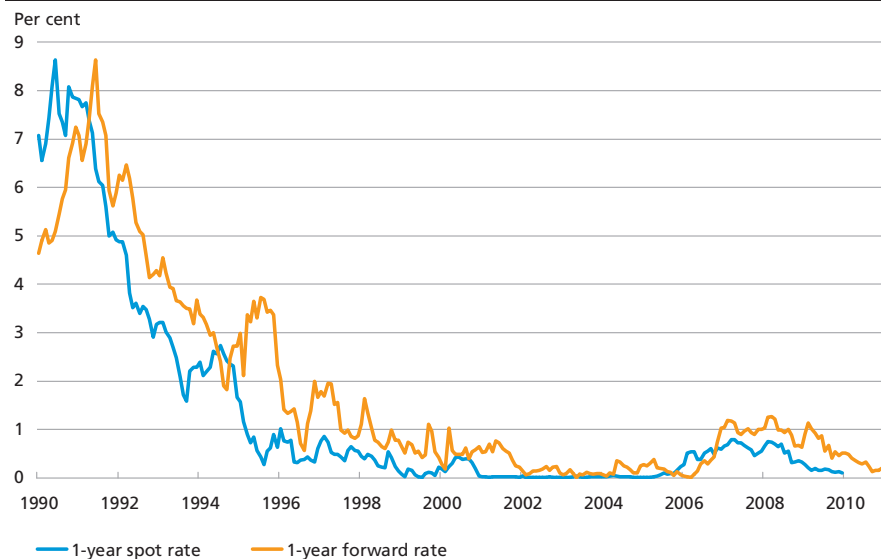
Source: Bloomberg.

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