

## Risk appetite in a dynamic financial market environment

The risk appetite of investors is of special importance to financial stability. The willingness of market participants to take risks can provide an indication of the condition of financial markets. Particularly in the light of the current low risk premiums, the question arises as to the extent and nature of interaction between the willingness of market participants to take risks and the performance of financial markets.

This article starts by explaining how risk appetite influences the market and identifies reasons for the variance of risk appetite over time. Following this, selected indicators are discussed which are used to investigate the risk appetite of investors in the international bond and stock markets in the period from 1995 to 2005. In addition, new indicators are drawn up which are based on an explicit separation between asset price risk and investors' willingness to take this risk.

It is shown that risk appetite is often subject to cyclical fluctuations. The models for measuring such fluctuations provide a useful tool for analysing potential risks in financial markets.

### Importance of risk appetite with regard to financial stability

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Financial stability is of crucial importance for economic and monetary policy. However, rec-

ognising potential dangers at an early stage and introducing effective measures in good time poses a special challenge.<sup>1</sup> It can be concluded from the currency crises in Europe in 1992-93 and in Mexico in 1994-95, the Asia, Russia and LTCM crises in 1997-98 and most recently the Argentina crisis in 2001-2002 that the economic environment is regularly confronted with financial crises.<sup>2</sup>

What is particularly important with regard to financial crises is that they can generally not be explained solely by fundamental factors.<sup>3</sup> It is becoming increasingly recognised that at the same time the risk appetite of market participants, which is subject to fluctuations over time, also has a decisive influence. Risk appetite is defined as the willingness of investors to bear risks. While there is often no distinction made in the literature between the terms risk aversion and risk appetite, this distinction is being made here on the basis of their different variability over time.<sup>4</sup>

Risk appetite poses a threat to financial stability in particular if the yields investors expect to receive in return for bearing risk appear disproportionately high or low in relation to their historical mean. The main problem, however, is that such mismatches cannot systematically be clearly identified *ex ante*, as neither the risk nor the risk appetite prevailing among market participants can be directly observed. Hence it is virtually impossible to specify a fair valuation level for the pricing of risks, which in turn makes it considerably more difficult to identify developments posing a danger to stability.

Risk appetite seems to fluctuate around an unknown equilibrium level. As it is not possible to precisely determine this level, a long-term average is calculated on the assumption that while risk appetite may diverge significantly from this over the short term, the long-term tendency points towards this level. This phenomenon is also referred to as the *mean reversion*. Deviations from this average can also be interpreted as indicating risk potential.

A drop in risk appetite leads *ceteris paribus* to higher financing costs, as the yield expectations of investors increase despite the risk remaining unchanged. This makes it more difficult to raise capital on equity and debt capital markets in phases of low risk appetite, for instance. With regard to financial stability it is crucial that a change in market sentiment does not only give rise to varying yield expectations from just a few individual securities but that it is able to influence a large number of securities, in many cases across national bor-

*The consequences of extreme forms of risk appetite*

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1 See Deutsche Bundesbank, Report on the stability of the German financial system, *Monthly Report*, October 2004, pp 5-84 for more details.

2 This is the result of a comparative study by M Bordo and B Eichengreen (1999), *Is our current international economic environment unusually crisis prone?*, in: D Gruen and L Gower, *Capital flows and the international financial system*, Reserve Bank of Australia, Sydney.

3 For instance, the importance of non-fundamental factors is shown based on the example of exchange rate developments in P De Grauwe (2000), *Exchange rates in search of fundamentals: The case of the euro-dollar rate*, *International Finance*, pp 329-356.

4 Risk aversion is seen as a relatively time-invariable degree of aversion towards uncertainty regarding future consumption possibilities. Rather than describing risk perception within a specific financial market environment, it reflects the underlying attitude to all types of (financial) risk. By contrast, risk appetite can also be subject to sharp short-term fluctuations. See also P Gai and N Vause (2004), *Risk appetite: concept and measurement*, *Financial Stability Review*, Bank of England, London, pp 127-136.

ders owing to the international portfolio connection.<sup>5</sup>

Mostly, however, it is not a below-average but an above-average or rising degree of risk appetite that is seen as a threat to financial stability. In this case the market price of risk falls and investors demand a smaller risk premium compared with typical reference situations. This gives rise to an increased demand for risky securities and a decreasing demand for relatively secure ones.<sup>6</sup> Hence investments can appear to pay off that in normal situations do not represent an efficient return-risk combination. A high risk appetite can therefore result in risky or unprofitable projects being carried out which would be unprofitable in the case of risk propensity in line with the long-term average. As the process of mean reversion in the long term causes risk appetite to decline again, the risk of instability cannot be ruled out in such situations. The financing conditions then deteriorate, so that some of the projects implemented are perceived as potentially loss-making, thus prompting some of the capital-providers to withdraw. As a result, this could potentially give rise to an inefficient termination of the project. The strength of the decline in risk appetite and the time frame in which it takes place are the primary factors determining the risk potential.

A change in risk appetite is reflected in the risk premiums of risky assets. A look at the change in the yield spread of risky corporate bonds over low-risk government bonds shows significant changes over time (see chart on page 88).

However, the fluctuations in the yield spread cannot be simply taken to point to an equivalent variance in risk appetite as the cause even if we assume that risk aversion remains constant.<sup>7</sup> The reason can also lie in a credit risk or liquidity risk that changes over time. If corporate bonds become more risky in relation to government bonds, the yield spread will increase. The fact that the yield spreads of the different rating classes move in the same direction can also not be interpreted as a clear sign of changes in risk appetite. Joint price movements of assets with varying degrees of risk may also result from a risk change simultaneously affecting all assets under consideration. It is also conceivable, however, that they might be brought about not by a shift in the absolute risk position but in the relative risk position compared to other assets.

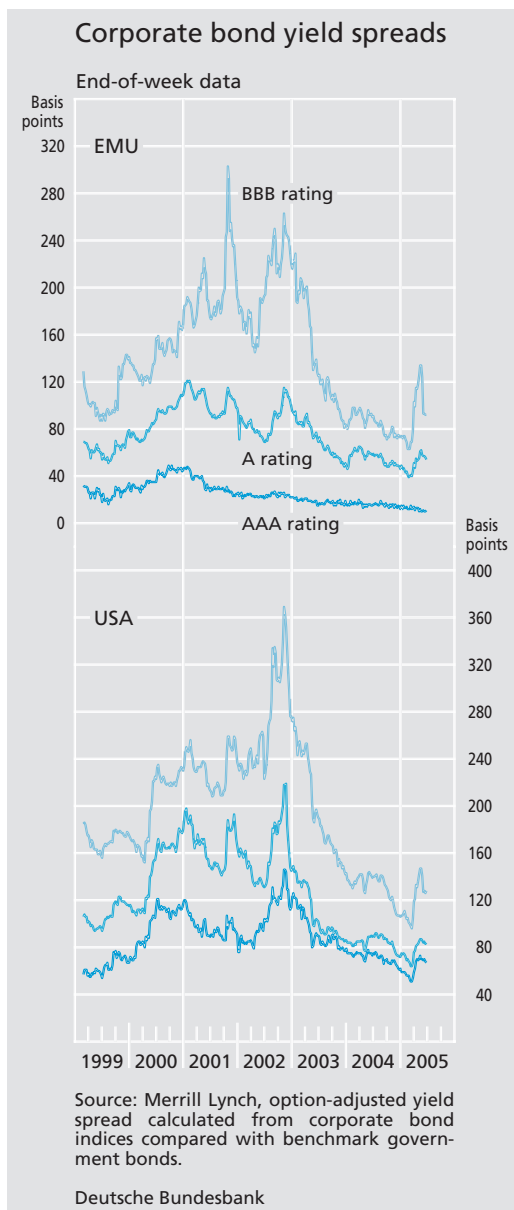
Nevertheless it can mostly be assumed that a change in the general risk appetite of market participants contributes to a similar extent to the fluctuation of the risk premium as the actual risk connected with the bonds in ques-

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<sup>5</sup> This is illustrated empirically in N Tarashev, K Tsatsaronis and D Karampatos, *Investors' attitude towards risk: what can we learn from options?*, BIS Quarterly Review, June 2003, pp 57-65.

<sup>6</sup> This basic conclusion is compatible with the Capital Asset Pricing Model (CAPM) as long as the risk-free interest rate at which all investors can borrow or invest an unlimited amount of money is no longer assumed to exist. For details see MS Kumar and A Persaud (2002), *Pure contagion and investors' shifting risk appetite: analytical issues and empirical evidence*, International Finance, pp 409-410.

<sup>7</sup> The risk associated with a bond should be reflected in its rating. If a bond remains in the same rating class, however, this does not imply per se that the risk has remained unchanged. For details, see, for instance, EI Altmann and HA Rijken (2005), *The impact of the rating agencies' through-the-cycle methodology on rating dynamics*, Economic Notes, Vol 34, No 2, pp 127-154.



tion. Hence the risk premium is determined by two factors. While it is negatively correlated to risk appetite, it has a positive correlation to the actual risk. Looking at the yield spread alone therefore does not enable any conclusions to be drawn regarding the extent of or change in risk appetite.

## The factors determining fluctuations in risk appetite

Various reasons are assumed for the sometimes sharp and protracted deviations of risk appetite from their (unknown) equilibrium. Empirical analyses show that there is a long-term positive correlation between risk appetite and economic performance.<sup>8</sup> Investors are more prepared to bear additional risk when financial markets are booming, while tense market phases often give rise to a rapid decline in risk appetite.

One reason for this behaviour by market participants is seen to lie in the fundamental limitation of human cognitive abilities, thus leading to bounded rational behaviour.<sup>9</sup> According to the theory of bounded rationality, human beings only have a limited ability to fully absorb information, process it quickly and store it for a sufficiently long period of time. Cognitive restrictions force the economic agent to use simplified rules of conduct that do not correspond with the behaviour of the customary theoretical construct of *homo oeconomicus*. However, the use of simplified heuristics in some cases leads to systematic wrong valuations and hence to deviations of risk appetite from the equilibrium path.

*Human behavioural patterns as the cause of typical fluctuations in risk appetite*

So-called availability and representativeness heuristics deserve particular mention in this

*The influence of availability and representativeness heuristics*

<sup>8</sup> For details see also BIS (2005), 75th Annual Report, pp 108.

<sup>9</sup> The concept of bounded rationality was introduced by Herbert Simon to replace the idea of utility maximisation with a more realistic view of economic behaviour. See H Simon (1957), *Models of man*, New York.

context.<sup>10</sup> The former refers to the fact that the probability of an event is rated higher the more firmly it is cognitively embedded in our consciousness. This means that in prospering markets there is a lower awareness of the risk of a downturn, while the probability of a continuation of the upturn is overestimated. This leads to a self-reinforcing process as the upswing (downturn) entails a rise (fall) in risk appetite and vice versa. The interactive enhancement continues until it is interrupted by one or more unexpected events which rekindle awareness of the existing risks and lead to a decline in risk appetite.

Representativeness heuristics exacerbate these processes by making the assessment of probabilities depend on how similar the different assets appear in the observer's eye. In this way a large number of assets can be affected by a change in risk appetite although the unexpected event was originally only relevant for a small number of them.<sup>11</sup>

In addition to the bounded rationality of market participants, there is another conceivable reason at a non-individual level for shifts in risk appetite. If the participant structure in market events changes, the risk appetite in the market generally also changes. In connection with the availability heuristics described above, a change in the composition of the investor group can therefore also trigger self-reinforcing processes.

It can be concluded from the relationship between risk appetite and fundamental factors which is explained by the concept of bounded rationality that strong deviations

from the long-term average are to be expected in the run-up to a pronounced change in the direction of risk appetite. Such changes of direction can pose a threat to financial stability as they are often followed by fundamentally non-justified price developments. An extremely high risk appetite can therefore pave the way for the emergence of financial crises. On the other hand, human behavioural patterns characterised by availability and representativeness heuristics cause negative surprises to be followed by a decline in the readiness to take risks.

In fact, some empirical investigations have proven that financial crises are often preceded by phases of extremely high risk appetite.<sup>12</sup> The successful development of reliable indicators for measuring risk appetite would enable warning signs of potential financial instabilities to be recognised at an early stage so that the necessary corrective action could be taken.

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10 See N Barberis and R Thaler (2003), *A survey of behavioral finance*, in: GM Constantinides, M Harris and R Stulz (eds), "Handbook of the economics of finance", Amsterdam, pp 1053-1123. De Grauwe adds a further heuristic factor, framing, but this is very similar to the ones mentioned here. See P De Grauwe (2000), pp 344-346.

11 For instance, the impact of risk appetite on the government bond spreads of transition countries increased as a result of the Enron scandal despite the fact that no prima facie connection can be recognised between the bonds issued by Enron and government bonds. For details, see A García-Herrero and Á Ortiz (2005), *The role of global risk aversion in explaining Latin American sovereign spreads*, Working Paper, Banco de España, Madrid.

12 See, for instance, ANR Sy (2001), *Emerging market bond spreads and sovereign credit ratings: reconciling market views with economic fundamentals*, IMF, Working Paper 01/165, pp 9 ff. See also KA Froot and PGJ O'Connell (2003), *The risk tolerance of international investors*, National Bureau of Economic Research, Working Paper 10157, Cambridge. See M Dungey, R Fry, B González-Hermosillo and V Martin (2003), *Characterizing global investors' risk appetite for emerging market debt during financial crises*, IMF, Working Paper 03/251.

## Indicators for the measurement of risk appetite

A number of financial crises occurred in the 1990s, the main examples being the Mexican peso crisis in 1994-95, the Asian economic and currency crisis in 1997, the moratorium on sovereign debt by Russia and the near-insolvency of the hedge fund LTCM in 1998. The financial literature already provided some models for explaining financial crises.<sup>13</sup> Despite this, economists and market participants failed to anticipate these events. Following this experience, efforts to improve the forecasting of financial crises were intensified.<sup>14</sup> In addition to predicting economic fundamentals, indicators for assessing the risk appetite prevailing on the financial markets were also developed. Some indicators relate directly to surveys assessing market participants' views or investor confidence. However, most indicators attempt to derive the risk appetite of investors from the development of market prices in the international financial markets. The main advantage of market prices compared with surveys is that they can be called up cheaply, are published more frequently and provide an up-to-date reflection of current developments. Furthermore, market prices reflect the actual views of market participants which were implemented in trading decisions. There are many different approaches to assessing the risk appetite of investors by means of market prices. Some of these indicators are presented below as examples.<sup>15</sup>

The Bank for International Settlements (BIS) calculates an indicator by comparing the stat-

istical likelihood of and subjective probability that market participants ascribe to future asset returns.<sup>16</sup> This concept is based on modern financial market theory, which states that asset prices reflect preferences regarding future returns and an assessment of the likelihood that these returns will be achieved. A further assumption is that the future benefits of capital gains for investors are the higher the smaller their wealth. This correlation gives rise to a preference-weighted probability above the statistical probability for low returns. The statistical probability of future returns is estimated using historic patterns in spot prices. The assessments of market participants are derived from the prices of stock options. The preference-weighted subjective probability of investors regarding future returns of the underlying of the option contracts can be estimated from a set of option prices with different strike prices. The higher the risks of losses assigned by investors to the underlying lie above the statistical probability of sharp losses, the lower the willingness of market participants to take on risks.

An indicator developed by Credit Suisse First Boston (CSFB) in 2001 draws on the correlation between risk appetite and the relative

*An index of the BIS based on option prices*

*The CSFB index is geared to the correlation between return and risk*

<sup>13</sup> See also B Eichengreen (1999), *Towards a new international financial architecture: A practical post-Asia agenda*, Institute for International Economics, Washington DC. This discusses three generations of models of the momentum of currency and financial crises.

<sup>14</sup> See M Goldstein, G Kaminsky and CM Reinhart (2000), *Assessing financial vulnerability: an early warning system for emerging markets*, Institute for International Economics, Washington DC.

<sup>15</sup> A good overview of indicators for measuring risk appetite is provided in M Illing and A Meyer, *A brief survey of risk-appetite indexes*, in: *Financial System Review*, Bank of Canada, June 2005, pp 37-43.

<sup>16</sup> See N Tarashev, K Tsatsaronis and D Karampatos (2003).

performance of riskier and less risky assets.<sup>17</sup> This approach is based on the assumption that an increasing risk preference shifts the demand from less risky investments to assets associated with higher risks, thus pushing their prices up relative to low-risk assets. In the event of lower risk appetite, however, there is a preference for risk-free assets whose prices increase as a result of the higher demand. This approach is methodologically implemented by relating the returns of 64 international stock and bond indices to their risk which is approximated by historic volatility. The value of the CSFB index is the slope of the regression line measuring the correlation between the current performance of shares and bonds in relation to their risk.

*Other indicators  
based on  
market prices*

Other examples of the broad variety of risk indicators are the indices of Goldman Sachs and JP Morgan. The indicator calculated by Goldman Sachs draws on a consumption-based Capital Asset Pricing Model for assessing the risk appetite of investors.<sup>18</sup> The Liquidity, Credit and Volatility Index (LCVI) of JP Morgan comprises seven sub-indices capturing credit risks, liquidity risks and volatility in different financial markets. The LCVI is calculated as the arithmetic average of the normalised sub-indices, thus smoothing out their fluctuations.<sup>19</sup> Furthermore, an aggregation of several individual indicators can also be used to identify risk appetite as a common factor of the individual indicators by means of a principal component analysis. This approach was selected by the Bundesbank in a previous report, for instance.<sup>20</sup>

The indicators can be used to assess the development of investors' risk appetite over time. The higher the indicator, the higher the risk appetite. However, the level of risk appetite can only be interpreted in relation to its historic development. Whether the willingness of market participants to take risks is relatively high or low can be assessed in comparison to the long-term average and the peaks and troughs reached by the indicators to date.

*How should the  
indicators be  
interpreted?*

The development of the indicators shows that risk appetite can change rapidly and that it fluctuates, at times in cyclical movements, around a long-term mean. A sudden drop in risk appetite can, for instance, be triggered

*Impact of  
financial crises*

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<sup>17</sup> See J Wilmot, P Mielczarski and J Sweeney, *Global risk appetite index*, in: Credit Suisse First Boston, Global Strategy Research: Market Focus, February 2004.

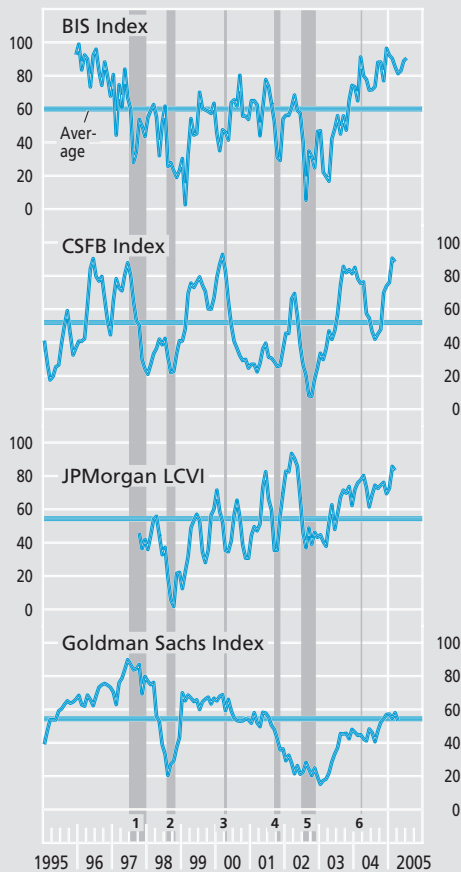
<sup>18</sup> See Goldman Sachs, *Risk aversion*, in: The Foreign Exchange Market, October 2003, pp 28-31. A fundamental assumption of this model is that individuals aim to smooth out their consumption over time. Hence capital investments that are profitable in times of high consumption offer them relatively little marginal utility. The relatively large difference in returns between shares and bonds is therefore said to be due to the risk aversion of market participants aiming for stable returns to keep consumption as constant as possible. The volatility of this difference in returns, which is higher than that of short-term US Treasuries and consumption, is thus explained by fluctuations in risk appetite over time.

<sup>19</sup> See L Kantor and M Caglayan (2002), *Using equities to trade fx: Introducing the LCVI*, in: JP Morgan Global Foreign Exchange Research, Investment Strategies, No 7. Liquidity risks are approximated by the difference in returns between so-called on-the-run and off-the-run US Treasuries. On-the-run Treasuries are the US Treasuries issued most recently that are normally traded the most intensively and therefore have a higher liquidity than older off-the-run Treasuries. In addition, US swap spreads are also included, as they generally expand during tense market phases. The differences in returns between US corporate bonds and government bonds of emerging countries on the one hand and US Treasuries on the other are used for assessing the credit risks. Volatility is taken into account on the basis of implied volatilities in the foreign exchange markets and in the US equity market.

<sup>20</sup> See Deutsche Bundesbank, Annex to the Report on the stability of the German financial system, *Monthly Report*, October 2004, pp 70 ff.



### Indicators for the measurement of risk appetite



All indices are scaled from 0 to 100 to enhance comparability. Higher values indicate a higher risk appetite. — 1 Asian crisis. — 2 Moratorium on sovereign debt by Russia and LTCM crisis. — 3 Burst of the dotcom bubble. — 4 Terror attacks on 11 September. — 5 Accounting scandals (Worldcom etc.). — 6 Terror attacks in Madrid.

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by financial crises that rekindle market participants' awareness of specific risks and thus significantly impact the risk perception of investors. Examples of this are the Asian financial and economic crisis in the second half of 1997, the events surrounding the moratorium on sovereign debt by Russia and the financial problems faced by the hedge fund LTCM in autumn 1998, and the burst of the technology and internet bubble in early

2000. On the other hand, an increase in risk appetite can also develop over a prolonged period, such as in 2003 after the end of the slump in the stock market.

A comparison of the indicators shows that they have undergone phases with similar movements over the past ten years. Periods showing varying developments are likely to be caused primarily by the different approaches to measuring risk appetite. For instance, the indicators of the BIS and Goldman Sachs are based on theoretic models while the LCVI is derived from a simple aggregation of observable individual indicators. Furthermore, the varying coverage of financial markets could also have an impact. While the BIS indicator relates exclusively to equity markets, the CSFB and Goldman Sachs indicators are based on bond and equity markets. Moreover, the LCVI also takes the foreign exchange markets into account. However, this last argument is put into perspective by the fact that integrated financial markets are influenced by investors with similar perceptions and that a change in the risk appetite of investors with diversified portfolios will probably have an impact across the financial markets.

When interpreting the indicators based on market prices it should be borne in mind that these are affected exclusively by market participants. Hence a varying composition of market participants over time could also give rise to variations in the indicators over time. For instance, an increased – often only temporary – activity of hedge funds, which are generally prepared to take on more risk than,

*Informative value of the indicators*



for example, pension funds or insurance companies, could also boost the measured risk appetite. Moreover, non-linear relationships between the development of market prices and risk appetite are also conceivable. Hence the indicators should not be considered as an accurate quantitative measure of risk appetite but rather as a qualitative assessment. Moreover, identifying risk appetite is dependent on the extent to which a separate allocation of the effects of risk appetite and risk on asset prices is possible. In this connection, risk means the risk of a negative deviation from the expected returns.

#### New indicators for the measurement of risk appetite

*New indicators for the measurement of risk appetite*

The indicators outlined below explicitly separate the impact of risk and risk appetite on the development of asset prices. These new indicators are based on the approach of the CSFB index, which derives risk appetite from the relative development of stocks and bonds of varying risk. The current performance of stocks and bonds is related to their volatility, which depicts the underlying investment risk. In addition, the impact of a change in the credit risks of bonds is also assessed on the basis of credit ratings. However, ratings often react with a time-lag to changes in credit risks. The stable and in part even slightly positive development of the ratings of emerging Asian countries in the years preceding the Asian crisis illustrate this phenomenon. They were only adjusted to the decline in the economic environment at the end of 1997. More recent studies have also shown that market

prices react significantly faster to new information regarding the credit risks of bonds and that upgrades and downgrades of ratings are reflected in the risk premiums of bonds several weeks beforehand.<sup>21</sup>

Although the ratings of agencies generally indicate drops in creditworthiness with a time-lag (the agencies point out above all that they only intend to depict sustained changes in solvency rather than temporary ones such as those spanning an economic cycle), their mostly ex post actions reflect a market consensus in assessment already established beforehand. They therefore do not have a forecasting character but a confirmatory one. This is the reason why we bring them forward by up to two months when including them in our estimates.

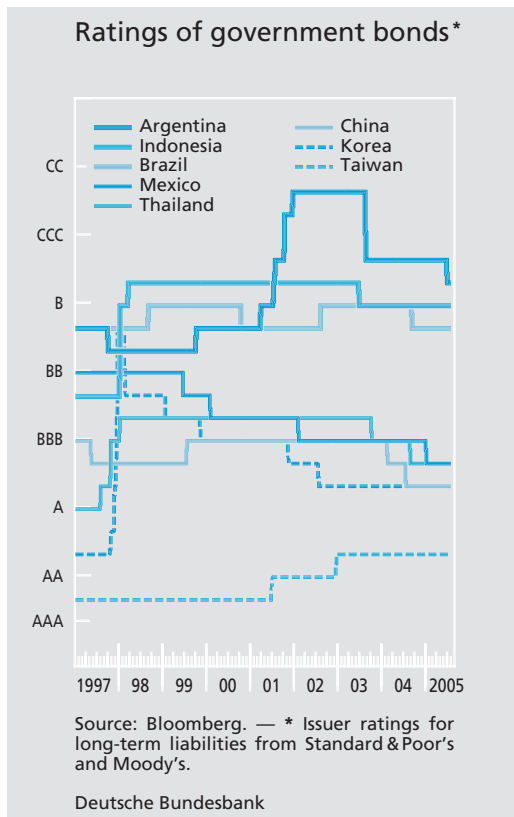
The approach presented calculates two new indicators, of which the first (Index 1) is based on 33 international corporate bonds indices and government bonds and the second (Index 2) additionally comprises a further ten stock indices. Whenever the new indicators approached values of two standard deviations above or below the mean, a trend reversal could often be observed. Reaching or exceeding these thresholds represents extreme values of investors' risk appetite by historical standards.

Index 2, which also comprises the equity markets, reaches very high values at the start of the Asian crisis in July 1997 and at the peak

*Development of alternative indicators*

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<sup>21</sup> See: Deutsche Bundesbank, Credit Default Swaps – functions, importance and information content, *Monthly Report*, December 2004, pp 43 ff.



of the bull market in February/March 2000. By contrast, the first indicator suggests that risk appetite in the bond markets during these months was at around the level of its long-term average.<sup>22</sup> As a result of the Asian crisis and the burst of the technology and internet bubble, both indicators decline sharply albeit that risk appetite in the equity markets fell to a larger extent, starting from a very high level, than in the bond markets.

In autumn 1998, the looming insolvency of the hedge fund LTCM initially boosted the decline in the risk appetite of market participants, which was already decreasing due to the moratorium on sovereign debt by Russia. The efforts of the US Federal Reserve to mitigate the crisis by coordinating financial aid and cutting interest rates several times helped

to instill market participants with renewed confidence. In an environment of improving market sentiment and rising prices, investors' risk appetite also rebounded rapidly.<sup>23</sup>

After risk appetite had picked up again in the two years following the burst of the technology bubble, a decline in the second indicator in mid-2002 coincided with stressed financial markets owing to the insolvency of Worldcom. The BIS and CSFB indicators also point towards a sharp drop in risk appetite at this time. By contrast, Index 1, which is based exclusively on the bond markets, performed relatively stably at this time and as early as autumn 2002 posted a sustained increase which in early 2003 resulted in a peak within the observation period. This development is primarily due to the fact that a global trend towards decreasing interest rates and bond spreads was already established at the end of 2002. From the end of 2002 the other indicators mentioned in this article also went up again significantly. This development in particular reflects the global recovery in the equity markets, although this would seem to be only partially attributable to an increase in risk appetite among investors. Instead, the upswing in the equity and bond markets was also driven by expectations of rising corporate profits.

The terror attacks in Madrid on 11 March 2004 and the financial problems of some

<sup>22</sup> Risk appetite was higher in the equity markets than in the bond markets at the start of 2000 in particular on account of the prevailing euphoria in the equity markets boosted by expectations of a continuing bull market.

<sup>23</sup> MS Kumar and A Persaud (2002) also come to this conclusion.

## New indicators for the measurement of risk appetite

The new indicators for the measurement of risk appetite are based on government bonds, corporate bond indices and stock indices across the world. The approach is based on the assumption that the level and development of the risk premiums is fundamentally determined by the underlying risk and the risk appetite of investors. An increase in investors' risk appetite *ceteris paribus* shifts demand in favour of riskier assets and their price rises relative to less risky assets. Conversely, decreasing risk appetite increases the demand for assets associated with low risks and triggers a price increase relative to riskier investments.

In order to implement this approach the current performance of stocks and bonds is regressed on their risk which is measured on the basis of the annualised volatility of the past twelve months. Furthermore, the effect of a change in the issuer's credit rating on bond prices is taken into account separately in the estimates by using a variable incorporating information on rating upgrades and downgrades.

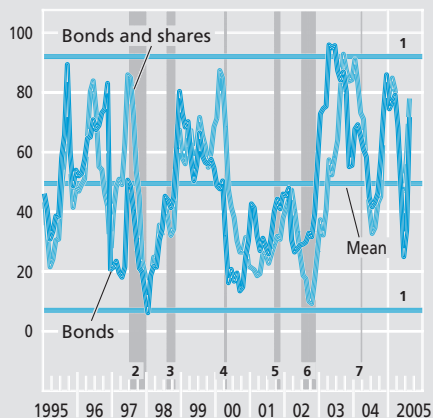
Two indicators are estimated, the first of which is based on 16 government bonds and 17 corporate bond indices and the second of which also includes another ten international stock indices. For the

period from January 1995 to mid-August 2005 the two indicators are estimated for each day using the following regression:

$$ER_i = \beta_0 + \beta_1 volatility_i + \beta_2 \Delta rating_i + \epsilon_i$$

where  $ER_i$  refers to the difference between the current six-month return of bond or stock  $i$  and short-term US Treasuries. The *volatility* variable stands for the historic volatility of the excess returns of the past 360 days.  $\Delta rating$  comprises the numerically scaled change in the issuer rating in the period from 60 days before to 30 days after a rating change. To this end the ratings have initially been ranked in increasing numerical order (from 1 for AAA to 21 for C). If in the next 60 days a rating upgrade or downgrade takes place or if this took place in the last 30 days,  $\Delta rating$  is negative (positive) and otherwise equivalent to 0. The constant  $\beta_0$  in the regression illustrates an overall market trend in bond prices on this day. The indicators for measuring risk appetite are derived from the coefficient  $\beta_1$  which measures the correlation between performance (excess return) and volatility. A positive (negative) coefficient indicates a relatively high (low) risk appetite. To facilitate the comparability with the indicators presented thus far,  $\beta_1$  has been transformed into a scale of 0 to 100 in the chart on page 96.

### New indicators for the measurement of risk appetite



Source: Thomson Financial and own calculations. Indices are scaled from 0 to 100 to enhance comparability. Higher values indicate a higher risk appetite. — 1 Interval thresholds  $\pm 2$  standard deviations from mean. — 2 Asian crisis. — 3 Moratorium on sovereign debt by Russia and LTCM crisis. — 4 Burst of the dotcom bubble. — 5 Terror attacks on 11 September. — 6 Accounting scandals (Worldcom etc). — 7 Terror attacks in Madrid.

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companies in the US automobile industry in early 2005 affected investors' risk appetite only temporarily. At present the two new indicators point to an increase in risk appetite until the start of August 2005.

### Interaction between risk appetite and financial market developments

*Interdependencies between risk appetite, returns...*

The financial markets in the USA and Europe have been dominated by decreasing interest rates and sharply declining risk premiums on bonds and stocks over the last two years, which have been reflected by rising bond and equity prices. As well as improved corporate profitability and declining default rates, investors' search for higher-yielding assets at a time of historically low interest rates will also

have contributed to the decline in risk premiums. By contrast, the high demand for low-risk government bonds seems not to represent a "flight to security" but could rather be due to other factors, such as purchases of Asian countries resulting from the large balance of payments surpluses in these countries or an expansionary monetary policy in connection with low inflation rates. The increased demand of insurance companies and pension funds for debt securities with longer maturities may also have played a role.

There is a long tradition in the finance literature of analysing the relationship between performance and volatility in the equity markets. A common explanation for the negative correlation between equity prices and their volatility is that the capital ratio decreases with declining equity prices, thereby causing the risk and volatility of the stock to increase.<sup>24</sup> The correlations calculated for the period from 1995 to 2005 between the different risk indicators and the development of equity prices and volatilities in the US financial markets show that the degree of investors' risk appetite also changes along with financial market dynamics. Whereas the interdependencies between the indicators vary, all indicators display a negative correlation with the VIX volatility index and – with the exception of Index 1 which refers solely to the bond markets – a positive correlation with the S&P 500.

*... and volatility*

<sup>24</sup> See F Black (1976), *Studies of stock price volatility changes*, Proceedings of the 1976 Meetings of the American Statistical Association, Business and Economic Statistics Section, pp 177-181.

Correlations (1995 to 2005) \*

Index	BIS	CSFB	LCVI	GS	Index 1	Index 2	S&P 500	VIX
BIS	1.00	0.39	0.66	0.27	-0.02	0.24	0.41	-0.77
CSFB	0.39	1.00	0.46	0.31	0.49	0.92	0.46	-0.58
LCVI	0.66	0.46	1.00	-0.07	0.13	0.30	0.16	-0.72
GS	0.27	0.31	-0.07	1.00	-0.21	0.21	0.52	-0.23
Index 1 <sup>1</sup>	-0.02	0.49	0.13	-0.21	1.00	0.71	-0.09	-0.25
Index 2 <sup>2</sup>	0.24	0.92	0.30	0.21	0.71	1.00	0.34	-0.48
S&P 500	0.41	0.46	0.16	0.52	-0.09	0.34	1.00	-0.37
VIX <sup>3</sup>	-0.77	-0.58	-0.72	-0.23	-0.25	-0.48	-0.37	1.00

\* Correlations based on monthly data. — **1** The new index 1 refers to risk appetite on the international bond markets. — **2** The new index 2 covers both bond and

equity markets. — **3** The Chicago Board of Options Market Volatility Index (VIX) uses option prices to depict the implicit volatility of the S&P 500.

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*Risk appetite  
and financial  
stability*

In the light of the interdependence between risk appetite, volatility and financial stability, measuring and interpreting a varying risk appetite is gaining importance. The indicators presented show that a self-reinforcing effect of declining prices for risky assets and decreasing risk appetite may occur. Such dy-

namics can be triggered by a crisis event. A trend reversal in risk appetite has often been observed after reaching historically high or low values. These findings might be helpful in assessing the future development of risk appetite.