B THE INFORMATION CONTENT OF CDS INDEX TRANCHES FOR FINANCIAL STABILITY ANALYSIS

Information extracted from credit default swap (CDS) index tranches can provide an important contribution to a forward-looking assessment of banking system risk. The market prices of CDS index tranches provide the basis for constructing an indicator of the level of systematic risk in the credit market. In particular, this indicator describes traders' views on the future relative development of systematic and idiosyncratic portfolio credit risk. Thus, it shows whether traders are more concerned about economy-wide credit risk or about firm-specific credit risk such as the default of a particular firm. This Special Feature constructs an estimate of the implied correlation for the euro credit market and describes its use in financial stability analysis. The three main results of this analysis are as follows. First, after January 2006, there was evidence that the focus of credit traders had moved from firm-specific credit risk towards systematic credit risk. This finding can be linked to a number of fundamental determinants of credit market valuation, all of which point in the same direction. Second, the implied correlation provides detailed information about how the credit markets functioned during the May 2005 market turbulence. Third, most of the variation in the implied correlation is not linked to other financial market indicators.

INTRODUCTION

A major structural innovation in the financial system has been the development of a market for credit risk transfer. This market offers a rapidly increasing number of instruments to deal with different aspects of credit risk. Besides providing default protection for individual firms through CDSs, the credit risk in entire credit portfolios can now be traded by means of collateralised debt obligations (CDOs). Essentially, a CDO represents a set of claims or tranches of varying exposure to the cash flows from a portfolio of credit instruments.

A major step in the development of the CDO market was the introduction of the iTraxx credit index in summer 2004. The launch of this commonly accepted benchmark has created an active market for standardised iTraxx tranches in Europe. Hence, firm-specific credit risk is traded through CDSs, and the correlation of credit risk within the underlying credit portfolio is traded through credit index tranches. As tranche prices depend on credit correlation, the CDO segment is also known as the "correlation market". Market quotes for iTraxx tranches therefore contain information about market expectations with respect to the credit correlations of European corporates.

The interpretation of this correlation estimate is however subject to some important caveats. First, changes in risk aversion and the corresponding risk premia provide some limitations in the interpretation of the empirical findings. Furthermore, the impact of liquidity shocks, for example due to demand for specific tranches, may temporarily have adverse effects on the information content of the implied credit correlation.

Correlated credit risk can have strong effects on the value of a bank's loan book. For instance, a bank may have extended loans to two individual firms with low probabilities of default. However, if their default probabilities are positively correlated, then the portfolio risk posed by the two firms is significantly higher than if their default probabilities are uncorrelated.

Other important channels for the impact of correlated credit risk are the sensitivity of individual borrowers to economic conditions or contagion effects. The importance of correlated credit risk is also acknowledged by banking supervisors. In particular, the internal ratings-based approach of the Basel II framework for banks' calculation of their regulatory capital requirements takes into account the fact that systematic risk may have a material effect on loan quality.

This Special Feature seeks to describe how information on the expected co-movement in the euro credit market can be extracted from the market prices of iTraxx tranches. The first section briefly reviews the functioning of the iTraxx CDS index. The second section describes the information contained in iTraxx tranche premia since summer 2004. The third section describes the linkages between iTraxx tranche premia and credit correlation. The fourth section documents the patterns in iTraxx credit correlation in the last two years and discusses the interpretation of this indicator in a financial stability context. The last section summarises the main conclusions.

THE ITRAXX CDS INDEX

CDSs are the most commonly traded credit derivatives and function like a traded insurance contract against the losses arising from a firm's default. They transfer the risk that a certain individual entity could default from the "protection buyer" to the "protection seller" in exchange for the payment of a premium. Should the reference entity default, the buyer is compensated, for example by receiving the difference between the notional amount of the corporate bond and its recovery value from the protection seller. In a CDS transaction, the premium paid by the protection buyer to the protection seller is expressed as an annualised percentage of the transaction's notional value, and constitutes the market quote for the CDS.

In June 2004, a harmonised global family of CDS indices was launched, namely iTraxx in Europe and Asia and CDX in North America. The launch of this credit index family has provided a commonly accepted benchmark for credit markets. The indices represent the average CDS premium of the most liquid firms, and are calculated daily. Based on a semi-annual poll of the main CDS dealers, the index composition is updated twice a year to reflect changes in liquidity and credit quality.[1]

The iTraxx Main index is designed to represent the investment-grade segment of the European credit market. It contains energy firms, industrial entities, consumer cyclical and non-cyclical firms, insurance companies, banks, telecommunications companies as well as automobile firms. The CDS premium on the iTraxx Main index is calculated as the average CDS premium of the 125 member firms.[2] This premium represents the price of credit protection on the entire pool of firms, i.e. a portfolio CDS covering all the 125 firms in the index.

Index CDSs essentially trade like CDSs on a single firm. In case of a firm's default, the firm in question is removed from the index portfolio, and the nominal value of the contract declines by 1/125, i.e. by 0.8%. According to market information, most activity is concentrated in the five-year maturity; this instrument is therefore the focus of the following analysis.[3]

Chart B.1 shows the development of the iTraxx main index with a maturity of five years since summer 2004. In this period, the average CDS index premium was 35 basis points. Thus, it cost 0.35% annually to obtain insurance for a horizon of five years against defaults among the 125 firms in the index. The lowest premium, at around 0.26%, was observed in May 2006 and the highest during the turbulence in credit markets in May 2005 at 0.60%. In this period, S&P's downgrade of Ford and General Motors from investment-grade to the high-yield segment led to a sharp but temporary rise in CDS premia. This had an adverse impact on the functioning of the credit derivatives market, reportedly causing large losses among some

1 For a more detailed description, see J.-P. Calamaro, T. Nassar, K. Thakkar and J. Tierney (2004), "Trading Tranched Index Products: The First Steps", *Deutsche Bank Global Markets Research – Quantitative Credit Strategy;* J. Amato and J. Gyntelberg (2005), "CDS Index Tranches and the Pricing of Credit Risk Correlations", *BIS Quarterly Review,* March 2005, pp. 73-87; and T. Belsham, N. Vause and S. Wells (2005), "Credit Correlation: Interpretation and Risks", *Bank of England Financial Stability Review,* December 2005, pp. 103-15.

2 In practice, there is a small difference between the portfolio CDS and the average across the 125 firms' CDSs. This difference is known as the "basis", and is caused by contractual differences and supply/demand effects.

3 The following analysis focuses on the "on-the-run" series, which is rolled over every half year to the new index composition according to the current poll ranking.

hedge funds (see the December 2005 FSR for a more detailed discussion).

Given the iTraxx index composition, the corresponding CDO comprises instruments with varying degrees of exposure to the joint loss distribution of the 125 firms. These tranches therefore provide claims to the cash flows of the iTraxx CDS portfolio, and in parallel serve as protection for a certain range of defaults in the portfolio. The equity tranche serves as the first level of protection against any defaults among the firms in the index and is therefore also called the "first loss piece". The subsequent levels of default protection are provided by mezzanine and senior tranches, where investors' exposure to default risk in the portfolio is quite small.[4] Specifically, the six iTraxx Main index tranches are Equity (ranging from 0% to 3% of the joint loss distribution), Low Mezzanine (3-6%), Mid Mezzanine (6-9%), High Mezzanine (9-12%), Super Senior (12-22%) and High Super Senior (22-100%).[5]

Collectively, the six tranches cover all the possible losses arising from defaults in the CDS index portfolio. In parallel, all cash flows from the CDS index portfolio are paid out, starting with the senior tranches and ending with the equity tranche. Tranches can be interpreted as options on the joint loss distribution. This option characteristic is reflected in the non-linear dependence of the individual tranches' payoffs on the underlying CDS index. Tranche trading takes place in the over-the-counter market among banks and brokers. Because the instruments are constructed as synthetic single-tranche CDOs, all tranches can be bought or sold individually.

In the case of a default, the procedure is as follows.[6] After the first firm in the index has defaulted, the buyer of the equity tranche, i.e. the seller of protection, has to pay compensation to the buyer of equity protection. After six defaults,[7] the equity tranche records a total loss and hence its 3% upper limit becomes effective. Consequently, protection against any additional defaults until the maturity of the instrument is now provided by the holder of the Low Mezzanine tranche, which covers the 3-6% segment of the joint loss distribution. In the absence of defaults during the five-year horizon, the tranche holders receive their premia for the entire period, and no insurance payments are necessary.

ITRAXX TRANCHE PREMIA SINCE 2004

Table B.1 provides a snapshot of the tranche premia for 1 August 2006.[8] There were large differences in individual tranche premia due to the variation in their inherent sensitivity to portfolio credit risk. The Super Senior tranche, which provides exposure from 12-22% of the loss distribution, pays 3.75 basis points

Chart B.1 iTraxx index

(iTraxx Europe main five-year maturity, basis points)

Source: JP Morgan Chase & Co.

4 According to market terminology, the buyer of a tranche, i.e. the buyer of credit portfolio risk, is selling protection to the counterparty.

5 In addition to the standardised synthetic CDOs discussed here, banks frequently use other types of CDO structures to transfer credit risk from their own loan books, for example in their loans to small and medium-sized enterprises (SMEs).

6 This discussion refers to the simplest instrument, namely a synthetic unfunded CDO, where no exchange of principal takes place and the portfolio consists of CDS.

7 This calculation proceeds as follows: assuming a loss-given default of 40%, six defaults – each of which has an exposure of 1/125% – lead to a total loss of 2.88%. This value is therefore just below the equity tranche's upper limit of 3%.

8 Given the high degree of riskiness, the investor in the equity tranche receives an upfront premium as well as a running premium. For the purpose of comparability, these two equity-specific premia are converted to a regular spread by assuming a duration of four years.

annually, the Mid Mezzanine tranche pays 21.25 basis points, while the Equity tranche pays around 990 basis points. Thus, in exchange for taking on the largest amount of risk in the capital structure, the buyer of the first piece of default insurance for the iTraxx portfolio would be compensated with an expected annual payment of close to 10%.

A major benefit of CDOs is that they complete the range of instruments traded in financial markets by offering new risk-return profiles that would otherwise not be available. This property can be observed in the table: from the CDS index portfolio with an annual premium of around 30 basis points, six new instruments are created, with premia ranging from 0.65 basis points to 990 basis points. To assess the risk in each tranche, the implied leverage, defined as the tranche premium divided by the index premium, provides a simple indication. By definition it equals unity for the CDS index, and ranges from a ratio of 32 (Equity) to a ratio of 0.02 (Super Senior).

Premia on investment-grade tranches are comparable to other credit instruments of similar credit quality. For instance, the premium of the Low Mezzanine tranche is similar to the credit spread on euro BBB-rated corporate bonds.

From a time series perspective, the movements of the five premia are rather heterogenous.[9] Chart B.2 shows the time series of the premia for the tranches covering the loss distribution from 0-22% for the sample from summer 2004 to summer 2006. Overall, a decline for less risky tranches and a sideways movement for the equity tranche can be observed. Among the main factors behind the decline in premia were a benign macroeconomic environment, low equity market volatility and the so-called hunt for yield, a phenomenon that describes institutional investors' strong demand for higher yielding assets in the aftermath of the collapse of stock prices, which started in March 2000. This search for higher yielding assets in the fixed income market manifested itself in many asset classes. In the credit market, this demand pressure, together with low equity market volatility, contributed to a sharp decline in credit spreads, which is clearly visible in the majority of series plotted. For instance, in summer 2004, the premium for the 6-9% tranche was around 60 basis points, whereas in summer 2006 it stood at below 20 basis points. The behaviour of mezzanine and equity tranches was influenced by the impact of arbitrage trading designed to exploit relative value potential between the riskier components of the tranche market.

Regarding the May 2005 episode, a sharp increase in premia is particularly distinct in the case of the equity tranche. The background to this episode is that many credit market investors were trading equity vs. mezzanine tranches by buying protection on the former and selling it on the latter. The sudden decline in the correlation, however, forced traders to rebalance their relative value positions. This renewed pressure may then have prolonged the turbulence.

Table B.1 Capital structure and tranche premia of iTraxx Main index

(attachment points (AP) of iTraxx tranches, premia as of 1 August 2006)

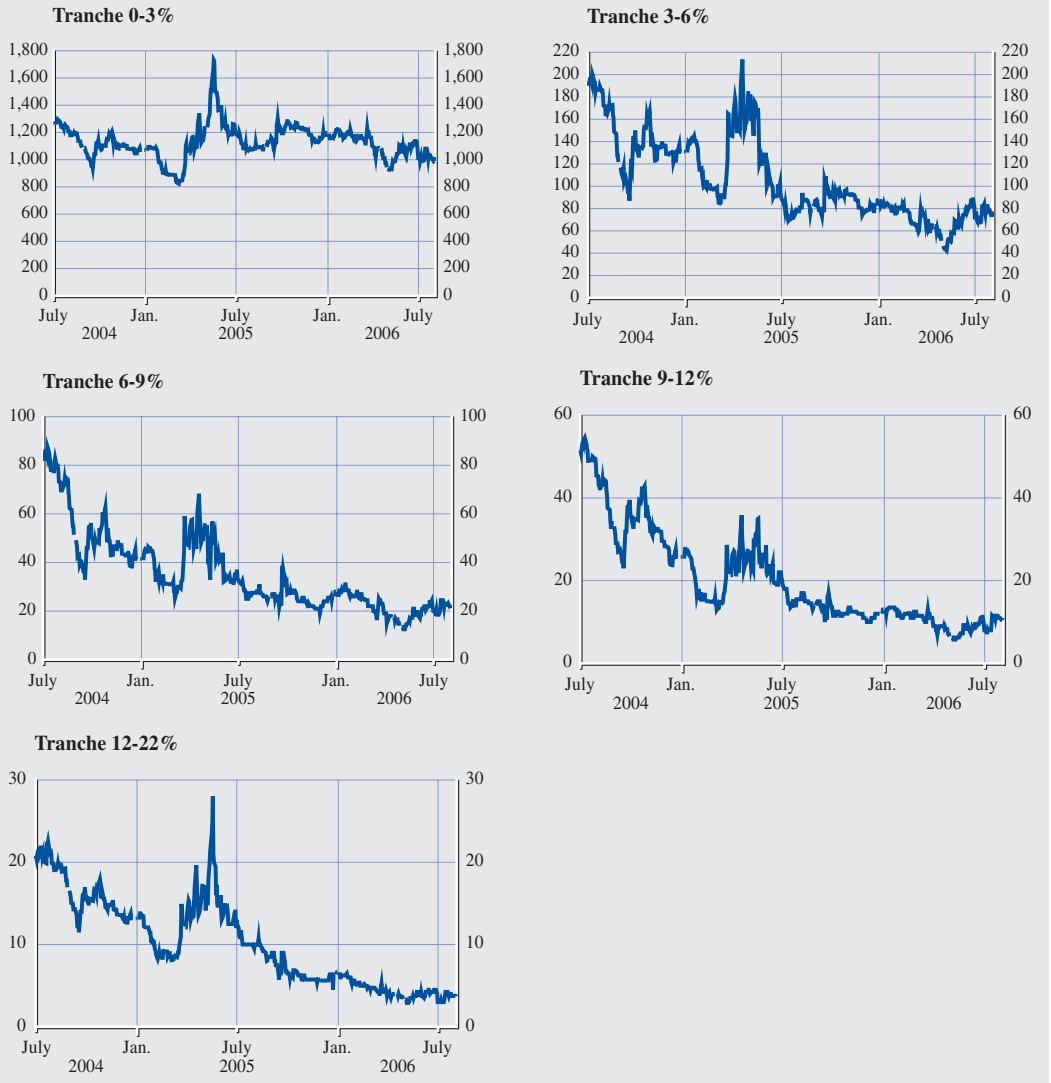
Designation	Lower AP (%)	Upper AP (%)	Premium (Basis points)	Leverage indicator
High Super senior	22	100	0.65	0.02
Super Senior	12	22	3.75	0.12
High Mezzanine	9	12	10.5	0.34
Mid Mezzanine	6	9	21.25	0.70
Low Mezzanine	3	6	72.5	2.38
Equity	0	3	990.62	32.48
Memo: Index	*0*	*100*	*30.5*	*1*

Sources: ECB and JP Morgan Chase & Co.
Note: Leverage is computed as the ratio of the tranche premium to the index premium.

9 Given its very low return, the 22-100% tranche is rarely traded and is therefore omitted from the following discussion.

Chart B.2 iTraxx tranche premia

(basis points)



Sources: JP Morgan Chase & Co. and ECB calculations.

According to a comprehensive academic study on the North American CDS index,[10] overall market pricing of tranches is efficient in the sense that firm-specific, industry-wide and economy-wide aspects, i.e. systematic credit risk factors, together account for a large part of tranche premia. The study also finds that even during the market turbulence in May 2005, there was no significant deterioration in market pricing.

TRANCHE PRICING AND THE CREDIT CORRELATION

Tranche premia are very sensitive to the credit correlation between firms in the portfolio because this correlation directly influences the distribution of risk across the tranches. In

10 See F. Longstaff and A. Rajan (2006), "An Empirical Analysis of the Pricing of Collateralized Debt Obligations", *NBER Working Paper,* No 12210.

particular, tranche premia depend on the joint loss distribution of the underlying portfolio and, given all other parameters, the credit correlation determines the shape of this distribution. As the credit correlation changes, the corresponding movement in the shape of the joint loss distribution is directly transmitted to the relative allocation of portfolio credit risk between equity, mezzanine and senior tranches.

To analyse the linkages between correlation and tranche premia, we describe the impact of increasing credit correlation. Such a rise in credit correlation represents a scenario of increasing systematic and therefore decreasing firm-specific risk in the credit portfolio. Thus, it can be interpreted as increasing risk of a general downturn in the economy rather than the default of a particular firm or a sector. In this scenario, the probability mass moves from the centre to the tails of the joint loss distribution of the iTraxx portfolio. These fatter tails imply that the likelihood of the realisation of multiple credit events has increased. Under this scenario, the overall shape of the joint loss distribution leads to a decline in the equity tranche premium, because the buyer of the equity tranche is not required to make a payment in the absence of a default.[11] This mechanism explains why market participants equate buying an equity tranche to taking a long position in credit correlation: rising correlation lowers the equity tranche premium and therefore raises the mark-to-market value of the position.

The opposite effect of rising correlation is in place for the premia of the senior tranches: this raises their premia and thus lowers their market value. Senior tranches can therefore be seen as "short" correlation positions. With regard to the mezzanine segment of the CDO capital structure, correlation generally has an ambiguous effect on premia.

Estimation of the implied correlation from tranche premia essentially requires a portfolio credit risk model. Based on this model's specification of the joint loss distribution, the individual tranches can then be priced. To estimate the implied correlation, the reverse approach is used: in an iteration procedure; the correlation is adjusted until the calculated premium from the theoretical pricing model equals the market quote for the specific tranche.

In the market for CDS index tranches we observe a modelling convention similar to the options markets, where the Black-Scholes-Merton model has become the standard methodology to link implied volatilities to quoted option prices.[12] Given that all other input parameters are already known, equity index options can be traded through the metric of implied volatilities. Analogously, CDS index tranches are traded through the metric of the implied credit correlation. To extract this parameter from tranche prices, market participants use a one-factor portfolio credit risk model, namely the Gaussian copula model. By means of this procedure, market participants' forecast of average pairwise credit correlation can be "implied" from index tranches (see Box B.1).

11 This result follows from the general characteristics of the joint loss distribution and does not depend on the market environment.

12 See for example J.-P. Calamaro, T. Nassar and K. Thakkar (2004) "Correlation: Trading Implications for Synthetic CDO Tranches", *Deutsche Bank Global Markets Research-Quantitative Credit Strategy;* and L. McGinty, E. Beinstein, R. Ahluwalia and M. Watts (2004), "Credit Correlation: A Guide", *JP Morgan Chase and Co. Research.*

Box B.1

ESTIMATING IMPLIED CORRELATIONS FROM CDS INDEX TRANCHES

Three components are required to evaluate the CDO tranches:[1]

– Probability of default (PD): Estimate of the likelihood of the firm defaulting on its obligations within a given horizon, e.g. one year. The PD is commonly estimated from the iTraxx firms' CDS premia.

– Loss-given default (LGD): Loss on the position following default, commonly expressed as a percentage of the debt's nominal value. The LGD is usually assumed to equal a constant percentage, e.g. 40%.

– Correlation: Estimate of the simultaneous link between the defaults of several firms.

The basis of the model is to establish the likelihood of an individual firm being unable to repay its debt, as determined by the distance between the value of its assets and the nominal value of its debt. The value of the firm's assets is modelled as a stochastic process, and default is assumed to occur when a firm's assets are insufficient to cover its debt. Thus, the asset value represents a measure of a firm's ability to repay its liabilities.

The standard CDO valuation model extends this firm-specific approach to a multivariate setting by means of a single factor, which describes the co-movement of firms' asset values. This common factor can be interpreted as a variable representing the state of the business cycle. Hence the model assumes that firms default owing to a deterioration in the systematic factor or to idiosyncratic, firm-specific shocks. Specifically, in the copula model, firm-specific default risk is "coupled" together through a Gaussian copula model.

One of the key advantages of the Gaussian copula model is that it separates the univariate (i.e. firms' default risk as measured by their PDs) from the multivariate analysis (i.e. the structure of credit risk correlation). Key assumptions in this model are that a single common factor drives firms' asset values and that the underlying portfolio, i.e. the portfolio of iTraxx firms, is sufficiently large and homogeneous. This single factor structure significantly reduces the computational burden.[2] Instead of the (125 * 125) correlation matrix, the computation procedure is reduced to a factor analysis. From the correlation with this factor, the pairwise correlation is computed by multiplying both firms' correlations with the index.

From the tranche premia and the CDS premia for the iTraxx index, an average pairwise asset correlation for the iTraxx firms in the index is estimated by inverting the Gaussian Copula model described above. The resulting implied correlation can be interpreted as the single bivariate correlation of asset returns which is consistent with the observed market price for a

1 See D. Duffie and N. Garleanu (2001), "Risk and Valuation of Collateralized Debt Obligations", mimeo, Stanford University; C. Bluhm (2003), "CDO Modeling: Techniques, Examples and Applications", mimeo, HypoVereinsbank; M. Gibson (2004), "Understanding the Risk of Synthetic CDOs", *Federal Reserve Board Finance and Economics Discussion Series,* 2004-36; L. Andersen and J. Sidenius (2005), "CDO Pricing with Factor Models: Survey and Comments", *Journal of Credit Risk,* 1/3, pp. 71-88; and N. Tarashev and H. Zhu (2006), "The Pricing of Portfolio Credit Risk", *Bank for International Settlements Working Paper* No 214.

2 Given the large number of firms in the iTraxx index, the implementation of multi-factor models is rather rare due to numerical issues.

tranche. Thus, each tranche delivers a separate implied correlation. A simple functional transformation then leads from the implied asset correlation to the implied default correlation. However, applying this correlation concept is problematic in that it frequently leads to multiple correlations for mezzanine and senior tranches. Therefore, a base correlation is now commonly used instead. The base correlation curve is obtained by a bootstrapping and iteration process.[3]

3 Some of the caveats of the base correlation approach are discussed in S. Willemann (2005), "An Evaluation of the Base Correlation Framework for Synthetic CDOs", Journal of Credit Risk, 1/4, pp. 181-90.

In this context, it is important to point out that the Gaussian copula is not chosen because it is the portfolio credit risk model with the best pricing performance, but because it is the most commonly accepted approach to extract the correlation. Furthermore, the theory behind the Gaussian copula approach shows some commonalities to the one-factor set-up used in the internal ratings-based approach of the Basel II framework for banks' calculation of their regulatory capital requirements.[13]

THE IMPLIED CREDIT CORRELATION OF THE ITRAXX INDEX

Applying this approach, the resulting time series of implied correlations for the equity tranche as plotted in Chart B.3. The interpretation of this graph can be explained by the last value of the implied credit correlation. Based on the quoted premium of the equity tranche for 1 August 2006, the 125 firms in the iTraxx set had an average pairwise implied credit correlation of 11.6%. Rising correlation reflects market participants' increased emphasis on systematic credit risk, whereas a decline shows that market participants put more emphasis on firm-specific credit risk.

After summer 2004, implied correlation moved between 0.09 and 0.22. The slight increase in implied credit correlation from January 2006 onwards indicates that investors attached a greater likelihood to systematic than to firm-specific credit risk. This assessment can be linked to two factors in the prevailing environment for the euro credit market. First, the relatively low number of defaults indicated that the stage of the credit cycle still provided support for credit investors, although concerns about an eventual downturn started to increase. Second, investors started to focus on credit risk among a specific number of firms, owing to specific ongoing concerns regarding the auto segment of the credit market and continuing event risk in the form of LBO activity.

The implied credit correlation also provides detailed information about credit market functioning during the May 2005 episode. The graph indicates the observation of a correlation breakdown,[14] when the implied credit correlation abruptly dropped from 0.22 to 0.08. This sudden change in expected correlation adversely affected the hedging strategies that many market

13 See for example M. Gordy (2003), "A Risk-factor Model Foundation for Ratings-based Bank Capital Rules", *Journal of Financial Intermediation,* 12, pp. 199-232.

14 See for example G. Venizelos (2005), "Correlation Correction", *ABN AMRO Credit in Focus.*

Chart B.3 iTraxx implied credit correlation

(iTraxx Europe main five-year maturity, 0-3% tranche correlation)

Source: JP Morgan Chase & Co.

participants had been using for a considerable time. During summer 2005, implied correlation temporarily rose again, but remained below the levels reached during the market turbulence in May 2005. This increase in perceived systematic credit risk at least partly reflected a decrease in the premia of the equity tranche as well as a decline in the CDS index.

In interpreting the implied credit correlation, several caveats need to be mentioned. To start with, inference has to be cautious because of the still rather limited sample period. In particular, the new market has not been through a full credit cycle. Furthermore, some technical factors unrelated to credit risk may affect the information content of market prices. For instance, investors' changing demand for specific tranches plays a non-negligible role, leading to potentially large temporary liquidity premia. This effect may also have played a role during the period of market turbulence. More generally, the credit risk transfer market is evolving rapidly and thus has not yet reached a steady state. In this context, the changing population of market participants as shown by the increasing role of hedge funds also needs to be taken into account.

Risk premia are another important determinant of the implied credit correlation. Given that the implied correlation is calculated from market prices, it does not necessarily equal the credit correlation estimated from historical data, even in the absence of technical factors. Implied credit correlation, which is conceptually similar to the implied volatility derived from equity index options, represents market participants' expectations of future realised credit correlation. Therefore, it contains not only the traders' correlation forecasts, but also a risk premium, which is in part driven by traders' degree of risk aversion.[15]

To evaluate the information content of the implied credit correlation, it is necessary to identify its main determinants. Therefore, we analyse how the implied credit correlation is related to four key financial market indicators: the credit risk premium, the slope of the term structure, equity market risk, and equity market returns. First, the credit risk premium as represented by the level of the iTraxx CDS index determines the central tendency of the joint loss distribution. Second, the slope of the term structure reflects how market participants assess the economic climate because of the linkage of the term structure to investors' portfolio decisions. If investors expect the business climate to deteriorate, they will shift some of their assets from short-maturity instruments into long-term bonds. This change in the portfolio composition will lead to a flatter slope of the term structure. A poorer outlook for the economy could also raise credit correlation, because investors may react to the increased likelihood of multiple defaults. In other words, a negative relation may be expected between the two. Third, equity market risk as measured by the implied equity index volatility is an indicator of market-wide uncertainty and should have a positive effect on the implied credit correlation since greater market risk may imply a greater likelihood of multiple adverse credit events. Finally, a sharp decline in stock prices may generally reflect the perception of increasing systematic risk implying a negative relation between these two variables.[16]

The effects of these factors are evaluated by means of a standard regression approach using the first differences of correlation as the dependent variable. Thus, the regression tests how a change in, for example, the slope of the term structure changes the implied credit correlation. In the simultaneous estimation with four explanatory variables, only one factor is statistically significant (see Table B.2). The change in the iTraxx CDS premium enters the equation with a negative coefficient: a rise in the CDS premium reduces the implied credit

15 See for example M. Scheicher (2003), "What Drives Investor Risk Aversion? Daily Evidence from the German Equity Market", *BIS Quarterly Review,* June 2003, pp. 67-74.

16 The slope of the term structure is defined as the ten-year swap rate minus the three-month money market rate. To measure equity market risk, the VDAX series of implied volatility for the DAX index is used. For the stock market, the EURO STOXX 50 index is used.

Table B.2 Determinants of implied credit correlation

Variable	Coefficient	t-Statistic	Prob.
C	-0.02	-0.76	0.45
CDS Index	-0.15	-2.96	0.00
VDAX	-0.04	-0.97	0.33
Slope	-0.88	-1.34	0.18
EURO STOXX	-1.64	-0.44	0.66
Adjusted R-squared	0.09		

Sources: ECB and JP Morgan Chase & Co.
Note: Method = least squares regression with a constant, the CDS index, the VDAX implied volatility, the slope of the term structure and stock returns as explanatory variables; Sample = 1 September 2004 - 2 August 2006, White standard errors and covariance, all variables are in first differences, EURO STOXX in log first differences.

correlation. There are no significant effects from the equity market or from the term structure.

Overall, the explanatory value of these four variables is rather low, as the adjusted R-square is less than 10%. The information contained in the set of four factors is only weakly related to the implied credit correlation, so that a large part of its variation can be seen as idiosyncratic. This empirical finding indicates that the implied credit correlation contains specific information not available in other indicators. Part of this idiosyncratic component may also be related to the technical factors mentioned earlier.[17] These results are also obtained if the financial market factors are orthogonalised by means of a principal components analysis. Thus the finding of weak explanatory power is robust to multicollinearity among the explanatory variables.

CONCLUDING REMARKS

This Special Feature has described how the market prices of CDS index tranches can be used to analyse market expectations regarding the degree of credit correlation among European corporates. This indicator slightly increased after January 2006, suggesting that investors attached a greater likelihood to systematic rather than to firm-specific credit risk. This finding can be linked to a number of determinants of credit market valuation, all of which point in a similar direction.

The methodology in this Special Feature can be extended in a number of directions, of which two particular ones may be highlighted. First, the implied correlation from mezzanine and senior tranches can be analysed. As the correlations of these tranches differ from the correlation implied from the equity tranche, there is a correlation "skew". Second, the scope of the CDS index can be extended in the dimensions of maturity and credit risk, i.e. towards longer maturities and towards the high-yield segment. In particular, the latter index category, which is represented by the iTraxx Crossover Index, may be interesting for an assessment of banking system risk, because many banks' loan books are exposed to the high-yield segment of the credit market through loans to small and medium-sized enterprises or via leveraged loans.

17 For an empirical demonstration of the importance of supply/demand shocks in US credit spreads, see P. Collin-Dufresne, R. Goldstein and J. S. Martin (2001), "The Determinants of Credit Spread Changes", *Journal of Finance,* 56, pp. 2177-2207.