

2 Financial markets

Investor appetite has weakened as concerns have mounted about the resilience of global growth prospects amid waning emerging market prospects and persistently low oil prices. As a result, global financial markets continued to be marked by occasional – but short-lived – periods of elevated volatility, particularly in some of the riskier asset class segments. The persistence of such bouts of volatility in global asset prices has been tempered by considerable policy accommodation, in particular the ongoing monetary policy stimulus of major central banks (both conventional in the form of low policy rates and unconventional in the form of negative rates and/or asset purchase programmes).

Euro area financial market developments have in many ways mirrored global developments, but they have also reflected euro area sector-specific concerns. Euro area high-yield segments as well as bank equity and hybrid debt instruments were hard hit by corrections earlier this year. Some market segments, crucial for the functioning of the financial system, were however less affected. Euro area money and sovereign bond markets – both of which were influenced by ECB measures – remained broadly stable over the review period.

Overall, the euro area financial system has been relatively resilient to the reversal of global risk premia observed earlier this year, with indicators of systemic stress remaining low. Notwithstanding this broad resilience, certain euro area financial markets have been hit by short-lived periods of substantial losses and sharp intraday movements. These bouts of volatility have probably been amplified by the prevailing low secondary market liquidity during periods of market stress. The financial stability consequences of these periods of volatility clearly depend not only on their magnitude but also on their persistence. Any prospect of more long-lasting volatility amid an uncertain evolution of underlying macro fundamentals would further test the resilience of investors and the financial system, suggesting a need for sufficient buffers to withstand any more protracted reversals of asset price risk premia.

2.1 Increase in global asset price volatility amid emerging market concerns, changing policy expectations and low oil prices

Global financial markets have continued to be characterised by transitory spikes in volatility – with a particularly marked episode at the beginning of the year. These gyrations, particularly in some of the riskier asset class segments, appear to be related in part to changing expectations regarding fundamentals, resulting in a downward revision of global growth prospects (particularly in emerging market economies – EMEs), monetary stimulus in several advanced economies and bouts of higher risk aversion. In this environment, a reach for less risky assets has resulted in sovereign and investment-grade corporate bond yields remaining at low

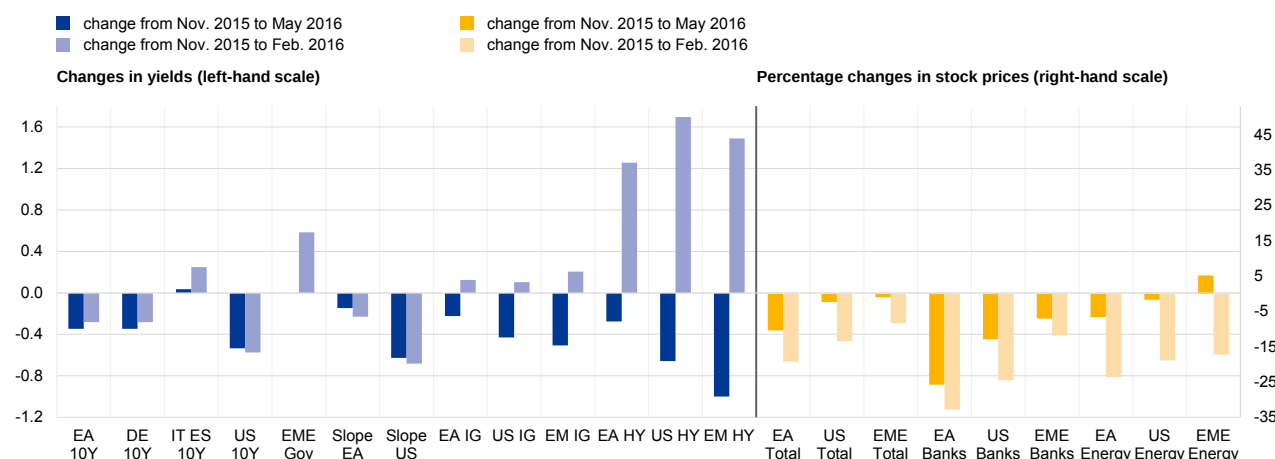
levels. By contrast, the more challenging macro outlook coupled with sector-specific concerns – particularly for the financial and energy sectors – have been detrimental to several risky asset classes, pushing their prices lower (see [Chart 2.1](#)).

Chart 2.1

Yields on safer assets remained low, while the prices of equities and high-yield corporate bonds fluctuated sharply amid a more challenging global growth outlook

Changes in global bond yields and stock prices since the November 2015 FSR

(developments from 25 Nov. 2015 until peak of turmoil (12 Feb. 2016) and until 13 May 2016; daily observations; left-hand scale relates to the blue bars (percentages per annum) and right-hand scale relates to the yellow bars (percentages per annum))



Sources: Bloomberg, Thomson Reuters Datastream and ECB calculations.
Note: EA stands for euro area, IG for investment grade and HY for high yield.

Concerns about the outlook for emerging markets, and that of China in particular, appear to be having a growing impact on asset prices globally.

Throughout 2015 and in the first months of 2016 EME portfolio flows predominantly hovered in negative territory after several years of continued inflows (see [Chart 2.2](#)). Outflows from China have been particularly pronounced as exchange rate expectations changed and investors became increasingly concerned about the limits of policy in steering the economy smoothly to a sustainable growth path. Concerns relate to elevated credit growth, the prospect of rising non-performing loans, further house price increases and signs of elevated stock market valuations. Reflecting these broad macro and financial stability concerns, but triggered specifically by the depreciation of the Chinese yuan on 4 January, Chinese stock prices dropped sharply across the board at the beginning of 2016 (see [Chart 2.3](#)). Similar to previous corrections, notably in the summer of 2015, the fall in Chinese stock prices had a global impact. Looking ahead, a further easing of regulations concerning the leveraged buying of stocks could lead to heightened volatility in the Chinese equity markets.

Chart 2.2

Portfolio outflows from emerging markets in the second half of 2015 and early 2016

Net portfolio flows of stocks and bonds to/from emerging markets

(Jan. 2010 – Apr. 2016; monthly data; three-month moving average of portfolio purchases in USD billions)



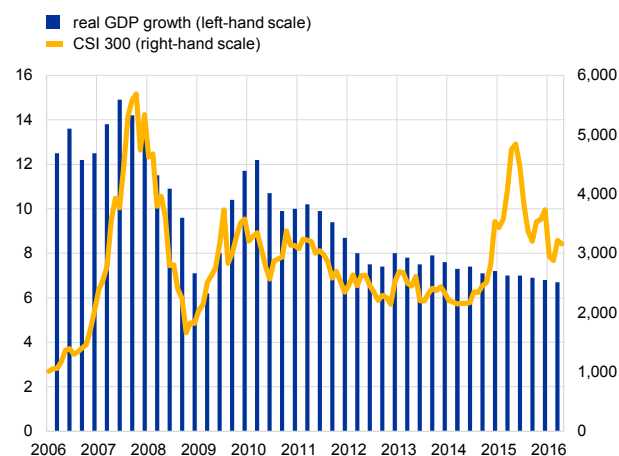
Source: Institute of International Finance.

Chart 2.3

No clear relationship recently between economic growth and stock prices in China

China's real GDP growth rates and the CSI 300 stock market index

(Q1 2006 – Q1 2016 (GDP) and Jan. 2006 – Apr. 2016 (stock prices); annual growth rates of GDP and index levels for stock prices)



Source: Bloomberg.

The near-term risk of higher global interest rates stemming from developments in the United States has receded as the global macro outlook has worsened.

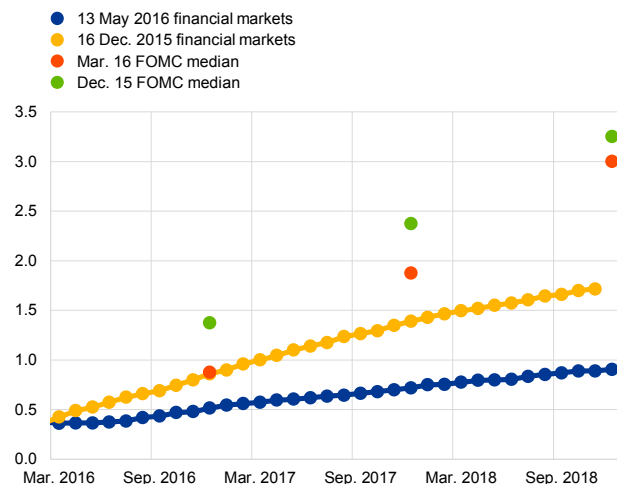
While the Federal Reserve tightened monetary policy at the end of last year, the expected pace of policy tightening has been revised down, partly on account of a more challenging external environment. This reassessment by the Federal Reserve contributed to a narrowing between the predictions for near-term policy rates by financial markets and those by the Federal Open Market Committee (FOMC) (see [Chart 2.4](#)). More aligned interest rate expectations reduce the risk of global asset price volatility stemming from monetary policy shocks in the United States. However, at longer horizons, policy rate divergence between financial markets and the FOMC has increased. This suggests that the risk of a sharp unexpected increase in US interest rates may have merely been pushed further into the future. Furthermore, should US interest rates nevertheless increase in the near term, the accommodative monetary policy stance in other major economies may dampen potential cross-country spillover effects. In contrast to earlier periods when US monetary policy was tightened, several other major central banks have eased monetary conditions further over the past six months (see [Chart 2.5](#)).

Chart 2.4

Both financial markets' and the Fed's interest rate predictions have been revised down

US federal funds rate forecasts by the FOMC and financial markets

(percentages per annum; forecasts for 2016, 2017 and 2018)



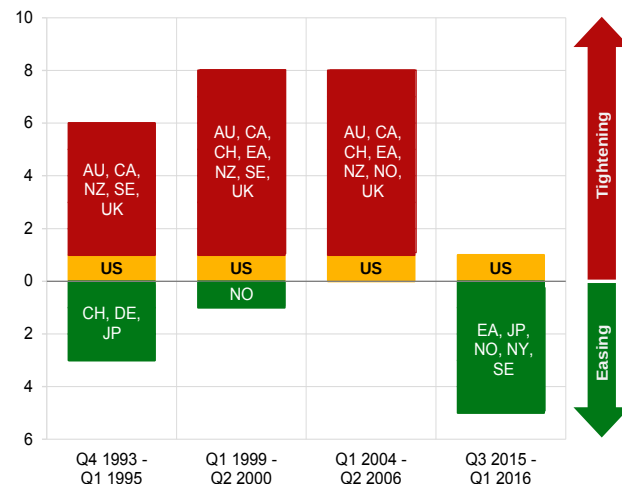
Source: Bloomberg.

Chart 2.5

Decoupling of monetary policy cycles in several advanced economies vis-à-vis the United States

US monetary policy tightening cycles and the respective policy stance in other advanced economies

(1993-2016; quarterly data; y-axis represents the number of countries)



Sources: Bloomberg and ECB calculations.

Notes: The chart identifies major Fed monetary policy tightening cycles since 1994. G10 central bank tightening (easing) of monetary policy is defined by an increase (decrease) of the main policy rate by more than 25 basis points over the Fed tightening cycle. Given the non-conventional measures adopted over recent years, the 25 basis point threshold is not applied to the most recent Fed monetary tightening cycle (Q4 2015 onwards). The Bundesbank's policy rates have been used as a proxy for the ECB's monetary policy before 1999. EA stands for euro area.

The factors depressing oil prices have pushed risk sentiment lower and influenced market-based inflation expectations in advanced economies.

Oil prices have been volatile and fallen sharply since the peak observed in mid-2014 when Brent crude oil hovered close to USD 115 per barrel. While the oil price decline is in principle a stimulus to economic growth in oil-importing economies, its drivers have shifted over time. While most of the early oil price decline in 2014 was explained by the strong rise in oil supply, supply and demand drivers have become less imbalanced, with weaker global demand conditions seemingly prevailing over recent quarters. The lower oil prices have led to a reassessment of credit risk and growth prospects, particularly for oil-exporting EMEs. Financial market developments in these economies have reflected these concerns, as seen from falling currencies and lower stock prices for oil-exporting economies vis-à-vis oil-importing economies (see [Chart 2.6](#)). The decoupling of correlations between riskier and safer global assets in relation to oil prices since the peak in oil prices in mid-2014 is also noteworthy. As oil prices began in 2015 to drop way below even the most bearish ex ante expectations, investors subsequently demanded a higher return on riskier assets (see [Chart 4](#) in the Overview). Oil price developments have also influenced specific market developments in advanced economies. In particular, market-based indicators of inflation expectations have been highly correlated with oil price movements since the peak in oil prices in mid-2014. This pattern reflects some concerns among investors not only that oil price movements increasingly reflect weak demand conditions, but also that inflation expectations may have become

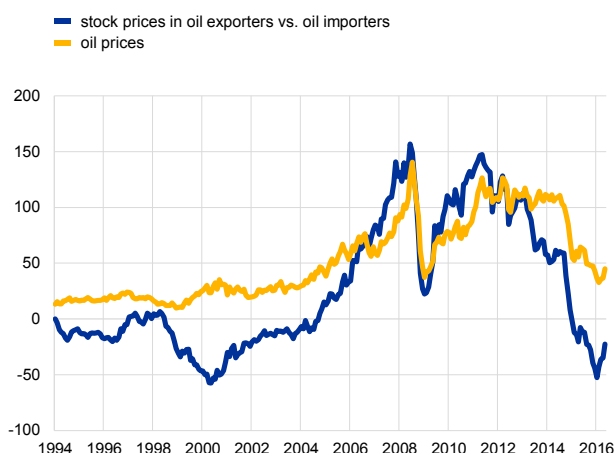
more adaptive and closely tied to persistently low inflation outcomes (see [Chart 2.7](#)). Clearly any prospects of a protracted period of deflation would be detrimental to financial stability.

Chart 2.6

Stock prices in oil-exporting economies relative to those in oil-importing economies

Stock price performance in oil-exporting economies relative to oil-importing economies and the level of oil prices

(Jan. 1994 – May 2016; monthly observations; relative cumulative stock market performance (%), indexed to 0 in Jan. 1994; Brent crude oil prices in USD)



Source: Thomson Reuters Datastream.

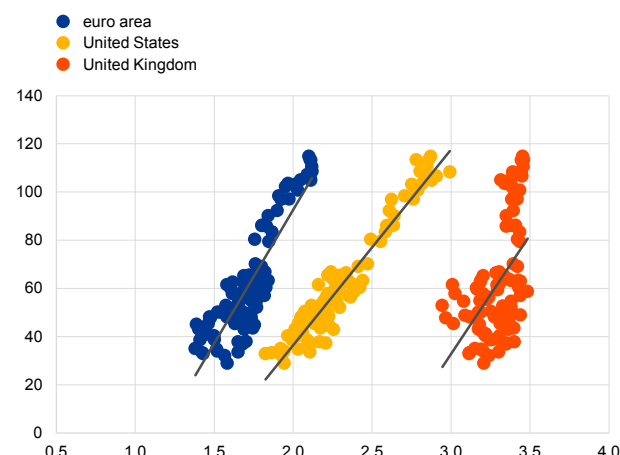
Notes: USD indices. Oil-exporting economies: Russia, Nigeria, Venezuela, Norway, Canada, Mexico, Colombia, the United Kingdom, Brazil and Indonesia. Oil-importing economies: the United States, China, Japan, India, South Korea, Germany, Singapore, Italy, France and the Netherlands.

Chart 2.7

Oil price developments gradually feeding into market-based long-term inflation expectations across major advanced economies

Five-year inflation swap rates in five years' time (x-axis) and Brent crude oil prices (y-axis)

(1 June 2014 – 13 May 2016; weekly data; percentages per annum; oil prices in USD)



Sources: Bloomberg and ECB calculations.

Note: Apart from measuring the "true" underlying long-term inflation expectations, market-based measures also contain an inflation risk premium. Thus, the close correlation may be due to time variation in both components.

2.2 Bouts of euro area financial market turbulence owing to the interplay of global factors and sector-specific challenges

The risks of an abrupt reversal of risk premia in financial markets highlighted in previous issues of the FSR partly materialised in early 2016. The higher

global financial stress due to the more challenging external environment was transmitted to the euro area and was amplified by sector-specific concerns within the euro area. The correction in euro area asset prices and the surge in volatility, while coinciding with broader developments in global markets, were uneven. Bank stocks and certain riskier debt instruments bore the brunt of the correction. Some segments, crucial for the functioning of the financial system, were however less affected. The euro area money market remained fully functional and sovereign bond yields were broadly stable during the height of the financial market turbulence in January and February. In the latter part of the review period, global market conditions improved gradually. In the euro area, ECB measures announced in March contributed to the improved market sentiment. In particular, the new longer-term lending arrangements

under TLTRO II calmed some market concerns that euro area banks' profitability would be adversely impacted by negative ECB deposit facility rates.⁶

Given the possibility of a further deterioration in the global growth outlook, the risk of further episodes of market turmoil remains high. Vulnerabilities outside the euro area have increased and have the potential to spill over to the euro area financial system. Furthermore, it cannot be ruled out that unexpected market events could trigger a further unwinding of positions not only in directly affected market segments but also more broadly amid changeable investor sentiment. If some of the vulnerabilities were to materialise, price corrections could be amplified by more fragile liquidity conditions.

Chart 2.8

Money market spreads were fairly stable at low levels over the past six months

Three-month EURIBOR/OIS spreads

(1 Jan. 2015 – 13 May 2016; weekly data; basis points)



Sources: Bloomberg, ECB, ICAP and STOXX.

Money market rates were insulated from the surrounding market volatility on account of abundant excess liquidity and the ECB's

commitment that this would be maintained. The turmoil in global financial markets had a relatively limited impact on the euro area money market. In fact, in the unsecured money market, the EURIBOR/OIS spreads remained fairly stable over the review period except for a slight increase in February (see [Chart 2.8](#)). The limited financial market contagion to the money market also reflects the regulatory efforts to reduce banks' reliance on short-term wholesale funding, the build-up of liquidity buffers against stress scenarios and improved capitalisations.

The turnover in the unsecured money market segment has fallen in recent quarters, accompanied by a reduction in the liquidity of short-term securities markets in the euro area. The reduction in money market volumes mainly reflects the increased

amount of excess reserves, which reduces the probability that any bank will need to borrow in the interbank market. Regulations have also played a role in reducing turnover in the money market segments. For example, the requirements for banks to maintain a more stable funding profile in relation to the composition of their assets have pushed issuance to maturities above one year. This in turn has contributed to a reduction in banks' issuance activities in the one-to-nine-month segment.

Secured markets have also been less active, predominantly owing to the ample liquidity and the low-rate environment. Similarly to the unsecured segment, volumes in secured markets remained low at the end of 2015 and the

⁶ In March 2016 the deposit facility rate was lowered by 10 basis points to -0.40% and the monthly purchases under the asset purchase programme were expanded to €80 billion per month (investment-grade euro-denominated bonds issued by non-bank corporations established in the euro area were added to the list of assets that were eligible for regular purchases). In addition, it was decided to launch a new series of four targeted longer-term refinancing operations (TLTRO II), starting in June 2016, each with a maturity of four years. For a full list of measures, see the [press release](#) following the 10 March 2016 Governing Council meeting.

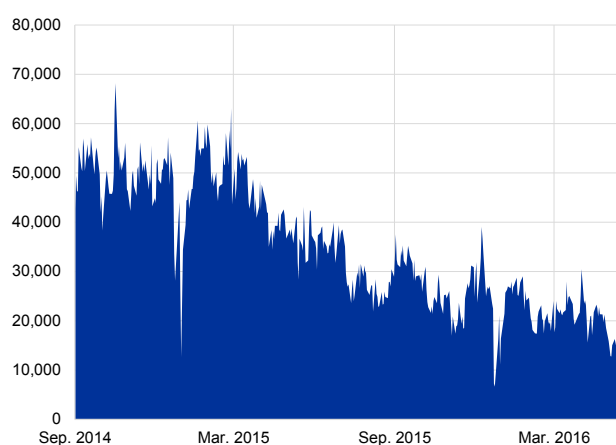
beginning of 2016 (see [Chart 2.9](#)). Also in this segment, excess liquidity and the low-rate environment are contributing to lower activity. In addition, market participants mention that the forthcoming implementation of the leverage ratio (expected to impose a 3% capital charge on the non-risk-based balance sheet of banks) is making the secured business more costly. For that reason, some actors are leaving the repo business which is contributing to the reduction in volumes. In terms of pricing, interest rates on general collateral repurchasing agreements have continued to trend down in recent years as policy rates have fallen further. At the same time, the interest rate patterns on balance sheet reporting dates (year-end and quarter-end) have changed since 2015. In particular, owing to the excess liquidity in the system, the usual increase in borrowing rates on reporting dates has become much more muted (see [Chart 2.10](#)). Additionally, at the end of 2015 and the end of the first quarter of 2016, repo rates on German and French general collateral declined noticeably, while they rose on Italian and Spanish general collateral, suggesting an increased preference among financial institutions to hold highly rated collateral around reporting dates.

Chart 2.9

Secured money market volume has declined considerably

STOXX GC Pooling EUR Deferred Funding Rate Volume Index

(1 Sep. 2014 – 13 May 2016; daily data; EUR millions)



Sources: Bloomberg, ECB, ICAP and STOXX.

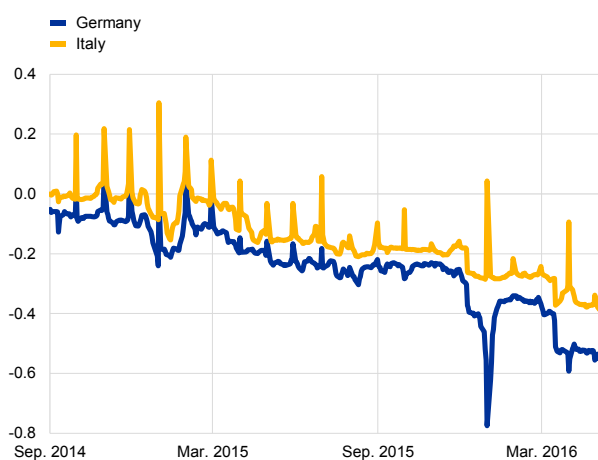
Note: The STOXX GC Pooling EUR Funding Rate Volume represents the total traded volume of all EUR overnight, tom/next and spot/next transactions in the GC Pooling ECB and ECB Extended baskets of the Eurex Repo GC Pooling market with the same settlement day.

Chart 2.10

Banks' higher cash holdings have impacted repo rates around balance sheet reporting dates

Repo rates for German/Italian general collateral

(1 Sep. 2014 – 13 May 2016; daily data; percentage points)



Sources: Bloomberg, ECB, ICAP and STOXX.

Euro area government bond yields continued to hover at low levels partly as a result of compressed term premia (see [Chart 2.11](#)). The low government bond yields in the euro area can partly be explained by the compressed term premia (see [Chart 2.12](#)). Model-based estimates suggest that euro area term premia became negative in January 2016 and thereafter fluctuated close to the previous lows observed before the sell-off in German government bond markets in April/May 2015. Low or even negative term premia are not just a euro area phenomenon. The term premia embedded in US government bond yields have fluctuated around similar levels in recent years. All in all, the prevailing low level of term premia in global

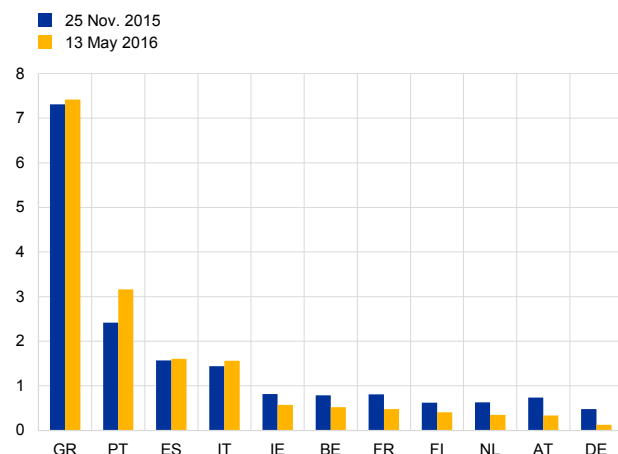
sovereign bond markets warrants close monitoring and investors should have sufficient buffers to withstand a reversal of this situation over the medium term.

Chart 2.11

Euro area sovereign bond yields have been stable overall at low levels since the November 2015 FSR...

Level of ten-year sovereign bond yields across selected euro area countries

(25 Nov. 2015 – 13 May 2016, percentages per annum)



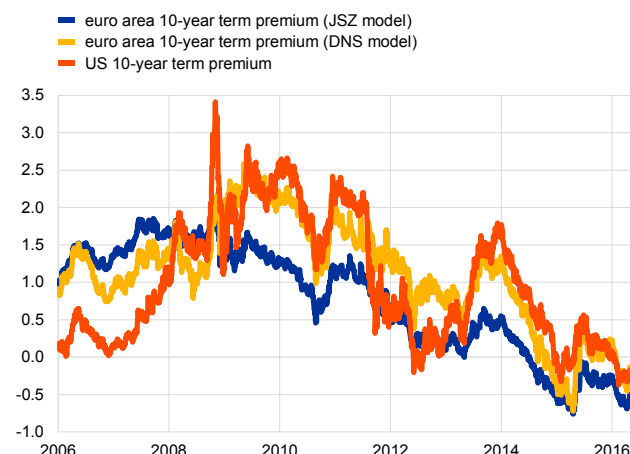
Source: Bloomberg.

Chart 2.12

... partly owing to compressed term premia

Term premia on US and euro area ten-year government bond yields

(1 Jan. 2006 – 13 May 2016; percentages per annum)



Sources: Bloomberg, New York Federal Reserve and ECB calculations.

Notes: The JSZ term premium for the euro area is derived from a Gaussian dynamic term structure model (for more details, see Joslin, S., Singleton, K. and Zhu, H., "A New Perspective on Gaussian Dynamic Term Structure Models", *Review of Financial Studies*, Vol. 24, No 3, 2011). The euro area DNS term premium is based on a rotated dynamic Nelson-Siegel model (see Nyholm, K., "A rotated Dynamic Nelson-Siegel model with macro-financial applications", *Working Paper Series*, No 1851, ECB, 2015). The US term premium is based on a regression approach (for more details, see Adrian, T., Crump, R. and Moench, E., "Pricing the term structure with linear regressions", *Journal of Financial Economics*, Vol. 110, No 1, 2013).

Euro area non-financial corporate bond spreads in the high-yield segment peaked in early 2016 as market sentiment deteriorated.

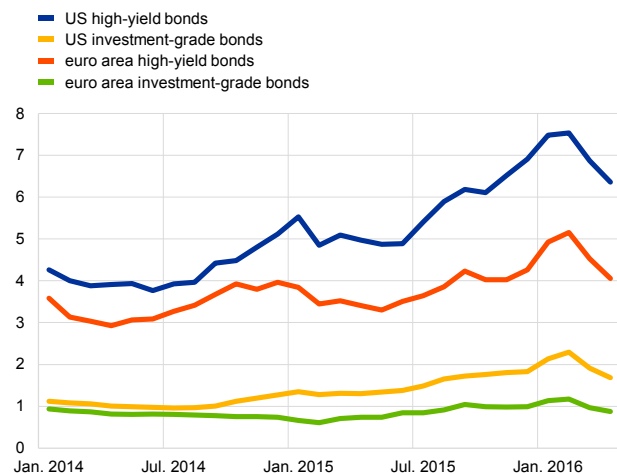
Corresponding spreads for investment-grade firms have remained broadly stable since the publication of the November FSR (see [Chart 2.13](#)). Bond spreads for lower-rated issuers and the energy sector increased sharply in the first months of the year as investors sold off riskier asset classes. The speed of upward adjustment was, however, more muted than that in similar US markets. In recent months, corporate bond spreads have narrowed as a result of the ECB measures announced in March (which included an expansion of its purchase programme to include euro-denominated bonds issued by non-bank corporations) coupled with better macroeconomic data. As at the end of April, the bond spreads for these sectors were broadly in line with model-based fair value (see [Chart 2.14](#)). As regards quantities, debt securities issuance hovered at low levels in January and February 2016, as firms halted planned issuance due to the high financial market volatility. Thereafter issuance increased as reduced global market volatility and ECB measures contributed to restoring market confidence and opened a window of opportunity to bring postponed issuance to the market (see [Chart 2.15](#)).

Chart 2.13

Bond spreads in the euro area below those in the United States

Selected US and euro area non-financial corporate bond spreads

(Jan. 2014 – Apr. 2016; monthly data; percentages per annum)



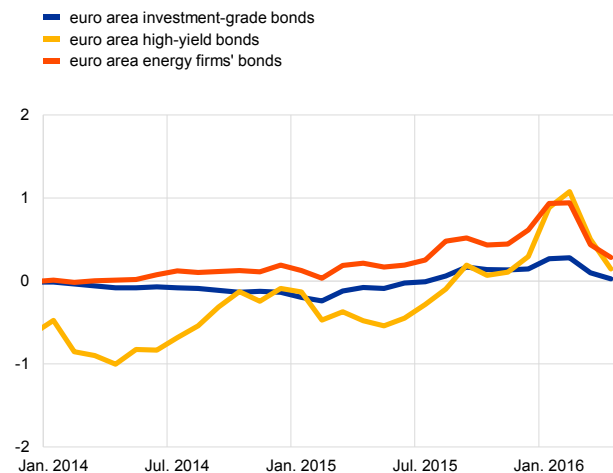
Sources: Bloomberg, Merrill Lynch and ECB calculations.

Chart 2.14

Euro area bond spreads broadly in line with fundamentals in April

Euro area non-financial corporations' excess bond premium

(Jan. 2014 – Apr. 2016; monthly data; percentages per annum)



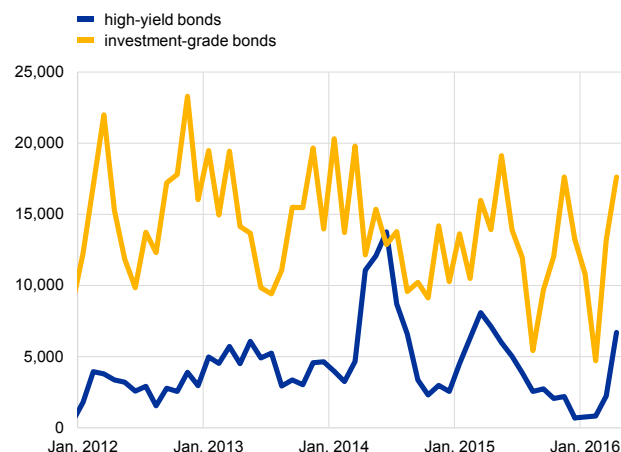
Source: De Santis, R. A., "Credit spreads, economic activity and fragmentation", *Working Paper Series*, ECB, forthcoming.
Notes: The excess bond premium is the difference between actual spreads and model-based implied spreads measuring credit risk at the individual bond level. An excess bond risk premium above/below zero suggests that corporate bond spreads are undervalued/overvalued vis-à-vis fundamentals.

Chart 2.15

Corporate bond issuance edged up in March and April

Gross issuance of euro area non-financial corporate bonds

(Jan. 2012 – Apr. 2016; monthly data; EUR millions; three-month moving averages)



Sources: Bloomberg and ECB calculations.

Financial and survey-based indicators continue to suggest more fragile secondary market liquidity conditions.

This Review has reported in previous issues that low secondary market liquidity in the euro area, particularly in the corporate bond markets, may amplify adverse developments during periods of stress.⁷ The low liquidity can thus be one factor explaining some of the sharp daily movements observed over the past year. Indeed, secondary market indicators for euro area sovereign bonds indicate low levels of market liquidity during the recent financial market turbulence between December 2015 and February 2016 (see [Chart 2.16](#), which compares a wide range of indicators that estimate different dimensions of market liquidity where values closer to the centre of the spider charts imply lower liquidity). Overall, sovereign bond market liquidity conditions during the bank turbulence earlier this year remained significantly above levels observed during the sovereign debt crisis, but more fragile compared with both the pre-crisis period and the period

⁷ For an overview of the asset purchase programme and differences in market liquidity, see *Financial integration in Europe*, ECB, April 2016, Box 2.

leading up to the introduction of the ECB's expanded asset purchase programme in March 2015. Liquidity conditions of vulnerable countries have been more adversely affected in the recent periods of market turmoil, particularly in the form of smaller deal sizes and lower turnover ratios, as well as higher bid-ask spreads and a greater price impact of trades. Low secondary market liquidity in the bond market is consistent with survey-based data. The March 2016 "Survey on credit terms and conditions in euro-denominated securities financing and over-the-counter derivatives markets" (SESFOD) suggests that the liquidity and functioning of some euro area sovereign and corporate bond markets deteriorated further in the first quarter of 2016.⁸ Furthermore, the results of the December 2015 SESFOD survey indicated a decrease in respondents' market-making activities in 2015, possibly reflecting the impact of changes in market microstructures on market liquidity. In particular, algorithmic and high-frequency trading may exacerbate volatility during stressed market conditions (see [Box 3](#)).

Chart 2.16

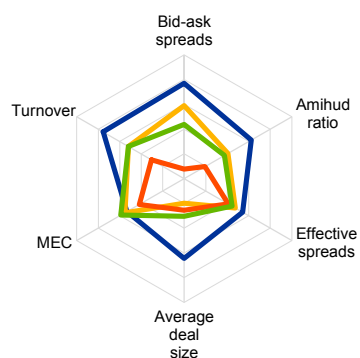
Financial and survey-based indicators suggest more fragile liquidity conditions in secondary markets

Euro area sovereign bond liquidity in euro area countries most affected by the financial crisis

(Jan. 2005 – Feb. 2016; average index value ranging from 0 (centre) to 1, where 1 = highly liquid)

- January 2005 to July 2007 (pre-crisis)
- August 2014 to March 2015 (Jackson Hole)
- May 2010 to July 2012 (sovereign crisis)
- December 2015 to February 2016 (bank turbulence)

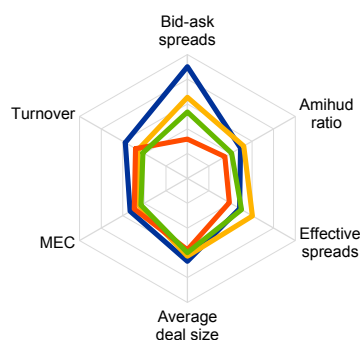
Euro area countries most affected by the financial crisis



Euro area sovereign bond liquidity in other euro area countries

(Jan. 2005 – Feb. 2016; average index value ranging from 0 (centre) to 1, where 1 = highly liquid)

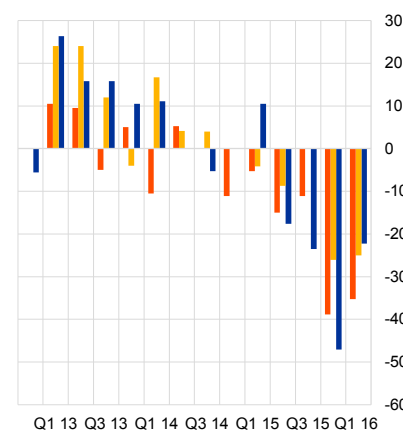
Other euro area countries



Changes in liquidity conditions from the SESFOD survey

(Q4 2012 – Q1 2016; net percentages of survey responses)

- government bonds
- investment grade
- high yield



Sources: MTS, iBoxx, Merrill Lynch, ECB and ECB calculations.

Notes: All liquidity indicators are normalised based on a cumulative distribution function for individual International Securities Identification Numbers (if granular data were available for the equivalent indicator; if not at a country level). Normalised indicators range from 0 to 1, where 1 indicates high liquidity. The indicators cover different liquidity dimensions: tightness (the cost of turning around a position over a short period of time), depth (the size of an order flow innovation required to change prices by a given amount) and resilience (the speed with which prices recover from a random, uninformative shock). Bid-ask spreads are an indicator for tightness; average deal size, effective spreads and the Amihud ratio are indicators for market depth (and breadth); and the market efficiency coefficient (MEC) is an indicator for resilience (deviations between long-term and short-term price volatility indicate deteriorating liquidity conditions). Turnover is an indicator for the volume of trading, which is not a liquidity dimension per se, but is often used as a complementary proxy for liquidity. For the right-hand chart, the net percentage is defined as the difference between the percentage of respondents reporting "increased somewhat" or "increased considerably" and that of those reporting "decreased somewhat" or "decreased considerably". Other euro area countries include Austria, Belgium, Finland, France, Germany and the Netherlands; euro area countries most affected by the financial crisis include Greece, Ireland, Italy, Portugal and Spain.

Euro area stock markets fell sharply around the turn of the year. In early January concerns about weakening economic activity around the globe (notably in emerging markets), compounded by potential adverse signals from falling commodity

⁸ The March 2016 SESFOD survey is available at: <https://www.ecb.europa.eu/press/pr/date/2016/html/pr160418.en.html>

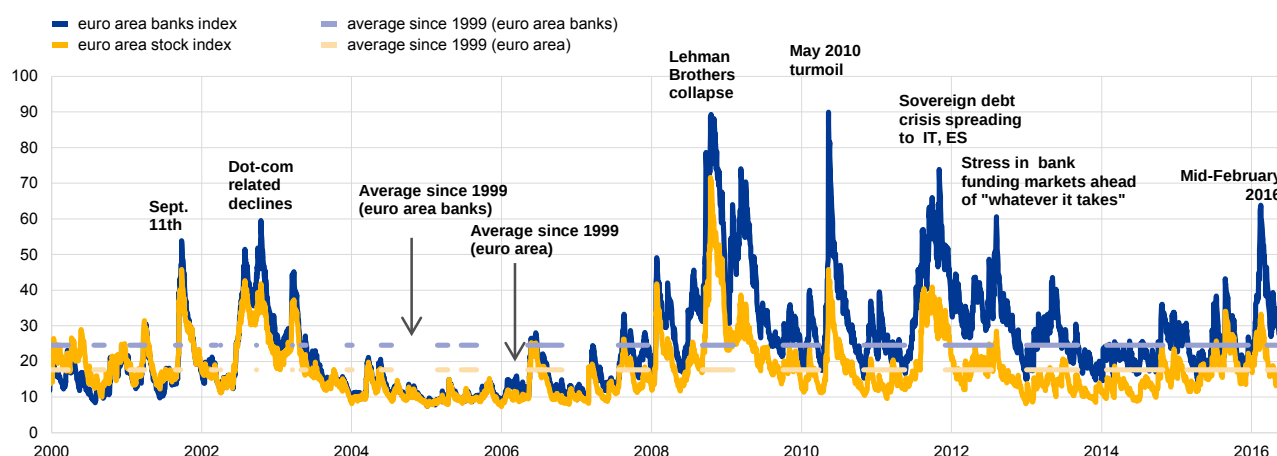
prices, dominated the stock markets. In addition, market participants became increasingly concerned about banks' ability to deliver sustainable profits in a low interest rate environment. Reflecting these sector-specific concerns, the prices of euro area bank stocks and of contingent convertible capital instruments fell sharply. Between the publication of the last FSR on 25 November and the trough recorded on 12 February, the EURO STOXX bank index lost around one-third of its value. The market turbulence was also vividly reflected in measures of stock market volatility. By mid-February the volatility of euro area bank stocks was similar to that seen during the stress observed in 2011-12, but was well below the peaks related to the Lehman Brothers collapse in 2008 and the May 2010 turbulence (see [Chart 2.17](#)).

Chart 2.17

High volatility observed in mid-February

Daily stock price volatility for the EURO STOXX index and the EURO STOXX bank index

(1 Jan. 2000 – 13 May 2016; daily observations; percentages per annum)



Sources: Thomson Reuters Datastream and ECB calculations.

Note: The volatilities have been computed using a GARCH (1.1) model.

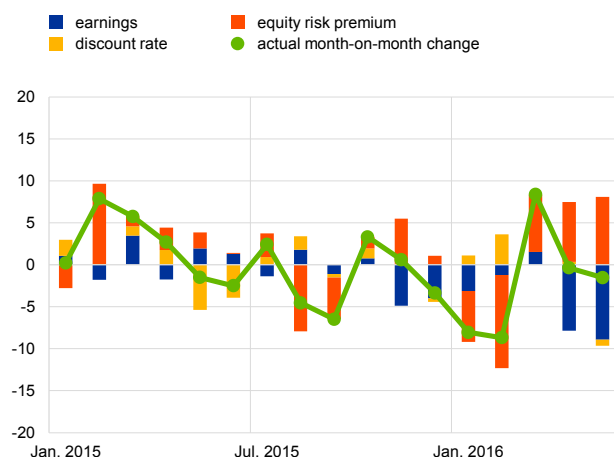
Model-based evidence suggests that the bulk of movements in euro area banks' stock prices in recent months can be explained by changes in investors' risk appetite. Looking at the determinants of banks' stock price movements from a dividend discount model viewpoint suggests that changing equity risk premia rather than earnings expectations made the largest contributions (see [Chart 2.18](#)). Some of the higher premia demanded in the first two months of 2016 have partly unwound since March. Notwithstanding the challenges facing the euro area banking system, this may provide some indications that the sheer speed and magnitude of the correction in euro area banks' stock prices earlier this year partly reflected an overreaction. Going forward, risk-neutral distributions for the EURO STOXX 50 index show that downside risks to future stock price movements have receded in recent months, but remain somewhat higher than six months ago (see [Chart 2.19](#)).

Chart 2.18

Higher equity risk premia were the main driver of the lower bank stock prices early this year

Contributions to changes in euro area bank stock prices

(Jan. 2015 – Apr. 2016; percentage points)



Sources: Thomson Reuters Datastream and ECB calculations.

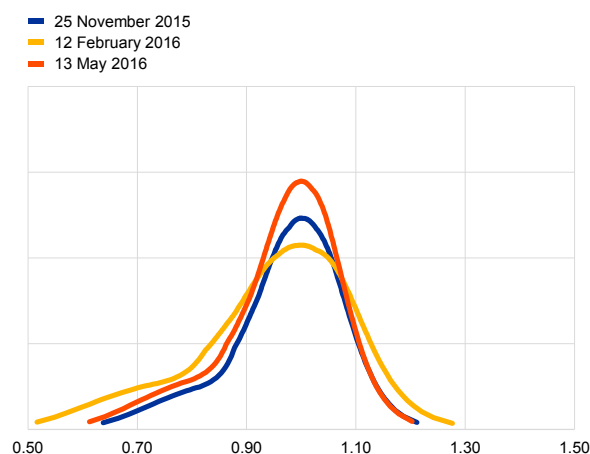
Notes: Contributions to monthly changes in stock price changes are estimated using a three-stage dividend discount model. A higher equity risk premium is displayed with negative values in the chart since it lowers stock prices.

Chart 2.19

Downside risks to euro area stock prices have receded in recent months

Risk-neutral distributions derived from options on the EURO STOXX 50 index

(25 Nov. 2015, 12 Feb. 2016 and 13 May 2016)



Sources: Thomson Reuters Datastream and ECB calculations.

Note: The y-axis shows the density of three-month constant maturity options on the Dow Jones EURO STOXX 50 index. On the x-axis, this index is normalised by rebasing it to 1 at the maximum of the probability density function, which – under normal circumstances – is near the closing level of the index for the day.

Box 3

Financial stability implications of structural changes in market microstructures – algorithmic and high-frequency trading

The use of algorithms to execute trades in financial markets has grown considerably in the last decades, amid technological advancements in computing power and the speed of processing information. Among the wide range of algorithmic trading strategies, high-frequency trading (HFT) has received perhaps the most attention given its potential for major market disruptions such as the “flash crashes” that have occurred in recent years. Gauging the financial stability implications of HFT strategies is complex given that different strategies may create very heterogeneous externalities (both positive and negative) for other market participants unable to process such high-frequency information. Such externalities give rise to financial stability risks encompassing liquidity, procyclicality, confidence in the face of prospective opacity, and market resilience.

HFT activity has tended to migrate towards electronic trading platforms and standardised products, the structured nature of which is a precondition for high-frequency algorithmic trading. The characteristics of the global foreign exchange market, the US Treasury market as well as certain equity and commodity futures markets meet these requirements, which has resulted in a high presence of HFT in those markets. In 2010 the TABB Group estimated that HFT represents 56% of trading volumes in US equity markets, 38% in European equity markets and in the range of 10-30% in Asia-Pacific equity markets. For FX markets, according to the BIS (2011), HFT amounted to 24-30% of spot market turnover. The BIS (2016) estimates that more than 50% of trading volume in benchmark US Treasury bonds can be associated with HFT. European bond

markets are, however, believed to be less exposed to HFT because the use of request-for-quote protocols that query for executable prices quoted to multiple counterparties simultaneously (rather than the use of central limit order books that match bid and ask orders in real time), manual processes, and a low degree of standardisation, as seen in euro area corporate and government bond markets, limit HFT trading strategies. In the euro area bond futures markets, which are more important for price discovery in the cash bond market than in the United States or Japan, HFT is however increasing in volume.

Four key issues from a financial stability perspective should be highlighted. A first risk relates to the implications for market liquidity and the presence of liquidity providers during stressed market conditions in particular. The impact of HFT on market liquidity and volatility is subject to controversy. Some studies cite benefits associated with HFT in terms of lowering transaction costs, helping price discovery, improving secondary market liquidity, and providing more diversity of market participants. Others argue that gains from HFT are only reaped by HFT participants themselves with limited societal benefits, and that HFT may exacerbate volatility in stressed market conditions.⁹ While the presence of HFT on top of central limit order books may improve liquidity for small transaction sizes, it can create the illusion of ample liquidity that disappears when transaction sizes become larger.

A second implication for financial stability is that a large presence of non-human trading may increase the “self-reflexivity of markets”, i.e. price changes are increasingly driven by prices themselves. To date, it is unclear what the implications of strategic behaviours among fast-adapting machines are, as in most cases these are agnostic to underlying fundamentals. A key question in this respect relates to the availability and effectiveness of, for example, circuit breakers in the event that the machine-led price discovery runs off track very quickly.

Third, the crowding-out of traditional committed market-makers is a concern from a financial stability perspective as their presence is needed in particular during adverse market conditions. Trust and confidence in the integrity of financial markets are key to ensure that markets can perform their fundamental role of matching suppliers and users of capital, hence efficiently allocating capital. Events such as “flash crashes”, the risk of fraudulent behaviour, adverse selection stemming from the competitive advantage of extremely low response times, concerns over the depth of central limit order books and the enforceability of observed prices may undermine that trust. More precisely, the perception of an uneven playing field may crowd out traditional market-makers and incentivise them to migrate their activities from “lit” markets to “dark” trading venues that function at a lower frequency.

A final implication for both financial stability and the prudential supervision of markets concerns the ability of infrastructures to cope with the surging speed of messaging and trading. Significant, albeit short-lived, price moves even on very liquid markets¹⁰ have highlighted the need for circuit breakers. The challenge for prudential supervision of markets relates to the large portion of orders being cancelled quickly and illegal market practices occurring too quickly for supervisors to detect them. While many of the perceived negative implications of HFT are already

⁹ See Chung, K. and Lee, A. (forthcoming) for a review of the literature on the impact of HFT and regulatory initiatives around the world.

¹⁰ Examples are the US equity markets (e.g. the August 2015 1,000 point drop in S&P futures) and the US Treasury markets (e.g. the October 2014 “flash crash”). See Bouveret, S. and Lemaître, M., “Characterizing conflicts in fair division of indivisible goods using a scale of criteria”, *Autonomous Agents and Multi-Agent Systems*, Vol. 30(2), 2015, pp. 259-290.

addressed by existing regulation, notably rules against market manipulation, some HFT trading strategies are however designed specifically to obscure their actual trading intent.

Amid this rapidly changing landscape, regulatory discussions around the world have focused on four main approaches to address the risks described above, which are already partially covered by the upcoming MiFID (Markets in Financial Instruments Directive) II rules.¹¹ First, minimum transparency requirements for all market-makers and trading risk controls, which will also involve a pre-trading test phase for algorithms, primarily intend to reinforce market integrity. Second, taxation and trading fee regimes intend to limit procyclicality, shore up market liquidity and enhance market integrity. Third, technical limitations on trading platforms, such as harmonised tick-size regimes, aim to strengthen market resilience. Finally, requirements to register on trading platforms and the imposition of market-making obligations and other trading commitments based on traders' activity levels will require large traders to maintain liquidity even under stressed market conditions and therefore help dampen market cyclicality. In addition, "soft regulation", such as establishing codes of conduct, is also considered by both the industry and policymakers to improve market integrity (see for instance the development by the BIS Foreign Exchange Working Group of a single code of conduct for the foreign exchange market). While single measures may not suffice to contain specific risks arising from (high-frequency) algorithmic trading given its complex nature, the collective set of measures taken together should enhance monitoring and oversight of high-frequency algorithmic trading – to the benefit of financial stability.

¹¹ See the 2015 ESMA draft Regulatory Technical Standard on MiFID II/MiFIR. See also Directive 2014/65/EU, Article 4(1)(39) and (40) and Articles 17(1) to 19(4).