Do Multiple CDO Ratings impact Credit Spreads?

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Abstract

We analyze whether multiple ratings for CDO tranches have an impact on credit spreads and examine the various effects with regard to the number of rating agencies involved. Based on a data set of more than 5,000 CDO tranches, we calculate index-adjusted credit spreads to isolate the specific credit risk per CDO tranche. First, we find a negative correlation between number of ratings and credit spreads per CDO tranche, i.e. additional ratings are accompanied by lower credit spreads. Additionally, on the basis of a valuation model we show that multiple ratings are a significant pricing factor and interpret, that investors demand an extra risk premium due to information asymmetries between CDO issuers and investors. Any additional rating reveals incremental information to the market and increases transparency with regard to the underlying portfolio's credit risk. Second, however, we could not find empirical support for the hypothesis that marginal tranche spread reduction decreases when additional rating agencies are added. Third, we find evidence that second or third ratings by Fitch on average are higher when directly compared with Moody's and/or S&P ratings per CDO tranche. This finding is in line with existing literature on corporate bonds and induces a bias also on CDO ratings due to their solicited character.

Keywords: Collateralized Debt Obligations, Multiple Ratings, Credit Spreads, Asymmetric Information

JEL Classification: G12, G14, G24

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I. Introduction

Structured credit products are complex with regard to their architecture, cash flow streams are difficult to extract from transaction reports and information about the underlying credit portfolio is usually highly opaque. Thus, from an investor's point of view, markets for Collateralized Debt Obligations (CDO) suffer dramatically from information asymmetries. Accordingly, credit ratings performed and published by rating agencies play a significant role since due diligence is usually delegated to them by investors. Especially during the latest market turmoil, the role of rating agencies in the structured credit market has been intensely discussed among market participants and regulators. However, empirical studies on the impact of information asymmetries on e.g. credit spreads and the role of rating agencies are still widely missing.

This paper analyzes the impact of multiple CDO ratings on credit spreads of the respective tranches. We argue that each additional rating incorporates new incremental information and thus reduces information asymmetry between the issuer and the investor. Reduced information asymmetry increases transparency, thereby lowers investors' demand for risk premiums and leads to lower credit spreads. The motivation for this empirical analysis becomes especially relevant when considering the current financial crisis: We interpret information asymmetries between issuers and investors to lie at the heart of the direct consequences of the subprime crisis. Misaligned incentive structures for issuers along the structuring process of CDOs lead to a situation where insufficient information was shared with investors.

Our findings are threefold: First, we find that on average credit spreads indeed decrease with an increasing number of ratings. Second, even with decreasing spread levels in place, we were not able to confirm the hypothesis that marginal tranche spread reduction decreases with the number of published ratings. Third, we found that in the case of joint (pair wise) ratings, on average Fitch assigned a higher credit quality (e.g. better rating) than its competitors Moody's and S&P for the very same CDO tranche. Since Fitch is by far the smallest of the three rating agencies in the field of structured credit, we see a potential explanation in the form of a selection bias.

Several papers have been published on corporate ratings to analyze the impact of multiple ratings on credit spreads and implied risk premiums. However, the application and transfer to CDOs cannot be found in finance literature yet. Accordingly, we analyze if CDO markets value credit ratings and, in particular, if and how the mere existence of multiple ratings from different rating agencies is priced into credit spreads of CDO tranches. In this context, multiple ratings are to be separated from split ratings as the latter refer to different rating results. Earlier studies argued that issuers of CDOs have economic incentives to take advantage of uneven information distribution between issuers and investors and found empirical evidence for rating model arbitrage (Fender and Kiff, 2005; Morkoetter and Westerfeld, 2008). At the present time, investors do not appear to be teaming up to enforce publication of multiple CDO ratings but rather accept rating model arbitrage in CDO markets. Apparently, no incentive exists for them to induce additional monitoring activities. However, investors might add a risk premium for information asymmetry and potential rating model arbitrage when pricing CDO tranches, which is the central argument in this paper. In addition, by introducing a double-step interpolation process to create a benchmark index for CDO spreads, we also extend existing literature on pricing factors of CDO tranches in terms of applied methodologies. Current literature primarily relies on regression analysis (e.g. Vink and Thibeault, 2008; Schiefer, 2008).

The paper is organized as follows: Based on a literature review in Section II, we present in detail the specific characteristics of the CDO rating market and accordingly formulate three different hypotheses (Section III). The underlying data sample for the empirical part of this paper is introduced in Section IV, as well as the description of index-adjusted credit spreads. Along the defined hypotheses we eventually analyze the data in Section V and perform several tests including a multiple regression analysis. Section VI concludes the paper.

II. Literature Review

Two very recent papers analyzing credit spreads of CDOs are Schiefer (2008) and Vink and Thibeault (2008). The latter compares credit spreads within different segments of the securitization market. The authors find that pricing factors differ significantly between CDOs, asset-backed securities and mortgage-backed securities. Besides their detailed analysis they do not address the topic of multiple ratings. Schiefer (2008) additionally provides a comprehensive analysis of pricing factors for CDO credit spreads. Again, the paper's focus is not on the role of multiple ratings within CDO markets but on pricing factors in general. However, in the course of our empirical analysis we were able to confirm some of their basic results for a larger data set of CDO tranches.

With regard to corporate bonds, various studies have been published dealing with multiple ratings. Generally, two types of literature can be distinguished: (1) analyzing the question why borrowers obtain more than one rating; and (2) assessing the impact of multiple ratings on bond yields.

Referring to (1), Cantor and Packer (1995) analyze whether the reason for getting an additional rating may be regulatory in nature. Many financial institutions have limits, either self imposed or imposed by government regulators, on the amounts of debt they can hold of certain ratings. As most of these regulations only require that the highest or second highest rating be above the cutoff point, the firm's chances of meeting the standard increase if a third or fourth rating is obtained. Therefore, issuers could have a strong incentive to obtain multiple ratings to reach those investors. However, the authors find no evidence that firms obtaining Fitch IBCA ratings are doing so in order to meet rating regulation requirements. In a later paper, Cantor and Packer (1997) empirically test for the existence of rating model arbitrage in bonds. They find evidence that third ratings in bond markets on average assign higher ratings than the first two rating outcomes and that the policy of rating on request induces a sample selection bias. However, they find no evidence for the theories that only firms with greater default risk uncertainty or firms engaged in rating shopping are interested in obtaining third ratings.

In contrast to bonds, CDO rating methodologies applied by the major three rating agencies differ substantially, which can result in clear differences in the ratings assigned by the agencies to certain tranche structures (Peretyatkin and Perraudin, 2002). Moody's has long relied on an EL criterion, as opposed to a criterion that focuses primarily on PD, as applied by its competitors S&P and Fitch. Other things being equal, an EL approach may therefore be more favorable to large senior tranches than a default probability approach, and less favorable towards more junior tranches that tend to be of thinner size. Fender and Kiff (2005) explore the impact of differences in methodologies across rating agencies for senior tranche rating outcomes. They conclude that because investors do not fully understand the possible implications of the effects analyzed for tranche ratings, rating model arbitrage is a theoretical possibility. In practice, the authors could only find limited evidence for this behavior. However, Morkoetter and Westerfeld (2008) find no empirical evidence to accept the hypothesis stating non-existence of rating model arbitrage on the basis of information asymmetry, as patterns of transaction characteristics per rating agency/rating methodology could be identified.

The second branch of literature deals with the effect of ratings on bond yields. These papers add to the question why borrowers seek a third or fourth rating as these ratings might convey information to the markets that reduces the cost of borrowing for the issuers. For the purpose of this paper, we explicitly differentiate between split and multiple ratings. In finance literature split ratings are defined as (bond) ratings in which two or more rating agencies assess the very same financial product but come up with different ratings (e.g. Jewell and Livingston, 1998). Multiple ratings in turn refer to the mere number of ratings existing for a specific entity/ note regardless if the rating results differ. However, following Jewell and Livingston (1999), the papers fail to reach a consensus on how the market prices bonds with split ratings. Kish et al. (1999) conclude that the market finds value in the ratings from each agency (Moody's and S&P) and that there is not enough evidence that the market values one agency over the other. Billingsley et al. (1985), Liu and Moore (1987) and Perry, Liu, and Evans (1988) find that the market prices bonds with split ratings as if only the lower of the two ratings conveys information. In contrast, Hsueh and Kidwell (1988) and Reiter and Ziebart (1991) conclude that markets price bonds as if only the higher of the two ratings conveys information. Jewell and Livingston (1998) conclude that when firms receive a split rating from Moody's and S&P, the markets considers an average of the two ratings when determining default spreads for the bond. Thus, markets place some value on both bond ratings. In a later paper, Jewell and Livingston (1999) even show that the bond markets value the ratings of three raters. The authors compare bond ratings of Fitch to those of Moody's and S&P to analyze the potential benefits of seeking out additional ratings from a smaller rating agency (Fitch), by comparing rating levels, rating changes, and the impact of ratings on bond yields. Inter alia, the authors test for the hypothesis that the average observed rating from Fitch is likely to be significantly higher than the "true" average rating from the two other agencies. Their analysis confirmed this hypothesis.

Like Jewell and Livingston (1999) in their analysis for bonds, we are not concerned with the determinants of ratings like the first branch of literature, as we accept the fact that CDO markets are multi-rating markets. However, we take the possibility for rating shopping based on information asymmetries between originators and investors as a given and accept this as a potential reason for adjusted risk premiums. Also, unlike the second branch of literature, we are not concerned with future default. Rather, we take the ratings as a given and analyze the market perception of the number of available ratings in terms of credit spreads.

III. Multiple Ratings and Credit Spreads within CDO Markets

As a starting point, we develop a basis outline of the CDO rating market: A plain vanilla CDO transaction is typically centered on a special purpose vehicle (SPV), which invests into various credit-linked assets (e.g. SME loans, bonds or tranches of other CDO transactions) and refinances its purchases through the issuance of notes, i.e. CDO tranches. Subordinated tranches act as credit enhancement for the more senior notes (subordination principle). The tranches are bought by international investors, e.g. hedge funds, banks or other SPVs investing in CDOs with each note paying interest either defined as a fixed rate or as a spread premium over a certain reference benchmark (typically some sort of LIBOR). According to market standards, the issuer (investment bank or external asset manager) assigns one or more rating agency to assess the transaction and provide a rating for all or some of the underlying tranches prior to note issuance. The issuer will only be willing to publish and share this information with investors if (i) the ratings are favorable for the tranches or if (ii) investors explicitly request the rating. The CDO rating market is an oligopolistic one with Fitch, Moody's and S&P as the three dominating players.

Ratings incorporate signaling attributes and are therefore used as a marketing instrument. Since CDO ratings are typically solicited, the issuer has to cover the costs. On average, these costs are around 4.25 basis points (Standard & Poor's, 2007) of the issuance volume. Consequently, the more rating agencies are assigned, the higher the underlying cost of the note issuance.

CDO rating processes diverge significantly from the rating process of corporate bonds. Unique features of the CDO rating market are the accessibility of rating tools used by the agencies, the different methodologies used (EL approach by Moody's, PD approach by S&P and Fitch) and the close cooperation between agency and issuer during the negotiation phase. The latter being heavily discussed in the wake of the recent subprime crisis. We do not intend to discuss independency issues of rating agencies here; however, we proceed with the assumption that the relationship and exchange between rating agencies and issuers is very close and thereby impacts information efficiency. In comparison to the bond rating market, a specific feature of the CDO rating market is the fact that S&P and Fitch apply the same rating methodology (probability of default-based) whereas Moody's relies throughout the rating process on an expected loss-based approach.

As a basis for our empirical analysis, we now formulate a set of different hypotheses. The first hypothesis is related to the fundamentals of information asymmetry and focuses on the principal-agent relationship between investor (principal) and issuer (agent): We argue that the credit spread of an individual CDO tranche is impacted by the number of outstanding ratings. The publication of a rating impacts the information distribution between the issuer and the investor. Thus we assume that each additional tranche rating conveys incremental information. Reduced information asymmetry should therefore lead to *ceteris paribus* lower credit spreads since the investors demand a lower premium due to less uncertainty about the credit quality. We test our first hypothesis as follows:

$H1_0$: The number of outstanding ratings does not influence the credit spreads of CDO tranches.

$H1_1$: The number of outstanding ratings does influence the credit spreads of CDO tranches (negatively).

In addition, we further investigate the magnitude of tranche spread reduction in absolute numbers. In particular, we compare the tranche spread reduction from single to double ratings and from double to triple ratings. Diminishing marginal utility should reduce the value of incremental information provided by each additional rating. Therefore, one could expect tranche spread reduction from single to double ratings to be larger than from double to triple ratings. However, the reduction of tranche spreads can also be the mere result of a selection bias. Since the issuer decides which rating is published and investors demand two ratings on average, the issuer will only publish a third rating if the rating outcome is favorable to the transaction. Thus one could expect spread reduction from double to triple ratings to be larger than from single to double ratings. Based on these considerations, we hypothesize that:

$H2_0$: Additional (marginal) ratings lead to a decreasing or constant reduction of the tranche spread.

$H2_1$: Additional (marginal) ratings lead to an increasing reduction of the tranche spread.

Based on Jewell and Livingston (1999) we additionally analyze the role of Fitch within CDO markets. In particular, we test the hypothesis that the average rating by Fitch is considerably higher than the average rating by Moody's and S&P. Fitch as the smallest of the three rating agencies might try to capture market share through the issuance of ratings in favor of the transaction. A second explanation again centers on the existence of a potential selection bias. We argue that Fitch is only considered by the issuer in case the rating outcome is expected to be favorable to the transaction. Thus, we propose:

$H3_0$: The average Fitch rating is not different from the average S&P or Moody's rating.

$H3_1$: The average Fitch rating is different (and better) than the average S&P or Moody's rating.

In order to eliminate potential bias in the empirical results we perform several robustness checks, including control variables for split ratings as well as for tranches solely rated by Fitch, Moody's or S&P.

IV. Data

We started our data analysis by setting up a database provided by Deutsche Bank consisting of a unique set of 9,536 CDO tranches from 1,454 transactions issued between January 2004 and March 2007. From these 9,536 CDO tranches, we removed all tranches with missing data points (e.g. rating or credit spread). For reasons of consistency we also excluded all tranches with fixed credit spreads as this would have caused dilution of our empirical results when approximating spread levels. Thus, our data sample incorporates only CDO tranches with floating credit spreads (e.g. three-month LIBOR plus X).

Accordingly, we used a total data set of 5,133 tranches. For each tranche the outstanding rating(s), transaction type, lead manager, issue date, rated volume, as well as the level of seniority within the specific transaction is available. We distinguish between three different transaction types (CLO, CBO & Exotic) and use this information as an independent variable in our regression analysis. As outlined in Table 1, the total number of tranches can be differentiated into tranches that carry single, double or even triple ratings. We grouped the sample according to rating agencies.

With 4,874 respectively 4,596 rated CDO tranches, S&P and Moody’s are the dominating rating agencies in our sample. Fitch has the smallest share with 1,281 rated tranches (24.96 %). 271 tranches (5.28%) carry a single rating, 4.106 tranches (79.99%) have double and 756 tranches (14.73%) carry triple ratings. If we further analyze double-rated tranches, we see that ratings are predominately published by the combination of Moody's and S&P (71.09%). The combination Fitch/ S&P (5.90%) respectively Moody's/ Fitch are ranked second and third. One potential explanation might be the higher market share of S&P in comparison to Moody's and the fact that the same rating methodology is applied by Fitch and S&P (PD-based approach).

Table 1: Data Sample "Multiple CDO Tranche Ratings"

Data Sample "Multiple CDO Tranche Ratings"

CDO Tranche Ratings	# of rated Tranches	in % of Total Sample	Mean Maturity (in years)	Mean Volume (in USDm)	Mean Rating Code
Total Sample	5,133	100.00%	7.96	86.38	4.98
Rating Agency					
Fitch	1,281	24.96%	7.77	100.21	4.86
Moody's	4,596	89.54%	7.97	89.92	4.92
S&P	4,874	94.95%	7.95	86.14	4.92
Single Rating					
Total	271	5.28%	7.48	45.20	5.42
Fitch	68	1.32%	9.20	31.27	7.25
Moody's	37	0.72%	7.22	47.06	4.65
S&P	166	3.23%	6.83	50.49	4.84
Double Rating					
Total	4,106	79.99%	8.07	83.81	5.02
Moody's/ S&P	3,649	71.09%	8.08	83.55	5.01
Fitch/ S&P	303	5.90%	8.04	64.69	5.14
Moody's/ Fitch	154	3.00%	7.74	127.53	5.10
Triple Rating					
Fitch/ Moody's/ S&P	756	14.73%	7.54	115.08	4.55

As can already be seen in Table 1, mean maturity of the transactions seems to be higher for double ratings than for single and triple ratings. However, concerning single ratings, it seems that Fitch rated not only the tranches with the longest maturity, but also with the lowest volume per tranche. Overall, the volume of single rated tranches is significantly lower than the volume of double and triple rated tranches. In addition, single rated tranches are not only the smallest in terms of volume, but also receive the lowest ratings in comparison to double and triple ratings. Both maturity and volume are important factors for debt instruments and will be analyzed in detail in Section V..

Concerning rating outcomes we refer to Table 2, which outlines the mapping of the individual rating notches of Fitch, Moody's and S&P on a numerical scale based on underlying one-year default probabilities (derived from Fitch, Moody's, S&P). This approach is commonly used in finance literature to be able to compare different rating scales (see e.g. Cantor and Packor 1995). Thereby, we are able to compare the rating outcomes of all three rating agencies. In the following, the terms ‘rating outcome’, ‘rating code’ as well as ‘rating notch’ are used synonymously.

As outlined in Table 1, our data set with 5,133 different CDO tranches incorporates a large portion of multiple ratings, which can be grouped according to the rating outcome. In the case of identical ratings per CDO tranche, all involved rating agencies assign the very same rating code for a specific tranche and calculated notch differences are zero. Split ratings occur only if the rating codes deviate from each other.

Table 2: Mapping Code for the Individual Rating Notches

Code	**Fitch** Class	**Moody's** Class	**S&P** Class
1	AAA	Aaa	AAA
2	AA+	Aa1	AA+
3	AA	Aa2	AA
4	AA-	Aa3	AA-
5	A+	A1	A+
6	A	A2	A
7	A-	A3	A-
8	BBB+	Baa1	BBB+
9	BBB	Baa2	BBB
10	BBB-	Baa3	BBB-
11	BB+	Ba1	BB+
12	BB	Ba2	BB
13	BB-	Ba3	BB-
14	B+	B1	B+
15	B	B2	B
16	B-	B3	B-
17	CCC+	Caa1	CCC+
18	CCC	Caa2	CCC
19	CCC-	Caa3	CCC-
20	CC	Ca	CC
21	C		SD
22	D		D

Thus, in case of split ratings, notch differences are always unequal to zero. Based on calculation of notch (code) differences credit quality assessments by the agencies can be compared.. According to the number of involved rating agencies (double or triple ratings), one or three notch differences can be calculated. We refer to these rating pairs as joint ratings, with split ratings being a specific form of joint ratings, but not the only one.

Table 3 displays the notch differences for our data set. Due to triple ratings the total number of joint ratings exceeds the number of 5,133 analyzed CDO tranches (448 split ratings in total). The level of differences – as documented in Table 3 – shows a direct comparison of the rating outcomes of each rating agency. For joint ratings, Moody's ratings are on average lower than the corresponding S&P ratings. In turn, S&P ratings are on average lower than the Fitch ratings.

Table 3: Notch Differences of jointly-rated CDO Tranches

Notch Differences of jointly-rated CDO Tranches				
	Moody's ./. S&P	Fitch ./. S&P	Moody's ./. Fitch	Total
# of joint ratings	4,405	1,059	910	6,374
Rating Differences				
# of identical ratings	4,126	987	813	5,926
# of one notch rating difference	248	59	79	386
# of two notches rating difference	26	11	17	54
# of three notches rating difference	5	2	0	7
# of four notches rating difference	0	0	1	1
# number of Split Ratings	279	72	97	448
Level of Differences				
*Overall Difference**	67	-39	57	
*Mean**	0.0152	-0.0368	0.0626	

** In case of (-), subtrahend has rated on average lower.*

This pattern also holds for joint ratings of Fitch and Moody's. Again, on average Fitch ratings are better than the corresponding ratings of the second rating agency (e.g. Moody's rated lower). It is noteworthy that split ratings mostly lie within a one-notch range. Our results confirm earlier research in the fields of corporate bond ratings (e.g. Cantor et al., 1997).

V. Empirical Results

i. Analysis of Credit Spreads

In order to derive a reliable credit spread to capture the effect of multiple ratings several adjustments have to be made. Since we already excluded all CDO tranches with fixed credit spreads, our data base only consists of floating credit spreads over Libor CS_{it}, denominated in basis points (bps) of the nominal volume of tranche i at the date of issuance t. In the following we refer to CS_{it} as the unadjusted credit spread.

Then we separate the part of the spread representing the systematic risk of the specific CDO tranche. By doing so we are able to analyze idiosyncratic credit spreads of different tranches without any dilution from systematic credit risk. We achieve this goal by subtracting an average CDO Credit Spread Index $CS\ Index_{jt}^{rc}$ from the individual unadjusted credit spread CS_{it} and receive an adjusted credit spread of the individual tranche i:

$$CS_{it} - CS\ Index_{jt}^{rc} = ACS_{it}$$

In the context of the CDO Credit Spread Index, j refers to a specific sub-index, t indicates the issuance date, r stands for the rating class of the CDO tranche and c for the currency in which the tranche is denominated. By introducing $CS\ Index_{jt}^{rc}$ we are able to calculate the corresponding adjusted credit spread ACS_{it} for each individual tranche, with a specific tranche i and its issuance date t. In the following we refer to ACS_{it} as the adjusted credit spread.

For the calculation of $CS\ Index_{jt}^{rc}$ we rely on three different sub-indices provided by Deutsche Bank. Each sub-index refers to a specific class of CDO transactions: Collateralized Loan Obligations, Collateralized Bond Obligations as well as exotic Collateralized Debt Obligations (e.g. ABS CDO, CDO Squared). According to the transaction structure, each tranche is flagged to match one of the three sub-indices. We do not only differentiate between transaction structures, but also between currency denominations, which enlarges the number of sub-indices by a factor two: tranches denominated in USD are attributed to CDx based sub-indices (one for each transaction type) and tranches denominated in EUR or other currencies are attributed to iTRAXX based sub-indices (one for each transaction type).

The six different sub-indices were originally not available for every rating class as presented in Table 2. Both for CDx and iTRAXX, sub-indices are only available for the rating codes 1, 6, 9 and 12, resulting in 24 sub-indices in total. Furthermore, the original sub-indices calculated by Deutsche Bank do not always refer to the same maturity. We overcome these two problems by a double interpolation process to overcome missing data (used e.g. by Blanco et al. (2005) for corporate bonds and credit default swaps). In a first step we equalize the term structure of the 24 existing sub-indices and fix the index maturity at ten years. Interpolation of maturity mismatches relies on the term structure of CDS Spreads (3, 5, 7 or 10 years; again divided into CDx and iTRAXX). In a second step we create the missing sub-indices for the rating codes 2 to 5, 7, 8, 10, 11 as well as 13 -16 by a second interpolation (again divided into CDx and iTRAXX). Since our data sample only consists of rating codes between 1 and 16, we do not need to compute the sub-indices for the rating codes 17 to 22. We do not follow the concept of linear interpolation but rely on the mean default probability distribution of the rating agencies as displayed in Table 2 in order to interpolate the missing data points. In the end, this two-step interpolation process leaves us with two sets (CDx and iTraxx) of sub-indices with each set consisting of three indices

(CLO, CBO and Exotic) for all rating classes (1-16) for the period from January 2004 to March 2007, resulting in 96 different CDO credit spread indices in total. Within this period sub-indices are calculated for every day on which a price for the basic CDO credit spreads indices was fixed by Deutsche Bank.

In order to give a comprehensive overview of CS_{it}^{s} and ACS_{it} we display the results on an aggregated level in Table 4 and 5. We group the underlying credit spreads by the number of ratings (Table 4) and by rating agencies (Table 5). For each table the results are displayed for each rating code in detail (1-16). It shows that in total the unadjusted credit spread CS_{it} positively correlates with the underlying rating code, i.e. a decreasing credit quality leads to an increasing spread level. Only for the rating codes 11 and 13 does this pattern not hold. However, with 64 respectively 57 tranches these ratings classes are rather small in comparison to the total data sample (5,133 tranches). Despite a few exceptions the assumption of positive correlation between CS_{it} and ACS_{it} also holds for single, double and triple ratings and rating agencies.

In both Tables 4 and 5 the unadjusted credit spread is always positive. Due to subtraction of $CS\ Index_{jt}^{rc}$, ACS_{it} is significantly lower than CS_{it} and in some cases even negative. Thus, negative ACS_{it} are a result of the benchmark composition of $CS\ Index_{jt}^{rc}$.

The six benchmark indices do not exclusively display the tranches included in our data sample but consider more transactions, which were sorted out, i. e. fixed rated tranches. This mismatch together with the applied two-step interpolation process explains why $CS_{it} - CS\ Index_{jt}^{rc}$ is in total not equal to zero (14.04 bps).

Based on the findings in Table 5 we note first signs of differences between rating agencies. Whereas the unadjusted credit spread is on a comparable level (132.07 bps vs. 134.92 bps) for Moody's and S&P, it is lower for tranches rated by Fitch (122.99 bps). In the case of adjusted credit spreads we find a comparable pattern (15.63 bps for S&P, 14.06 bps for Moody's but only 1.64 bps for Fitch). Homogeneity between the group of tranches rated by Moody's and S&P in distinction to tranches rated by Fitch also holds for tranche volume. In comparison to the average tranche volume of Moody's (89.92 mUSD) and S&P (86.14 mUSD), Fitch is higher on average (100.21 mUSD).

To test the significance of differences in mean values between the rating agencies we perform a series of t-tests. As expected, the difference between mean values of the group of tranches rated by Moody's and the group of tranches rated by S&P is not significant. In turn, for both groups the difference in mean values compared to the group of tranches rated by Fitch is significant at the 0.05 level. The only exception is illustrated for the case of tranche volume: the difference between the groups 'Fitch' and 'Moody's' is not significant at the 0.05 level. These test results also hold for a one-way ANOVA performed for the three groups stating the affiliation to a specific rating agency. For all variables (here also for tranche volume) the group means are not equal at a significance level of 0.05.

Table 4: Credit Spread of CDO Tranches (grouped by Multiple Ratings and Rating Code)

Code	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Single Rating																	
# of tranches	271	79	5	39	8	6	36	13	1	41	7	2	24	7			3
Volume in mUSD (Mean)	45.20	89.94	53.84	40.84	31.38	14.33	30.06	27.42	15.00	18.74	20.26	20.90	14.13	18.71			22.93
Maturity in Years (Mean)	7.48	6.67	6.60	6.60	7.16	6.17	7.68	7.91	6.70	8.68	9.00	6.90	8.29	9.67			9.53
Unadjusted Credit Spread (in bps)																	
Mean	170.35	52.53	64.40	77.00	114.38	150.00	125.03	168.85	265.00	248.05	242.14	462.50	482.63	491.57			700.00
Median	105.00	45.00	57.00	80.00	110.00	170.00	122.50	165.00	265.00	250.00	200.00	462.50	475.00	480.00			700.00
Standard Deviation†	1.00	0.49	0.20	0.45	0.34	0.32	0.43	0.41		0.34	0.48	0.42	0.30	0.18			0.79
Minimum	0.00	0.00	55.00	14.00	35.00	90.00	45.00	65.00	265.00	75.00	175.00	325.00	100.00	395.00			150.00
Maximum	1250.00	150.00	85.00	200.00	165.00	200.00	250.00	325.00	265.00	475.00	500.00	600.00	700.00	675.00			1250.00
Adjusted Credit Spread (in bps)																	
Mean	22.36	18.34	29.38	29.98	49.39	69.05	30.49	39.60	95.24	7.77	-88.71	75.25	22.02	-11.80			160.88
Median	21.31	14.97	28.60	40.09	59.43	69.41	24.54	42.84	95.24	0.71	-75.55	75.25	77.21	24.09			289.81
Standard Deviation†	4.69	1.48	0.27	1.25	0.86	0.50	1.90	1.98		14.40	-1.03	2.42	9.39	-13.43			3.75
Minimum	-496.84	-37.64	21.62	-36.26	-21.43	34.39	-129.59	-63.31	95.24	-300.09	-205.91	-53.31	-467.36	-195.13			-496.84
Maximum	689.67	113.91	40.83	159.87	104.63	122.44	187.68	199.02	95.24	270.30	69.36	203.81	312.63	246.11			689.67
Double Ratings																	
# of tranches	4,106	1,276	73	696	63	26	642	146	39	622	171	52	245	47		6	2
Volume in mUSD (Mean)	83.81	207.23	44.95	40.23	25.36	27.88	28.99	27.10	14.88	22.35	20.74	10.03	16.19	17.92		23.10	7.50
Maturity in Years (Mean)	8.07	7.26	8.46	8.20	6.93	7.70	8.42	8.44	7.62	8.26	8.59	8.59	9.73	9.62		8.90	11.45
Unadjusted Credit Spread (in bps)																	
Mean	136.83	35.54	48.02	55.77	69.67	86.85	111.18	137.74	220.38	248.72	260.94	607.88	448.91	448.62		622.50	850.00
Median	69.00	32.00	40.00	52.00	63.00	69.00	95.00	132.50	150.00	242.50	195.00	625.00	425.00	410.00		595.00	850.00
Standard Deviation†	1.08	0.43	0.48	0.36	0.29	0.57	0.44	0.44	0.56	0.40	0.53	0.23	0.27	0.26		0.15	0.00
Minimum	0.00	0.00	21.00	19.00	40.00	22.00	24.00	60.00	55.00	16.00	45.00	100.00	65.00	210.00		500.00	850.00
Maximum	900.00	180.00	145.00	170.00	130.00	225.00	350.00	500.00	525.00	750.00	800.00	900.00	800.00	725.00		750.00	850.00
Adjusted Credit Spread (in bps)																	
Mean	16.23	2.88	9.11	5.16	3.00	-8.22	16.96	15.70	30.39	41.50	-13.87	233.12	21.21	34.36		223.10	322.02
Median	3.75	-1.55	1.86	0.76	1.71	-4.76	7.61	5.64	20.64	20.96	-50.13	271.80	10.00	13.68		262.19	322.02
Standard Deviation†	4.09	5.56	2.57	3.56	7.97	5.66	2.31	3.77	4.64	1.99	9.66	0.71	4.61	1.97		0.60	0.06
Minimum	-498.36	-40.48	-15.45	-56.85	-41.14	-84.02	-205.00	-216.62	-310.95	-287.00	-498.36	-386.88	-405.00	-81.41		56.35	308.49
Maximum	493.31	131.60	110.27	119.97	74.74	125.96	240.76	292.55	325.84	490.00	419.40	493.31	439.88	221.71		360.85	335.56
Triple Ratings																	
# of tranches	756	267	8	130	13	24	90	33	22	110	27	10	16	3		3	
Volume in mUSD (Mean)	115.08	265.57	35.68	51.72	17.86	31.66	31.59	19.35	24.37	23.52	24.48	6.02	20.53	96.00		50.77	
Maturity in Years (Mean)	7.54	7.22	7.26	7.74	6.59	8.04	7.77	8.23	8.87	7.34	8.10	6.90	8.03	5.73		7.70	
Unadjusted Credit Spread (in bps)																	
Mean	111.23	38.74	65.00	61.06	67.85	71.29	106.26	115.79	145.23	239.07	199.56	515.70	418.81	308.33		550.00	
Median	65.00	35.00	65.00	56.00	65.00	68.50	90.00	100.00	140.00	262.50	200.00	587.50	403.50	275.00		550.00	
Standard Deviation†	1.01	0.44	0.28	0.39	0.52	0.37	0.44	0.37	0.25	0.37	0.30	0.28	0.27	0.26		0.00	
Minimum	0.00	0.00	41.00	15.00	18.00	25.00	29.00	70.00	105.00	53.00	61.00	275.00	250.00	250.00		550.00	
Maximum	725.00	130.00	90.00	160.00	150.00	150.00	260.00	225.00	265.00	550.00	335.00	650.00	725.00	400.00		550.00	
Adjusted Credit Spread (in bps)																	
Mean	-0.84	6.77	31.01	7.30	1.09	-36.99	-3.45	-23.81	-69.53	11.78	-123.60	141.09	-2.01	-25.31		198.05	
Median	2.44	3.33	35.18	6.08	1.93	-43.53	0.15	-45.79	-71.24	32.45	-124.51	243.31	4.90	-11.76		195.72	
Standard Deviation†	82.85	2.32	0.61	3.02	27.29	1.20	14.46	2.35	0.86	8.60	0.73	1.49	84.36	2.67		0.02	
Minimum	-345.32	-40.54	1.29	-50.26	-36.54	-144.01	-156.62	-167.37	-246.79	-345.32	-343.05	-197.20	-327.02	-98.73		195.72	
Maximum	411.30	87.60	55.12	98.24	79.59	85.27	175.20	100.83	28.02	352.13	61.72	372.94	411.30	34.55		202.71	
Total																	
# of tranches	5,133	1,622	86	865	84	56	768	192	62	773	205	64	285	57		12	2
Volume in mUSD (Mean)	86.38	211.12	44.60	41.98	24.77	28.05	29.35	25.79	18.25	22.32	21.22	9.74	16.26	22.12		29.98	7.50
Maturity in Years (Mean)	7.96	7.22	8.24	8.06	6.90	7.68	8.31	8.37	8.05	8.15	8.54	8.27	9.51	9.42		8.76	11.45
Unadjusted Credit Spread (in bps)																	
Mean	134.83	36.90	50.55	57.52	73.64	86.95	111.26	136.07	194.44	247.31	252.21	588.94	450.06	446.51		623.75	850.00
Median	70.00	33.00	42.50	52.00	64.50	70.00	95.00	130.00	145.00	250.00	200.00	625.00	425.00	420.00		580.00	850.00
Standard Deviation†	1.08	0.45	0.45	0.38	0.38	0.53	0.44	0.43	0.55	0.40	0.52	0.25	0.27	0.26		0.40	0.00
Minimum	0.00	0.00	21.00	14.00	18.00	22.00	24.00	60.00	55.00	16.00	45.00	100.00	65.00	210.00		150.00	850.00
Maximum	1,250.00	180.00	145.00	200.00	165.00	225.00	350.00	500.00	525.00	750.00	800.00	900.00	800.00	725.00		1250.00	850.00
Adjusted Credit Spread (in bps)																	
Mean	14.04	4.27	12.33	6.60	7.12	-12.27	15.20	10.52	-4.02	35.48	-30.88	213.81	19.98	25.55		201.28	322.02
Median	3.88	0.94	5.39	1.67	2.31	-22.70	7.18	4.62	-28.58	20.49	-58.26	259.27	10.00	13.68		209.41	322.02
Standard Deviation†	4.97	3.98	1.91	3.15	4.21	4.40	2.78	5.90	31.61	2.48	4.31	0.82	5.76	3.27		1.36	0.06
Minimum	-498.36	-40.54	-15.45	-56.85	-41.14	-144.01	-205.00	-216.62	-310.95	-345.32	-498.36	-386.88	-467.36	-195.13		-496.84	308.49
Maximum	689.67	131.60	110.27	159.87	104.63	125.96	240.76	292.55	325.84	490.00	419.40	493.31	439.88	246.11		689.67	335.56

† scaled by absolute mean values of tranche volumes.

Table 5: Credit Spread of CDO Tranches (grouped by Rating Agency and Rating Code)

Code	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Fitch																	
# of tranches	1281	414	17	201	16	35	168	76	39	204	43	17	40	6	3	2	
Volume in mUSD (Mean)	100.21	246.69	42.68	46.10	16.68	29.06	30.77	27.53	27.47	21.52	18.64	14.58	17.25	54.42	50.77	12.80	
Maturity in Years (Mean)	7.77	7.16	6.49	7.82	7.33	8.11	7.87	8.80	8.37	7.81	8.33	13.03	8.25	7.40	7.70	8.50	
Unadjusted Credit Spread (in bps)																	
Mean	122.99	39.41	60.65	62.55	73.19	77.66	110.07	127.08	153.62	243.09	214.33	457.76	455.83	317.50	550.00	612.50	
Median	73.00	35.00	55.00	58.00	65.00	70.00	100.00	125.00	133.00	250.00	210.00	500.00	450.00	337.50	550.00	612.50	
Standard Deviation†	0.99	0.49	0.60	0.40	0.42	0.47	0.44	0.33	0.44	0.38	0.28	0.32	0.29	0.48	0.00	0.26	
Minimum	0.00	0.00	20.00	15.00	27.00	29.00	24.00	37.00	55.00	53.00	61.00	250.00	170.00	65.00	550.00	500.00	
Maximum	750.00	130.00	145.00	170.00	150.00	180.00	260.00	265.00	325.00	750.00	350.00	650.00	750.00	475.00	550.00	725.00	
Adjusted Credit Spread (in bps)																	
Mean	1.64	7.33	27.59	9.45	2.02	-31.29	4.46	-11.89	-33.42	11.42	-114.79	90.60	2.42	-91.36	203.98	62.57	
Median	2.52	3.46	12.97	6.24	2.90	-43.43	3.68	-20.43	-29.66	21.10	-123.40	75.17	12.22	-106.57	201.69	62.57	
Standard Deviation†	42.22	2.43	1.35	2.48	14.38	1.39	10.80	4.52	2.05	9.04	0.78	1.90	64.22	0.96	0.02	0.14	
Minimum	-345.32	-40.54	-10.56	-50.26	-36.54	-144.01	-156.62	-167.37	-246.79	-345.32	-343.05	-197.20	-327.02	-195.13	201.69	56.35	
Maximum	485.00	87.60	110.27	119.97	79.59	85.27	175.20	129.69	138.67	485.00	108.33	372.94	411.30	34.55	208.55	68.78	
Moody's																	
# of tranches	4,596	1,457	86	783	72	74	686	156	58	670	190	63	236	55		8	2
Volume in mUSD (Mean)	89.92	220.83	44.31	42.83	21.52	28.38	28.99	27.50	20.66	22.22	22.25	8.98	16.71	21.52		38.79	7.50
Maturity in Years (Mean)	7.97	7.26	8.52	8.16	6.67	7.70	8.40	8.28	7.93	8.13	8.50	6.72	9.82	9.14		8.76	11.45
Unadjusted Credit Spread (in bps)																	
Mean	132.07	35.67	49.05	55.58	73.56	95.32	110.28	135.91	207.28	248.37	246.64	591.67	451.50	417.05		538.75	850.00
Median	65.00	33.00	42.00	52.00	65.00	75.00	95.00	130.00	150.00	245.00	190.00	625.00	425.00	400.00		560.00	850.00
Standard Deviation†	1.09	0.41	0.41	0.35	0.34	0.53	0.44	0.47	0.52	0.40	0.55	0.25	0.26	0.26		0.32	0.00
Minimum	0.00	0.00	19.00	15.00	18.00	24.00	20.00	30.00	95.00	16.00	45.00	90.00	170.00	210.00		150.00	850.00
Maximum	900.00	180.00	135.00	160.00	150.00	225.00	350.00	500.00	525.00	750.00	800.00	900.00	800.00	700.00		750.00	850.00
Adjusted Credit Spread (in bps)																	
Mean	14.06	3.09	10.71	4.46	8.64	-2.17	15.36	7.18	7.94	40.60	-35.80	237.39	25.09	-1.95	163.85	322.03	
Median	3.71	0.05	5.09	0.63	3.89	-12.16	6.93	-0.82	-13.42	22.64	-58.51	261.93	10.00	-5.67	209.41	322.03	
Standard Deviation†	4.91	5.00	1.96	3.98	3.05	23.91	2.65	9.30	16.99	2.09	3.81	0.67	3.92	57.81	1.68	0.06	
Minimum	-498.36	-40.54	-15.01	-56.85	-41.14	-144.01	-205.00	-216.62	-310.95	-345.32	-498.36	-386.88	-405.00	-338.30	-496.84	308.49	
Maximum	514.79	131.60	81.47	98.24	79.59	122.44	240.76	292.55	325.84	490.00	419.40	514.79	411.30	221.71	360.85	335.56	
S&P																	
# of tranches	4874	1621	22	841	78	52	716	159	66	738	180	70	270	48		11	2
Volume in mUSD (Mean)	86.14	202.00	40.63	41.86	26.40	32.11	28.84	22.59	22.26	22.52	20.72	11.22	16.37	20.83		28.61	7.50
Maturity in Years (Mean)	7.95	7.29	6.59	8.03	6.91	7.94	8.35	8.19	7.87	8.16	8.54	8.25	9.56	9.76		8.59	11.45
Unadjusted Credit Spread (in bps)																	
Mean	134.92	37.25	53.25	58.20	69.72	84.87	111.66	137.65	198.30	247.80	260.04	572.76	452.13	446.58		666.82	850.00
Median	69.00	33.00	55.00	53.00	63.00	70.00	100.00	135.00	147.50	242.50	202.50	625.00	425.00	410.00		590.00	850.00
Standard Deviation†	1.09	0.45	0.49	0.39	0.37	0.49	0.43	0.48	0.56	0.40	0.52	0.26	0.27	0.23		0.31	0.00
Minimum	0.00	0.00	15.00	14.00	18.00	22.00	27.00	29.00	53.00	16.00	45.00	100.00	100.00	250.00		500.00	850.00
Maximum	1,250.00	180.00	145.00	220.00	165.00	225.00	350.00	500.00	525.00	800.00	800.00	900.00	800.00	725.00		1250.00	850.00
Adjusted Credit Spread (in bps)																	
Mean	15.63	4.42	20.59	7.34	3.33	-17.41	15.30	16.65	6.06	37.80	-21.57	204.14	20.92	32.21		264.75	322.03
Median	4.20	0.79	21.13	2.08	-0.81	-27.45	6.93	15.11	-6.33	21.89	-54.35	251.99	10.00	14.40		216.11	322.03
Standard Deviation†	4.43	3.87	1.32	2.95	8.21	-2.76	2.76	3.93	20.42	2.35	-6.32	0.85	5.25	2.25		0.65	0.06
Minimum	-498.36	-40.54	-12.54	-56.85	-41.14	-144.01	-205.00	-216.62	-310.95	-345.32	-498.36	-386.88	-467.36	-174.53		56.35	308.49
Maximum	689.67	131.60	110.27	165.34	104.63	84.27	240.76	292.55	325.84	532.87	419.40	493.31	439.88	246.11		689.67	335.56

† scaled by absolute mean values of tranche volumes.

ii. Impact of Multiple Ratings

In Table 4 we compare in detail the credit spreads of single, double and triple ratings. This allows us to perform first tests for Hypothesis 1. With mean values of 170.35 bps for unadjusted credit spreads (22.36 bps for adjusted credit spreads) for single ratings, 136.83 bps (16.23 bps) for double ratings and 134.83 bps (14.04 bps) for triple ratings we observe that with an increasing number of ratings the level of both unadjusted and adjusted credit spread decreases. In addition to the negative correlation between number of outstanding ratings and credit spreads we also observe a positive relationship between number of tranche ratings and average tranche size as the latter increases from 45.2 mUSD (Single Ratings) to 115.1 mUSD (Triple Ratings). This finding seems to be reasonable since an increasing tranche size allows allocation of rating fees to a broader capital basis.

In order to further determine if CS_{it}, ACS_{it}, maturity and tranche volume are indeed significantly different for single, double and triple ratings we perform several robustness checks which confirm our findings on a statistically significant level (see Table 6). Relying on a one-way ANOVA as well as robust tests of equality (Welch and Brown-Forsythe) all four tranche characteristics are statically significantly different from each other. In addition, we perform a test of homogeneity of variances which leads to the very same results. Thus, with regard to Hypothesis 1 we are able reject the null hypothesis, and not reject the alternative hypothesis respectively, allowing us to argue that there is a negative correlation between the number of outstanding ratings and the level of credit spreads. Each additional rating leads to a lower credit spread – both for adjusted and unadjusted credit spreads.

Table 6: Robustness Checks for the Grouping Factor Multiple Ratings

Robustness Checks for the Grouping Factor Multiple Ratings

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Volume	Between Groups†	1109,657.48	2	554,828.74	13.99	0.0000
	Within Groups	203,426,186.18	5130	39,654.23		
	Total	204,535,843.66	5132			
Maturity	Between Groups	243.25	2	121.63	20.26	0.0000
	Within Groups	30,792.20	5130	6.00		
	Total	31,035.46	5132			
Unadjusted Credit Spread	Between Groups	779,357.33	2	389,678.67	18.60	0.0000
	Within Groups	107,459,348.51	5130	20,947.24		
Adjusted Credit Spread	Total	108,238,705.84	5132			
	Between Groups	205,843.88	2	102,921.94	21.34	0.0000
	Within Groups	24,739,518.43	5130	4,822.52		
	Total	24,945,362.31	5132			

Robust Tests of Equality of Means

		Statistic‡	df1	df2	Sig.
Volume	Welch	28.94877899	2	778.98	0.0000
	Brown-Forsythe	12.61674765	2	1,020.08	0.0000
Maturity	Welch	29.62322859	2	668.65	0.0000
	Brown-Forsythe	29.22022976	2	864.24	0.0000
Unadjusted Credit Spread	Welch	22.05001686	2	630.30	0.0000
	Brown-Forsythe	18.38957736	2	617.24	0.0000
Adjusted Credit Spread	Welch	20.21044313	2	588.85	0.0000
	Brown-Forsythe	13.32254807	2	562.70	0.0000

† Groups are defined as Single, Double and Triple Ratings

‡ Asymptotically F distributed

iii. Decreasing Reduction of Underlying Tranche Spreads

In the following, we analyze if the level of correlation between credit spreads and number of ratings changes when moving from single to double or from double to triple ratings. In Table 7 we compare in detail the mean differences of unadjusted and adjusted credit spreads between single, double and triple ratings. In addition, we display mean differences for maturity and tranche volume. Due to different interest term structure tranche maturity is by definition an important factor when discussing attributes of debt instruments. Tranche volume is especially relevant for structured credit transactions as rating cost are usually fixed cost decrease per investor when tranches are of significant seize. Furthermore, small tranches are usually less transparent than larger ones as they are sometimes tailor-made for large investors or sold in club markets. Therefore, tranche volume is an important factor.

According to Table 4 tranche volume seems to positively correlate with the number of outstanding ratings. Thus, it is reasonable to analyze incremental correlation between these two factors if moving from single to double or double to triple ratings.

While average maturity appears to increase from single to double ratings and to decrease from double to triple ratings (see Table 4), no clear pattern can be derived for tranche maturities. The average tranche volume increases from single to double and double to triple ratings with decreasing marginal differences: Volume grows by 38.61 mUSD on average from single to double ratings, whereas growth from double to triple ratings amounts to 31.28 mUSD on average. With 33.51 bps (single to double ratings) versus 25.60 bps (double to triple ratings) this pattern also holds for unadjusted credit spreads. Thus, the reduction of unadjusted credit spread levels decreases with an increase in the number of outstanding ratings. In contrast, exclusion of systematic credit risk (adjusted credit spreads) leads to a different result: reduction of credit spreads levels increases from 6.13 bps between single and double ratings to 17.07 bps between double and triple ratings.

Since we already proved that variances of the variables volume, maturity and (un)adjusted credit spreads are unequal (see Table 6), we are able to apply a Games-Howell test in order to check for significance of mean differences on the 0.05 significance level. Mainly, we are able to confirm significance at a 0.05 level. Cross-checking the Games-Howell results with the testing algorithms of Tamhane's T2, Dunnett's T3 as well as Dunnett's C leads to the same significance levels.

Regarding Hypothesis 2 it becomes clear that in the case of unadjusted credit spreads we are not able to reject the null hypothesis but the alternative hypothesis. For the adjusted credit spreads we note in turn a rejection of the null hypothesis and a non-rejection of the alternative hypothesis. We could not find empirical support on all levels for the hypothesis stating that marginal tranche spread reduction decreases when adding additional rating agencies. Against the background of these results we are not able to observe a clear pattern relating to the question whether marginal ratings lead to increasing, decreasing or constant credit spreads. However, since we created the adjusted credit spreads in order to analyze the idiosyncratic credit risk without any dilution of the systematic credit risk, multiple ratings should have the highest impact on adjusted credit spreads. Thus, we analyze mean spread differences of adjusted credit spreads and interpret increasing credit spread reduction as representing a selection bias. Also missing levels of significance for mean difference between single and double ratings (adjusted credit spreads) does not change this view since mean difference between double and triple ratings are significant (Table 7).

Table 7: Multiple comparisons of underlying tranche spread differences

Multiple Comparisons of Underlying Tranche Spread Differences (Games-Howell Test)

Dependent Variable	(I) MultipleRatings	(J) MultipleRatings	Mean Difference (I-J)	Std. Error	Sig.
Volume (in mUSD)	Single Rating	Double Rating	-38.6083*	5.7876	0.0000
		Triple Rating	-69.8854*	11.8965	0.0000
	Double Rating	Single Rating	38.6083*	5.7876	0.0000
		Triple Rating	-31.2771*	11.1395	0.0141
	Triple Rating	Single Rating	69.8854*	11.8965	0.0000
		Double Rating	31.2771*	11.1395	0.0141
Maturity (in Years)	Single Rating	Double Rating	-0.5915*	0.1365	0.0001
		Triple Rating	-0.0656	0.1452	0.8937
	Double Rating	Single Rating	0.5915*	0.1365	0.0001
		Triple Rating	0.5259*	0.0755	0.0000
	Triple Rating	Single Rating	0.0656	0.1452	0.8937
		Double Rating	-0.5259*	0.0755	0.0000
Unadjusted Credit Spread (in bp)	Single Rating	Double Rating	33.5144*	10.5623	0.0047
		Triple Rating	59.1163*	11.0834	0.0000
	Double Rating	Single Rating	-33.5144*	10.5623	0.0047
		Triple Rating	25.6019*	4.6885	0.0000
	Triple Rating	Single Rating	-59.1163*	11.0834	0.0000
		Double Rating	-25.6019*	4.6885	0.0000
Adjusted Credit Spread (in bp)	Single Rating	Double Rating	6.1288	6.4510	0.6091
		Triple Rating	23.1991*	6.8556	0.0023
	Double Rating	Single Rating	-6.1288	6.4510	0.6091
		Triple Rating	17.0704*	2.7441	0.0000
	Triple Rating	Single Rating	-23.1991*	6.8556	0.0023
		Double Rating	-17.0704*	2.7441	0.0000

* The mean difference is significant at the .05 level.

iv. CDO Tranches Rated by Fitch

Sorting the CDO tranches for rating agencies result in 3 different groups (Table 5): 1,281 tranches rated by Fitch, 4,596 tranches rated by Moody's and 4,874 tranches rated by S&P adding up to 10,751 cases in total. Since multiple ratings exist, many tranches are included in more than one group. We now focus on the average rating per rating agency and compare the rating outcome. Specifically, we test according to Hypothesis 3 if the average Fitch rating is different from the average S&P or Moody's rating or not.

Table 8 provides a detailed overview of mean ratings. Since numbers of tranches per agency differ substantially (Fitch 1,281 tranches, Moody's 4,596 tranches, S&P 4,874), this figure only displays a first illustration of mean ratings. However, with a mean rating code of 4.8595 Fitch ratings obtain the highest credit quality; Moody's and S&P in turn achieve lower mean rating levels. Starting from here, we focus on the detailed ratings assigned by the agencies for the very same tranche. This approach leaves us with two different samples: multiple and joint ratings. Multiple ratings come as single, double and triple ratings; joint ratings only pair wise. Single ratings are not directly applicable to compare different rating outcomes; however, they give an indication if a specific rating agency is favored by issuers for a specific part of the seniority structure.

Table 8: Comparison of rating outcomes (grouped by rating agencies and rating code)

Rating Outcomes of CDO Tranches (grouped by Rating Agency)

Rating Agency	# of rated Tranches	in % of Total Sample	Fitch	Moody's	S&P	Moody's ./. S&P	Fitch ./. S&P	Moody's ./. Fitch
			Average Rating Code			**Average Notch Difference†**		
Total	5,133	100.00%	4.8595	4.9238	4.9179	0.0059	-0.0584	0.0644
Single								
Fitch	68	1.32%	7.2500					
Moody's	37	0.72%		4.6486				
S&P	166	3.23%			4.8373			
Total	271	5.28%						
Double Ratings								
Moody's/ S&P	3,649	71.09%		4.9918	4.9794	0.0123**		
Fitch/ S&P	303	5.90%	5.1023		5.1254		-0.0231	
Moody's/ Fitch	154	3.00%	5.0260	5.0455				0.0195
Triple Ratings								
Fitch/ Moody's/ S&P	756	14.73%	4.5132	4.5847	4.5556	0.0291**	-0.0423**	0.0714**
Joint Ratings								
Moody's/ S&P	4,405			4.9219	4.9067	0.0152**		
Fitch/ S&P	1,059		4.6818		4.7186		-0.0368**	
Moody's/ Fitch	910		4.6000	4.6626				0.0626**

† In case of (-), subtrahend has rated on average lower.
**Significant at the 0.05 level.

With a mean value of 7.25 single ratings by Fitch correspond to a significantly lower credit quality than single ratings by Moody's (4.6486) and S&P (4.8373). This indicates that Fitch rates more junior tranches than the other agencies do. What is even more revealing is the analysis of double and triple ratings. Based on notch differences we observe that Fitch – when directly compared with Moody's and Fitch –on average assigns a better rating as do Moody's and S&P for the very same tranche in double ratings (Table 8). In turn, S&P ratings document on average a higher credit quality as do Moody's ratings for the very same tranches. With 4.5132 (Fitch), 4.5556 (S&P) and 4.5847 (Moody's) this pattern also holds for triple ratings. In cases where a tranche is rated by all three rating agencies, Fitch ratings are on average better (e.g. lower in terms of rating codes) than the corresponding ratings by Moody's and S&P. Moody's in turn assigns the highest rating codes (lowest credit quality). Thus, the biggest notch difference is between Moody's and Fitch. The analysis of jointly-rated tranches supports these results, since Fitch again assigns on average the best rating and the lowest rating code in direct comparison to Moody's and S&P.

For triple and joint ratings all notch differences are significant on the 0.05 level (see Table 8). For double ratings significance of mean notch differences is only given for the combination Moody's/ S&P. However, it needs to be considered that the pairs Fitch/ S&P and Moody's/ Fitch are comparatively rare with 303 and 154 tranches. Significance on the level of jointly-rated tranches for Fitch/ S&P as well as Moody's/ Fitch confirms the results obtained throughout the analysis of triple ratings on a larger scale (1,059 and 910 tranches). With regard to Hypothesis 3 we can reject the null hypothesis and not reject the alternative hypothesis. This means that the average Fitch rating is different and significantly better than the corresponding Moody's and S&P ratings.

v. Regression Analysis

To assess the impact various factors have on the underlying credit spread the application of a regression analysis is a widely accepted measure in financial literature and also commonly used in the context of multiple ratings (e.g. Kish et al., 1999; Jewell and Livingston, 1999; Vink and Thibeault, 2008). So far we limited our analysis to univariate statistics. In the following we perform a series of regression analyses in order to specify the impact multiple ratings have on the underlying tranche credit spread. We define the unadjusted credit spread CS_{it} and the adjusted credit spread ACS_{it} as the dependent variables and multiple ratings as well as several other factors (e.g. volume) as independent variables and perform a regression analysis according to Vink and Thibeault (2008). We define our valuation model as follows:

$$CS_{it} = \alpha + \beta_1 Multiple\ Ratings_i + \beta_2 Rating\ Code_i + \beta_3 Tranche\ Volume_i + \beta_4 Maturity_i + \beta_5 Transaction\ Type_i + \beta_6 Currency_i + \beta_7 Year\ of\ Issuance_i + \varepsilon_i$$

with:

$\text{Multiple Ratings}_i$:	Zero-one variables for multiple ratings (single and double ratings); takes one if the tranche received a corresponding multiple rating, zero if otherwise; triple ratings function as a base case and are thus excluded from the analysis
Rating Code_i:	Zero-one variables for average rating codes (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15); takes one if the tranche received a rating of the corresponding rating code, zero if otherwise; rating code 16 functions as a base case and is thus excluded from the analysis, rating code 14 is also not displayed since no data points are existing for this rating code. In a second set of regression analyses (Set B) we replace zero-one variables with a single metric scale representing the tranche average rating code (Mean Rating Code).
Tranche Volume_i	Volume of tranche i in mUSD
Maturity_i	Maturity of tranche i in years
$\text{Transaction Type}_i$	Zero-one variables for transaction type (CBO and CLO); takes one if the transaction type corresponds to the specific type, zero if otherwise; transaction type Exotic functions as a base case and is thus excluded from the analysis
Currency_i:	Zero-one variable for currency (USD and other currencies); takes one if the transaction is denominated in USD, zero if otherwise
$\text{Year of Issuance}_i$:	Zero-one variables for year of issuance (2005, 2006, 2007); takes one if the tranche was

issued in the corresponding year, zero if otherwise; year 2004 functions as a base case and is thus excluded from the analysis

We explicitly include multiple ratings as two nominal zero-variables (single and double ratings) and not as a scale metric (number of outstanding ratings) as applied by Vink and Thibeault (2008). This differentiation allows us to isolate the impact of the individual characteristic (single or double ratings). Different rating codes like zero-one variables consider the seniority structure of a CDO transaction and test for increasing spread levels with decreasing credit quality. Maturity and tranche volume are a natural choice to be incorporated in our valuation model since both variables are crucial for each CDO tranche. Literature (Vink and Thibeault 2008) and the comparison of different CDO credit spread indices in our data set already reveal that credit spreads do not necessarily have the same level for different transaction types. Specifically, exotic CDOs are traded at higher spreads compared to CLOs and CBOs.

The majority of tranches is denominated in USD (81.2%) followed by EUR. Besides, with approx. 15 tranches other currencies play no meaningful role (approx. 15 tranches) and we thus merged EUR and other currencies into one group. Relevance of currency as a major impact variable relates to the fact that rating agencies assign to different recovery rates U.S, and European CDOs. Recovery rates in turn directly impact losses to which credit spreads are positively correlated. Mostly the collateral pool consists of assets located in the transaction's currency area (e.g. U.S. assets are typically used as a collateral pool of transactions denominated in USD). Thus, there exists a link between the transaction's currency and the underlying tranche spread. Finally, we also included the year of issuance into our valuation model. Year of issuance is of particular interest since we observe over our whole sample period (2004-2007) decreasing credit spreads on an overall basis. Specifically, in case of unadjusted credit spreads we expect high significance levels. Prior to our regression analysis we controlled for normal distribution of all independent variables (Kolmogorov-Smirnow Test).

We display the results of our regression analysis in Table 9. As outlined before, we perform our analysis for two dependent variables: unadjusted and adjusted credit spreads. In addition, we analyze two sets of independent factors (Set A & B). We created two compositions of independent variables because regression analysis of Set A leaves us with very modest signs of multicollinearity for selected zero-one variables of the average rating code (e.g. 3, 9, 12). Since we do not want to dilute our analysis or our R^2 through imprecise data, we replaced the zero-one variables by the scale metric mean rating code of each tranche in a second trial (Set B). However, we kept the zero-one variables for Set A due to information about seniority structure of a CDO.

In addition we also checked for outliers. Since the exclusion of outliers impacted the final results only on a very modest basis (e.g R^2 of regression analysis Set B with unadjusted credit spread only increased from 0.7080 to 0.7250) and we believe in the reliability of the underlying data, we decided to apply the regression analysis of Table 9 to the original data set of 5.133 different CDO tranches. Thus we maintain data consistency with the prior analysis of our empirical section.
In each regression (adjusted and unadjusted credit spreads) of Set A and Set B all variables have significant impact on the credit spread level. A large majority of variables is even significant on the 0.01 level. Concerning multiple ratings we observe that single ratings lead to higher credit spreads than double ratings. This finding supports the results of our preceding univariate analysis of negative correlation between number of ratings and level of credit spreads (see table 4). It is particularly interesting that the impact of standardized coefficients is higher for adjusted credit spreads in both sets. Thus,

the exclusion of the systematic credit risk proves to help to isolate the specific impact multiple ratings have on credit spread levels. A second indication for this fact is the lower impact of mean rating code on adjusted credit spreads than on unadjusted credit spreads in Set B (0.217 versus 0.8560). Based on Hypothesis 1, we can reject the null hypothesis and not reject the alternative hypothesis. In addition, the results of our regression analysis emphasize a negative correlation between number of ratings and credit spread. Thus, it confirms our results illustrated on a univariate basis in Table 4.

The coefficients of different zero-variables relating to the rating codes decrease with increasing rating codes, which equals a higher spread level for decreasing credit quality and thus confirms the results of Vink and Thiebeault (2008). Relating to the standardized coefficients of the regression analysis in Set A as well as in Set B zero-one variables of the average rating code have on average the highest impact. Again, this finding is not surprising and confirmed in Set B through the high impact of mean rating code. In contrast to our univariate analysis (Table 4) the impact of tranche volume is negligible in both sets and around zero in absolute terms.

A possible explanation could be the mode of payment for CDO ratings. The issuer pays a fee, which is predominately a percentage of the underlying tranche volume (e.g. 4.5 bps), which dilutes the incentive to rate only tranches with large volumes by multiple rating agencies. Maturity in turn has a slightly higher impact and can be explained by different interest rate term structures. For the transaction structure we observe that CBO structures lead to lower credit spreads as documented for CLOs. A potential explanation for this finding could be the fact that the collateral pool of a CBO is expected to be more liquid than the collateral pool of a CLO. Thus, the whole transaction becomes more price sensitive from the investor's angle. The results relating to the zero-one variables of the issuance year are in line with the development of CDS spreads as a benchmark over the same period. Thus, this dummy variable behaves as expected. Specifically, the comparably low credit spreads documented for 2007 result in a decreasing unstandardized coefficient of the independent variable "YEAR OF ISSUANCE 2007".

Since our valuation model (Table 9) consists of a number of different independent pricing factors, we additionally perform several robustness checks in order to control for potential effects left undetected throughout our initial regression analysis (Set A & B). We want to control for the explanatory power of multiple ratings on credit spread levels. First, each independent pricing factor is individually regressed on unadjusted and adjusted credit spreads. Second, we include the dummy variables relating to multiple ratings (single and double ratings) and again perform a regression analysis for each independent pricing factor. If multiple ratings indeed incorporate explanatory power the generated R^2, values should increase following the inclusion of multiple rating dummy variables. In Table 10 we have exemplarily outlined the results of the robustness checks for the pricing factor tranche volume Throughout our analysis of credit spreads we observed a positive correlation between number of outstanding ratings and tranche volume. Thus, the performed robustness checks should give us an insight, if we have covered a mere size effect throughout our valuation model. For both dependent variables we note increasing R^2 values as well as high levels of significance for the two dummy variables of multiple ratings. Even though the increase is rather modest on an absolute basis, relative differences are high. The pattern documented for tranche volume (Table 10) also holds for the other independent pricing factors. Thus, we find empirical proof for the explanatory power of multiple ratings on credit spread levels.

Table 9: Impact of Multiple Ratings on CDO Credit Spreads (Multiple Regression Analysis)

SET A

	Dependent Variable: Unadjusted Credit Spread	Dependent Variable: Adjusted Credit Spread
N	**5,133**	**5,133**
F	**1,074.84**	**82.24**
R^2	**0.8350**	**0.2790**
Independet Variables	**Coefficients**	**Coefficients**
(Constant)	936.4885***	407.6073***
SINGLERATING	44.8969***(0.0691)	25.6809***(0.0824)
DOUBLERATING	26.4475***(0.0729)	22.5819***(0.1296)
RATINGCODE 1	-845.4537***(-2.7068)	-346.2465***(-2.3091)
RATINGCODE 2	-821.8987***(-0.7265)	-332.1769***(-0.6116)
RATINGCODE 3	-824.4751***(-2.1253)	-340.0975***(-1.8262)
RATINGCODE 4	-824.2198***(-0.7201)	-350.9642***(-0.6387)
RATINGCODE 5	-795.7164***(-0.5692)	-356.1795***(-0.5307)
RATINGCODE 6	-767.0254***(-1.8841)	-329.7169***(-1.6871)
RATINGCODE 7	-757.2764***(-0.9895)	-335.3720***(-0.9129)
RATINGCODE 8	-697.6798***(-0.5248)	-348.7539***(-0.5465)
RATINGCODE 9	-636.7029***(-1.5682)	-311.8145***(-1.5997)
RATINGCODE 10	-624.0415***(-0.8415)	-371.6635***(-1.0440)
RATINGCODE 11	-308.5228***(-0.2358)	-133.8774***(-0.2131)
RATINGCODE 12	-412.2900***(-0.6502)	-314.1313***(-1.0319)
RATINGCODE 13	-402.7010***(-0.2906)	-301.9321***(-0.4539)
RATINGCODE 15	-234.6547***(-0.0780)	-129.7039***(-0.0899)
TRANCHE VOLUME	-0.0132***(-0.0181)	-0.01733***(-0.0496)
MATURITY	-3.5378***(-0.0599)	-8.7632***(-0.3091)
TRANSACTIONTYPE CBO	-54.3929***(-0.0227)	-49.6281***(-0.0432)
TRANSACTIONTYPE CLO	-42.2555***(-0.1453)	-3.6198*(-0.0259)
CURRENCY	-17.2768***(-0.0465)	-13.6782***(-0.0767)
YEAR 2005	-30.0737***(-0.0901)	-4.0772(-0.0254)
YEAR 2006	-34.6765***(-0.1194)	-5.7583**(-0.0413)
YEAR 2007	-16.5672***(-0.0323)	-9.3106***(-0.0378)

SET B

	Dependent Variable: Unadjusted Credit Spread	Dependent Variable: Adjusted Credit Spread
N	**5,133**	**5,133**
F	**1,127.36**	**79.28**
R^2	**0.7080**	**0.1460**
Independet Variables	**Coefficients**	**Coefficients**
(Constant)	13.1810**	54.5407***
SINGLERATING	52.0463***(0.0802)	29.2973***(0.0940)
DOUBLERATING	28.01530***(0.0772)	23.7821***(0.1365)
MEANRATINGCODE	33.3743***(0.8561)	4.0677***(0.2173)
TRANCHE VOLUME	0.0323***(0.0444)	-0.0135***(-0.0387)
MATURITY	-3.6400***(-0.0616)	-8.8089***(-0.3107)
TRANSACTIONTYPE CBO	-56.6195***(-0.0237)	-54.5171***(-0.0475)
TRANSACTIONTYPE CLO	-34.4079***(-0.1183)	-5.5371***(-0.0397)
CURRENCY	-16.3814***(-0.0441)	-16.6892***(-0.0935)
YEAR 2005	-29.2951***(-0.0878)	-4.0414(-0.0252)
YEAR 2006	-30.6680***(-0.1056)	-4.6811*(-0.0336)
YEAR 2007	-12.7319***(-0.0248)	-8.3343**(-0.0338)

* Significance at the 0.1 level
** Significance at the 0.05 level
*** Significance at the 0.01 level
Values in brackets refer to standardized coefficients.

Table 10: Robustness Checks (Controlling for Size Effect)

Regression Analysis			Regression Analysis		
Dependent Variable: Unadjusted Credit Spread			**Dependent Variable: Adjusted Credit Spread**		
N	**5,133**	**5,133**	**N**	**5,133**	**5,133**
F	**318.54**	**114.90**	**F**	**32.16**	**23.53**
R^2	**0.0585**	**0.0630**	**R^2**	**0.0062**	**0.0136**
Independet Variables	**Coefficients**	**Coefficients**	**Independet Variables**	**Coefficients**	**Coefficients**
(Constant)	150.0248***	131.0579***	(Constant)	16.4172***	2.0978
SINGLERATING		47.0774***(0.0725)	SINGLERATING		21.4132***(0.0687)
DOUBLERATING		20.2139***(0.0557)	DOUBLERATING		16.2711***(0.0937)
RATINGCODE 1			MEANRATINGCODE		
RATINGCODE 2			TRANCHE VOLUME	0.0323***(0.0789)	-0.0256***(-0.0732)
RATINGCODE 3			MATURITY		
RATINGCODE 4			TRANSACTIONTYPE CBO		
RATINGCODE 5			TRANSACTIONTYPE CLO		
RATINGCODE 6			CURRENCY		
RATINGCODE 7			YEAR 2005		
RATINGCODE 8			YEAR 2006		
RATINGCODE 9			YEAR 2007		
RATINGCODE 10					
RATINGCODE 11					
RATINGCODE 12					
RATINGCODE 13					
RATINGCODE 15					
TRANCHE VOLUME	-0.1759***(-0.2418)	-0.1723***(-0.2368)			
MATURITY					
TRANSACTIONTYPE CBO					
TRANSACTIONTYPE CLO					
CURRENCY					
YEAR 2005					
YEAR 2006					
YEAR 2007					

* Significance at the 0.1 level
** Significance at the 0.05 level
*** Significance at the 0.01 level
Values in brackets refer to standardized coefficients.

VI. Conclusion

The main objective of this paper is to analyze the impact of multiple CDO ratings on credit spreads of the respective tranches. The analysis is performed on a data set of more than 5,000 CDO tranches for which we calculated index-adjusted credit spreads by subtracting an average CDO Credit Spread Index $CS\ Index_{jt}^{rc}$ from the individual unadjusted credit spread CS_{it} to isolate the specific credit risk per CDO tranche. Thereby, we are able to analyze idiosyncratic credit spreads of different tranches without any dilution from systematic credit risk. We argue that each additional rating incorporates new incremental information and thus reduces information asymmetry between the issuer and the investor. Reduced information asymmetry increases transparency, thereby lowers investors' demand for risk premiums and leads to lower credit spreads. The motivation for this empirical analysis becomes especially relevant when considering latest market turmoil: We interpret information asymmetries between issuers and investors to lie at the heart of the direct consequences of the subprime crisis. Misaligned incentive structures for issuers along the structuring process of CDOs lead to a situation where insufficient information was shared with investors.

Our key findings are threefold: First, we find that on average credit spreads indeed decrease with an increasing number of ratings. The obtained negative correlation between multiple ratings and adjusted credit spreads is statistically robust and cross-checked for various factors. In addition, we developed a valuation model incorporating multiple ratings as an independent variable. It shows that multiple ratings not only negatively correlate with credit spreads but also have a significant explanatory content for their level. Introduction of index-adjusted credit spreads reduced the impact of variables linked to the tranche's credit quality in our valuation model and in turn led to a further increase of observed influence levels for multiple ratings.

Second, even with decreasing spread levels in place, we were not able to confirm the hypothesis that marginal tranche spread reduction decreases with the number of published ratings. These results make it rather difficult to determine and recommend an optimal number of ratings an investor should opt for when structuring a CDO. Additional ratings always come with additional costs; thus, the incremental value of additional ratings through spread reduction should at least amount to the level of costs associated with an additional rating. CDO rating costs are viewed to be in the range of 4.5 bps of the underlying tranche volume. However, in both cases (single to double and double to triple ratings) documented spread reduction is a lot higher. Therefore, investors have an economic incentive to seek multiple ratings.

Third, we reviewed the outcome of Fitch ratings in direct comparison to Moody's and S&P ratings. Research exists targeting this issue from the perspective of corporate bonds (e.g. Jewell and Livingston, 1999) while, again, the role of Fitch ratings within structured finance transactions has not been analyzed before. We found that in the case of joint (pair wise) ratings, on average Fitch assigned a higher credit quality (e.g. better rating) than its competitors Moody's and S&P did for the very same CDO tranche. Since Fitch is by far the smallest of the three rating agencies offering services in the field of CDO ratings, we see a potential explanation in the form of a selection bias. Issuers only assign a CDO rating to Fitch if the expected outcome is better than the one obtained by Moody's or S&P.

The role of multiple ratings in valuation models for corporate bonds has been widely discussed in the literature. However, the transfer of the results to the field of securitization is rather inappropriate since the CDO rating process is substantially different from the rating process of corporate bonds: CDO ratings are solicited by the issuer, who chooses the rating agencies and controls the rating process. Additionally, issuer and rating agency are in close contact throughout the rating process – a behavior heavily criticized in the recent past by politicians and regulatory authorities. This negotiation process as well as the role of rating agencies in structured finance business and their business models will be intensely discussed in future research. Future analysis might also focus on how different rating outcomes for the very same CDO tranche can be linked to different CDO rating processes and applied models.

Reflecting the results of our analysis with regard to the current discussion on required regulation of markets and rating agencies in particular, we interpret them as a support for the argument, that the crisis was caused by misaligned incentives and ensuing intransparency. Accordingly, investors should not only request for higher credit spreads in opaque situations but also demand transparency and thereby induce the development of sophisticated incentive structures.

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