Relations Between Stock Prices and Bond Yields

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INTRODUCTION AND SUMMARY

The stock and bond markets are closely related and the covariation between stock prices and bond yields is an indicator of the factors driving the financial markets. The degree of covariation is furthermore important for investors wishing to diversify their portfolios.

This article describes the historical development in the covariation and focuses on investors' assessment of risk in the financial markets, as well as on the interaction between economic activity, inflation and monetary policy.

During the past 40 years, the covariation in the USA has been predominantly negative, i.e. stock prices have typically been falling when bond yields have been rising. The explanation could be that, all other things being equal, higher interest rates reduce stock values.

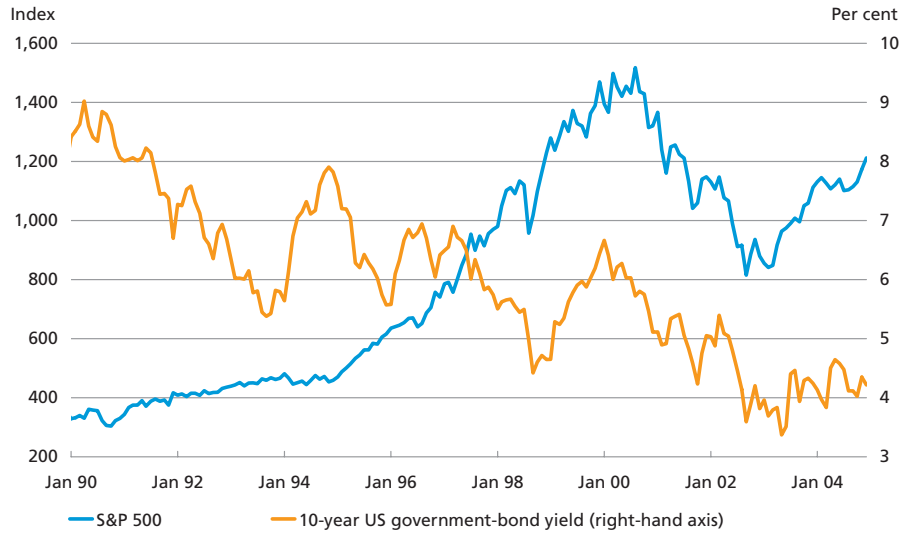
In recent years, however, the covariation between stock prices and bond yields has been positive in e.g. the USA and Denmark. The reason may be that several events have led to changes in investors' assessment of risk in the financial markets, thereby creating substitution between stocks and bonds.

The covariation drew close to zero in 2004, when investors' risk assessment was apparently stable. The covariation remained positive, however. The reason may be that both inflation and market players' inflation expectations fluctuate less than was previously the case. In a regime with low and stable inflation the official interest rates will to a great extent match the development in general economic activity and thereby in business earnings.

DEVELOPMENT IN THE COVARIATION BETWEEN STOCK PRICES AND BOND YIELDS

During the 1990s there was a tendency for stock prices in the USA to rise when bond yields were falling, cf. Chart 1. At the same time, the development in stock prices was often negative, or less positive, when bond

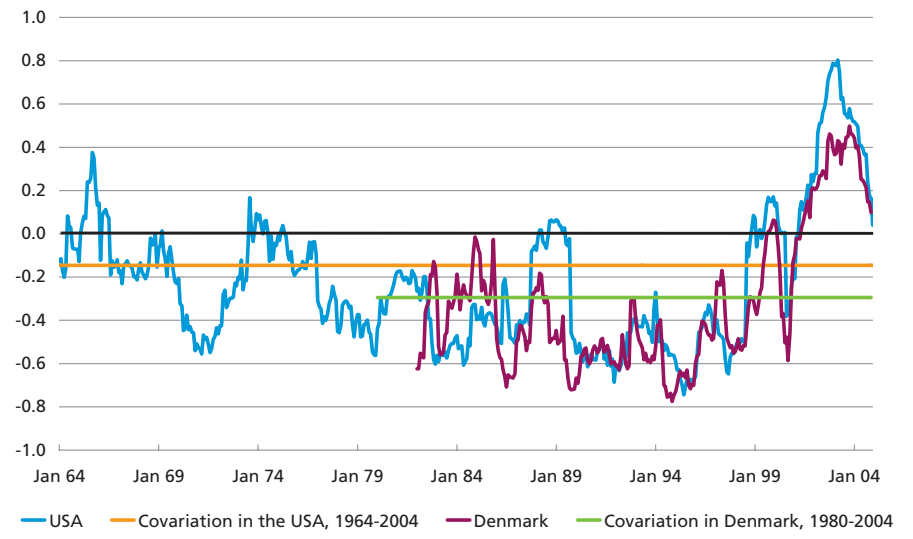
US STOCK PRICES AND BOND YIELDS — Chart 1



Note: Monthly observations.
Source: Bloomberg.

yields were rising. The covariation between stock prices and bond yields was thus negative, whereas for the last four years there has been a tendency for stock prices and bond yields to fluctuate in the same direction.

COVARIATION BETWEEN STOCK PRICES AND BOND YIELDS — Chart 2



Note: S&P 500 is the stock index used for the USA. Global Financial Data's all-share-index is used for Denmark. 10-year government-bond yields are used. The covariation (correlation) is calculated as the two-year moving correlation for monthly, relative changes. A correlation of 1 indicates perfect positive covariation. A correlation of -1 indicates perfect negative covariation. A correlation of 0 indicates no covariation.
Source: Bloomberg and Global Financial Data Inc.

THE VIX INDEX Box 1

The VIX index is the implicit volatility on options based on the S&P 500 index. Implicit volatility indicates the expected volatility (the expected relative fluctuations). This is calculated on the basis of the price of a number of call and put options. Call options give the purchaser the right, but not the obligation, to buy an asset at a given price. Put options give the buyer the right, but not the obligation, to sell an asset at a given price. The greater the fluctuation in the price of the asset expected by an investor, the greater the value of an option, in view of the increase in the probability of realising the option at a profit. The implicit volatility of the options therefore expresses the expected fluctuations in S&P 500. A high VIX index value is thus equivalent to large expected fluctuations in S&P 500 and thereby a considerable risk for investors.

In both the USA and Denmark the covariation over a longer period has been negative, cf. Chart 2. The high positive covariation characterising the last four years is thus unusual in a more long-term perspective. The considerable fluctuations in the covariation reflect that some factors have a positive effect on the covariation, while others have a negative effect, and that the various factors are dominant at different times.

In recent years the development in the covariation between stock prices and bond yields has been uniform across geographical markets. This reflects that the stock and bond markets fluctuate synchronously, due to the greater integration of the global economy, among other factors, cf. Obstfeld and Taylor (2001).

ASSESSMENT OF RISK AND RISK WILLINGNESS

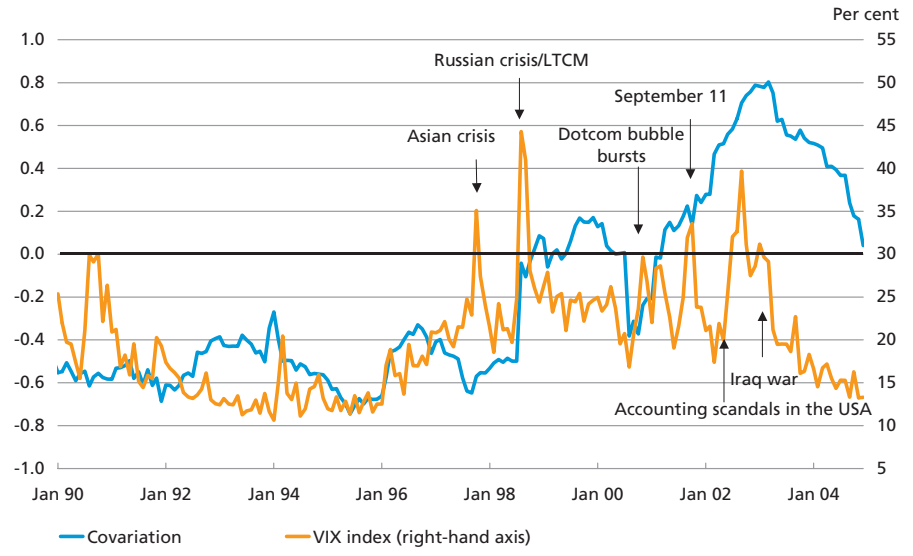
During the past eight years several events have changed investors' assessment of risk in the financial markets. An often used measure of risk is the VIX index, described in Box 1. During the periods marked, the VIX index has risen and has therefore been subject to considerable fluctuation, cf. Chart 3. To a great extent the fluctuations in the VIX index coincide with the shift from negative to positive covariation between stock prices and bond yields. It is therefore natural to analyse whether the fluctuations in the risk assessment can contribute to explaining the shift in the covariation.

Investment in stocks is typically considered to entail greater risk than investment in bonds. On placing funds in bonds, the bond's nominal yield to maturity is known to the investor and the investor will always receive the principal of the bond on its maturity[1]. In contrast, the ongoing dividend payments on a stock, and the future price of the stock, are

[1] The credit risk on bonds is disregarded. The credit risk on government bonds from e.g. Denmark, the USA and Germany is low.

COVARIATION BETWEEN US STOCKS AND BOND YIELDS, AND THE VIX INDEX

Chart 3



Note: The covariation is calculated as the two-year moving correlation on monthly relative changes in S&P 500 and the 10-year US government-bond yield. The VIX index is stated as monthly observations.

Source: Bloomberg.

not known beforehand. If investors' assessment of risk in the financial markets increases, this can lead to greater demand for bonds rather than stocks. This is often termed a "flight to quality", causing stock prices and bond yields to fall (while bond prices rise). If investors assess risk to be diminishing, this will have the opposite effect, so that stock prices and bond yields will rise. Periods when the assessment of risk is subject to considerable fluctuation may therefore lead to substitution between stocks and bonds, and thereby positive covariation between stock prices and bond yields. The same will apply on a change in investors' willingness to take risk.

Connolly, Stivers and Sun (2004) show that changes in the VIX index, and thereby in investors' assessment of risk, lead to positive covariation between stock prices and bond yields.

All other things being equal, an increase in bond yields reduces the value of stocks, since the discounted value of the stock dividends diminishes, cf. Box 2. This creates a negative covariation between stock prices and bond yields, which has also been observed over longer horizons, cf. Chart 2. It therefore seems probable that changes in the risk assessment are the primary factor behind the positive covariation during the past four years.

Investors' assessment of risk was stable in 2004, cf. Chart 3, which may explain the decrease in covariation. However, the covariations calculated

THE VALUE OF A STOCK Box 2

The theoretical value of a stock can be calculated using the discounted dividend model (Fuller and Hsia 1984, Saabye 2003). Here the stock price is expressed as the expected present value of the future dividends, cf. equation (1).

$$(1) \quad S_1 = E\left[\sum_{t=1}^{\infty}\left(\frac{D_t}{(1 + i_{1,1} + ERP_1)(1 + i_{1,2} + ERP_1)...(1 + i_{1,t} + ERP_1)}\right)\right]$$

S_1 is the expected (E) present value of the stock for an investor at the start of period 1. The stock gives the owner the right to the future flow of dividends (D_t, where D_t is disbursed at the end of the period t), and the value of the stock therefore depends on the expected dividends. The denominator reflects the investor's required return on the stock. This depends on the annual (nominal) return on an alternative investment expected by the investor at the start of period 1, and a risk premium for any additional risk on the stock investment (ERP_1). If the alternative investment is 1-year government bonds that are reinvested annually, the alternative return is the annual yields ($i1,_t$) that are expected. The risk premium is normally positive since stocks, as described above, are considered to entail a greater risk than bonds. As the dividends depend on the company's earnings, an equivalent valuation method is to calculate the present value of the company's future earnings, cf. Danmarks Nationalbank (2003b). The formula can also be an average for a stock index such as S&P 500.

If the risk assessment increases, or investors' risk willingness decreases at time 1, ERP_1 increases. The value of the stocks hereby declines. This can lead to substitution to bonds and thereby falling yields (rising bond prices).

Equation (1) also shows that, all other things being equal, an increase in the expected yields reduces the value of the stocks. This gives rise to a negative covariation between stock prices and bond yields.

for the USA, Germany and Denmark in 2004 are still predominantly positive[1]. This indicates that other factors besides changes in the risk assessment have played a role for the development in covariation in recent years.

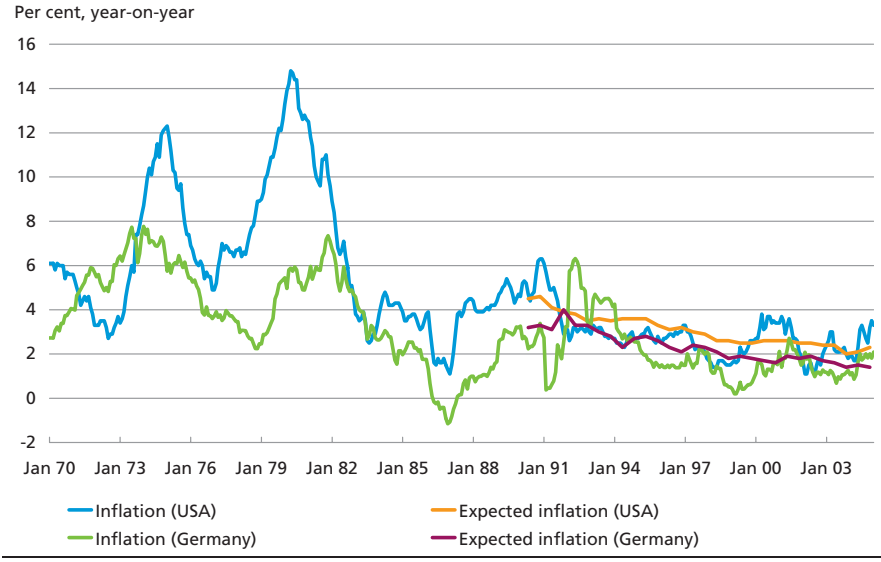
ECONOMIC ACTIVITY, INFLATION AND MONETARY POLICY

Development in inflation

In the 1970s and early 1980s inflation was high and volatile in most countries, including the USA and to some extent Germany, cf. Chart 4. Since then inflation has fallen to a lower, more stable level, and infla-

[1] The correlation between US stock prices (S&P 500) and the 10-year government-bond yield was -0.06 calculated on a monthly basis, 0.35 calculated on a weekly basis and 0.09 calculated on a daily basis. The correlation between German stock prices (DAX) and the 10-year government-bond yield was 0.25 calculated on a monthly basis, 0.30 calculated on a weekly basis and 0.25 calculated on a daily basis. The correlation between Danish stock prices (KFX) and the 10-year government-bond yield was 0.03 calculated on a monthly basis, 0.02 calculated on a weekly basis and 0.12 calculated on a daily basis.

INFLATION AND INFLATION EXPECTATIONS Chart 4



Note: The inflation expectation at a given time in year t is the expected inflation in the calendar year t+2. Inflation is stated as monthly observations, while the inflation expectations are stated as biannual observations.
Source: Bloomberg, Global Financial Data Inc. and Consensus Economics Inc.

tion expectations have stabilised. At the beginning of the 1990s inflation expectations were falling, whereas since 1998 they have been virtually constant or slightly declining in both Germany and the USA. This may be related to the greater weight given to price stability by many central banks, cf. Danmarks Nationalbank (2003a).

This stabilisation of inflation expectations occurs simultaneously with the increase in the covariation between stock prices and bond yields. It may therefore contribute to explaining the positive covariation, also in 2004 when the assessment of risk in the stock market was stable.

Expectations of dividends and yields

Two key factors affecting expectations of yields and dividends are expectations of economic activity and inflation expectations. These expectations are affected by a number of factors such as key economic indicators, the financial statements of business enterprises, announcements by central banks and forecasts from various organisations.

Economic activity and inflation are related, but the relation is complex. In the economic literature it is often assumed that higher economic activity leads to greater inflationary pressure in the longer term, for instance due to the increased wage pressure resulting from lower unemployment. Inflation is also affected by other factors such as the development in exchange rates. On the other hand, high inflation

THE VALUE OF A BOND Box 3

A bond's value is calculated as the discounted payments to which the bond entails a right. For a government bond these are normally the coupon payments over the maturity of the bond, as well as the principal on maturity of the bond.

The value of a bond can also be expressed as the nominal yield guaranteed to the owner over the maturity of the bond. As an alternative to a bond with a term to maturity of n years, the bond holder may place the funds in a bond with a term to maturity of one year and for the following n-1 years reinvest in 1-year bonds. If the two investments are to be equally attractive, the average annual yield ($i_{n,1}$) for the maturity of the long-term bond (n) at the start of the period 1 must correspond to the expected (E) 1-year yields ($i_{1,t}$, where t = 1,2,…,n) plus any risk premium ($BRP_{n,1}$) for investing over a longer horizon, cf. equation (2).

$$(2) \qquad (1+i_{n,1})^n = E\left[(1+i_{1,1}+BRP_{n,1})(1+i_{1,2}+BRP_{n,1})\ldots(1+i_{1,n}+BRP_{n,1})\right]$$

The central bank determines the official interest rate, which affects the short-term yield. All other things being equal, an increase in the official interest rate will increase the long-term yield via the effect on the short-term yield. The longer the term to maturity of the bond, the smaller the effect on the long-term yield.

Expectations of the future monetary policy also affect the long-term yields via the impact on the expected short-term yields.

The risk premium on bonds is e.g. affected by the inflation expectations. Higher inflation typically means that inflation will show greater fluctuation. Expectations of higher inflation therefore increase uncertainty concerning the real bond yield, which can increase the risk premium required by investors for holding long-term bonds.

has a negative impact on economic activity, cf. Pedersen and Wagener (2000).

Higher economic activity may affect expectations of business earnings, and thereby dividends, positively. If business earnings match the general development in prices, expectations of higher inflation will also increase expectations of corporate dividends.

Central banks are typically expected to react to higher economic activity or higher inflation by tightening monetary policy. If higher economic activity or inflation is expected, expectations of the future official interest rates will therefore increase, which will typically lead to increases in long-term yields, cf. Box 3. At the same time, expectations of higher inflation will normally increase the risk premium that investors require for holding long-term bonds. This also exerts upward pressure on long-term yields.

If higher yields and higher dividends are expected at the same time, the impact on stock prices is not unequivocal, cf. equation (1). In general, factors leading to larger changes in interest rates than in

expected dividends will create negative covariation between stock prices and bond yields, while factors affecting dividend expectations more than yield expectations will create positive covariation.

Monetary-policy reaction to economic activity and inflation

The Taylor rule has become a standard generally applied to describing the behaviour of central banks, cf. Taylor (1993). The rule dictates that the official interest rate is raised by more than one percentage point if inflation increases by one percentage point, and that the official interest rate is raised by less than one percentage point if GDP growth increases by one percentage point. The Taylor rule is also perceived by many authors as a description of the actual behaviour of central banks.[1]

If the market players assess that the central bank sets the official interest rate according to a Taylor rule, a change in the assessment of economic activity will affect the expected dividends more strongly than the expected yields. This will tend to create positive covariation between stock prices and bond yields, cf. equation (1). On the other hand, a change in inflation expectations will tend to affect the expected yields more than the expected dividends, which tends to create negative covariation. The covariation can therefore indicate the degree to which an event has affected the market players' expectations of economic activity in relation to inflation expectations, cf. the examples in Box 4.

On the basis of the above, the positive covariation between stock prices and bond yields in 2004 may reflect that the valuation of stocks and bonds has been affected by shifting expectations of economic activity rather than changes in inflation expectations[2]. This is in harmony with the apparent stability of inflation expectations, cf. Chart 4[3].

OTHER FACTORS THAT CAN AFFECT THE COVARIATION

Many factors affect the covariation between stock prices and bond yields. This article focuses on assessment of risk in the financial markets, as well as the interaction between economic activity, inflation and monetary policy, as these are considered to be particularly significant.

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1 Taylor (1999) for instance finds that the Federal Reserve reacted as described in the period 1987-1997. Clarida, Galí and Gertler (1998) show that in the period 1979-1993/1994 the Bundesbank and the Bank of Japan also reacted according to a variant of the Taylor rule.

2 Results from other studies concur that the development in inflation and inflation expectations has influenced the covariation between stock prices and bond yields. Ilmanen (2003) finds a negative relation between inflation and the covariation between S&P 500 and the US 20-year yield in the period 1928-2001. An equivalent relation is found in Japan and Germany. Li (2002) concludes that a decreasing risk of high inflation increased the covariation between stock prices and bond yields in the G7 countries in the 1990s.

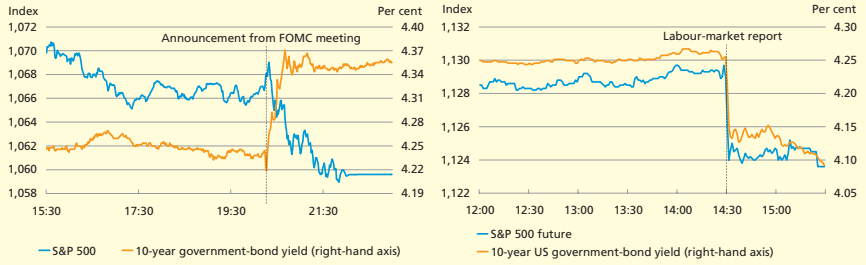
3 Central banks' greater focus on price stability will theoretically result in greater variation in economic activity, cf. Christensen and Hansen (2003).

EXAMPLES OF REACTIONS TO KEY INDICATORS AND ANNOUNCEMENTS — Box 4

Reaction to FOMC meeting

Negative covariation was seen between stock prices and bond yields after the Federal Open Market Committee Meeting on 9 December 2003, cf. Chart 5, left. The reaction indicates that the market players' inflation expectations were influenced more than their expectations of economic activity. This accords with the Federal Reserve's upward adjustment of its inflation assessment at the FOMC meeting.

REACTION TO THE FOMC MEETING ON 9 DECEMBER 2003 AND TO THE LABOUR MARKET REPORT ON 9 JANUARY 2004 — Chart 5



Note: Danish timing. The S&P 500 future is used in the right-hand graph as the release took place before the US stock markets opened.
Source: Bloomberg.

Reaction to the labour market report

In 2004 market participants focused e.g. on the development in US employment. As the monthly labour market report in January showed a lower increase in the number of employed than expected, both stock prices and bond yields fell, cf. Chart 5, right. This may indicate that this event affected market players' assessment of economic activity, rather than their assessment of inflation.

This section gives examples of other factors that can influence the covariation.

A change in investment requirements can create negative covariation. For example, demographic factors can increase savings and thereby the investment requirement. This can increase demand for both stocks and bonds, and push stock and bond prices up (and yields down). The growing proportion of middle-aged people in parts of the western world in the 1990s, and this group's greater propensity to save, may thus have contributed to negative covariation between stock prices and bond yields, cf. Davis and Li (2003).

Expectations of future business earnings can be affected by other factors than the general economic activity. Shifts in the remuneration of the production factors may thus affect expected dividends. For example, a higher profit ratio will make stocks relatively more attractive than bonds, which can have a positive impact on both stock prices and bond yields.

Institutional factors can also amplify a positive covariation between stock prices and bond yields. In a scenario with falling stock prices and falling bond yields, pension schemes with extensive guarantees will increasingly impose limitations on the pension companies' choice of investment strategy. This was the case in the autumn of 2001, when returns on investment were affected negatively by falling stock prices, while the falling interest rates contributed to increasing insurance provisions, and thereby the solvency requirements of pension companies. Therefore some Danish pension companies sold stocks and purchased bonds, cf. Danmarks Nationalbank (2002).

CONCLUDING REMARKS

Stock-exchange commentaries for various days may often appear to contradict each other. On some days they report how positive key indicators drove up stock prices and bond yields. On others, apparently similar events are stated to have pushed bond yields up and stock prices down. More detailed analysis can often explain the fluctuations. As the article describes, many factors influence the financial markets and the interaction between them. Comparison of developments in various financial markets can often give considerable insights from an analytical perspective on the factors driving the financial markets.

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