WP/06/107

IMF Working Paper

Idiosyncratic and Systemic Risk in the European Corporate Sector: A CDO Perspective

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INTERNATIONAL MONETARY FUND

 WP/06/107

IMF Working Paper

Monetary and Financial Systems Department and Asia Pacific Department

Idiosyncratic and Systemic Risk in the European Corporate Sector: A CDO Perspective

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April 2006

Abstract

Systemic risk remains a major concern to policymakers since widespread defaults in the corporate and financial sectors could pose substantial costs to society. Forward-looking measures and/or indicators of systemic default risk are thus needed to identify potential buildups of vulnerability in advance. In this paper, we explain how to construct idiosyncratic and systemic default risk indicators using the information embedded in single-tranche standardized collateralized debt obligations (STCDOs) referencing credit derivatives indices. As an illustration, both risk indicators are constructed for the European corporate sector using mid-price quotes for STCDOs referencing the iTraxx Europe index.

JEL Classification Numbers: G10, G12, G15

Keywords: Systemic risk, idiosyncratic risk, credit derivatives, credit derivatives indices, collateralized debt obligations, tranches

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[1] We thank seminar participants at the IMF for their comments and suggestions. All errors and omissions remain our sole responsibility. Please address correspondence to both authors.

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I. INTRODUCTION

Systemic risk is a major concern for those in charge of ensuring financial stability. While the default of an isolated corporation or financial institution could be very costly, as experienced in the recent defaults of Delphi, Enron, and Worldcom in the United States, it may not have a major impact on other corporations and institutions. Increased financial integration across markets and institutions, however, suggests that single defaults could trigger a second round of defaults. The possibility of such an event was highlighted dramatically during the 1998 collapse of Long Term Capital Management, a large, highly leveraged, hedge fund.

Therefore, the assessment of systemic risk remains a major policy challenge. Fortunately, the rapid growth of the credit derivatives market during the past five years has opened a window to the market views on systemic risk. According to the British Bankers Association, the notional amount in the global credit derivatives market amounted to about $5 trillion in 2005, up from less than $1 trillion five years ago. In contrast to other over-the-counter derivatives markets such as the swaps market, not only has the notional amount of credit derivatives products increased rapidly but also the complexity of the contracts has increased as well.

Some of the most complex derivatives products can broadly be categorized as portfolio products, since their payoffs are associated to the default loss distribution of a pool of reference contracts. The reference contracts can be loans, corporate and sovereign bonds, plain-vanilla credit default swaps, or a combination of them. Thus, the price of these contracts should partly reflect market participant views on the probability of observing multiple defaults in the reference pool of contracts.

Among portfolio products, the most popular portfolio contract is the collateralized debt obligation (CDO). In a CDO, the cash flows associated to the reference portfolio are sold to investors in different tranches. Each tranche has a different default risk profile as the subordinated tranches bear the first losses associated with the defaults in the reference portfolio.

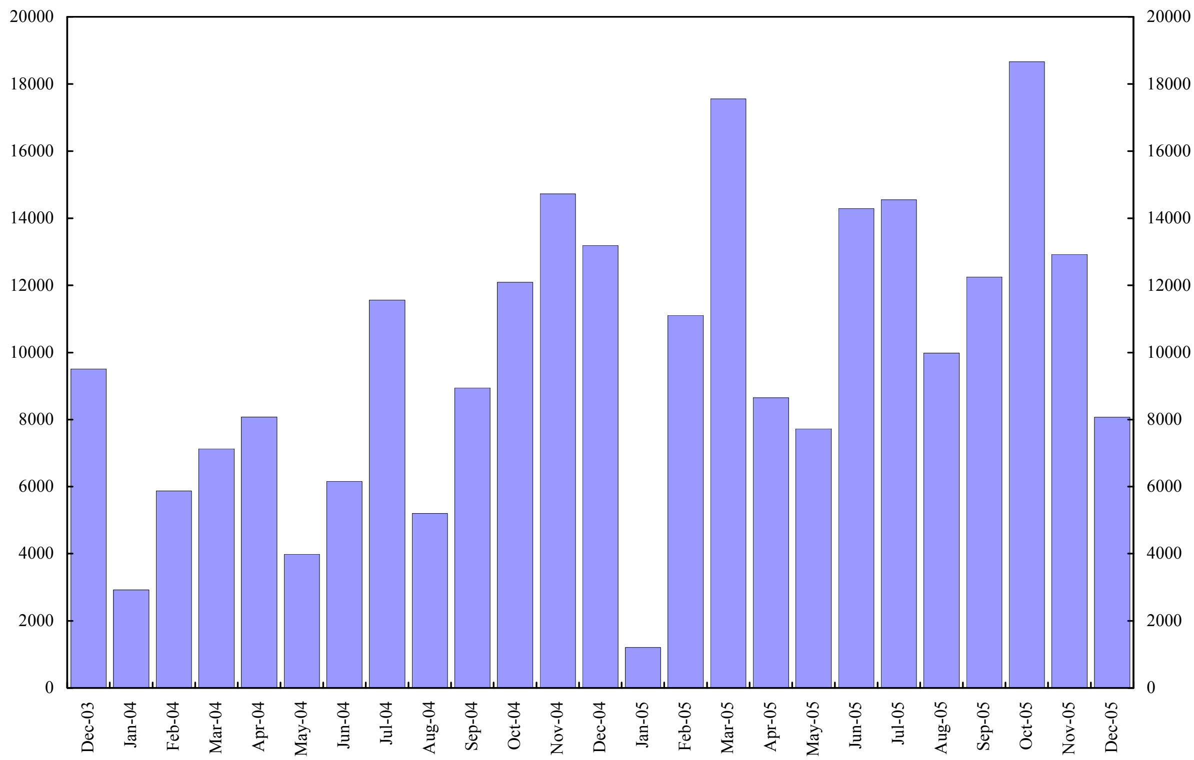
In this paper we construct idiosyncratic and systemic risk indicators for Europe using price information on the default loss distribution implied by the prices of different tranches of standardized CDOs. Standardized CDOs reference standard credit derivatives indices in Europe and the United States. Each regional credit derivatives index references a broad pool of the largest corporate issuers in the region, and hence, incorporates market views on the loss distribution of the region's corporate sector. Because tranche prices react differently to idiosyncratic and systemic risk depending on its degree of loss subordination, it is possible to extract the different risk components from tranche prices.

We provide background information on CDOs in Section II. The reader already familiar with these concepts may want to jump ahead to Section V, which describes the data and empirical method used to extract the idiosyncratic and systemic risk components. Conclusions and future work are discussed in Section VII.

II. A Brief Primer on Collateralized Debt Obligations

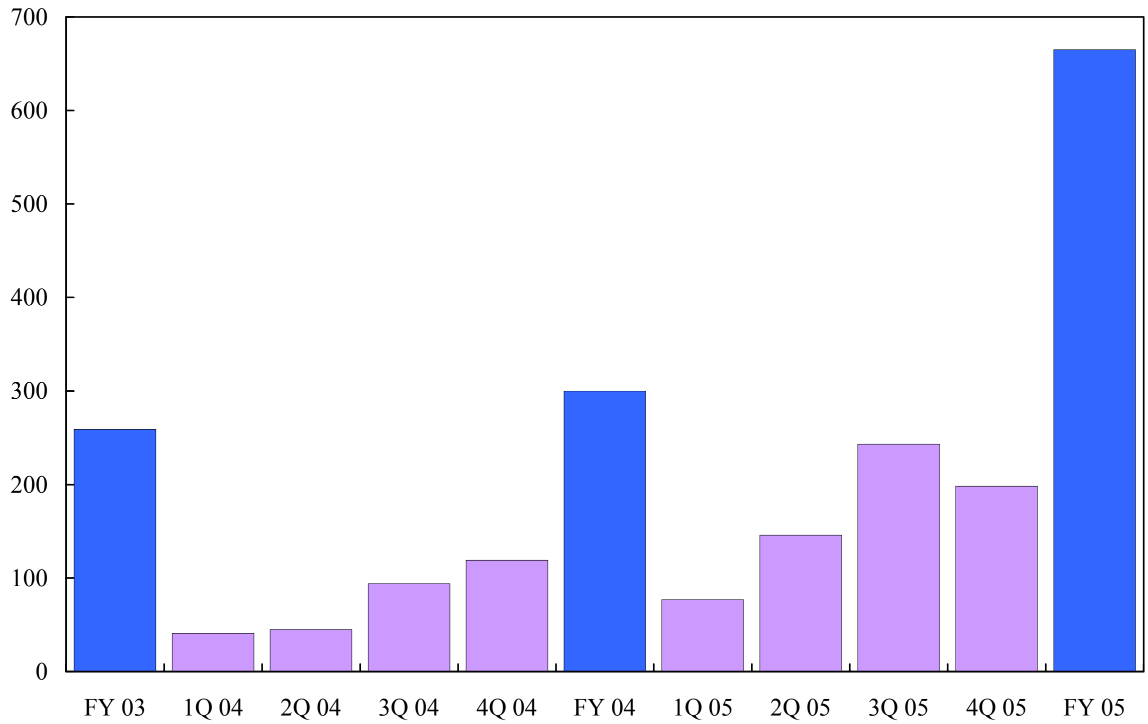
A Collateralized Debt Obligation (CDO) is an investment vehicle that issues notes to investors to raise funds that are invested in a portfolio of risky financial assets. The CDO market has been one of the fastest-growing segments of the credit derivatives market. For instance, the issuance of cash CDOs in the United States increased to $137 billion in 2005 from $91 billion in 2004, while the outstanding notional amount of single-tranche CDOs almost doubled during the same period (Figures 1 and 2 respectively). The market itself has witnessed the evolution of several types of CDOs with each one reflecting an increasingly sophisticated demand from investors and the emergence of new financial products.

Figure 1. U.S. Cash CDO Issuance
(In millions of U.S. dollars)



Source: Merrill Lynch

Figure 2. Single Tranche CDO, Global Notional Outstanding Amount
(In billions of U.S. dollars)



Source: CreditFlux

A. Cash CDOs

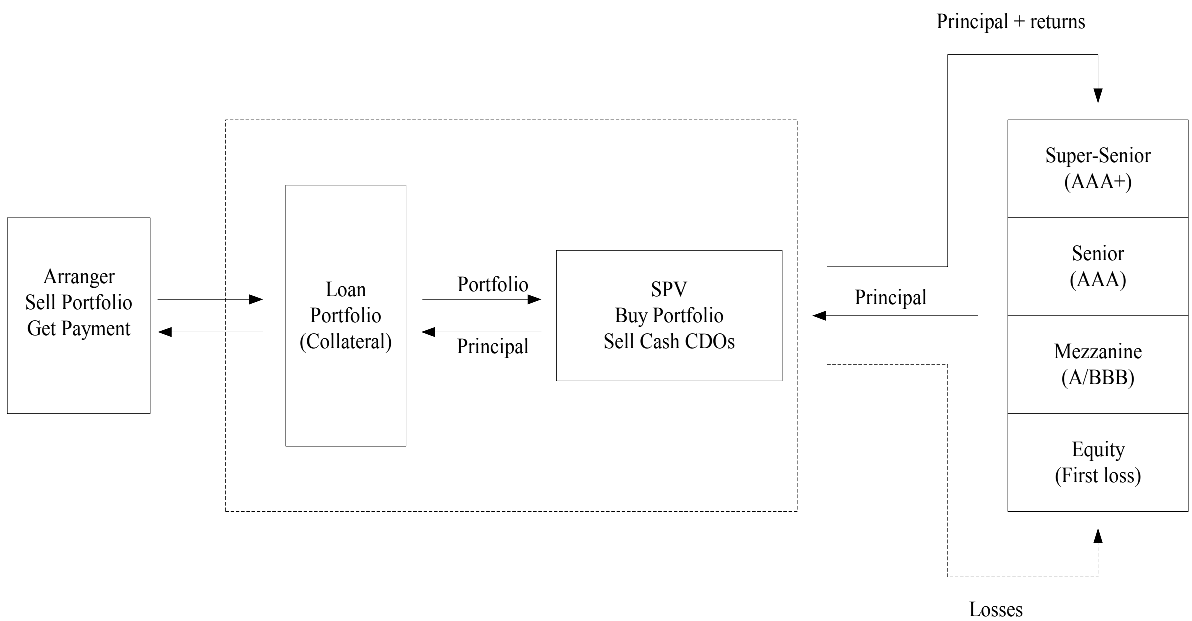
The earliest type of CDOs took the form of cash CDOs. As implied by the name, cash CDOs rely on the cash flows generated from a portfolio of risky financial assets to pay returns to investors holding CDO notes. The first deal was done in 1987 with high yield bonds in its portfolio.[2] As the capital market has become increasingly sophisticated and globally integrated, corporate loans, mortgage loans, emerging market corporate bonds, and sovereign bonds have been added to the CDOs underlying portfolios.

Besides investors, two other counterparties are involved in a standard cash CDO deal: an arranger and a special purpose vehicle (SPV). The arranger, usually a bank, is the originator of the CDO deal, who conducts the CDO deal at the beginning. In the next step, an SPV is established to buy the financial assets from the arranger. One requirement of the CDO is that the SPV has to be bankruptcy-remote from the originator, meaning that the SPV will not default on its obligations if the arranger goes bankrupt. In order to raise funds to buy the financial assets, the SPV issues to investors the CDO notes, which are collateralized by the financial assets held by the SPV.

[2] See UBS (2005).

The cash CDO is tranched into different credit risk classes ─ equity, mezzanine, senior, and super-senior tranches ─ to cater to the different risk-return profiles of investors. The equity tranche is the most junior tranche. Investors in equity tranches could lose their principal as they absorb the first losses on the collateral pool (zero percent attachment point). But they are compensated by receiving all the remaining returns after all the other investors receive their returns specified in the contract. The mezzanine tranche, though not subject to the first loss, could still face considerable default risk and is typically rated as A/BBB. The senior tranche is rated AAA, and the super-senior tranche is rated above AAA. A typical cash CDO structure is represented in Figure 3.

Figure 3. A Typical Cash CDO Structure



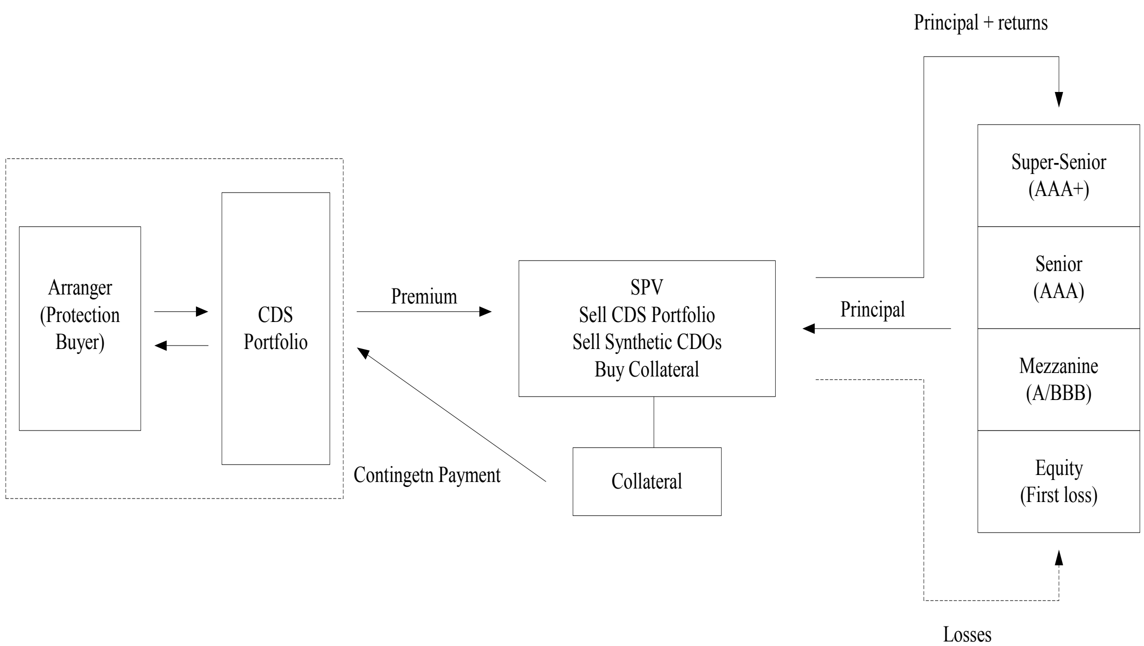
Cash CDOs are attractive to both arrangers and investors, which explains their emergence and popularity in both the demand and supply side of the credit derivatives market. One main incentive for a bank to arrange a CDO is reducing the required regulatory capital. By selling financial assets to an SPV, the arranger removes the financial assets from its balance sheet and therefore eliminates the required regulatory capital against these assets. For investors, CDOs offer the opportunity to invest in a diversified portfolio of assets. Since some assets are illiquid and difficult to find in the market, the existence of a portfolio of such assets saves the investors time and money while providing them with the desired credit exposure. Due to diversification and leverage, the investment grade tranches, such as senior and super-senior tranches, usually generate higher returns compared with other alternative investments with the same credit ratings.

B. Synthetic CDOs

Rapid growth and liquidity in the credit derivatives market has led to the emergence of a second type of CDO, synthetic CDOs. Instead of referencing assets that can generate cash flows, synthetic CDOs reference credit derivatives, usually credit default swaps (CDSs).[3] The SPV associated to a synthetic CDO sells a portfolio of CDSs to the arranger and then uses the CDS premiums to pay investors.[4]

Synthetic CDOs have two structures, funded and unfunded structures. In a funded synthetic CDO, the SPV sells a portfolio of CDSs to the arranger. Accordingly, the SPV buys some collateral assets against the sold-out portfolio and, if a bond that is linked to one or some of the CDSs defaults, it sells part of the collateral to make a payment to the arranger. In order to buy the collateral assets, the SPV has to issue to investors the CDO notes, and investors have to pay the principal at the inception of the deal. In the mean time, investors receive CDS premiums, but face a loss of the principal when defaults happen. Same as in a cash CDO, equity tranche investors absorb the first losses on the collateral assets in return for the highest return. Figure 4 shows the typical structure of a funded synthetic CDO.

Figure 4. A Funded Synthetic CDO Structure



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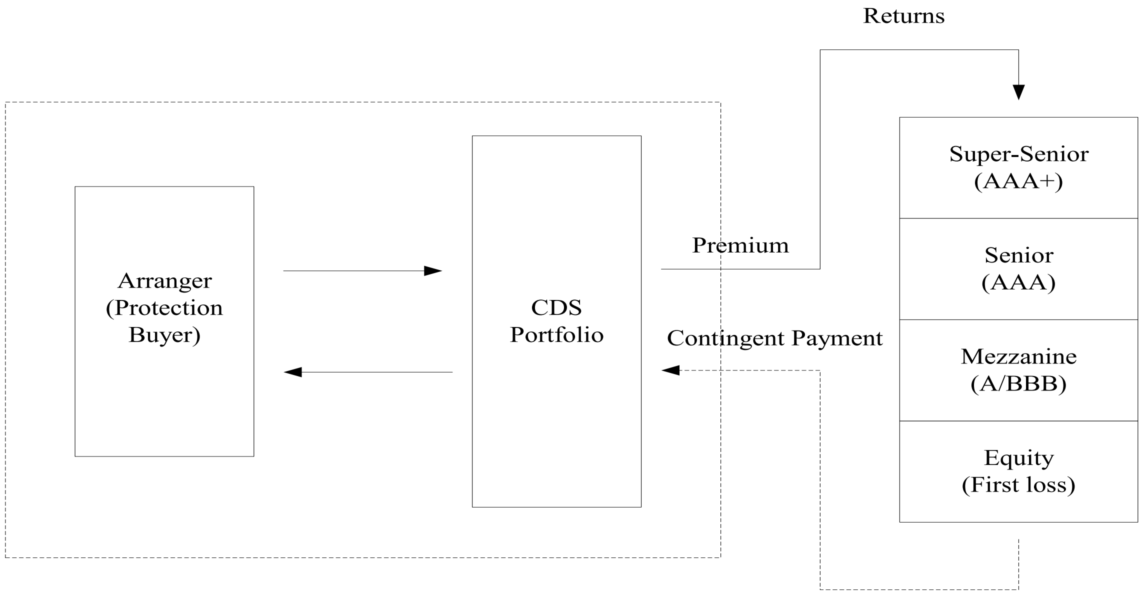
[3] CDSs work as an insurance against credit risks. The seller of a CDS contract agrees to insure a credit risk in exchange of regular premiums paid by the buyer.

[4]Selling a CDS is equivalent to buying the underlying bond to which the CDS is linked, but without having to pay the up-front price of the bond.

Figure 5. An Unfunded Synthetic CDO Structure



An unfunded synthetic CDO shown in Figure 5 works as a swap. The arranger directly buys a portfolio of CDSs from investors in the market by issuing CDO notes with different tranches. The premiums paid by the arranger are shared by the CDO investors, who have to make a payment to the arranger if any defaults happen. And senior tranche investors make a payment only when the losses of the portfolio exceed the liabilities of subordinate tranche investors. Since no money is exchanged at the inception of the deal, SPV is not needed and the arranger has to manage the counterparty credit risk.

C. Single-Tranche CDOs

More recently, the market has witnessed the emergence of single tranche CDOs (STCDOs), which are more flexible than synthetic CDOs. In a synthetic CDO, all tranches, from equity to super-senior, have to be sold in order to finalize the deal. If one tranche cannot be sold, the deal cannot be completed no matter how marketable the rest of the tranches are. Owing to the difficulty of marketing synthetic CDOs, arrangers have begun to offer STCDOs.

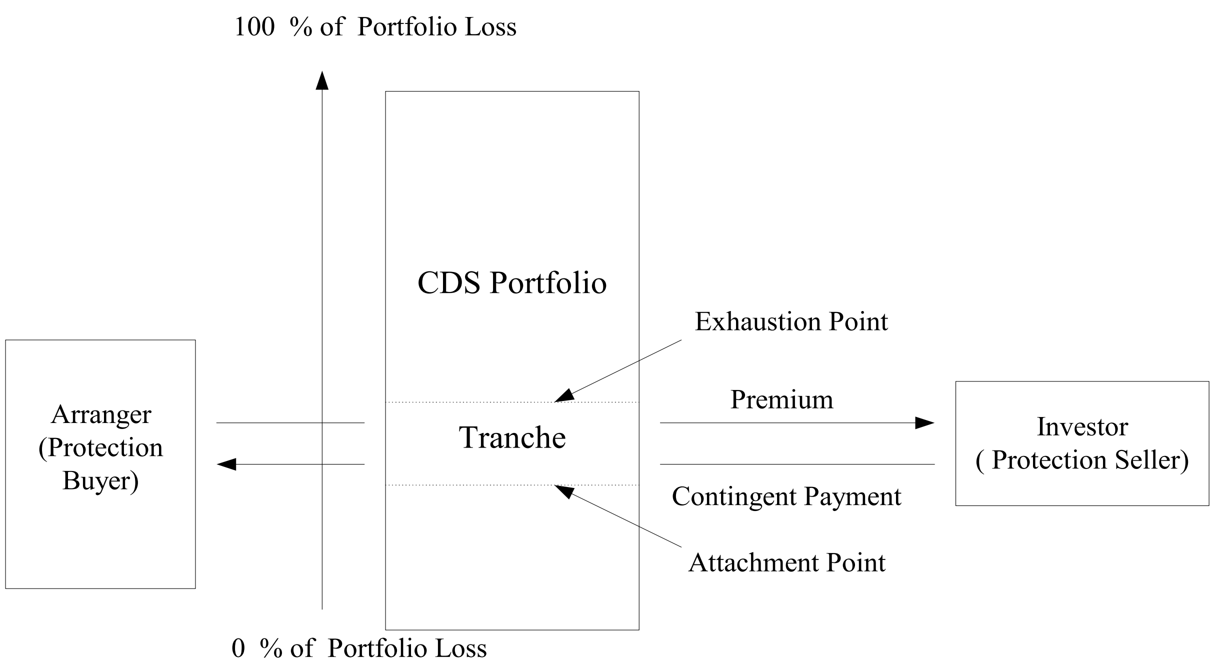
In a STCDO, only one tranche is sold to the investor. The investor is exposed to potential losses as specified by the attachment points of the tranche. For example, an investor in a 3-7 percent mezzanine tranche is required to pay the arranger for losses in excess of 3 percent of the portfolio but the investor's liability is limited to 7 percent of the portfolio losses. The arranger has to hedge his credit exposure by selling protection on the single names comprising the portfolio in an amount that offsets his exposure, that is, the arranger delta hedges his exposure by selling single-name CDSs. Or the arranger can sell the entire portfolio of CDSs, implicitly holding the unsold tranches of the CDOs. In this case, the arranger can hedge the credit exposure in the unsold tranches by buying protection in an amount that offsets the exposure.

Standardized Single-Tranche CDOs on Credit Derivatives Indices

In the past two years, a standardized STCDO market has emerged following the creation of two major CDS indices: Dow Jones CDX in the United States, and iTraxx in Europe and Asia. The CDX IG is composed of equally weighted most liquid CDSs linked to 125 investment grade companies in the United States. Similarly, the iTraxx Europe index is composed of the most liquid CDSs of top 125 investment grade (IG) companies in Europe. The single tranche standardized attachment points are 0-3%, 3-7%, 7-10%, 10-15%, and 15-30% for STCDOs referencing the CDX IG, and 0-3%, 3-6%, 6-9%, 9-12%, and 12-22% for those contracts referencing the iTraxx Europe.[5] iTraxx Asia covers three markets: Australia, Japan, and Asia ex-Japan.

The difference between arrangers (buyers of protection) and investors (sellers of protection) is blurred in the STCDO market, as the market allows them to enter either short or long credit positions. Market makers provide liquidity to the market as they stand ready to buy protections from protection sellers and sell them to protection buyers. Prices of the STCDO tranches are the market clearing equilibrium prices. A typical STCDO structure is shown in Figure 6.

Figure 6. A Single-Tranche CDO Structure



[5] See Amato and Gyntelberg (2005) for a comprehensive discussion of standardized STCDO on credit derivatives indices.

III. Default Probability And Default Correlation, in STCDOs

In a STCDO, both the protection buyer and the protection seller need to hedge the risks arising from changes in the default probability of a single company in the portfolio, and from changes in the default correlation of the portfolio. Changes in the default probability of the company affect the price (or premium) of the linked CDS, and affect the value of the reference portfolio. The investors then have to calculate the hedge position for each CDS in the portfolio by computing the sensitivity (delta) of the tranche to changes in the underlying CDS spreads. The value of a STCDO also depends on the assumed default correlation. While the value of the whole reference portfolio is not affected by changes in default correlation, the loss distribution is. Default correlation, therefore, affects the probability that losses could potentially reach the subordination level of the tranche.

Let's analyze in a qualitative way how the prices of STCDO tranches react to changes in default probability and default correlation.[6] Intuitively, a change in the default probability of a single issuer or a group of issuers will have a similar impact on the prices of STCDO tranches. For instance, an increase in default probabilities of one or some companies in the portfolio causes price increases for both junior and senior tranches since the overall default probability increase make the default protections more valuable. Vice-versa, a decrease in default probabilities will make default protection cheaper, pushing tranche prices down.

Prices of different tranches react differently to changes in the default correlation. As the default correlation increases, the loss distribution of the portfolio spreads out and the probability of experiencing either very low or very high losses increases. In the case of the equity tranche, higher probabilities of experiencing very low losses imply that losses may not be large enough to exceed the exhaustion point. For example, if no defaults, the investor of an equity tranche doesn't have to make any payment. Thus, the spread of the equity tranche, or price of equity protection, falls. That's why in the market jargon, selling protection on an equity tranche is equivalent to "long" correlation: as correlation increases, the mark-to-market value of the short position on the equity tranche increases.

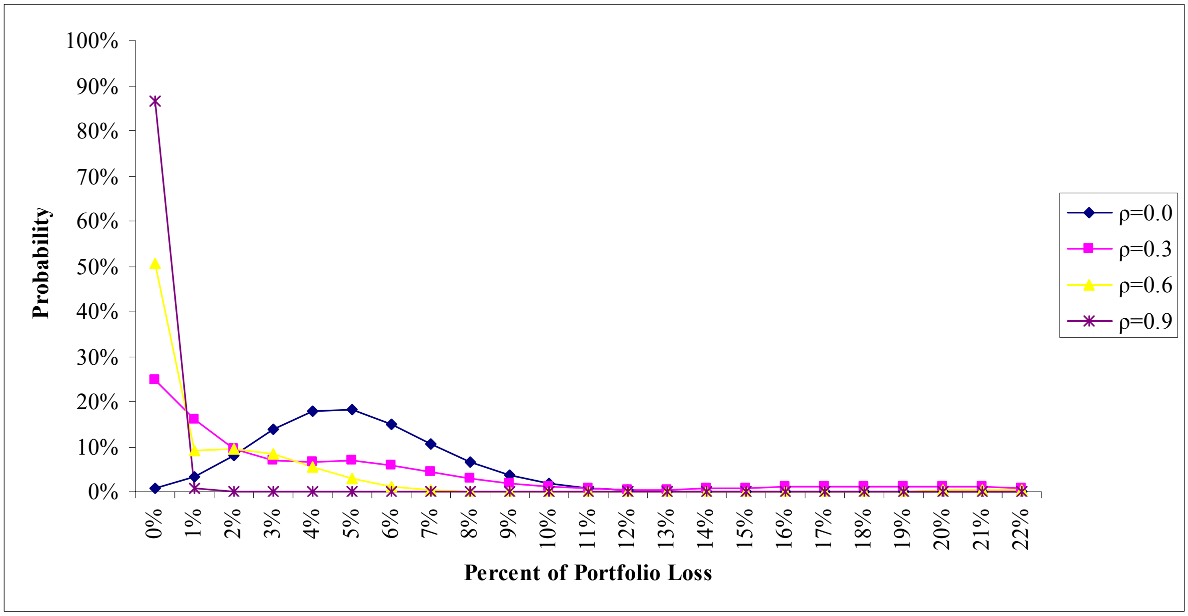
In the case of the super-senior tranche, the increased probability of very high losses owing to the increase in correlation implies that losses could exceed the exhaustion point. Thus, the price of protection on super-senior tranches increases. Hence, selling protection on a super-senior tranche is equivalent to "short" correlation: when correlation increases, the short position on the tranche suffers mark-to-market losses.

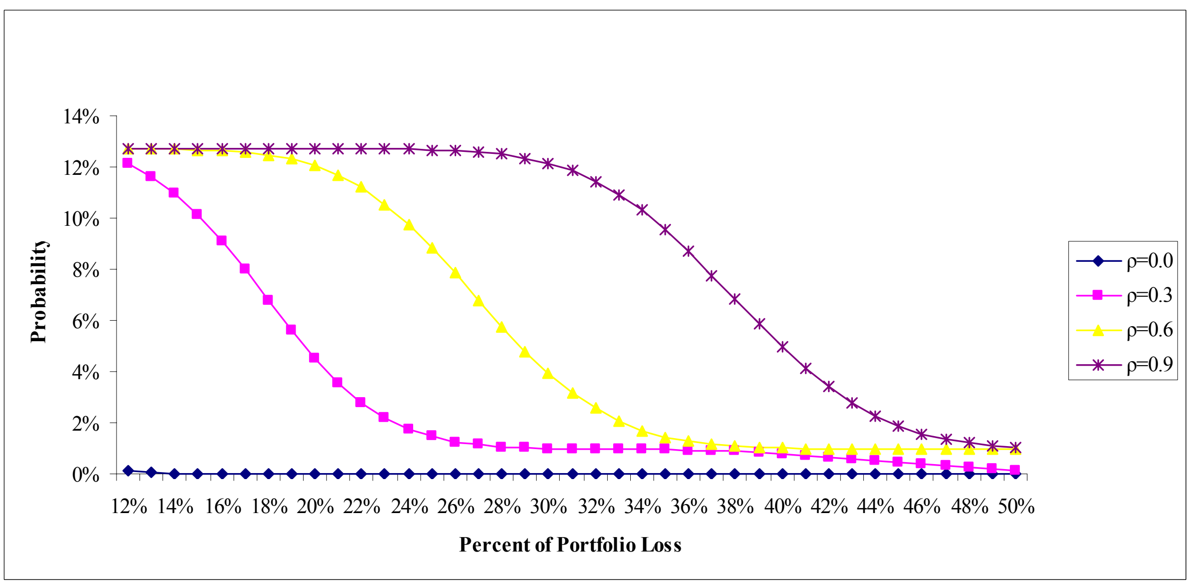
We use a made-up portfolio containing 100 homogenous names to illustrate the relationship between the default correlation and the portfolio loss. The result is shown in Figure 7. The first part of the figure shows the impact of the correlation on the portfolio loss distribution. As we can see, as the default correlation (ρ) increases, the probability of the zero portfolio

[6] For a technical discussion, see Duffie and Garleanu (2001), and Gibson (2004).

loss increases, which makes the short position on the equity tranche protection more valuable. The second part of the figure shows the impact of correlation on the probability of losses at or above the level displayed on the x-axis. For example, under the assumption of zero correlation, the probability that the losses exceed 12% is almost zero. The figure shows that for the super-senior tranche with attachments of 12-22%, the probability that losses exceed exhaustion point (22%) increases as the default correlation increases.

Figure 7. The Impact of Default Correlation on the Portfolio Loss Distribution





Source: Authors' calculations.

IV. Idiosyncratic and Systemic Risk in STCDO Tranches

Changes in the default probability and default correlation can be linked respectively with idiosyncratic and systematic risk factors. Idiosyncratic risk is company-specific, so we observe that changes in the creditworthiness of a company are reflected in the changes of its default probability. In contrast, the default correlation reflects the systematic risk of the macro environment in which companies operate. Even if default probabilities remain constant, a change in the default correlation will change the probability of experiencing a large number of defaults. Therefore, increases in default correlation correspond to increases in systemic risk.

Therefore, using the market prices on STCDO tranches, we can track the idiosyncratic and systematic risks in the portfolio and the market where the portfolio is selected. Namely, the price of equity and super-senior tranches should react similarly to changes in idiosyncratic risk. In contrast, the prices of these two tranches should move in opposite directions in response to changes in systemic risk. Hence, the price comovements of the equity and super-senior tranches allow us to identify the driving force in the market: idiosyncratic risk or systemic risk.

V. Data and Empirical Framework

A. Data

We exploit the qualitative response of the equity and super-senior tranches to idiosyncratic and systemic risk to identify idiosyncratic and systemic risk factors in Europe. We use price data for the traded tranches referencing the iTraxx Europe credit derivatives index. The index is constructed using dealer liquidity poll, which is administered by the International Index Company (IIC). Each market maker submits to the IIC a list of companies based on criteria such as that the companies have to be incorporated in Europe and have the highest CDS trading volume as measured over the previous six months. The companies in the index are ranked according to trading volumes—the one with the highest volume is ranked as number one.[7] Then, the IIC removes any companies rated as BBB- by Standard and Poor's or on negative outlook. The final portfolio consists of 125 companies by selecting the highest ranking issuers in each sector─10 autos, 30 consumers (15 cyclicals and 15 non-cyclicals), 20 energy , 20 industrials, 20 telecoms, medias, and technologies (TMT), and 25 financials. Each company in the portfolio is weighted equally. The index is rolled over every six months by adding the next most liquid entity in the sector to replace the one that is defaulted, merged, or downgraded.

[7] The licensed market makers for iTraxx European indices are ABN AMRO, Bank of America, Barclays Capital, Bayerische Landesbank, BBVA, Bear Stearns, BNP Paribas, CALYON, Citigroup, Commerzbank, CSFB, Deutsche Bank, Dresdner Kleinwort Wasserstein, Goldman Sachs, HSBC, HypoVereinsbank, ING, IXIS, JP Morgan, Lehman Brothers, Merrill Lynch, Morgan Stanley, Natexis Banques Populaires, Nomura, Royal Bank of Scotland, Santander, Sociéte Générale, TD Securities and UBS.

The summary statistics corresponding to quotes for five-year STCDO tranches referencing the iTraxx Europe index are shown in Table 1. The equity tranche (0-3%) is quoted differently than the other three tranches, as investors receive an upfront fee, measured as a percent of the notional amount, and an annualized spread of 500 basis points (bps) paid quarterly during the life of the contract if no default happens. The other tranches pay investors a quarterly spread quoted in bps.

Table 1. iTraxx tranches: Summary Statistics, August 28, 2003 – May 16, 2005

	Attachment points (in percent)	Tranche prices, in bps 1/ Average	Minimum	Maximum	Standard deviation
Tranches					
Equity	0 - 3	26.3	12.9	46.5	5.4
Junior Mezzanine	3 -6	182.6	84.6	330.0	56.6
Senior Mezzanine	6 - 9	70.9	25.3	152.5	28.2
Super-senior	12 - 22	18.0	8.1	39.0	5.4

1/ Equity tranche prices quoted as an upfront percentage of the notional amount of the contract plus a 500 bps annualized spread paid quarterly.

Source: Authors' calculations.

B. Principal Component Analysis

Principal component analysis (PCA) is used to reduce a set of correlated variables to a smaller set of uncorrelated variables and has been widely applied to analyze financial data.[8] Table 2 shows that this is the case for the iTraxx tranche spreads. Correlations range between 0.76 to 0.98, suggesting that it is proper to analyze the data using PCA.

Table 2. iTraxx Spreads Correlations, August 28, 2003 – May 16, 2005

	Attachment points (in percent)	Tranches: Equity	Junior Mezzanine	Senior Mezzanine	Super Senior
Tranches					
Equity	0 - 3	1.000			
Junior Mezzanine	3 - 6	0.822	1.000		
Senior Mezzanine	6 - 9	0.774	0.976	1.000	
Super-Senior	12-22	0.755	0.851	0.905	1.000

Sources: Authors' calculations.

[8] See Timm (2002) for a basic discussion of principal component analysis, and Litterman and Scheinkman (1991) for an early application on modeling the term structure of interest rates.

The mechanics underlying the extraction of the principal components is relatively simple. Once the data is ordered in a matrix $Y_{n \times k}$, where n is the number of observations and k is the number of variables analyzed, the principal components corresponds to the columns of the matrix $P_{k \times k}$ such that the variance of the transformed data $Z = P'Y$ is maximized subject to the constraint that $P'P=I$, where I is the identity matrix . Simple linear algebra shows that the principal components correspond to the eigenvectors associated to the characteristic vector λ which solves the eigenequation $| \sum - \lambda I| = 0$, where $\sum$ is the variance-covariance matrix of Z. The results are presented in the next section.

VI. Results

Table 3 shows the coefficients associated to each principal component and the percentage of the variation explained by each component. The results presented there are robust to different specifications of the sample period, so only the results corresponding to the full sample are reported. The results suggest that the first principal component explains most of the variation of the transformed data, while the contribution of the third and fourth components is negligible. The iTraxx spreads react positively to changes of the first principal component since its coefficients are all positive. The first principal component can be identified then with idiosyncratic risk factor in Europe, which accounts for most of the variation of the series. In contrast, the equity tranche coefficient of the second principal component has the opposite sign of the senior tranche coefficient, enabling us to identify it with the systemic risk factor.

Table 3. Principal Component Analysis of iTraxx Tranche Spreads

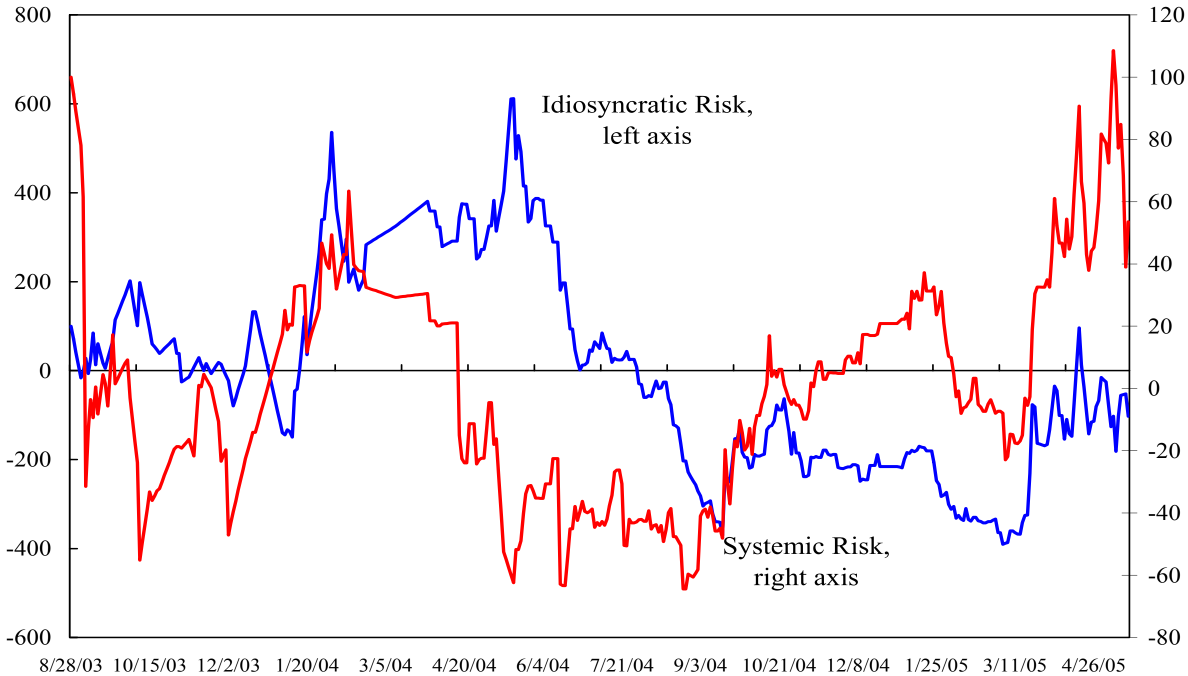
	Principal Components Coefficients			
	First	Second	Third	Fourth
Equity	0.0007	-0.0012	-0.0069	-1.0000
Junior Mezzanine	0.8950	-0.4391	-0.0787	0.0017
Senior Mezzanine	0.4400	0.8395	0.3189	-0.0029
Super-Senior	0.0740	0.3201	-0.9445	0.0062
Percent of variation explained	99.05	0.85	0.10	0.00

Source: Authors' calculations.

After identifying the idiosyncratic and systemic risk components, it is possible to recover their time series behavior from the transformed data set Z, as shown in Figure 8. It should be bear in mind that these components are *forward-looking* risk measures, as they captured the market views on default risk going forward five years.

In the second half of 2004, systemic risk reacted to rapid increases of oil and commodity prices and uncertainty about the relative pace of interest rate tightening in the United States and European region. Idiosyncratic risk surged up in early 2004 following the bankruptcy of Parmalat, Italy's eighth largest industry group. Idiosyncratic and systemic risks rose together in May 2005 when hedge funds active in credit markets were forced to unwind their positions following the announcement of rating downgrades of General Motors and Ford. Mounting losses among hedge funds increased counterparty risk for the banks they were dealing with and drove credit spreads up in the banking sector. Concerns about credit risk in the banking sector contributed to the simultaneous increase in systemic and idiosyncratic risk observed at the end of our sample.

Figure 8. Idiosyncratic and Systemic Risk in Europe



Source: Authors' calculations.

VII. Conclusions

We have presented a simple method for extracting measures of idiosyncratic and systemic risk from the prices of CDO tranches. The method relies on the different impact changes in idiosyncratic and systemic risk have on the tranches prices, and was used to extract risk measures for the corporate sector in Europe. These forward-looking measures are useful to policymakers concerned about a buildup of risks that could potentially threaten financial stability. Currently, the robustness of these indicators under different econometric methods. Going forward, there are a number of extensions we will explore in future work. They include assessing the comovements of idiosyncratic risk and systemic risk across emerging markets, Asia, Europe, and the United States; and examining what the main economic determinants of both types of risk are with a view to predict their future evolution.

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