The Upgrade and Downgrade of CMBS Credit Ratings[*]

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[*] The views expressed are not necessarily those of the Board of Governors of the Federal Reserve System. All errors remain our own.

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Executive Summary

We take the first effort to systematically study the rating migrations of CMBS. We seek to first lay out some important facts about CMBS rating migrations. For example, how often are CMBS upgraded or downgraded? Which CMBS rating classes are more likely to be downgraded than others? What is the chance of an AAA rated CMBS bond falling below investment rating? Are there temporal variations in the rate of upgrades and downgrades? Do the rating migrations issued by different CRAs follow the same or different patterns? Then we take a step further to examine the drivers and determinants of CMBS rating migrations. We build models for the upgrade and downgrade probabilities of CMBS and study the importance of macroeconomic factors, CMBS deal-specific factors and peer behavior in affecting CMBS upgrades and downgrades. We also investigate whether there are structural breaks in CMBS rating migrations.

The main data used in this study are the history of CMBS credit ratings made by the three major CRAs, Standard & Poor's (S&P), Fitch and Moody's. We also match CMBS deal, bond and loan data from Morningstar as well as macroeconomic and financial data from other sources to the ratings data.

Our main findings are: 1) many of the CMBS credit ratings change subsequent to their initial assignment and the change can be as significant as three or more notches downgrade. All three major CRAs have over 50 percent of their initial credit ratings changed, and about 30 to 38 percent of the CMBS bonds had three or more notches downgrade. 2) CMBS rating migrations are asymmetric. All three CRAs have significantly more downgrades than upgrades, even though Fitch has more symmetric rating migrations comparing to the other two CRAs. 3) CMBS bonds issued in different rating classes have significant discrepancies in upgrade and downgrade probabilities. Generally, speculative CMBS bonds (BB or below) have the highest probability of downgrades while AA and A bonds have the highest probability of upgrades. 4) Contrary to some CRAs' claims that their ratings are "through-the-cycle", CMBS ratings change depending on the business cycles. There are systematically more downgrades during recessions, and business cycle indicators such as national unemployment rate, coincident indicator and yield slope are significant drivers of CMBS rating migrations. 5) In addition to macroeconomic conditions, deal-specific factors such as loan-to-value ratio (LTV) and debt-service coverage ratio (DSCR) affect CMBS rating transitions. Improvement in deal average of the LTV and DSCR has positive impact on rating upgrade and negative impact on rating downgrade. 6) CRAs take information quality into consideration when making rating changes. When the realized DSCR is better than the underwritten DSCR, CRAs are more likely to upgrade CMBS bonds and less likely to downgrade CMBS bonds. 7) There is clear herding in CRAs rating change behavior. Lagged rating changes of the other CRAs are good predictors of current rating changes of a particular CRA. The results are very consistent across all three CRAs. 8) The CRAs tend to resist to multiple rating changes on the same bond, possibly due to the bad signal such behavior sends out about their initial ratings (they had to make multiple changes subsequently). 9) We see a structure break in CMBS rating migrations in 2009. CRAs became reluctant to rating upgrades and more likely to issue rating downgrades.

1. Introduction

Structured finance products such as commercial mortgage-backed securities (CMBS) have credit ratings similar to those issued to traditional debt instrument such as corporate bonds. Each of the tranches in a given CMBS deal is assigned an initial credit rating by the credit rating agencies (CRAs) at CMBS issuance. Subsequently, it can be adjusted up or down[1]. Changes in CMBS credit rating reflects the CRAs estimates of credit risk to the tranche. This not only sends a signal to investors, it may impact the reserve requirements of particular bonds for regulated investors, affecting investors' risk management and asset allocation decisions. From a macro perspective, changes in CMBS credit rating send out signals about the strength of the CMBS market and can have profound impact on the credit market and the broader macro economy[2]. Despite their importance, however, little research has been done on CMBS ratings migrations, which sharply contrasts the extant literature on corporate bond rating transitions (see, e.g., Altman and Kao, 1992; Jarrow, Lando and Turnbull, 1997 among many others).

In this paper, we take the first effort to systematically study the rating migrations of CMBS. We seek to first lay out some important facts about CMBS rating migrations. For example, how often are CMBS upgraded or downgraded? Which CMBS rating classes are more likely to be downgraded than others? What is the chance of an AAA rated CMBS bond falling below investment rating? Are there temporal variations in the rate of upgrades and downgrades? Do the rating migrations issued by different CRAs follow the

[1] For example, in the last quarter of 2006 Moody's upgraded 110 CMBS bond classes from 44 CMBS transactions. More recently, Moody's downgraded eight CMBS classes of the WBCMT 2006-C26 deal in November 2012.

[2] For example, large scale of rating downgrades during the recent financial crisis has contributed to the temporary shut down of the CMBS market and permanent changes in the rules and structures of the CMBS market.

same or different patterns? Then we take a step further to examine the drivers and determinants of CMBS rating migrations. We build models for the upgrade and downgrade probabilities of CMBS and study the importance of macroeconomic factors, CMBS deal-specific factors and peer behavior in affecting CMBS upgrades and downgrades. We also investigate whether there are structural breaks in CMBS rating migrations.

The current study should prove useful to CMBS investors in addition to an academic audience. The stylized facts can help investors assess the changing risk of CMBS investment, and the rating transition models can help them better understand and predict CMBS rating migrations.

In addition, in the aftermath of the recent financial crisis, there is an increased interest in the academic community to try to understand the appropriateness and efficacy of CRAs' credit ratings (see, e.g., Griffin and Tang, 2011, 2012; Bolton, Freixas and Shapiro, 2012; Stanton and Wallace, 2012; among many others). In that regard, knowing what happened after CRAs' initial rating assignment but not just at CMBS issuance will help complete the picture.

The main data used in this study are the history of CMBS credit ratings made by the three major CRAs, Standard & Poor's (S&P), Fitch and Moody's. We also match CMBS deal, bond and loan data from Morningstar as well as macroeconomic and financial data from other sources to the ratings data.

A quick summary of our main findings: 1) many of the CMBS credit ratings change subsequent to their initial assignment and the change can be as significant as three or

more notches downgrade. All three major CRAs have over 50 percent of their initial credit ratings changed, and about 30 to 38 percent of the CMBS bonds had three or more notches downgrade. 2) CMBS rating migrations are asymmetric. All three CRAs have significantly more downgrades than upgrades, even though Fitch has more symmetric rating migrations comparing to the other two CRAs. 3) CMBS bonds issued in different rating classes have significant discrepancies in upgrade and downgrade probabilities. Generally, speculative CMBS bonds (BB or below) have the highest probability of downgrades while AA and A bonds have the highest probability of upgrades. 4) Contrary to some CRAs' claims that their ratings are "through-the-cycle", CMBS ratings change depending on the business cycles. There are systematically more downgrades during recessions, and business cycle indicators such as national unemployment rate, coincident indicator and yield slope are significant drivers of CMBS rating migrations. 5) In addition to macroeconomic conditions, deal-specific factors such as loan-to-value ratio (LTV) and debt-service coverage ratio (DSCR) affect CMBS rating transitions. Improvement in deal average of the LTV and DSCR has positive impact on rating upgrade and negative impact on rating downgrade. 6) CRAs take information quality into consideration when making rating changes. When the realized DSCR is better than the underwritten DSCR, CRAs are more likely to upgrade CMBS bonds and less likely to downgrade CMBS bonds. 7) There is clear herding in CRAs rating change behavior. Lagged rating changes of the other CRAs are good predictors of current rating changes of a particular CRA. The results are very consistent across all three CRAs. 8) The CRAs tend to resist to multiple rating changes on the same bond, possibly due to the bad signal such behavior sends out about their initial ratings (they had to make multiple changes

subsequently). 9) We see a structure break in CMBS rating migrations in 2009. CRAs became reluctant to rating upgrades and more likely to issue rating downgrades.

The current study fits to the broader literature on rating migrations. The literature on corporate and sovereign bonds has a long tradition to calculate rating transition matrix and to fit mathematical models such as the Markov chain models to it (e.g., Altman and Kao, 1992; Jarrow, Lando and Turnbull, 1997; Altman, 1998; Israel, Rosenthal and Wei, 2001; Lando and Skodeberg, 2002). More recent studies introduce time-variant Markov models and intensity models to rating migrations to try to capture the impacts of time-related and other factors (Bangia, Diebold and Schuermann, 2002; Kadam and Lenk, 2008; Frydman and Schuermann, 2007; Koopman, Lucas and Monteiro, 2008; Fei, Fuertes and Kalotychou, 2012). In this paper, we apply methodologies that are well developed in that literature to help understand the rating transitions of a particular segment of the structured finance markets, the CMBS market. On the other hand, our study of CMBS rating transitions contributes to that general rating migrations literature, because unlike corporate rating migrations where credit risk is endogenous (Hill and Faff, 2010; Krisgen, 2009), the causality of credit risk on CMBS rating migrations is theoretically unidirectional. Therefore, a study of CMBS rating migration can better identify the relation between credit risk changes and rating migrations.

The rest of the paper is organized as follows: in the next section, we explain our data and methodology; in section 3, we present our analysis results; conclusions and discussions are in the final section.

2. Data and Methodology

We integrate two sources of data in this project: CRAs' rating histories and Morningstar data on the CMBS loans and tranches.

We access rating histories of 14,959 CMBS bonds, among which 7,456 were rated by S&P, 9,406 were rated by Fitch, and 8,988 were rated by Moody's. This dataset contains information on the bonds that the CRAs' track via their models of existing CMBS deals. It does not necessarily include the rating the CRA issued the bond at issuance.[3] In cases where the CRAs only started tracking the bond sometime after issuance, we impute their initial rating as the highest rating among the other CRAs that were tracking the deal from the time of issuance. Table 1 shows when the initial ratings of those CMBS bonds were made by those three CRAs. As evidenced in Panel A, S&P's initial ratings concentrate in the years of 2003-2006, although its first CMBS rating appeared in 1995 in our data. In the single year of 2006, S&P rated 2,412 CMBS bonds. As a comparison, it only rated one bond per year in 2011 and 2012. Fitch has a broadest coverage of CMBS credit ratings. It has 9,406 initial ratings in our database. Moreover, Fitch's initial ratings are more evenly distributed between 1993 and 2013, although their numbers of initial ratings are larger in 2005-2007 relative to other years. They even rated 7 CMBS bonds in the year of 2009 when the CMBS market was dismal. Based on our data, Moody's entered into the CMBS ratings business relatively late but has good market penetration all the way from 1996 to 2013. In 2005, it suppressed Fitch to be the number one CMBS rating agency and have kept its leading role since then. It rated 64 CMBS bonds in 2009.

[3] The models for newly issued CMBS and legacy CMBS can at times vary. In 2012 the difference in S&P's issuance and legacy rating models were such that they had to pull the rating for a CMBS the day of closing to avoid downgrading bonds they has just rated for issuance. (http://www.reuters.com/article/2012/10/05/markets-credit-idUSL1E8L5BGN20121005)

In Table 2, Panels A, B and C, we report the distributions of initial ratings by S&P, Fitch, and Moody's, respectively. Among the 7,456 bonds rated by S&P, 2,900 (38.9%) were initially rated AAA, the highest possible rating. Less than 0.7% were initially rated D, the lowest grade. Less than 1% of the CMBS bonds were rated between CCC- and CCC+. The rest of the bonds were evenly distributed between AA+ and B-. Fitch had fewer bonds initially rated below B-; no bonds were initially rated CCC- or D; only 0.4% were initially rated CCC, and only 0.01% (1 bond) was initially rated CCC+. Among the 9,406 CMBS bonds rated by Fitch, 3,330 (35.4%) were initially rated AAA. Table 3 contains detailed breakdown of initial rating distributions by year of rating. Among the 8,988 bonds rated by Moody's, 3779 (42%) were initially rated AAA and the rest are evenly distributed across other rating classes.

Our other data source, Morningstar, provides loan-level CMBS data collected by the master servicers. For each CMBS loan, Morningstar tracks its performance status from the time the loan enters the CMBS pool to the current date. In addition, Morningstar provides detailed loan characteristics. Morningstar also provide detail information on the tranches in the CMBS pools, including the CUSIP numbers that are used to match the data with the rating transition data. The Morningstar data we use runs from 1998 to 2012 and there are over 30,000 loans covered. The three datasets are matched through CMBS deal identification information. Notice that due to data matching problems we do not have all 30,000 loans matched to the rated tranches.

With the aforementioned data in hand, we first calculate the frequencies of upgrades and downgrades, and compute rating transition matrixes. For rating upgrades and downgrades, we also count the number of notches a rating change contains, and classify

them into: no down (up), down (up) by one notch, down (up) by two notches, and down (up) by more than two notches. Then bivariate analysis helps us answer questions such as whether investment grade CMBS bonds are more stable than speculative grade bonds, whether CMBS rating upgrades and downgrades are symmetric, what a typical rating duration is, and whether there are time variations in upgrades and downgrades. We also compare the rating change behaviors of the three CRAs.

We then estimate rating transition models. We follow Afonso, Gomes and Rother (2009) and Alsakka and Gwilym (2010) to estimate an ordered Probit model with random effect. We obtain quarterly rating transitions. Rating transitions are identified by notches: 0, 1, 2, and >2. We estimate upgrade and downgrade models separately, so two dependent variables are defined: UP_{it} for the upgrade model and DW_{it} for the downgrade model. Each of the two models takes the following form:

$$y_{it}^{*} = \alpha_i + X_{it}'\beta + \varepsilon_{it}. \qquad (1)$$

y_{it}^{*} is an unobserved latent variable linked to the observed ordinal response categories y_{it} (either UP_{it} for the upgrade model or DW_{it} for the downgrade model) by the measurement model:

$$y_{it} = \begin{bmatrix} 0 & if\ y_{it}^{*} \le \mu_1 \\ 1 & if\ \mu_1 < y_{it}^{*} \le \mu_2 \\ 2 & if\ \mu_2 < y_{it}^{*} \le \mu_3 \\ 3 & if\ \mu_3 < y_{it}^{*} \end{bmatrix}, \mu_1 < \mu_2 < \mu_3\ , \qquad (2)$$

where μ represents thresholds to be estimated along with the β coefficients using maximum likelihood estimation (MLE). α_i is the random effect at bond level. The covariates X_{it} (explanatory variables) include: rating related variables such as the initial ratings,[4] business cycle indicators such as the national unemployment rate, coincident indicator, yield slope, etc.., and CMBS loan related variables such as changes in the weighted average LTV and DSCR of the deal. We also include the deal-level difference between the underwritten DSCR and the realized and reported DSCR as of the third month after of deal issuance. Underwritten DSCR is usually based on forecasts, and thus the difference variable is a proxy of deal underwritten information quality. To capture impacts from CRA peers, we include lagged peer rating change behavior (upgrade or downgrade) in the model. We also include the last rating change behavior of the CRA itself in the model.

3. Results

3.1 Descriptive statistics

We first report distributions of the final ratings in Table 3. Our data collection point is the first quarter of 2013. Therefore, for those bonds that where still alive in 2013Q1 final rating means the current rating in 2013Q1. For those bonds that are already mature or were terminated, final rating means the last rating they had before maturity or termination. As we can see from Panel A of Table 3, among the 7,456 S&P rated bonds about 39% have final ratings as AAA. This percentage is comparable to that of initial ratings. However, we see a large proportion of bonds (21%) that were finally rated D,

[4] We intend to extend the list of rating related variables to include rating duration, etc.; deal and bond issuance variables such as bond size, issuer type, rating shopping proxies, issuer-servicer relationship, deal structure complexity.

while only about 0.7% were originally rated D. Almost 7% of the bonds have final ratings in the CCC range (CCC+, CCC, and CCC-) while less than 1% had initial ratings in the CCC range. Among the 9,406 CMBS bonds originally rated by Fitch, 48% ended up with a rating of AAA. This percentage is higher than that of the initial ratings (35%). However, similar to S&P, Fitch has a significant proportion (12%) of bonds that were finally rated D. Recall that Fitch didn't assign D rating to any bond initially. The percentage of AAA ratings in Moody's final ratings is slightly lower than that in the initial ratings (39% vs. 42%). Similar to S&P and Fitch, Moody's has a large increase in D ratings in the final ratings, comparing to the initial ratings (20% vs. 2%). Moody's also has significantly more CCC ratings in the final ratings than in the initial ratings.

To better compare the initial and final rating distributions, we plot the data in Tables 1 and 3, and show them in Figures 1A, 1B and 1C. We see that in S&P's rating, there are significant reductions in AA, A, BBB, BB and B classes, and the increase in the proportion of CCC and below ratings is substantial. In Fitch's rating, despite gains in the AAA class, all the AA, A, BBB and BB classes shrink. The boost in the CCC and below ratings is very significant. We see similar patterns when we compare Moody's initial and final rating distributions.

Next, we compute the full rating transition matrixes. They are shown in Table 4, Panel A, Panel B and Panel C for S&P, Fitch and Moody's, respectively. Each row shows the transition probabilities of a particular rating class. For example, we can see from Panel A that in S&P ratings, 91% of the AAA bonds had no rating changes, 0.8% of them were downgraded to AA+, 1% were downgraded to AA, 0.5% were downgraded to AA-, 0.7% were downgraded to A+, 1.1% were downgraded to A and 0.6% were downgraded to A-.

Surprisingly, a number of AAA bonds were downgraded to junk status (from BB+ to CCC-). Among all the initially rated BBB- bonds (the lowest investment grade bonds), only about 18% had no rating changes, about 7.1% were downgraded to BB+, about 2.3% were upgraded to BBB, about 35% were downgraded to D and about 1.5% were upgraded to AAA.

Notice that the diagonal of the rating transition matrix shows the proportion of bonds that had no rating changes, and that more bonds are close to the diagonal, more stable the ratings are. Apparently, S&P's ratings are quite unstable given that the upper right corner of the rating transition matrix (representing downgrades) are fully populated with significant percentages. The ratings of Fitch seem to be relatively more stable than those of S&P's. Moody's seems to be between S&P and Fitch.

The full rating transition matrix is overwhelming given how many rating classes it has. To better see the patterns, we simplify the transition matrix by classifying rating changes to a few categories: up by one notch, up by two notches, and up by more than two notches, and similarly for downgrades. There is also a "no change" category. We present aggregate results in Table 5. From Panel A of Table 5, we see that more than 38% of S&P rated bonds had more than two notches downgrade while only less than 4% had more than two notches upgrade. About 43% of bonds had some degree (one, two or more than two notches) of downgrades, while only about 10% of bonds had some degree of upgrades. Fitch's rating changes are relatively more symmetric than S&P's, but still, there were significantly more downgrades than upgrades. Panel B of Table 5 shows that 29% of Fitch rated bonds had more than two notches downgrade, while only about 15% had more than two notches upgrade. About 32% of bonds had some degree (one, two or

more than two notches) of downgrade while 22% of bonds had some degree of upgrades. For Moody's, nearly 37% had more than two notches downgrade while only fewer than 8% had more than two notches upgrade.

We plot the upgrade and downgrade percentage numbers in Figures 2A, 2B and 2C. We can easily see that among the 7,456 CMBS bonds rated by S&P, about 47% didn't have rating changes; 3.8%, 2.4% and 3.9% had one notch upgrade, two notches upgrade and more than two notches upgrade, respectively; 2.5%, 2.6% and 38% had one notch downgrade, two notches downgrade and more than two notches downgrade, respectively. Among the 9,406 CMBS bonds rated by Fitch, about 46% had no rating changes; upgrades are 2%, 4.6% and 15%, respectively; while downgrades are 1.0%, 2.1% and 29%, respectively. And among the 8,988 CMBS bonds rated by Moody's, about 46% had no change; one, two and more than two-notches upgrades are 2.5%, 2.4% and 7.6%, respectively; while downgrades are 2.2%, 2.2% and 36.8%, respectively.

We present rating upgrades and downgrades by initial rating classes in Table 6 as well as in Figures 3A, 3B and 3C. In S&P ratings, CCC had the highest probability of downgrades (94%), while B- had the highest probability of downgrades by more than two notches (87%); AA had the highest probability of upgrades (27%) while A+ had the highest probability of more than two notches upgrades (18%). AAA bonds had the least chance of downgrades (9%) while B- had the least chance of upgrades (2%). In Fitch ratings, CCC+ had the highest probability of downgrades (100%), and they had the highest probability of downgrades by more than two notches (100%); AA had the highest probability of upgrades (58%) while A had the highest probability of more than two notches upgrades (51%). AAA bonds had the least chance of downgrades (8%) while B+

had the least chance of upgrades (7%). From this perspective, there are obvious differences between S&P's and Fitch's rating changes. In Moody's rating changes, B+ has the highest probability of having more than two notches downgrade (75%) while A+ has the highest probability of having more than two notches upgrade (34%).

Finally, we present the number of upgrades and downgrades by quarter in Table 8 and the percentages in Figures 4A, 4B and 4C. We see that S&P was not active in rating changes before 2007. They had some upgrades in 2007, 2008 and 2012, but a large amount of downgrades during 2009-2011. Fitch has been active in rating changes since 1998. They had more downgrades than upgrades in late 1990s, followed by a wave of upgrades during 2001-2003, and then a big wave of downgrades during 2009-2012. These patterns of CMBS upgrades and downgrades made by S&P and Fitch tend to echo changes in the commercial real estate market. Moody's claim their ratings to be "through-the-cycle". We see that seemed to be true before 2005. But after that, we see a wave of upgrades during 2006-2007 and big waves of downgrades during the recent crisis period.

3.2 Model results

We now present the ordered Probit model results. Different from previous analyses, which are based on the initial and final ratings at two points in time, we look at the quarterly rating changes in the model. Therefore, we first construct the quarterly event history of each bond, and then use the full history in model estimation.

We separate upgrades from downgrades. The ordinal response categories are no change, one notch upgrade, two notches upgrade, and more than two notches upgrade in the upgrade model and similarly, no change, one notch downgrade, two notches downgrade, and more than two notches downgrade in the downgrade model.

Panels A, B and C of Table 8 contain model results for S&P, Fitch and Moody's, respectively. The initial rating class is included as an explanatory variable. In the upgrade model, the omitted (reference) group is AAA initial rating, and in the downgrade model the reference group is CCC or below initial rating. The initial rating is mostly significant in the upgrade models of all three CRAs. For S&P, the most likely to upgrade rating class is AA, everything else being equal. For Fitch and Moody's, it is A. In the downgrade models, the initial rating class is significant in Moody's rating changes, and the most likely to downgrade class is AA. The AAA class is the least likely to downgrade in Moody's ratings. The initial rating classes of AAA and AA are significantly less likely to downgrade comparing to the CCC class and other classes in S&P ratings. For Fitch, AAA is also the least likely to downgrade but then the other rating classes are equally likely to downgrade.

From each Panel of Table 8, we see that CMBS rating transitions are business cycle dependent. Since unemployment rate, coincident indicator and yield slope are highly correlated, we only use one of those three variables in the model. We see that the higher the unemployment rate, the lower probability there is for CMBS bonds to get upgraded and the higher probability there is for them to get downgraded. Using coincident indicator or yield slope give us consistent results. This business cycle dependency in CMBS rating transitions seems to be intuitive. However, it is hard to reconcile it with the CRAs' claims that their ratings are "through-the-cycle".

Changes in deal-specific factors also drive CMBS rating migrations. For example, Increase in deal weighted average LTV has a negative impact on upgrades, which conforms to the expectation – when the risk of a particular deal increases, the upgrade of

CMBS bonds in that deal should be adversely affected. For S&P, improvement in deal average DSCR will help prevent CMBS bonds from downgrade, which is also intuitive – when the deal's DSCR improves it has lower default risk and thus bonds from this deal should be downgraded less frequently. Interestingly, Fitches downgrades are not sensitive to changes in deal-level LTV or DSCR. It is possible that Fitch places small weights on deal-specific drivers. Moody's results are hard to explain. For example, changes in deal average LTV has a negative impact on downgrades, which is counterintuitive.

In addition to changes in DSCR from quarter to quarter, we also include a variable that is the difference between the underwritten DSCR and the realized and reported DSCR three months after the deal issuance. Underwritten DSCR is usually based on pro forma estimates. Therefore, this variable is a measure of CMBS deal underwritten information quality. When the underwritten DSCR is higher than realized DSCR (our variable is negative), it indicates that the DSCR was overestimated and it is a bad signal of the underwritten information quality. From the model results, we see that the CRAs tend to penalize (award) bad (good) information by issuing more (fewer) downgrades and fewer (more) upgrades. The results are consistent across different CRAs.

Finally, we include the lagged rating changes of both the CRA itself and its peers. Interestingly, we see that the lagged rating changes of peer CRAs have a positive impact on a particular CRA's rating changes. Therefore, there is herding in CRAs' CMBS rating behavior. On the contrary, the CRA's own lagged rating changes have a negative impact on its current rating changes. A possible reason is that CRAs try to avoid making multiple rating changes to the same CMBS bond because such actions would send out bad signals about their initial credit ratings or their rating methodology.

4. Conclusions and Discussions

Like in corporate bonds, the credit ratings of CMBS can be upgraded or downgraded by the CRAs, which would have wide impact on CMBS investors, issuers and regulators. However, unlike in corporate bonds, the rating migrations of CMBS are under-studied. In this paper, we try to fill this gap in the literature by systematically examining the rating changes of CMBS made by the three major CRAs, S&P, Fitch and Moody's.

We find over 50 percent of CMBS bonds have subsequent rating changes after issuance. The incidence of rating downgrades significantly exceeds that of rating upgrades for CMBS. Such rating transition asymmetry can serve as preliminary evidence that CMBS bonds were systematically over-rated. We also find that CMBS bonds with different initial rating have significantly different probability of getting upgraded or downgraded. For investors, it is worth to incorporate the whole rating transition matrix into their credit risk estimations and to pay special attention to those bonds that are the most unstable in ratings. CMBS bond rating transitions are business cycle dependent and such a dependency can amplify the credit cycles. S&P and Moody's are shown to consider changes in deal-specific factors in their rating changes, while Fitch seems to pay less attention to those factors. Herding (or learning) is found to exist in CRAs' CMBS rating changes. On the one hand, one would expect CRAs could benefit from such behaviors as the ratings of other CRAs may have provided additional information. On the other hand, such behaviors make the credit rating from additional CRAs less valuable.

Future research could examine whether the market power of a particular CMBS issuer have influences over the rating changes of the CRAs.

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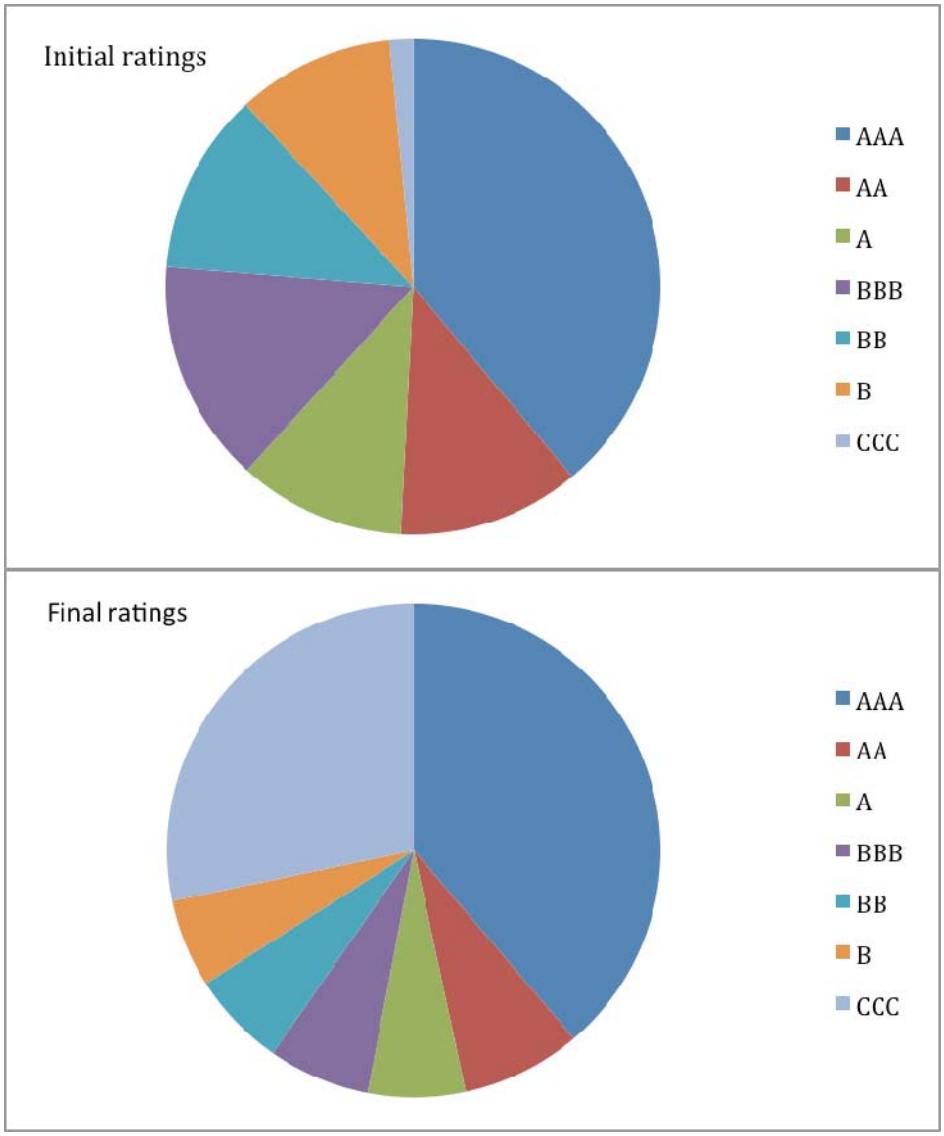

Figure 1A Comparison of Initial and Final Ratings Distribution: S&P

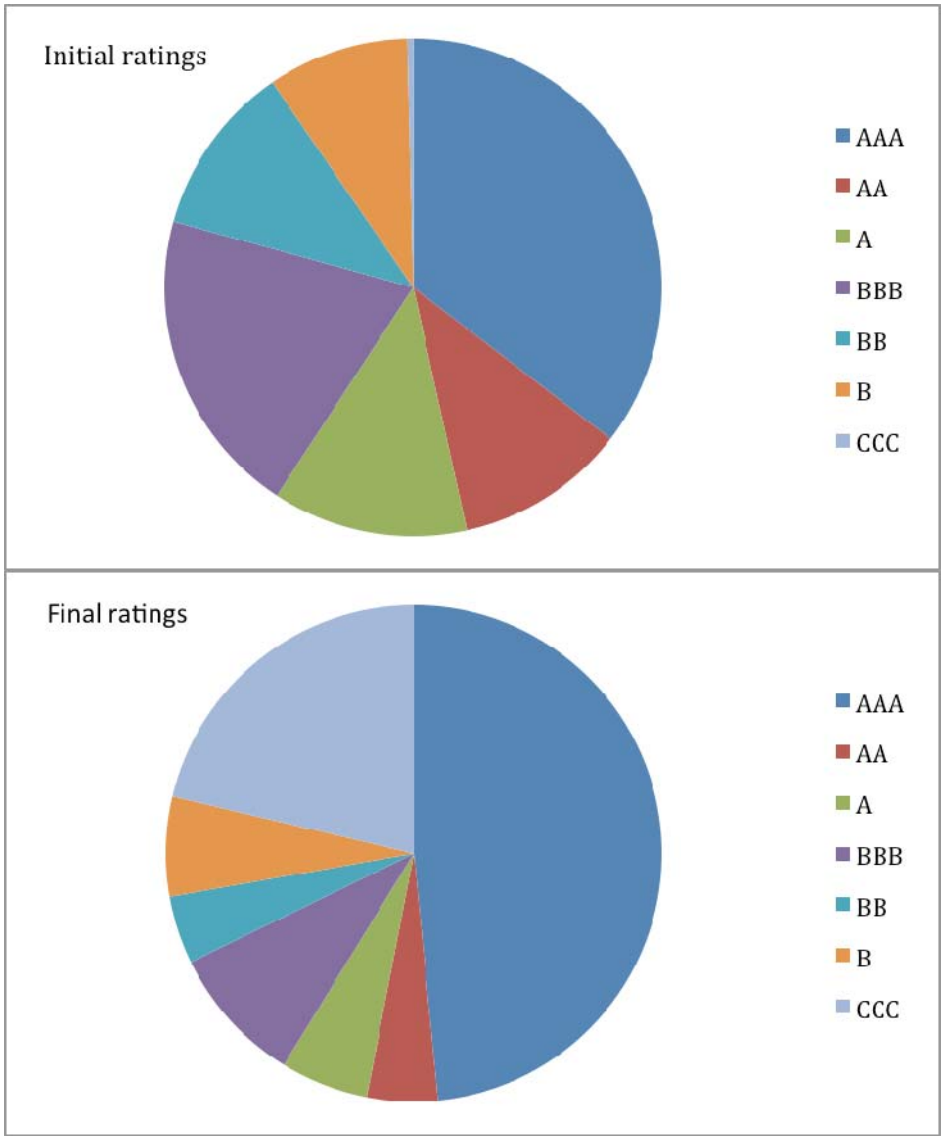

Figure 1B Comparison of Initial and Final Ratings Distribution: Fitch

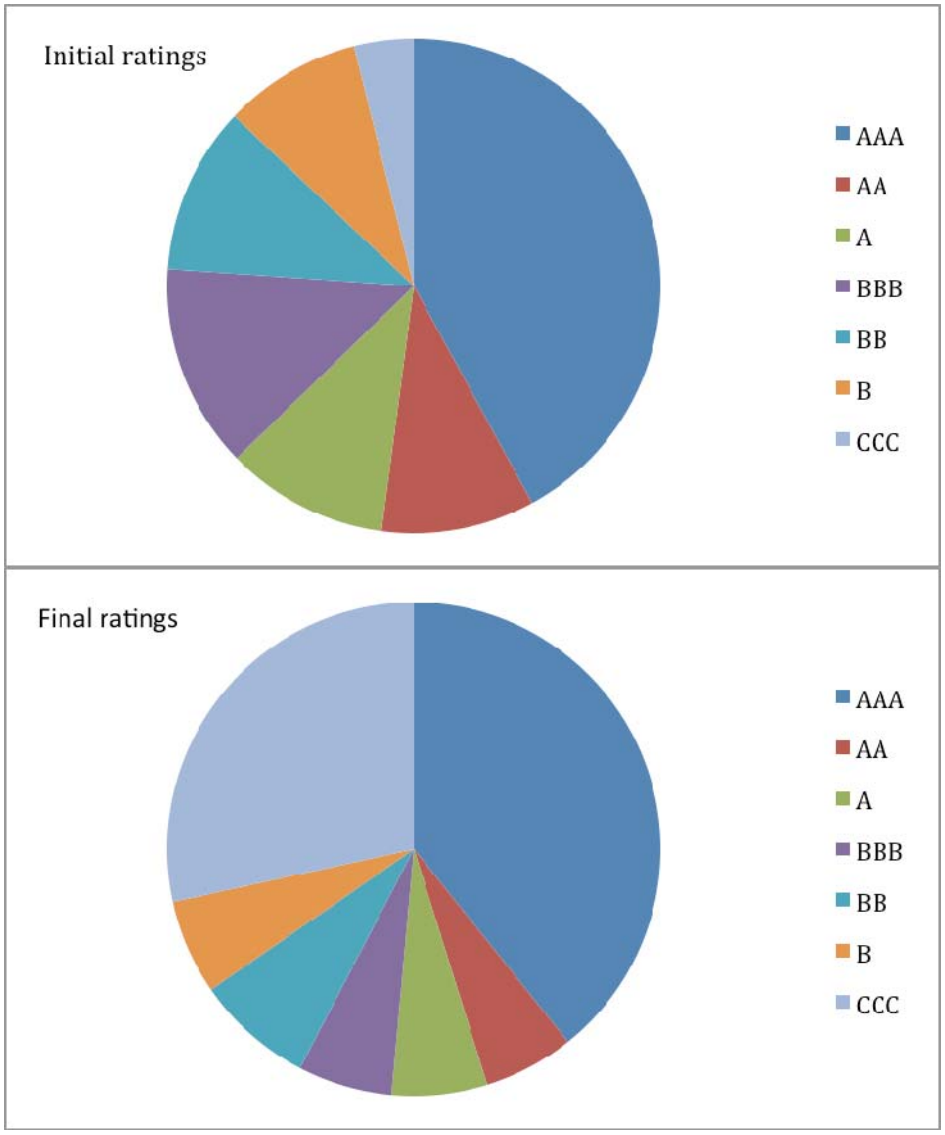

Figure 1C Comparison of Initial and Final Ratings Distribution: Moody's

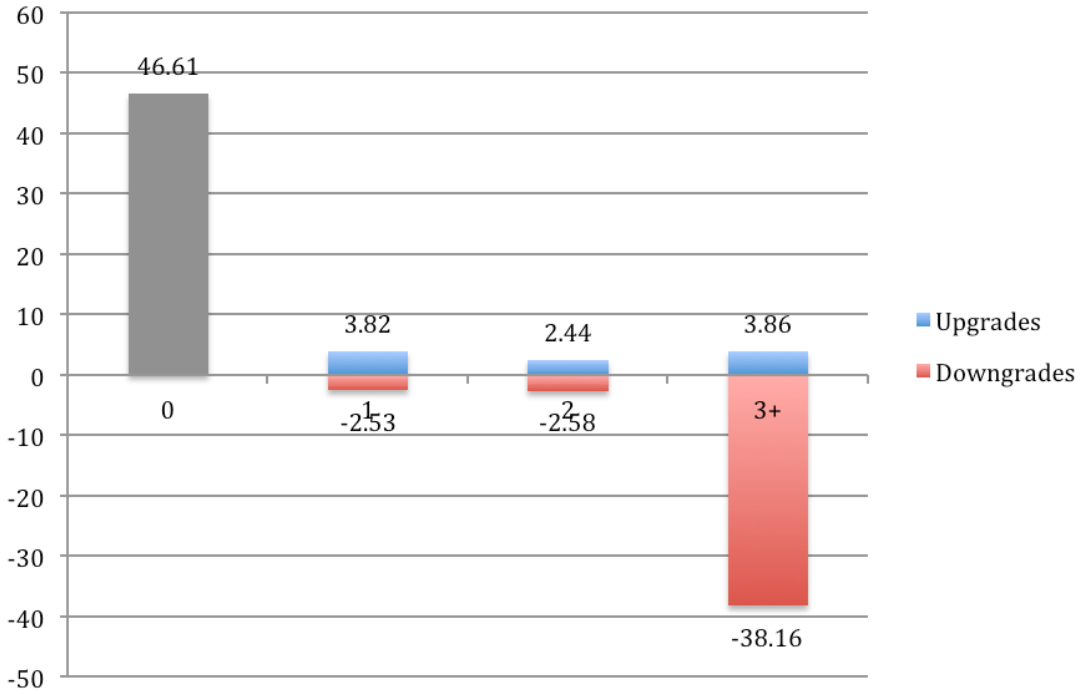

Figure 2A Percentage of Upgrades and Downgrades by Notches: S&P

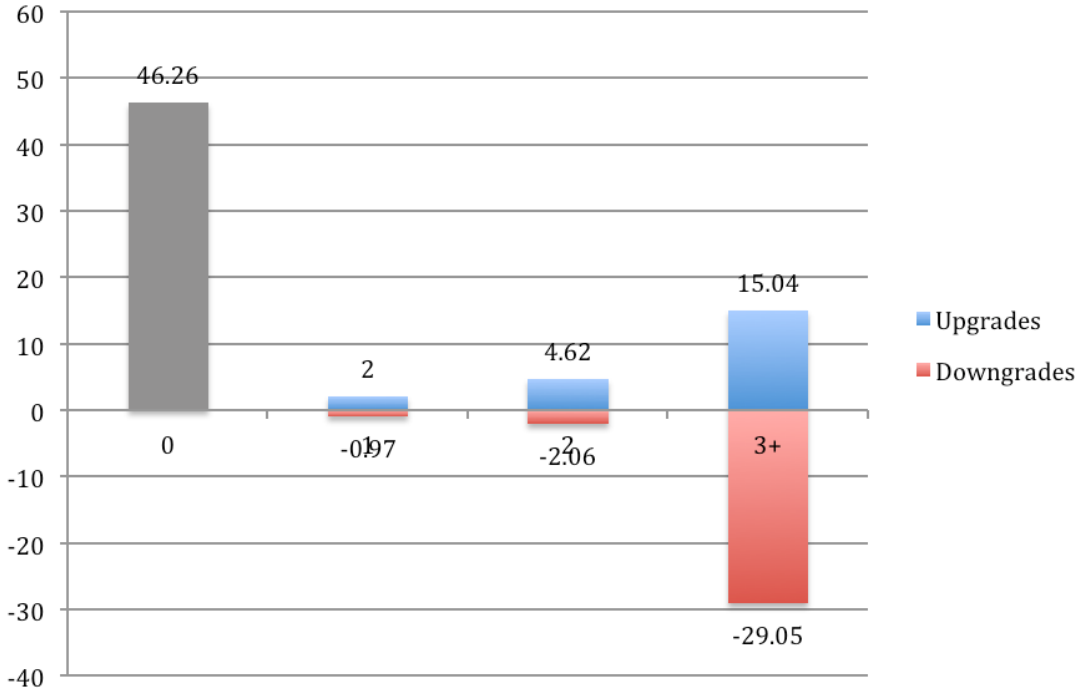

Figure 2B Percentage of Upgrades and Downgrades by Notches: Fitch

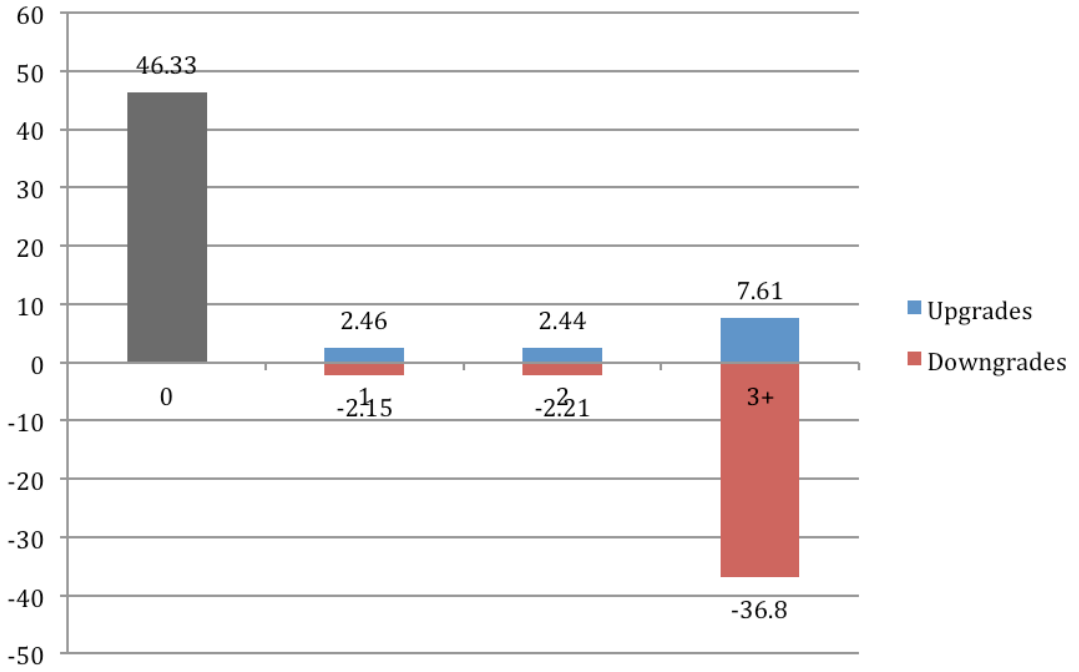

Figure 2C Percentage of Upgrades and Downgrades by Notches: Moody's

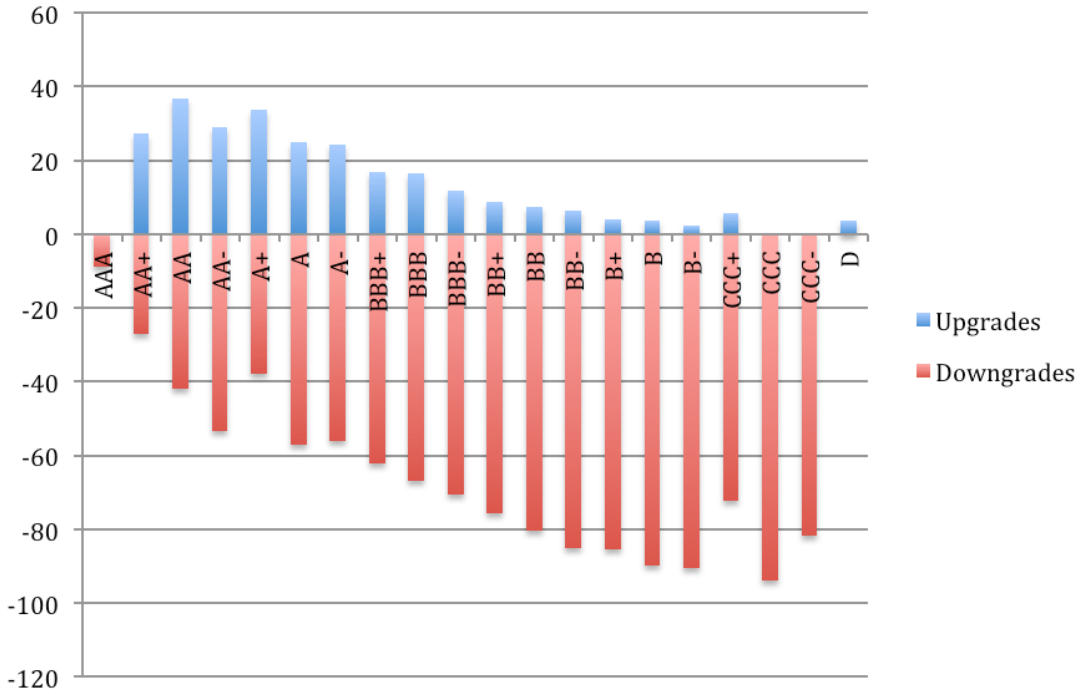

Figure 3A Upgrades and Downgrades by Initial Rating Class: S&P

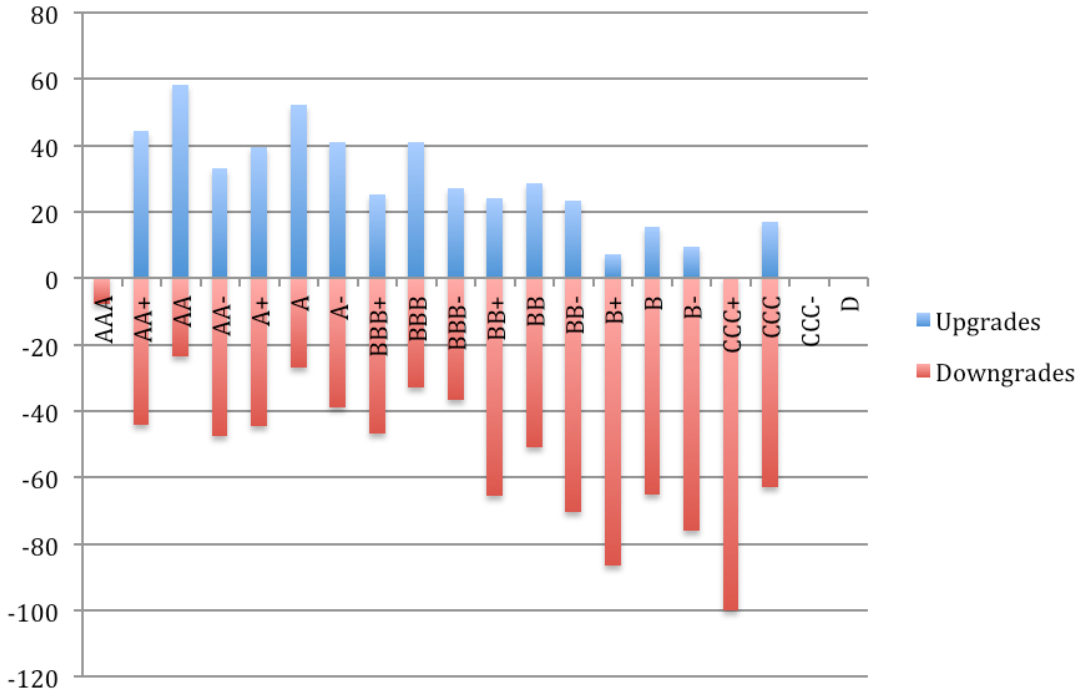

Figure 3B Upgrades and Downgrades by Initial Rating Class: Fitch

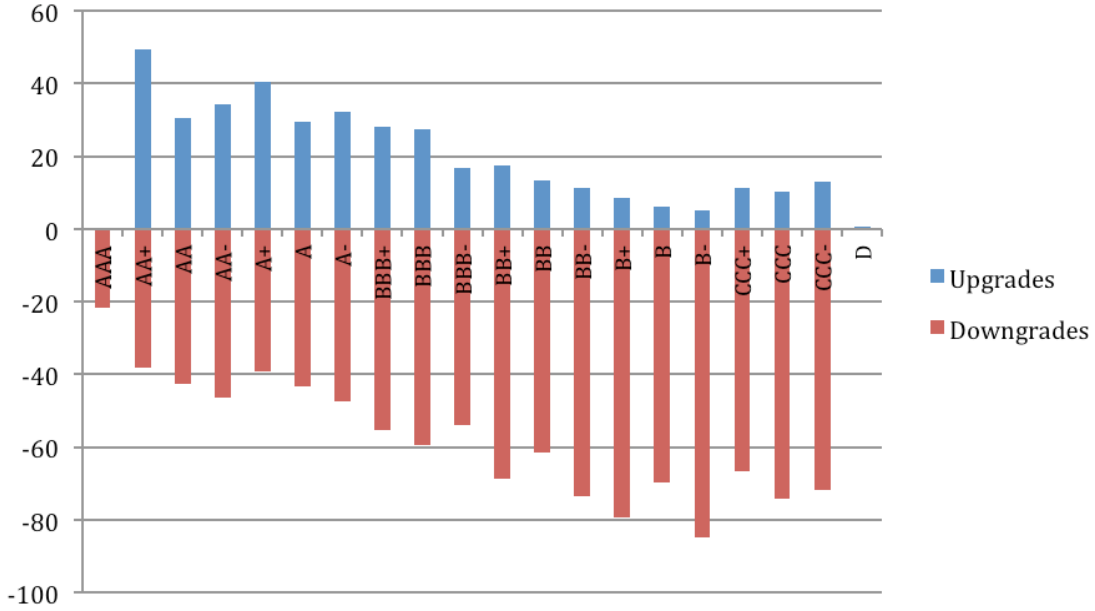

Figure 3C Upgrades and Downgrades by Initial Rating Class: Moody's

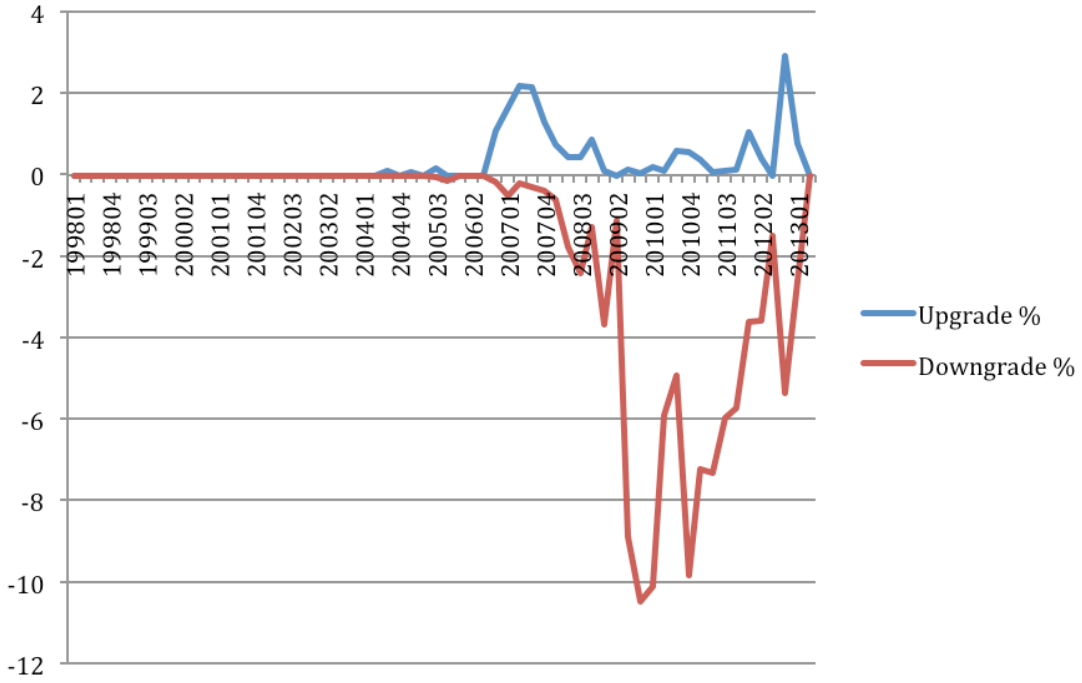

Figure 4A Upgrades and Downgrades by Quarter: S&P

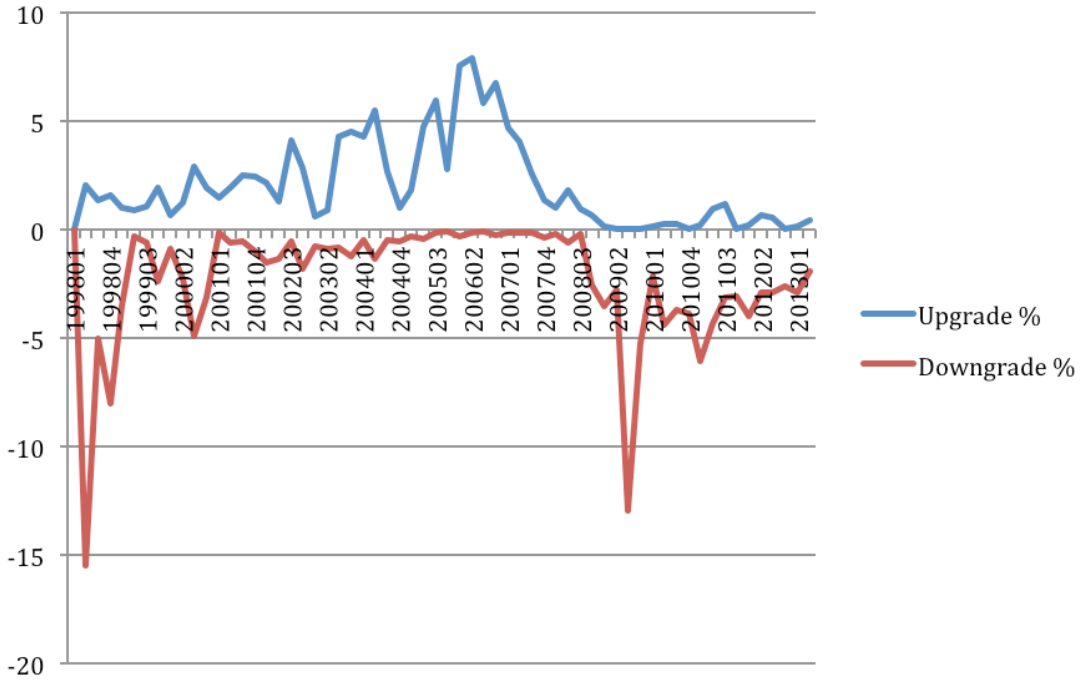

Figure 4B Upgrades and Downgrades by Quarter: Fitch

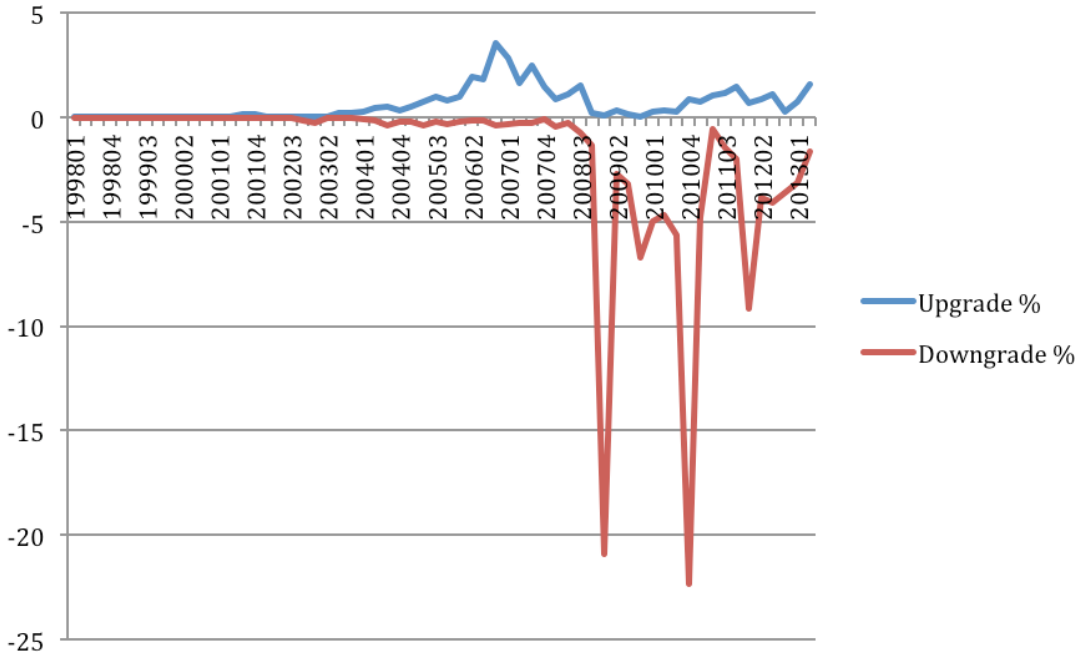

Figure 4C Upgrades and Downgrades by Quarter: Moody's

Table 1 Number of Ratings by S&P and Fitch by Year of Rating

Panel A: S&P	Number of ratings	Percentage
1995	2	0.03
1996	1	0.01
1997	17	0.23
1998	51	0.68
1999	50	0.67
2000	141	1.89
2001	250	3.35
2002	266	3.57
2003	617	8.28
2004	1207	16.19
2005	2355	31.59
2006	2412	32.35
2007	66	0.89
2008	3	0.04
2009	12	0.16
2010	4	0.05
2011	1	0.01
2012	1	0.01
Total	7456	100.00
Panel B: Fitch		
1991	2	0.02
1993	31	0.33
1994	40	0.43
1995	164	1.74
1996	280	2.98
1997	341	3.63
1998	319	3.39
1999	424	4.51
2000	473	5.03
2001	719	7.64
2002	526	5.59
2003	700	7.44
2004	809	8.60
2005	1132	12.03
2006	1246	13.25
2007	1258	13.37
2008	100	1.06
2009	7	0.07
2010	74	0.79
2011	201	2.14
2012	313	3.33
2013	247	2.63

Total	9406	100.00
Panel C: Moody's		
1996	13	0.14
1997	51	0.57
1998	86	0.96
1999	124	1.38
2000	129	1.44
2001	266	2.96
2002	376	4.18
2003	538	5.99
2004	1090	12.13
2005	1510	16.80
2006	2187	24.33
2007	1075	11.96
2008	242	2.69
2009	64	0.71
2010	278	3.09
2011	232	2.58
2012	376	4.18
2013	351	3.91
Total	8988	100.00

Table 2 Initial Ratings Distribution

Panel A: S&P	Number of ratings	Percentage
AAA	2900	38.89
AA+	226	3.03
AA	366	4.91
AA-	296	3.97
A+	169	2.27
A	306	4.1
A-	339	4.55
BBB+	353	4.73
BBB	336	4.51
BBB-	397	5.32
BB+	326	4.37
BB	292	3.92
BB-	267	3.58
B+	250	3.35
B	263	3.53
B-	256	3.43
CCC+	18	0.24
CCC	32	0.43
CCC-	11	0.15
D	53	0.71

Total	7456	100
Panel B: Fitch		
AAA	3330	35.4
AA+	157	1.67
AA	596	6.34
AA-	294	3.13
A+	164	1.74
A	588	6.25
A-	443	4.71
BBB+	410	4.36
BBB	666	7.08
BBB-	808	8.59
BB+	317	3.37
BB	424	4.51
BB-	308	3.27
B+	230	2.45
B	353	3.75
B-	282	3
CCC+	1	0.01
CCC	35	0.37
CCC-	0	0
D	0	0
Total	9406	100
Panel C: Moody's		
AAA	3779	42.04
AA+	202	2.25
AA	367	4.08
AA-	334	3.72
A+	202	2.25
A	403	4.48
A-	352	3.92
BBB+	344	3.83
BBB	360	4.01
BBB-	497	5.53
BB+	315	3.5
BB	350	3.89
BB-	319	3.55
B+	260	2.89
B	293	3.26
B-	260	2.89
CCC+	45	0.5
CCC	58	0.65
CCC-	39	0.43
D	209	2.33
Total	8988	100

Table 3 Final Ratings Distribution

Panel A: S&P	Number of ratings	Percentage
AAA	2891	38.77
AA+	279	3.74
AA	180	2.41
AA-	127	1.7
A+	151	2.03
A	170	2.28
A-	154	2.07
BBB+	169	2.27
BBB	153	2.05
BBB-	176	2.36
BB+	200	2.68
BB	143	1.92
BB-	124	1.66
B+	161	2.16
B	120	1.61
B-	150	2.01
CCC+	98	1.31
CCC	117	1.57
CCC-	293	3.93
D	1600	21.46
Total	7456	100
Panel B: Fitch		
AAA	4556	48.44
AA+	67	0.71
AA	278	2.96
AA-	89	0.95
A+	67	0.71
A	350	3.72
A-	122	1.3
BBB+	145	1.54
BBB	316	3.36
BBB-	386	4.1
BB+	72	0.77
BB	301	3.2
BB-	43	0.46
B+	36	0.38
B	280	2.98
B-	294	3.13
CCC	913	9.71
D	1091	11.6
Total	9406	100
Panel C: Moody's		

AAA	3529	39.26
AA+	131	1.46
AA	220	2.45
AA-	182	2.02
A+	164	1.82
A	211	2.35
A-	187	2.08
BBB+	166	1.85
BBB	129	1.44
BBB-	261	2.9
BB+	198	2.2
BB	163	1.81
BB-	333	3.7
B+	174	1.94
B	201	2.24
B-	183	2.04
CCC+	194	2.16
CCC	228	2.54
CCC-	315	3.5
D	1819	20.24
Total	8988	100

Table 4 Rating Transition Matrix

Panel A: S&P

	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-	D
AAA	**91.1**	0.83	1.03	0.52	0.66	1.14	0.62	0.45	0.66	0.55	0.45	0.41	0.24	0.34	0.21	0.21	0.03	0.03	0.28	0.24
AA+	27.43	**45.58**	2.21	0.44	1.33	1.33	1.77	0.88	3.1	2.21	2.65	1.77	2.65	1.77	0.88	0.88	0.88	1.33	0.44	0.44
AA	19.13	17.76	**21.31**	4.37	1.37	2.46	2.73	3.28	1.64	3.83	3.01	1.91	1.91	3.28	3.83	1.64	0.55	1.64	1.64	2.73
AA-	11.49	8.45	9.12	**17.57**	4.05	4.39	3.72	2.7	2.03	3.72	3.72	3.72	3.04	3.04	3.04	4.39	1.01	1.35	4.39	5.07
A+	10.65	7.69	7.1	8.28	**28.4**	2.37	3.55	1.18	2.37	0.59	4.73	1.18	2.37	2.96	1.78	6.51	1.18	1.18	2.37	3.55
A	7.84	2.94	3.27	3.92	6.86	**17.97**	3.27	5.56	3.59	3.27	4.25	2.61	2.94	4.58	3.59	2.61	3.59	3.59	4.58	9.15
A-	3.54	1.47	2.65	3.83	5.9	6.78	**19.76**	3.24	3.54	5.31	4.42	0.88	2.95	3.54	3.54	4.13	0.59	3.83	7.67	12.39
BBB+	2.55	2.83	1.42	0.28	1.98	3.68	3.97	**21.25**	4.25	3.4	3.97	5.1	1.42	3.12	1.98	4.53	3.68	3.97	7.65	18.98
BBB	1.49	2.68	0.6	0.89	1.49	2.68	1.79	4.76	**16.67**	2.98	3.27	2.38	2.98	2.98	2.08	2.08	3.57	4.46	12.2	27.98
BBB-	1.51	2.27	0.5	0	1.51	1.26	1.01	1.51	2.27	**17.63**	7.05	3.53	2.77	2.52	2.02	3.27	2.02	2.52	10.08	34.76
BB+	1.53	0.61	0	0	0.61	0.31	0.92	0.61	1.84	2.15	**15.64**	3.99	3.07	3.99	1.23	3.07	2.45	3.68	8.59	45.71
BB	1.03	0.34	0	0	0.68	0.68	0	0.68	0.68	0.68	2.74	**11.99**	2.4	3.08	2.05	3.08	2.05	1.71	9.25	56.85
BB-	0.37	0.75	0	0	0	0	0	0.37	0	0	2.62	2.25	**8.61**	3.75	2.62	1.87	2.62	1.5	7.49	65.17
B+	0	0.4	0	0	0.4	0	0	0	0	0	0.8	0.4	2	**10.4**	1.6	1.6	3.6	1.6	4	73.2
B	0	0.38	0	0	0	0	0.38	0.38	0	0	0.38	0	0	2.28	**6.46**	2.66	1.9	1.52	5.7	77.95
B-	0	0	0	0	0	0	0	0.39	0	0	0.39	0.39	0.39	0	0.78	**7.03**	1.17	2.34	3.52	83.59
CCC+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.56	0	**22.22**	0	5.56	66.67
CCC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**6.25**	3.13	90.63
CCC-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**18.18**	81.82
D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.89	0	1.89	0	**96.23**

Panel B: Fitch

	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-	D
AAA	**92.37**	0.06	1.17	0.03	0	1.71	0.03	0	0.75	0.36	0	0.66	0	0	0.57	0.15	0	2.07	0	0.06
AA+	44.59	**11.46**	3.82	0	0	8.92	0	0.64	3.18	0.64	0	0.64	0	0	3.18	1.27	0	21.02	0	0.64
AA	57.05	1.34	**18.29**	0	0.17	2.85	0	0	2.52	1.68	0	2.01	0	0	2.35	1.17	0	9.9	0	0.67
AA-	25.85	1.7	5.44	**19.39**	0	3.74	0.34	0	4.76	2.04	0	6.46	0.34	0	2.38	2.04	0	24.15	0	1.36
A+	33.54	1.22	2.44	2.44	**15.85**	4.27	0	1.22	1.22	2.44	0.61	5.49	0	0.61	3.66	2.44	0	19.51	0	3.05
A	44.22	1.7	4.59	1.19	0.68	**20.75**	0.68	0.17	2.72	0.68	0.17	3.06	0	0	3.74	1.53	0	12.24	0	1.87
A-	29.57	0.9	2.93	1.35	1.58	4.51	**20.32**	0.45	2.71	2.71	0	3.84	0.45	0.23	3.39	3.39	0	18.28	0	3.39
BBB+	14.15	0.49	3.17	0	1.22	4.63	1.46	**28.29**	1.71	1.95	0.24	4.39	0.73	0.73	5.85	5.85	0	19.02	0	6.1
BBB	30.78	1.35	2.4	1.05	1.35	1.95	1.35	0.75	**25.98**	1.5	0.3	3.6	0.3	0.3	2.55	6.16	0	11.71	0	6.61
BBB-	16.83	0.5	1.98	0.37	0.62	2.97	0.74	1.36	1.61	**36.51**	1.11	3.59	0.99	0.12	2.72	4.58	0	10.52	0	12.87
BB+	10.73	0	0.95	0.32	1.58	3.47	0.95	0.95	3.47	1.89	**10.41**	5.99	0.95	0	4.1	7.57	0	18.61	0	28.08
BB	15.33	0.47	1.89	0.47	0	3.07	0.24	0.94	2.36	1.89	1.89	**20.52**	0	0.71	4.72	6.13	0	10.61	0	28.77
BB-	6.82	0	1.3	0.32	1.3	3.9	0.32	0	2.27	1.3	0.97	4.87	**6.17**	0	4.55	4.55	0	14.94	0	46.43
B+	0.43	0	0	0	0	2.61	0	0	0.87	0.43	0.87	2.17	0	**6.09**	3.48	9.13	0	15.22	0	58.7
B	5.95	0	1.13	0	0	1.13	0	0	0.57	1.42	1.98	0.85	0.57	1.98	**19.26**	4.82	0	9.92	0	50.42
B-	1.77	0	0	0	0.35	0	0	0	0.35	0	1.77	1.06	1.06	1.06	2.13	**14.54**	0	9.93	0	65.96
CCC+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	100
CCC	5.71	2.86	0	0	0	0	0	0	2.86	0	0	0	0	2.86	0	2.86	0	**20**	0	62.86
CCC-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0
D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**

Panel C: Moody's

	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-	D
AAA	**78.3**	0.74	1.32	1.03	0.85	0.74	0.69	0.56	0.45	0.48	0.85	0.24	5.66	0.79	0.77	0.95	1.38	1.27	2.49	0.45
AA+	49.5	**12.38**	0.5	1.49	2.97	1.49	1.49	0.5	1.98	1.98	4.46	1.49	0.99	0	1.49	1.98	6.44	5.45	2.48	0.99
AA	28.07	2.45	**26.98**	1.91	0.82	2.45	3.27	1.91	1.63	1.91	2.18	1.91	1.91	2.18	1.91	1.63	2.72	5.72	4.63	3.81
AA-	23.65	5.39	5.09	**19.46**	2.4	0.9	2.4	2.99	1.2	2.69	1.5	1.8	1.5	2.99	1.5	2.1	2.69	3.29	6.89	9.58
A+	25.74	8.42	4.46	1.98	**20.3**	1.98	0.99	1.49	1.49	3.47	3.47	0.5	0.99	0.99	1.98	2.48	1.49	3.47	2.97	11.39
A	15.14	2.73	3.47	4.22	3.72	**27.3**	3.72	1.49	1.99	1.99	2.23	1.99	1.24	0.74	1.49	2.23	3.23	1.74	4.96	14.39
A-	14.2	2.27	3.41	4.55	3.69	3.98	**20.45**	3.69	1.14	1.99	3.69	1.7	1.7	2.56	1.14	1.99	1.99	3.98	2.84	19.03
BBB+	9.88	1.45	2.03	3.2	5.23	3.2	2.91	**16.86**	2.91	3.78	3.78	1.45	1.74	2.62	2.62	2.33	2.33	3.49	3.78	24.42
BBB	8.33	1.11	1.11	1.39	3.06	4.17	3.61	4.44	**13.33**	4.17	3.33	1.39	1.39	2.5	3.33	3.61	3.61	4.17	3.89	28.06
BBB-	4.83	0.6	0.2	1.01	1.01	1.21	3.42	2.41	2.01	**29.38**	3.62	1.61	2.82	3.22	1.41	3.82	2.41	3.62	4.83	26.56
BB+	4.44	0.63	0.63	0.95	1.27	0.95	1.27	2.54	2.54	2.22	**13.65**	2.22	2.54	4.44	3.17	2.54	1.59	4.13	6.03	42.22
BB	2.86	0	0.29	0.29	0.86	0.29	0.86	1.43	1.71	2	2.86	**25.14**	1.43	4	2.57	2.57	1.71	2.29	3.71	43.14
BB-	2.19	0.31	0.63	1.25	0.94	0	0.31	0.94	0.31	2.51	1.57	0.31	**15.05**	2.82	4.08	4.39	3.45	2.82	2.82	53.29
B+	1.54	0	0.38	0.38	0.38	0.77	0	1.15	0	0	3.08	0	0.77	**12.31**	2.31	2.31	3.46	4.23	3.08	63.85
B	0.34	0	0	0.34	0.34	0	0	0	0	0.34	1.02	2.05	0.34	1.37	**24.23**	2.05	1.71	2.05	3.41	60.41
B-	0	0	0	0	0	0.77	0.38	0	0	1.15	1.15	0.38	0.38	0.38	0.38	**10**	2.69	2.31	5.77	74.23
CCC+	2.22	0	0	0	0	0	0	0	0	0	0	2.22	2.22	4.44	0	0	**22.22**	4.44	8.89	53.33
CCC	0	0	0	0	0	0	0	0	0	1.72	0	1.72	0	1.72	5.17	0	0	**15.52**	6.9	67.24
CCC-	0	0	0	0	0	0	0	0	0	0	0	0	2.56	2.56	5.13	0	2.56	0	**15.38**	71.79
D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.48	**99.52**

Table 5 Rating Upgrades and Downgrades

Panel A: S&P	Number of ratings	Percentage
No Downgrade	4230	56.73
Down 1	189	2.53
Down 2	192	2.58
Down More than 2	2845	38.16
Total	7456	100
No Upgrade	6701	89.87
Up 1	285	3.82
Up 2	182	2.44
Up More than 2	288	3.86
Total	7456	100
Panel B: Fitch		
No Downgrade	6389	67.92
Down 1	91	0.97
Down 2	194	2.06
Down More than 2	2732	29.05
Total	9406	100
No Upgrade	7368	78.33
Up 1	188	2
Up 2	435	4.62
Up More than 2	1415	15.04
Total	9406	100
Panel C: Moody's		
No Downgrade	5288	58.83
Down 1	193	2.15
Down 2	199	2.21
Down More than 2	3308	36.8
Total	8988	100
No Upgrade	7864	87.49
Up 1	221	2.46
Up 2	219	2.44
Up More than 2	684	7.61
Total	8988	100

Table 6 Rating Upgrades and Downgrades by Initial Rating Class

Panel A: by S&P

	No Down	Down 1	Down 2	Down > 2	Total		No Up	Up 1	Up 2	Up > 2	Total
AAA	91.1	0.83	1.03	7.03	2900		100	0	0	0	2900
AA+	73.01	2.21	0.44	24.34	226		72.57	27.43	0	0	226
AA	58.2	4.37	1.37	36.07	366		63.11	17.76	19.13	0	366
AA-	46.62	4.05	4.39	44.93	296		70.95	9.12	8.45	11.49	296
A+	62.13	2.37	3.55	31.95	169		66.27	8.28	7.1	18.34	169
A	42.81	3.27	5.56	48.37	306		75.16	6.86	3.92	14.05	306
A-	43.95	3.24	3.54	49.26	339		75.81	6.78	5.9	11.5	339
BBB+	37.96	4.25	3.4	54.39	353		83.29	3.97	3.68	9.07	353
BBB	33.04	2.98	3.27	60.71	336		83.63	4.76	1.79	9.82	336
BBB-	29.47	7.05	3.53	59.95	397		88.16	2.27	1.51	8.06	397
BB+	24.23	3.99	3.07	68.71	326		91.41	2.15	1.84	4.6	326
BB	19.52	2.4	3.08	75	292		92.47	2.74	0.68	4.11	292
BB-	14.98	3.75	2.62	78.65	267		93.63	2.25	2.62	1.5	267
B+	14.4	1.6	1.6	82.4	250		96	2	0.4	1.6	250
B	10.27	2.66	1.9	85.17	263		96.2	2.28	0	1.52	263
B-	9.38	1.17	2.34	87.11	256		97.66	0.78	0	1.56	256
CCC+	27.78	0	5.56	66.67	18		94.44	0	5.56	0	18
CCC	6.25	3.13	90.63	0	32		100	0	0	0	32
CCC-	18.18	81.82	0	0	11		100	0	0	0	11
D	100	0	0	0	53		96.23	0	1.89	1.89	53

Panel B: by Fitch

	No Down	Down 1	Down 2	Down > 2	Total		No Up	Up 1	Up 2	Up > 2	Total
AAA	92.37	0.06	1.17	6.4	3330		100	0	0	0	3330
AA+	56.05	3.82	0	40.13	157		55.41	44.59	0	0	157
AA	76.68	0	0.17	23.15	596		41.61	1.34	57.05	0	596
AA-	52.38	0	3.74	43.88	294		67.01	5.44	1.7	25.85	294
A+	55.49	4.27	0	40.24	164		60.37	2.44	2.44	34.76	164
A	73.13	0.68	0.17	26.02	588		47.62	0.68	1.19	50.51	588
A-	61.17	0.45	2.71	35.67	443		59.14	4.51	1.58	34.76	443
BBB+	53.41	1.71	1.95	42.93	410		74.88	1.46	4.63	19.02	410
BBB	66.97	1.5	0.3	31.23	666		59.01	0.75	1.35	38.89	666
BBB-	63.49	1.11	3.59	31.81	808		73.02	1.61	1.36	24.01	808
BB+	34.7	5.99	0.95	58.36	317		75.71	1.89	3.47	18.93	317
BB	49.06	0	0.71	50.24	424		71.46	1.89	1.89	24.76	424
BB-	29.55	0	4.55	65.91	308		76.62	4.87	0.97	17.53	308
B+	13.48	3.48	9.13	73.91	230		92.61	0	2.17	5.22	230
B	34.84	4.82	0	60.34	353		84.42	1.98	0.57	13.03	353
B-	24.11	0	9.93	65.96	282		90.43	2.13	1.06	6.38	282
CCC+	0	0	0	100	1		100	0	0	0	1
CCC	37.14	0	62.86	0	35		82.86	0	2.86	14.29	35

Panel C: by Moody's

	No Down	**Down 1**	**Down 2**	**Down More than 2**	**Total**		**No Up**	**Up 1**	**Up 2**	**Up More than 2**	**Total**
AAA	78.3	0.74	1.32	19.63	3779		100	0	0	0	3779
AA+	61.88	0.5	1.49	36.14	202		50.5	49.5	0	0	202
AA	57.49	1.91	0.82	39.78	367		69.48	2.45	28.07	0	367
AA-	53.59	2.4	0.9	43.11	334		65.87	5.09	5.39	23.65	334
A+	60.89	1.98	0.99	36.14	202		59.41	1.98	4.46	34.16	202
A	56.58	3.72	1.49	38.21	403		70.72	3.72	4.22	21.34	403
A-	52.56	3.69	1.14	42.61	352		67.9	3.98	3.69	24.43	352
BBB+	44.77	2.91	3.78	48.55	344		72.09	2.91	3.2	21.8	344
BBB	40.56	4.17	3.33	51.94	360		72.78	4.44	3.61	19.17	360
BBB-	46.08	3.62	1.61	48.69	497		83.3	2.01	2.41	12.27	497
BB+	31.11	2.22	2.54	64.13	315		82.54	2.22	2.54	12.7	315
BB	38.57	1.43	4	56	350		86.57	2.86	2	8.57	350
BB-	26.33	2.82	4.08	66.77	319		88.71	0.31	1.57	9.4	319
B+	20.77	2.31	2.31	74.62	260		91.54	0.77	0	7.69	260
B	30.38	2.05	1.71	65.87	293		93.86	1.37	0.34	4.44	293
B-	15	2.69	2.31	80	260		95	0.38	0.38	4.23	260

CCC+	33.33	4.44	8.89	53.33	45		88.89	0	0	11.11	45
CCC	25.86	6.9	67.24	0	58		89.66	0	0	10.34	58
CCC-	28.21	71.79	0	0	39		87.18	0	2.56	10.26	39
D	100	0	0	0	209		99.52	0.48	0	0	209

Table 7 Rating Upgrades and Downgrades in Each Quarter

Panel A: by S&P

Quarter	Down_More_than_2	Down_2	Down_1	No_Change	Up_1	Up_2	Up_More_than_2
199801	0	0	0	11	0	0	0
199802	0	0	0	19	0	0	0
199803	0	0	0	18	0	0	0
199804	0	0	0	27	0	0	0
199901	0	0	0	33	0	0	0
199902	0	0	0	48	0	0	0
199903	0	0	0	53	0	0	0
199904	0	0	0	60	0	0	0
200001	0	0	0	64	0	0	0
200002	0	0	0	66	0	0	0
200003	0	0	0	83	0	0	0
200004	0	0	0	104	0	0	0
200101	0	0	0	112	0	0	0
200102	0	0	0	145	0	0	0
200103	0	0	0	158	0	0	0
200104	0	0	0	186	0	0	0
200201	0	0	0	232	0	0	0
200202	0	0	0	265	0	0	0
200203	0	0	0	331	0	0	0
200204	0	0	0	369	0	0	0
200301	0	0	0	432	0	0	0
200302	0	0	0	435	0	0	0
200303	0	0	0	519	0	0	0
200304	0	0	0	587	0	0	0
200401	0	0	0	753	0	0	0
200402	0	0	0	881	0	0	0
200403	0	0	0	1069	0	0	1
200404	0	0	0	1252	0	0	0
200501	0	0	0	1500	0	0	1
200502	0	0	0	1658	0	0	0
200503	1	0	0	1888	0	1	2
200504	2	1	0	2325	0	0	0
200601	0	0	0	2829	0	0	0
200602	0	0	0	3239	0	0	0
200603	0	0	0	3430	0	0	0
200604	1	4	2	3927	16	15	12
200701	11	5	6	4283	25	20	28
200702	2	4	3	4218	28	35	32
200703	6	1	5	4209	50	13	30
200704	4	4	8	4258	27	14	16

200801	3	9	14	4302	18	3	12
200802	25	26	24	4145	14	4	1
200803	34	26	41	4081	14	5	0
200804	11	3	39	4126	31	6	0
200901	64	42	47	4027	5	0	0
200902	24	8	14	4087	0	0	0
200903	290	45	29	3737	5	0	1
200904	390	28	22	3761	2	0	0
201001	323	46	53	3751	8	0	0
201002	110	43	91	3875	4	1	0
201003	120	40	43	3901	13	7	5
201004	232	64	107	3678	11	5	7
201101	173	54	67	3755	7	3	5
201102	148	60	86	3722	2	0	1
201103	97	38	105	3771	3	1	0
201104	133	39	56	3745	2	1	2
201201	41	43	58	3764	13	10	19
201202	65	33	42	3775	5	8	3
201203	23	10	25	3856	0	0	0
201204	93	62	56	3613	30	28	58
201301	54	25	23	3768	8	6	16
201302	0	0	0	3888	0	0	0

Panel B: by Fitch

Quarter	Down_More_than_2	Down_2	Down_1	No_Change	Up_1	Up_2	Up_More_than_2
199801	36	11	1	685	1	3	7
199802	103	20	7	692	0	0	17
199803	38	7	3	896	2	1	10
199804	63	14	4	915	0	0	16
199901	29	9	1	1056	2	2	7
199902	3	0	1	1218	8	1	2
199903	6	1	1	1305	6	4	4
199904	22	4	8	1366	13	6	8
200001	9	2	2	1472	4	1	5
200002	25	6	4	1506	9	5	5
200003	58	15	9	1540	30	11	7
200004	43	10	2	1660	14	7	12
200101	1	1	1	1823	13	6	8
200102	8	3	0	1832	19	8	9
200103	5	3	4	2063	35	7	11
200104	16	4	4	2319	24	23	11
200201	26	8	3	2374	15	11	26
200202	13	8	14	2480	12	11	10
200203	2	6	6	2574	73	14	23

200204	15	25	10	2615	42	17	18
200301	4	8	11	2982	12	4	2
200302	13	12	4	3278	10	12	8
200303	8	12	9	3405	54	42	57
200304	16	14	16	3513	57	48	62
200401	2	6	10	3686	40	44	81
200402	21	16	16	3715	107	65	45
200403	7	8	6	4121	57	37	19
200404	7	14	3	4304	16	14	13
200501	6	6	3	4405	36	22	24
200502	9	3	9	4433	83	48	90
200503	3	3	2	4594	107	90	93
200504	1	0	3	4899	73	36	32
200601	8	4	6	4862	108	111	179
200602	0	5	2	5064	117	126	193
200603	1	4	1	5071	96	84	133
200604	7	5	1	4917	149	98	110
200701	2	1	4	5467	143	75	49
200702	1	4	3	5706	139	55	46
200703	0	3	7	5939	89	32	34
200704	4	8	14	6351	37	10	38
200801	2	7	6	7141	49	9	12
200802	9	15	19	6665	93	18	11
200803	3	3	8	6858	34	14	16
200804	55	65	58	6702	17	7	20
200901	87	70	84	6562	4	3	2
200902	109	40	45	6704	0	1	1
200903	669	160	51	5900	0	0	0
200904	280	76	42	7209	0	0	0
201001	105	35	13	6868	2	0	5
201002	212	70	19	6495	4	8	5
201003	193	43	16	6572	5	4	9
201004	188	75	11	6797	0	0	0
201101	284	113	8	6269	2	3	9
201102	187	87	13	6259	21	17	25
201103	134	64	10	6411	26	22	29
201104	122	76	8	6448	0	1	0
201201	161	92	12	6393	7	2	3
201202	127	58	7	6399	9	9	25
201203	136	52	5	6434	11	10	13
201204	138	36	3	6628	0	0	0
201301	131	65	2	6644	1	2	4
201302	95	34	6	6779	1	5	22

Panel C: by Moody's

Quarter	Down_More_than_2	Down_2	Down_1	No_Change	Up_1	Up_2	Up_More_than_2
199801	0	0	0	0	0	0	0
199802	0	0	0	120	0	0	0
199803	0	0	0	164	0	0	0
199804	0	0	0	190	0	0	0
199901	0	0	0	222	0	0	0
199902	0	0	0	302	0	0	0
199903	0	0	0	377	0	0	0
199904	0	0	0	435	0	0	0
200001	0	0	0	481	0	0	0
200002	0	0	0	522	0	0	0
200003	0	0	0	580	0	0	0
200004	0	0	0	625	0	0	0
200101	0	0	0	686	0	0	0
200102	0	0	0	739	0	0	0
200103	0	0	0	857	1	0	0
200104	0	0	0	991	0	1	0
200201	0	0	0	1130	0	0	0
200202	0	0	0	1199	0	0	0
200203	0	0	0	1340	0	0	0
200204	1	1	0	1423	0	0	0
200301	0	2	2	1557	0	0	0
200302	0	0	0	1643	0	0	0
200303	0	0	0	1783	0	2	1
200304	0	0	1	1881	0	4	0
200401	1	1	0	2128	0	5	0
200402	0	0	4	2293	2	5	3
200403	3	6	1	2543	4	4	4
200404	0	5	1	2793	1	6	1
200501	3	0	3	3106	0	8	8
200502	5	3	5	3312	7	10	8
200503	2	2	4	3695	16	11	10
200504	7	3	4	3957	4	16	12
200601	4	4	1	4408	13	17	14
200602	4	0	2	4615	15	31	43
200603	2	1	4	4944	15	24	53
200604	16	1	2	5082	46	32	110
200701	6	2	10	5528	73	36	50
200702	2	5	9	5906	44	27	25
200703	1	5	11	6165	65	49	41

200704	2	3	2	6497	51	19	24
200801	11	8	12	6695	34	8	15
200802	5	1	13	6610	28	26	20
200803	5	15	31	6662	49	24	27
200804	27	22	44	6733	6	5	0
200901	1209	110	101	5358	5	0	1
200902	122	40	20	6511	11	6	4
200903	118	43	53	6441	4	2	1
200904	351	66	37	6304	0	0	0
201001	270	34	36	6448	7	3	5
201002	240	48	27	6398	15	4	1
201003	298	43	38	6307	3	2	11
201004	1074	218	199	5137	19	12	24
201101	126	92	99	6268	19	22	8
201102	10	14	13	6456	28	23	17
201103	25	27	44	6448	37	19	18
201104	42	45	46	6376	35	29	29
201201	476	55	78	5995	16	14	15
201202	111	65	81	6362	28	12	17
201203	72	83	122	6402	18	40	15
201204	92	77	82	6640	3	5	7
201301	89	48	82	6703	19	8	24
201302	43	36	38	6812	33	22	55

Table 8 MLE Estimates of the Ordered Probit Models for Rating Upgrades and Downgrades

Panel A: S&P

Upgrade				**Downgrade**			
Parameter		Estimate	S.E.	Parameter		Estimate	S.E.
Intercept 3	**3**	-2.30***	0.05	**Intercept**	**3**	-4.35***	0.10
Intercept 2	**2**	-2.07***	0.05	**Intercept**	**2**	-4.22***	0.10
Intercept 1	**1**	-1.85***	0.05	**Intercept**	**1**	-4.08***	0.10
sp_rAA		0.67***	0.03	**sp_rAAA**		-0.96***	0.09
sp_rA		0.59***	0.04	**sp_rAA**		-0.20*	0.09
sp_rBBB		0.43***	0.03	**sp_rA**		-0.13	0.09
sp_rBB		0.24***	0.04	**sp_rBBB**		-0.04	0.08
sp_rB		-0.09	0.05	**sp_rBB**		0.00	0.08
sp_rCCC		-0.02	0.21	**sp_rB**		-0.01	0.08
us_unemployment_rate		-0.13***	0.01	**us_unemployment_rate**		0.32***	0.01
a_chg_avg_ltv		-2.70***	0.27	**a_chg_avg_ltv**		0.82***	0.23
a_chg_avg_dscr		-0.03	0.02	**a_chg_avg_dscr**		-0.04***	0.01
diff_dscr		0.01	0.02	**diff_dscr**		-0.04*	0.02
lag_sp_up		-1.18**	0.43	**lag_sp_dw**		-0.24***	0.01
lag_ftch_up		0.33***	0.03	**lag_ftch_dw**		0.18***	0.01
lag_mody_up		0.24***	0.05	**lag_mody_dw**		0.12***	0.01
y2009		-0.71***	0.12	**y2009**		0.02	0.02
N		155,854		N		155,854	
-2 Log L		15,605		-2 Log L		47,312	

Notes: 1) These are quarterly rating transition models; 2) random effect at the bond level is included; 3) in the upgrade model initial rating AAA is the reference group, and in the downgrade model initial rating CCC is the reference group; 4) when we replace national unemployment rate by the coincident indicator or yield slope, we obtain consistent results. Those results are available upon request; 5) *** for p<0.01%, ** for p<0.01%, and * for p<0.5%.

Panel B: Fitch

Upgrade				**Downgrade**			
Parameter		Estimate	S.E.	Parameter		Estimate	S.E.
Intercept	**3**	-2.50***	0.09	**Intercept**	**3**	-4.39***	0.18
Intercept	**2**	-2.23***	0.09	**Intercept**	**2**	-4.22***	0.18
Intercept	**1**	-1.95***	0.09	**Intercept**	**1**	-4.17***	0.18
ftch_rAA		1.46***	0.08	**ftch_rAAA**		-0.63***	0.17
ftch_rA		1.61***	0.08	**ftch_rAA**		0.19	0.17
ftch_rBBB		1.50***	0.08	**ftch_rA**		0.12	0.17
ftch_rBB		1.35***	0.08	**ftch_rBBB**		0.15	0.17
ftch_rB		1.01***	0.08	**ftch_rBB**		0.29	0.17
ftch_rCCC		0.83**	0.30	**ftch_rB**		0.18	0.17
us_unemployment_rate		-0.27***	0.01	**us_unemployment_rate**		0.28***	0.01
a_chg_avg_ltv		-1.63***	0.19	**a_chg_avg_ltv**		-0.39	0.24
a_chg_avg_dscr		0.02	0.01	**a_chg_avg_dscr**		-0.01	0.01
diff_dscr		0.02*	0.01	**diff_dscr**		-0.06	0.03
lag_sp_up		0.28***	0.03	**lag_sp_dw**		0.08***	0.01
lag_ftch_up		-0.16***	0.03	**lag_ftch_dw**		-0.49***	0.03
lag_mody_up		0.24***	0.03	**lag_mody_dw**		0.11***	0.01
y2009		-1.41*	0.60	**y2009**		0.25***	0.02
N		158,095		N		158,095	
-2 Log L		20,160		-2 Log L		45,186	

Notes: 1) These are quarterly rating transition models; 2) random effect at the bond level is included; 3) in the upgrade model initial rating AAA is the reference group, and in the downgrade model initial rating CCC is the reference group; 4) when we replace national unemployment rate by the coincident indicator or yield slope, we obtain consistent results. Those results are available upon request; 5) *** for p<0.01%, ** for p<0.01%, and * for p<0.5%.

Panel C: Moody's

Upgrade				Downgrade			
Parameter		Estimate	S.E.	Parameter		Estimate	S.E.
Intercept	**3**	-3.53***	0.07	**Intercept**	**3**	-3.96***	0.06
Intercept	**2**	-3.25***	0.07	**Intercept**	**2**	-3.85***	0.06
Intercept	**1**	-3.04***	0.07	**Intercept**	**1**	-3.75***	0.06
mody_rAA		0.92***	0.05	**mody_rAAA**		-0.40***	0.04
mody_rA		0.95***	0.05	**mody_rAA**		0.29***	0.04
mody_rBBB		0.74***	0.05	**mody_rA**		0.21***	0.04
mody_rBB		0.48***	0.05	**mody_rBBB**		0.15***	0.04
mody_rB		0.23***	0.06	**mody_rBB**		0.10*	0.04
mody_rCCC		0.44**	0.14	**mody_rB**		0.11**	0.04
us_unemployment_rate		-0.04***	0.01	**us_unemployment_rate**		0.25***	0.00
a_chg_avg_ltv		--	--	**a_chg_avg_ltv**		-0.56*	0.22
a_chg_avg_dscr		0.04**	0.01	**a_chg_avg_dscr**		-0.01	0.01
diff_dscr		0.12***	0.02	**diff_dscr**		-0.10***	0.02
lag_sp_up		0.30***	0.04	**lag_sp_dw**		0.08***	0.01
lag_ftch_up		0.29***	0.03	**lag_ftch_dw**		0.04**	0.01
lag_mody_up		-0.07	0.05	**lag_mody_dw**		-0.31***	0.02
y2009		-0.77***	0.09	**y2009**		0.29***	0.02
N		165,366		N		163,388	
-2 Log L		14,373		-2 Log L		57,912	

Notes: 1) These are quarterly rating transition models; 2) random effect at the bond level is included; 3) in the upgrade model initial rating AAA is the reference group, and in the downgrade model initial rating CCC is the reference group; 4) when we replace national unemployment rate by the coincident indicator or yield slope, we obtain consistent results. Those results are available upon request; 5) *** for p<0.01%, ** for p<0.01%, and * for p<0.5%.