The Chicken or the Egg?
Rating Performance and the Relation between County Ratings and Sovereign Bond Market Yields

Abstract

We discuss the role of country ratings by asking whether ratings by S&P and Moody's provide new information to bond markets or if rating events are anticipated by markets. We analyze changes in bond prices before, during and after rating events. We contribute to the literature by using several statistical tests that are firstly applied in this context, as well as utilizing new approaches to identify the market movements related to specific rating events, e.g., the use of holding period (excess) returns modeled with Engle's Dynamic Conditional Correlation model.

JEL: G14, G15, F34

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Introduction

Ratings by leading agencies like S&P and Moody's have been seen as the most important credit risk measures for many years. However, the quality of ratings as risk indicators and sources of information on default risk is controversial in the literature. Much skepticism emerged, especially during the recent financial crisis, because the agencies failed in assessing credit risk of sub-prime credits and credit derivatives. Additionally, in some financial crises in developing countries, rating agencies often did not anticipate major financial turmoil, e.g. the Asian crisis in 1997. Many observers ask whether rating agencies actually have special knowledge and provide additional information to that already anticipated by the financial markets or whether markets process information faster and better than rating agencies, while rating changes simply follow the market price changes.

Our paper deals with this issue by considering the relation between ratings and bond market prices. We analyze changes of bond prices and the implied bond yields observed on secondary bond markets *before, during and after rating events* of the major rating agencies.[1] The relation between market data and ratings is extensive and acutely debated in the literature. There are a number of papers that analyze these relations, for example: the relation between *stock prices* and *corporate ratings* (see, e.g., Pinches and Singleton (1978), Griffin and Sanvincente (1982), Holthausen and Leftwich (1986), Goh and Ederington (1993), Dichev and Piotrovski (2001)).[2] Some interesting papers, discuss the relation between *sovereign rating* and *national stock markets* (see Brooks et al. (2004)) and between *sovereign ratings and international stock markets* (see Ferreira and Gama (2007)). Several interesting papers also discuss the relation between *bond market data* and ratings in the case of *corporate ratings*. Weinstein (1977) and Hite and Warga (1997) are early examples for papers who examine the

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[1] While our paper is concerned with the relation between country ratings and market data, and interesting strand of the literature (see, Güttler and Wahrenburg (2007)) discusses the relation between ratings issued by different rating agencies.

[2] Odders-White and Ready (2006) analyze relations between credit ratings and measures of equity market liquidity and show that future rating changes can be predicted using current levels of adverse selection.

behavior of corporate bond prices when rating changes occur, while Hand et al. (1992) and Kliger and Sarig (2000) consider the value of stocks as well as the value of bonds in periods of rating changes. Hull et al. (2004) consider the relation between rating announcements and credit default swap spreads (as well as to bond yields). We contribute to the literature on rating behavior in relation to market prices by focusing on *country or sovereign ratings* of default risky emerging market countries and prices of their government bonds, rather than considering *corporate* bonds and their ratings. In the case of country ratings, only a few contributions on their relation to bond market prices exist.[3] These papers and our contributions to this literature are overviewed in the following.

The relation between country ratings and market data on spreads of government bonds is also analyzed in Cantor and Packer (1996). Before considering the relation between ratings and spreads, Cantor and Packer consider to which extent economic variables determine country ratings by performing an OLS regression with cross-sectional data of 49 countries (observed on September 29, 1995) where ratings of Moody's and Standard and Poor's are used as dependent variables. An impressive R^2 of above 0.90 is achieved with a limited number of observable economic variables. This may be interpreted as evidence that rating agencies do not provide much additional information to that which is publicly observable and already included in market prices. Several other interesting papers, which analyze determinants of ratings with regression approaches, also find high R^2 using observable economic data. Afonso (2002) and Rowland (2005) apply OLS regressions on cross-section data and find R^2 up to 0.87 and 0.68, respectively. Using panel data Mulder and Perelli (2001) obtain R^2's up to 0.80 and Rowland and Torres (2004) obtain R^2's up to 0.70. In a second step, Cantor and Packer use credit ratings as an independent variable in order to explain yield spreads, which also reveals a close relation

[3] Some interesting recent papers, as Fender et al. (2012) or Ismailescu and Hossein (2010), consider alternatively CDS spreads and their determinants respectively their relation to ratings.

between ratings and spreads (again with R^2 above 0.90). However, the question of which variable leads and which one follows is not answered.

To analyze the relation between ratings and bond spreads with respect to their timing, Cantor and Packer apply a second research approach. They consider the dynamics of bond spreads before, during and after S&P and Moody's rating changes for 18 countries from 1987 to 1994. They consider government bond spreads for countries where a rating change happened in a time span of thirty days before and thirty days after the date of the rating event. For all rating events of equal type (e.g., upgrade or downgrade) they calculate average spread changes in the 60-day window around the rating event. By considering these average values, Cantor and Packer find that considerable spread changes precede the respective rating changes, i.e. spreads clearly increase before a country is downgraded or decrease before a country is upgraded. This can be interpreted as evidence that markets are faster than rating agencies in processing the information that leads to the rating change. On the other hand, the ratings also influence spreads the day the rating changes are announced, which is confirmed using a standardized t-test. This means that ratings are considered a significant signal of default risk by some market participants.

Later studies partly question and partly confirm these results. Larrain, Reisen and von Maltzan (1997), for example, include data from 1989 to 1995, which allows to consider additionally data observed during the Mexican Crisis of 1994/95. They find that rating events are lead by spread changes, but spreads also react to rating events. However, a reaction in the opposite direction of similar size follows in the time span after the rating event, which indicates an overshooting of market prices that is corrected afterwards. A more detailed analysis shows that changes themselves do not lead to statistically significant response in yield spreads for emerging market countries, but changes in outlook/watchlist, i.e. announcements to consider a possible rating change in the future, lead to price responses (at least for possible downgrades).

However, this study confirms that, for emerging market countries, negative announcements and also negative rating changes are preceded by significant increases in spreads.[4] Gonzalez-Rozada and Yeyati (2008) apply the Engle-Granger methodology (see Engle and Granger (1987)) on spreads of JP Morgan's EMBI-Global index for thirty-three emerging economies in the time span between 1993 and 2005. They find that increases in spreads precede *downgrades* and only a mild contemporaneous adjustment occurs afterwards. A smaller preceding decline in spreads for *upgrades* is then noticed. The authors detect a stronger influence from spreads on rating changes than the other way around, i.e. from ratings on spreads. Kaminsky and Schmukler (2001) investigate the effects of rating changes on emerging market bonds using panel and event studies. In the event studies, they apply a 20-day window around a rating change. In the panel regressions, spread changes are used as dependent variables and rating changes (besides interest rate changes) are used as explaining variables. The authors find that upgrades occur when markets are rallying and downgrades occur more visibly when they are collapsing. They interpret this as evidence that markets are anticipating rating changes and as proof of pro-cyclical behavior of rating agencies.

Another strand of the literature focuses on the relation between rating changes and actual defaults instead of bond market prices. These papers analyze whether ratings forecast actual defaults and financial crises (see, e.g., Reinhart (2002) and Sy (2004)). The results are mixed. In some settings significant forecast ability is found, whereas in others it cannot be detected. In our paper we concentrate on testing the requirement that ratings should add

[4] In a later paper, Reisen and von Maltzan (1999) include data from 1989 to 1997, i.e. the time of the Asian Crisis. Considering all types of rating events together yields only weak evidence (on a 10 % level) for a reaction of spreads on ratings and vice versa. Decomposition shows that positive announcements (outlook/watchlist) and rating downgrades significantly influence market data, whereas other rating events do not influence spreads. However, these rating events, as well as positive announcements, also are preceded by significant changes of spreads.

information to the market and not simply follow market trends. This approach implies in some sense weaker requirements because rating agencies are not blamed for their failures if markets also fail to foresee a default. One could argue that some things are indeed unforeseeable, and we should not blame the agencies in such cases. However, we should at least require the agencies to provide significant additional information instead of simply following the market trend. The question of whether this is the case or not is tested in our paper.

We basically apply the research design already suggested by Cantor and Packer (1996) and analyze the development of bond spreads before, during and after rating changes by using statistical tests. However, we contribute to the literature in several ways. *Firstly,* we apply different statistical tests, which may avoid some drawbacks of the tests used thus far in the literature. Whereas Cantor and Packer (1996), e.g., use a t-test only, we apply three additional statistical tests, which enables us to provide more robust results. In addition to two parametric tests bounded to distributional assumptions, the normal t-test and the modified t-test, we use two non-parametric tests: the Wilcoxon sign rank test and the Corrado test. These two tests are not bounded to distributional assumptions. Each of these tests has its pros and cons and there is no silver bullet. Thus, we apply the approaches used in the literature but also provide results of different tests to produce a more comprehensive picture of the situation. The same intention underlies our further contributions to the literature.

Secondly, we apply different concepts in considering market data in the analysis. In addition to the spread of redemption yields (or yield to maturity) considered in the literature thus far, we use holding period returns. This is because most investors in government bond markets will trade bonds actively and, thus, aim to maximize holding period returns rather than redemption yields. Information drawn from holding period returns may provide a broader and clearer picture of the research topic and the information content of market data. In particular, we consider the *excess returns* resulting from rating events. To calculate these excess returns we model (expected) returns using a time series framework (ARMA(1,1)), which accounts for heteroscedasticity by applying a GARCH (1,1) model for the volatility. This means we compare the actual return with the return predicted by our time series model. In addition, we consider the fact that beta factors are time varying by applying the Dynamic Conditional Correlation Model (DCC) of Engle (2002).

Finally, our paper contributes to the literature by considering a broad data set with long time series (observed for 36 developing countries) from January 1994 up to March 2011; it covers tranquil times as well as several crises and defaults in developing countries and, in particular, it includes data observed during the international financial and economic crisis from 2007 - 2011. Such a broad view with recent data may be of importance since the results of the literature were typically changed by including additional time spans (in particular new crises periods, as discussed above). We consider all countries included in JP Morgan's Emerging Market Bond Index for which ratings are provided by Moody's and/or Standard and Poor's. This comprehensive data set and especially the consideration of data of the recent crisis may be seen as a fourth contribution of our paper.

All in all, our analysis is more comprehensive than the previous literature. It includes the data and the methods considered thus far, as well as providing several new approaches and additional information. Our results indicate that markets are indeed faster than rating agencies in processing information. This is because rating events are preceded by considerable changes of spreads and excess return rates, which are found to be statistically significant with several tests. Rating changes, however, lead to significant changes of spreads and excess return rates on the announcement day. However, for some rating events, there is also a significant countermovement some days after the rating action.

The remainder of the paper is organized as follows: in Section I we discuss methodological issues, as opportunities in calculating the returns, the benchmark term and the statistical test procedures used in the paper. Section II is concerned with the empirical investigation and its results and Section III concludes.

I. Methodical Issues

A. Yield to Maturity versus Holding Period Return and the Benchmarks

To analyze the relation of ratings to financial markets we consider returns of investments in government bonds. On the one hand, we use the redemption yield or yield to maturity and, on the other, the holding period return. The yield to maturity is the yield the bondholder receives if all future cash flows will be made and if the bond will be held to maturity. The holding period return, by contrast, is the percentage increase in value for a specific time span (below the time to maturity). We consider one-day returns of investment in the bond. When considering the coupon payments, the continuous holding period return is:

$$r_{i,t} = \ln\left(\frac{dp_{i,t} + cup_{i,t-1}}{dp_{i,t-1}}\right) \quad (1)$$

$$dp_{i,t} = cp_{i,t} + \frac{cup_i}{360} * d_i \quad (2)$$

with : $dp_{i,t}$: *Dirty Price of bond i on day t*

cup_i: *Annual coupon payment of bond i*

d_i: *Number of days since the last coupon payment was made for bond i*

$cup_{i,t-1}$: *Realized coupon Payment on the bond holder at the end of day t − 1*

Both approaches have their advantages and disadvantages. The yield to maturity allows the investor to calculate the fair value of different kinds of bonds with diverse maturities and coupon payments. However, only a minority of investors will pursue the goal of holding the bond until maturity. Most bondholders have a shorter investment horizon and will look at the factual return in their investment period rather than at the redemption yield. Whereas the yield to maturity (and its spread to a (default-) risk-free benchmark) is used in several important papers, the holding period return seems to be more important for the actual decisions of investors. In our study we consider both the holding period return and the yield to maturity to provide a complete picture of the issue.

When analyzing the relation between bond markets and rating changes, only the change in bond returns that is related to the rating event should be considered. In this way we identify the market reaction to the specific rating change or a price movement in anticipation of the rating change, which is caused by the information on default risk that finally leads to the rating change. To specify the price movements related to specific rating changes and to exclude influences resulting from changes in the term structure of risk-less interest rates, spreads between the return of analyzed default risky bonds and the risk-less term structure (obtained from yields of US treasuries) are usually considered (see, e.g., Cantor and Packer (1996) or Larrain et al. (1997)). We consider spreads between yields of the risky bonds and the risk-free rate, which is approximated by the US term structure in the case of redemption yields. For the holding period returns, we relate the observed returns to holding period returns for risk-free benchmarks.

B. The Modeling of Holding Period Returns and Benchmarks

B.1. A Time Series Model for the Returns

In analyzing holding period returns we consider excess returns to a benchmark obtained by modeling both the return of the default risky bond and the benchmark with a time series approach. We assume that both the return $r_{i,t}$ of every bond i and the return $r_{b,t}$ of benchmark bond b follow an ARMA(1,1) process:

$$r_{i,t} = a_1^i * r_{i,t-1} + a_2^i * u_{i,t-1} + u_{i,t} \quad (3)$$

$$r_{b,t} = a_1^b * r_{b,t-1+}a_2^b * u_{b,t-1} + u_{b,t} \quad (4)$$

This process leads to error terms $u_{i,t}$ and $u_{b,t}$, for which the expected value is zero. Heteroscedasticity of the error terms usually observed in financial data is modeled by a GARCH-Model for both bonds and benchmark:

$$E_{t-1}[u_{i,t}^2] = \sigma_{i,t}^2 = b_o^i + b_1^i * u_{i,t-1}^2 + b_2^i * \sigma_{i,t-1}^2 \quad (5)$$

$$E_{t-1}[u_{b,t}^2] = \sigma_{b,t}^2 = b_o^b + b_1^b * u_{b,t-1}^2 + b_2^b * \sigma_{b,t-1}^2 \quad (6)$$

We use a bivariate GARCH(1,1) process, in order to determine a time varying covariance between bond i and its related benchmark bond b:

$$E_{t-1}[u_{i,t} * u_{b,t}] = \sigma_{i,b,t} = b_o^{i,b} + b_1^{i,b} * u_{i,t-1} * u_{b,t-1} + b_2^{i,b} * \sigma_{i,b,t-1} \quad (7)$$

Since the expected value of both error terms – $u_{i,t}$ and $u_{b,t}$ – is zero, the conditional covariance at time t of these terms can be expressed as:

$$\sigma_{i,b,t} = COV_{t-1}\left[u_{i,t} * u_{b,t}\right] = E_{t-1}[u_{i,t} * u_{b,t}] \quad (8)$$

The time varying correlation at time t is given by:

$$\rho_{i,b,t} = \frac{E_{t-1}[u_{i,t} * u_{b,t}]}{\sqrt{E_{t-1}[u_{i,t}^2] * E_{t-1}[u_{b,t}^2]}} \quad (9)$$

Hence, we determine the conditional standard deviation $\sigma_{i,t}$ for bond i and the conditional standard deviation $\sigma_{b,t}$ for its related benchmark bond b for every point in time t. The error terms $u_{i,t}$ and $u_{b,t}$ are standardized as follows:

$$\varepsilon_{i,t} = \frac{u_{i,t}}{\sigma_{i,t}} \quad or \quad \varepsilon_{b,t} = \frac{u_{b,t}}{\sigma_{b,t}} \quad (10)$$

For the standardized error terms an expected value of zero and a variance of one is assumed.

The conditional correlation between the error terms $u_{i,t}$ and $u_{i,t}$ is equal to the conditional covariance between the standardized error terms $\varepsilon_{i,t}$ and $\varepsilon_{i,t}$. It is equal to the conditional correlation of the standardized error terms:

$$\rho_{i,b,t} = \frac{E_{t-1}[u_{i,t} * u_{b,t}]}{\sqrt{E_{t-1}[u_{i,t}^2] * E_{t-1}[u_{b,t}^2]}} = E_{t-1}[\varepsilon_{i,t} * \varepsilon_{b,t}] = COV_{t-1}[\varepsilon_{i,t} * \varepsilon_{b,t}] \tag{11}$$

B.2. Time Varying Beta Factors and the Dynamic Conditional Correlation Model

A common finding in the literature is that a constant beta factor is typically not observed in financial time series. Thus, a model with time varying beta factors is more appropriate. We consider time varying beta factors using the Dynamic Conditional Correlation (1,1) Model (DCC). The following assumptions for the conditional correlation of the error terms from bond i and its related benchmark bond b are made:

$$\rho_{i,b,t} = \frac{q_{i,b,t}}{\sqrt{q_{i,i,t} * q_{b,b,t}}} \; with \tag{12}$$

$$q_{i,b,t} = \overline{\rho_{i,b}} + c_1^{i,b} * \left(u_{i,t-1} * u_{b,t-1} - \overline{\rho_{i,b}}\right) + c_2^{i,b} * \left(q_{i,b,t-1} - \overline{\rho_{i,b}}\right) \tag{13}$$

$$\overline{\rho_{i,b}}: unconditional\ correlation\ between\ u_i\ and\ u_b$$

If $c_1^{i,b} + c_2^{i,b} < 1$ holds true, the conditional correlation reverts to the unconditional correlation. For our data this was always the case, i.e. we get the results of a mean reverting process. The time varying conditional correlation varies around its average value.

B.3. Modeling the Benchmark Term

For every bond and its related benchmark bond we calculate the conditional correlation followed by the conditional covariance. Afterwards, we determine the conditional beta factor for every point in time t:

$$beta_{i,b,t} = \frac{\sigma_{i,b,t}}{\sigma_{b,t}^2} \tag{14}$$

Finally, we create the following benchmark term by using an ARMA(1,1) model:

$$r_{i,t} = d_1^{i,b} * beta_{i,b,t} * r_{b,t} + d_2^{i,b} * r_{i,t-1+} d_3^{i,b} * v_{i,b,t-1} + v_{i,b,t} \tag{15}$$

The observed excess return for bond i at time t is given by the error term $v_{i,b,t}$:

$$ER_{i,t} \coloneqq v_{i,bi,t} \tag{16}$$

Using this model, we estimate the expected return of bond i. Excess returns caused by unanticipated events related to the specific bond under consideration are reflected only by the error term of the model. All other influences on bond prices are captured by the benchmark model. Excess returns different from zero can be related to events (that are assumed to influence prices) observed on that respective date. Under the assumption that rating activities are such an event and that the rating activity includes new price relevant information, we can expect a reaction of the market participants and, thus, of the market prices on the event. If the market has received the information earlier from other sources, excess returns will occur before rating changes rather than on the announcement day. In that case the price reaction is reflected by the error term of the model before the rating change.

B.4. The Findings of the DCC-model

Here we present some results obtained from our benchmark model. The estimation of the parameters of the benchmark term has the following results:

(i) Most of the AR-parameter d_2 lies in the interval $0<d_2<0.6$, this implies that the bond prices follow a trend, meaning that positive returns will – on average – cause positive returns and negative returns will – on average – cause negative returns.

(ii) In most cases the MA-parameter d_3 lies in the interval $-0.8<d_3<0$, so if this trend is disrupted, caused by an up-to-date event, an opposing price reaction can be expected in the following time period in a weaker form.

Since we find this evidence for the existence of significant AR and MA effects, it seems to be appropriate to use an ARMA model in estimating excess returns in order to identify abnormal price changes that may be related to rating events. The aim of the analysis is to model predictable price changes that follow a trend or autoregressive process. This is to clearly distinguish and identify unexpected price changes caused by the rating event or the information on solvency risk that resulted in the rating event. Only abnormal returns resulting from these unexpected price changes are captured with the observed excess return given by the error term.

C. Statistical Tests

The backbone of our empirical analysis are the statistical tests of whether significant price or – more precisely – return changes occur at dates of rating events, as well as before and after rating events. As already explained in the introduction, we advance the literature by applying several additional statistical test procedures, which are explained in this subsection. Four different statistical tests are used in our paper. There is no silver bullet, every test has its pros and cons, whereby we aim to adjust failings of an individual test by conducting other tests and providing a broader picture of our research topic.

The return of the benchmark term is supposed to match the expected return of the respective bond, if no price relevant events happen. Thus, the determined excess return has an expected value of zero.[5] Greater observed abnormalities after a rating event or when the event

[5] The discussion of statistical tests proceeds in terms of excess returns. Similar reasoning applies for changes of yield to maturity spreads discussed in the introduction and also analyzed in the empirical application. In this case the spread change is expected to be zero if no relevant information occurs.

happens are a signal that this rating action has significant influence. Similarly, excess returns before rating events may be seen as evidence that the market anticipates the event or processes the information leading to the event more quickly than rating agencies.

The mean excess return for every time t is:

$$\overline{ER_t} = \frac{\sum_{i=1}^{n} ER_{i,t}}{n} \tag{17}$$

$ER_{i,t}$: *Excess return of bond i at time t*

$\overline{ER_t}$: *Mean Excess return at time t*

n: *Number of rating events*

For aggregated time periods, as for example the 30 days period [-30;0] before a rating event, we get:

$$\overline{AER_{se}} = \sum_{t=s}^{e} \frac{ER_{i,t}}{n} \tag{18}$$

$\overline{AER_{se}} = Aggregated\ mean\ excess\ return\ for\ the\ time\ period\ [s;e]$

Two parametric and two non-parametric tests are applied.

C.1. Parametric Tests

C.1.1. Normal t-Test

The Normal-t-test is the standard test applied in the literature (see the discussion in the introduction). This test assumes independently identically normally distributed observations with an expectation value, μ, equal to zero and an unknown variance. The test hypotheses are:

H_0: The mean excess return for every time t is equal to its expected value of zero:

$$\overline{ER_t} = 0\ respectively \tag{19a}$$

$$\overline{AER_{s,e}} = 0 \tag{19b}$$

H_1: The mean excess return is different from zero:

$$\overline{ER_t} \neq 0 \; respectively \tag{20a}$$

$$\overline{AER_{s,e}} \neq 0 \tag{20b}$$

The test statistic, t_n, for a time span of one day is:

$$t_n = \frac{\overline{ER_t} * \sqrt{n}}{\sigma(ER_t)} \; with: \tag{21}$$

$$\sigma(ER_t) = \sqrt{\frac{1}{n-1} * \sum_{i=1}^{n} (ER_{i,t} - \overline{ER_t})^2} \tag{22}$$

$\sigma(ER_t)$: $crosssection\ standard\ deviation\ of\ the\ excess\ return\ at\ time\ t$

For aggregated time periods [s,e] the test statistic is:

$$t_n = \frac{\overline{AER_{s,e}} * \sqrt{n}}{\sigma(AER_{s,e})} \; with: \tag{23}$$

$$\sigma(AER_{s,e}) = \sqrt{\frac{1}{n-1} * \sum_{i=1}^{n} \left(AER_{i,s,e} - \overline{AER_{s,e}}\right)^2} \tag{24}$$

$AER_{i,s,e}$: $Aggreagted\ excess\ return\ ob\ bond\ i\ for\ the\ time\ period\ [s,e]$

$\sigma(AER_{s,e})$: $crosssection\ standard\ deviation\ of\ the\ excess\ returns\ for\ the\ time\ period\ [s,e]$

The standardization is done by considering $\sigma(ER_t)$ or $\sigma(AER_{s,e})$ respectively, i.e. using the corresponding cross section standard deviation of the excess returns.

The test relies on the assumption of independent observations; however, this is not the case. There are, for example, correlations between the returns observed for different emerging market countries. Another problem of this test is the assumption of a normal distribution. In fact, the return distribution has excess kurtosis. However, the test is robust regarding deviations to the normal distribution and can be used for an approximation (see, e.g., Markowski (1990)). The test also assumes an identical distribution of the individual excess returns. However, the volatilities of our determined excess returns differ clearly for different bonds. Therefore we get distorted results by overweighting bonds with a high return volatility and underweighting relatively price-stable bonds.

C.1.2. Modified t-Test:

To account for the changing variances and leptokurtosis we use a modified t-test in addition to the Normal t-test. In the Modified t-test, the individual excess returns are standardized with their conditional variance, which was individually ascertained for each time series from the complete longitudinal section. Here, we use a GARCH(1,1)-model.

$$ER_{i,t} = w_{i,t} \tag{25}$$

$$E\left[{w_{i,t}}^2\right] = \theta_{i,t}^2 = f_0^i + f_1^i * u_{i,t-1} + f_2^i * \theta_{i,t-1}^2 \tag{26}$$

The standardized excess return of bond i at time t is:

$$SER_{i,t} = \frac{ER_{i,t}}{\theta_{i,t}} \tag{27}$$

$$with\ (the\ essential\ assumption): SER_{i,t} \sim N(0; 1)$$

The hypotheses for the modified t-test are:

H_0: The mean standardized excess return is equal to its expected value of zero:

$$\sum_{i=1}^{n} \frac{SER_{i,t}}{n} = 0 \tag{28a}$$

$$\sum_{t=s}^{e} \sum_{i=1}^{n} \frac{SER_{i,t}}{n} = 0 \tag{28b}$$

H_1: The mean standardized excess return is different from zero.

$$\sum_{i=1}^{n} \frac{SER_{i,t}}{n} \neq 0 \qquad (29a)$$

$$\sum_{t=s}^{e} \sum_{i=1}^{n} \frac{SER_{i,t}}{n} \neq 0 \qquad (29b)$$

The test statistic is then:

$$t_m = \sum_{i=1}^{n} SER_{i,t} * \sqrt{n} \qquad (30a)$$

$$t_m = \sum_{t=s}^{e} \sum_{i=1}^{n} SER_{i,t} * \sqrt{n} \qquad (30b)$$

C.2. Non-parametric tests

To account for the problem of distributional assumptions not being fulfilled in the parametric tests (described above), we apply two additional non-parametric tests. The cardinal data are transformed into ordinal data. The arising efficiency loss is marginal.

C.2.1. Wilcoxon-sign-rank-test

The Wilcoxon (1945) test assumes that the elements of a population are independently identically distributed, but no specific distribution is assumed. The only assumption concerning the distribution is that it is continuous and symmetric around its median zero. We have:

$$D_{i,t} \coloneqq ER_{i,t} \quad R_{i,t}^{+} = R\left(\left|D_{i,t}\right|\right) \qquad (31)$$

$$Z_{i,t} = 1 \; if \; D_{i,t} \geq 0; \; Z_{i,t} = 0 \; if \; D_{i,t} < 0 \qquad (32)$$

$$W_t^{+} \coloneqq \sum_{i=1}^{n} R_{i,t}^{+} * Z_{i,t} \qquad (33)$$

$R_{i,t}^{+}: Rank\ of\ the\ absolute\ value\ of\ the\ excess\ return\ of\ bond\ i\ at\ time\ t$

$W_t^+: Wilcoxon\ test\ statistic$

First, the absolute values of our estimated excess return rates are estimated and arranged in ascending order. We then assign rank numbers $R_{i,t}$ to these assorted values. Lastly, we take the sum of only the rank numbers of positive excess return rates receiving our test statistic.

For aggregated time periods it similarly follows:

$$D_{i,s,e} \coloneqq AER_{i,s,e} \quad R_{i,s,e}^+ = R(|D_{i,s,e}|) \tag{34}$$

$$Z_{i,s,e} = 1\ if\ D_{i,s,e} \geq 0;\ Z_{i,s,e} = 0\ if\ D_{i,s,e} < 0 \tag{35}$$

$$W_{s,e}^+ \coloneqq \sum_{i=1}^{n} R_{i,s,e}^+ * s,e \tag{36}$$

$R_{i,s,e}^+: Rank\ of\ the\ absolute\ value\ of\ the\ excess\ return\ of\ bond\ i\ for\ time\ period\ [s;e]$

The test hypotheses are:

$$H_0: W_t^+ = E[W_t^+] \tag{37a}$$

$$W_{s,e}^+ = E[W_{s,e}^+] \tag{37b}$$

$$H_1: W_t^+ \neq E[W_t^+] \tag{38a}$$

$$W_{s,e}^+ \neq E[W_{s,e}^+] \tag{38b}$$

The test statistic is normally distributed for more than 20 observations, leading to:

$$z = \frac{W_t^+ - E[W_t^+]}{\sigma[W_t^+]} \tag{39a}$$

$$z = \frac{W_{s,e}^+ - E[W_{s,e}^+]}{\sigma[W_{s,e}^+]} \quad with \tag{39b}$$

$$E[W_t^+] = E[W_{s,e}^+] = \frac{n * (n+1)}{4} \tag{40}$$

$$\sigma^2[W_t^+] = \sigma[W_{s,e}^+] = \frac{n * (n+1) * (2n+1)}{24} \tag{41}$$

The excess returns are not always symmetrically distributed. Thus, the significance of this test is limited. For this reason, we also use the Corrado-test – another non-parametric test described below. The advantage of the Wilcoxon test lies in the simple comparison of the aggregated rank numbers of the absolute value returns. There is no necessity to consider returns of time periods before and after the rating event (as in the Corrado test).

C.2.2. Corrado-test

The Corrado-test has the advantage that it does not impose any restrictions concerning the distribution, i.e. skewness or excess kurtosis in the observed population is allowed, (see Corrado (1989)). We rank the excess returns in an ascending order by using the longitudinal section data for every bond for the time period t=[-180;180]. We have chosen a relatively long time period of 361 days (approximately one year) to exclude short-term price fluctuations and get an adequate long-lasting comparison time span. A longer lasting period would contain a high risk of capturing another rating event. Thus, we are working with 361 rank orders. If the rating action will not trigger any price reaction, we will get a mean rank order of $\overline{CO} = 181$ for every time t. This means if the rating will have no significant price influence, the rank number for the rating day t=0 is supposed to be 181 on average.

$$\overline{CO} = \frac{1 + 361}{2} \tag{42}$$

The test statistic is:

$$t_C = \frac{\frac{1}{n} * \sum_{i=1}^{n} (CO_{i.t} - \overline{CO})}{\sigma(CO_t)} \quad with: \tag{43}$$

$$CO_{i.t} = R(ER_{i,t}) \tag{44}$$

$$\sigma(CO_t) = \sqrt{\frac{1}{181} * \sum_{t=-180}^{180} \left(\frac{1}{n} * \sum_{i=1}^{n} (CO_{i.t} - \overline{CO}) \right)^2} \tag{45}$$

$\sigma(CO_t)$: $Standard\ deviation\ of\ the\ longitudinal\ section\ data$

The Test hypotheses are:

$$H_0: \sum_{i=1}^{n} (CO_{i.t} - \overline{CO}) = 0 \tag{46}$$

$$H_1: \sum_{i=1}^{n} (CO_{i.t} - \overline{CO}) \neq 0 \tag{47}$$

For cumulated time periods we get:

$$t_C = \frac{\frac{1}{n} * \sum_{i=1}^{n} \sum_{t=s}^{e} (CO_{i.t} - \overline{CO})}{\sigma(CO_{s,e})} \quad with: \tag{48}$$

$$\sigma(CO_{s,e}) = \sqrt{\frac{1}{181} * (e - s + 1) * \sum_{t=-180}^{180} \left(\frac{1}{n} * \sum_{i=1}^{n} (CO_{i.t} - \overline{CO}) \right)^2} \tag{49}$$

The Test hypotheses are:

$$H_0: \sum_{i=1}^{n} \sum_{t=s}^{e} (CO_{i.t} - \overline{CO}) = 0 \tag{50}$$

$$H_1: \sum_{i=1}^{n} \sum_{t=s}^{e} (CO_{i.t} - \overline{CO}) \neq 0 \qquad (51)$$

The standard deviation $\sigma(CO_t)$ is calculated using the time period of 361 days. The original distribution of the excess returns will be transformed in a unique distribution, regardless of the (a)symmetry of the original distribution. The test is robust with respect to changes of the variance for the event time period. Furthermore, the test shows greater power than the t-test when the population is not normally distributed.

I. Empirical Analysis

A. Research Design and Data Sample

In our empirical analysis, we follow the literature and relate market changes (excess returns and spread changes) to specific rating events. On the one hand, we consider the development of average returns before and after rating announcements in a qualitative manner. On the other, we apply the statistical tests described in Subsection I.C. to assess whether the observed market movements are statistical significant. We distinguish between different types of events: upgrades/downgrades; positive/negative outlook changes; positive/negative watchlistings, i.e. announcements of possible rating changes in the future. We analyze these types of events separately in order to avoid confusion and to gain deeper insights into the relation between rating events and market movements.

We consider market movements at the date of the rating event as well as for several time spans before and after the rating event. If the market gets new price relevant information from the rating, there should be a significant price effect on the announcement day. If the markets get the information that causes the rating action earlier and/or process the information faster a significant price change prior to the rating action should be observed. In addition, we consider the reaction of markets on rating events, i.e. the changes in market prices in after-event periods. Many rating events are announced in the evening, meaning that the market can only react the next day. Therefore the time window t=[0;1] is our rating event period. For simplicity we call this period 'announcement date' in the following.

We observe governmental bonds of emerging markets to identify the effect of rating events on bond prices. Instead of single bond issues we use country specific index data of JP Morgan's Emerging Market Bond Index EMBI (global).[6] Using data of a (country specific) index instead of single bond issues has the advantage that issue-specific characteristics have only marginal influence on the results, which is appropriate since we consider issuer ratings of countries and not ratings related to specific issues. Data for the EMBI Global Index are provided for the period since December 31, 1993, meaning the maximum investigation period goes from January 1994 to March 2011. The index contains bonds of different emerging market countries. Not all of these countries have a rating or a rating change from Moody's or S&P in the investigation period. Our investigation includes 35 countries and their EMBI Global governmental indices with at least one rating change. As a default-risk-free benchmark we apply the JP-Morgan United States Government Bond Index.

We consider holding period returns as well as redemption yields. Excess returns for the former are determined, as explained in Section I.B., by calculating the daily holding-period-returns for every governmental index. Additionally, we use the EMBI spread of redemption yields as suggested already by Cantor and Packer (1996). To be consistent with the literature, we do not apply the discussed excess return model when considering the spreads of the yield to maturity to the risk-free benchmark. Furthermore, we only apply the t-test and do not apply the

[6] See Cavanagh and Long (1999) for more and detailed information on the EMBI (global). JP Morgan provides separate data for the EMBI for a number of emerging market countries (in addition to an overall index for all emerging markets). The numbers for risky yields and spreads in the EMBI for a specific country are averages of the major and most liquid bond issues of each country.

modified t-test for the spreads of these redemption yields since we do not observe a leptokurtic distribution for the spreads. Thus, the GARCH approach is not appropriate.

The data sample contains 686 rating events and is therefore much broader than the data sample used in the literature so far, particularly because it comprises data from the recent international financial crisis.[7] In particular we observe 135 downgrades and 190 upgrades, 50 negative and 50 positive rating watchlist changes. Moreover, our study analyzes 99 negative and 140 positive rating outlook changes.

B. Results for Rating Changes

B.1. Downgrades

Figure 1 shows the development of cumulated average excess returns and spreads around rating downgrades. Line b1 describes the average cumulative holding period excess return. The average cumulative EMBI spread changes can be seen in line b2.

The course charts for the holding period excess returns show a considerable negative trend, which starts approximately 25 days before the rating announcement. The yield to maturity spread shows a positive trend, which begins about 18 days before the announcement date. In the time span t=[-30;-1], we can observe a cumulative excess return (b1) of -67.4 basis points (bp) and a redemption yield spread change (b2) of 186.5bp. Both curves move in the direction that a rating downgrade indicates. A downgrade means an increase of default risk and a decrease in the value of the bond. Thus, the excess return (deviation from the benchmark) of holding period returns is supposed to be negative. The spread of the redemption yield over the risk-free benchmark is supposed to increase if default risk increases since the internal rate of

[7] The study of Cantor and Packer, e.g., considers 79 events, of which are 39 rating changes and 40 watch list changes. Reisen and von Maltzan consider 152 events, of which 97 are observed in emerging markets. In the panel study by Kaminsky and Schmukler, the authors have looked at 123 rating changes for emerging market bonds.

return of an investment increases if it's current price for given promised repayment conditions decreases.

<Insert Figure 1 here>

At the announcement date we observe an additional jump in the expected direction. However, compared to the change in advance of the rating change, the changes at the rating date are rather low. The mean change of the excess return is -8.5bp (compared to -67.4bp in the pre-event period) and the average yield spread changes about 40.3bp (compared to 186.5bp in the pre-event period). After the rating event, the curve flattens for b2. For the holding period return, we observe a slight movement in the opposite direction, i.e. a decrease of returns. Such a reverse movement can be interpreted as evidence that markets correct their overreactions on rating announcements.

Our most important finding is that the revaluation of bonds clearly starts before the actual downgrade announcement. The majority of the revaluation occurs before the downgrade, which is evidence that markets have an advantage in acquiring and/or processing information. However, the short lasting boost of market prices for several days, which results from the rating downgrade, implies that markets recognize ratings as source of information (perhaps a source that confirms the information state of markets).

These results proved to be statistically significant by our four tests (see Table AI in the appendix). *For the announcement date (i.e. the window [0;1])*, all tests reject the null hypothesis (of no excess return) with a p-value of below 1% for holding period returns (b1) and redemption yield spreads (b2). The only exception is the normal t-test for holding period returns (b1), which approves an abnormal change at the 5%-level.

However, our statistical tests also confirm the qualitative observations for the pre-event periods that rating changes are preceded by distinct market movements. When considering the *pre-event-periods* of the rating downgrade, we get highly significant test results for nearly all tests with p-values below 1%. This holds true whether we consider long or short pre-event-periods. The significance for longer periods implies an adaptation of bond prices on its new solvency level long before rating agencies react to the new information. The significance of market changes in shorter periods or even the day before rating downgrades can be interpreted as evidence that ratings react to new information after the markets have already processed this information.

For the *after-event-periods* we get mixed results. For the shorter periods, t = [0;5] and t = [0;10], all tests imply significant excess returns for the redemption yield, whereas the holding period returns are only significant for the modified t-test, but not for other tests. For the longer after-event-period, t = [0;30], the significance of the redemption yield spreads vanishes. This may result from the hump-shaped figure: for several days following the event, the spreads continue to grow, which is corrected partly in the later days of the observation period.

For the holding period return we can even confirm a countermovement, which, however, does not start immediately after the event but several days later. In the first ten days after the rating downgrade we still can observe a weak cumulative price loss, which, except for the modified t-test, is not statistically significant. Observing the cumulative price change in the after event periods starting from day five, we find positive price movements confirmed by different statistical tests. For the periods [5;10], [5;15] and [5;30] three of our four tests (except for the modified t-test) find significant positive price changes. Therefore we do find evidence that ratings cause an overreaction that is corrected afterwards if we consider holding period returns instead of redemption yield spreads.

All in all, we can conclude that rating downgrades are on average foreseen by the market in longer time spans and/or the markets are faster in processing the information that caused the rating change. Even the date of the rating event itself seems to be no surprise because even in the day before the event we find significant price changes. Nevertheless the rating change seems to be considered by the markets as price-relevant information since the changes stimulate significant reaction. However, we find (weak) evidence that markets overreact on downgrades.

B.2. Upgrades

For rating upgrades we find similar results as for downgrades, i.e. markets react well in advance of rating agencies to the underlying information but also show a significant reaction on the announcement date. Both changes point in the expected direction. We observe an increase in *holding period (excess) returns* because of the lower default risk in relation to the rating upgrade. The extent of the reaction of prices to the rating upgrade on the announcement date is, however, much weaker than for the rating downgrade (note the respective scaling differences between Figures 1 and 2). For the announcement date we observe a mean excess return for b1 of only around 3.6bp (whereas for the downgrade we observed -8.5bp). In the 30-day-pre-event-period, we observe a change of 15.3bp for the upgrade (whereas for the downgrade it was -67.4bp). After the announcement date the positive development of the excess return rates proceeds (with a lower slope).

<Insert Figure 2 here>

The average change in *spreads of the yield to maturity* also shows the expected negative development, which reflects market participants' anticipation of a lower default risk. This leads to an increase in prices and a corresponding drop in the internal rate of return and therefore in the spreads as well. This development starts about 22 days before the rating event but again is much weaker than the spread change observed for downgrades. The average spread change for the 30 days prior to the upgrade is -31.2bp (compared to 186.5bp for the downgrade). The average change in spread on the announcement date is about -7.4bp and (40.3bp for the downgrade). The trend continues in a weaker form until approximately 18 days after the upgrade announcement followed by a constant yield spread course.

As in the case of the downgrade, the larger part of the price reaction takes place prior to the rating upgrade, but the upgrade still stimulates a price reaction on the announcement date. The weaker reactions to the upgrades indicate a smaller information value of rating upgrades than for rating downgrades. Another difference between downgrades and upgrades is that upgrades have no reverse development in the days following the rating change, i.e. we do not observe markets correcting an overreaction to rating upgrades.

Again these results turn out to be statistically significant (see Table AII). All tests indicate highly significant market movements on the announcement date [0;1] for both redemption yields and holding period returns (whereas for single days [0] or [1] the results are mixed). Additionally, for the majority of cases in the considered pre-event period we observe significant changes; we only find no significance in a few exceptional cases. We receive significant test results for all long pre-event periods and all tests (except for the Corrado-test, which shows no significant excess return rate for b1 for all three pre-event periods and no significant spread change for b2 for the periods [-30;-1] and [-5;-1]).[8] In all other cases we find significance. Only for the day immediately before the rating change [-1], the results are more mixed; the redemption yields show no significant change, whereas the holding period returns do.

For the after-event periods the results are also mixed. Three out of our four tests detect significant abnormal excess returns for b1 for all after-event periods considered (again with the exception being the Corrado test). The redemption yield spreads are found to be significant in

[8] To understand why the Corrado test shows different results one may remember its procedure. It is based on the comparison of the returns/spread changes in the considered window with the average excess return/change in the time window [-180;180], for which we observe a considerable time trend. Since we observe an almost constant trend in the whole period there are no significant changes detected in periods under consideration.

the most cases for the period [0;5]. The other two periods show no clear results. The Corrado-test detects no statistically significant market movements in the after-event period for both of the benchmarks. Our tests also confirm that, in contrast to downgrades, upgrades show no evidence of a correction after rating events.

To sum up: rating upgrades stimulate a weak but significant price reaction on the announcement date. However, also upgrades are foreseen by the markets or the information that leads to these upgrades is processed in advance of rating events to a large extent. This is indicated by the market movements and by statistical evidence. Also for the after-event periods we observe a (in the most cases significant) reaction in the expected direction and no correction afterwards.

C. Results for Watchlist Changes

C.1. Negative Watchlist Changes

To argue in favor of rating agencies, one could state that markets are forewarned of possible rating changes since issuers are put on a watchlist by the rating agencies, which indicates possible changes in the future. Therefore it is not surprising that market movements are observed before rating changes since these rating changes themselves are often preceded by watchlistings. To analyze this issue, we consider watchlistings as another type of a rating event. We start with negative watchlistings.

In the case of (negative) watchlist changes, the curves (see Figure 3) also show a development of the respective returns in the expected direction, i.e. a negative trend for the holding-period-returns (b1) and a positive trend for the spread of the redemption yield (b2) that clearly starts before the rating event. In the 30-day time period before the watchlist announcements, a considerable change in holding-period-returns of -33.2bp can be observed. Also the redemption yield spreads change of (132.3bp) is strong, especially in relation to the movement on the announcement date. Furthermore, we can see distinct abnormal excess returns on the day before the negative watchlist announcement of -5.9bp and 10.6 bp for b1 and b2 respectively. This may be interpreted as evidence that either markets foresee the watchlist change the day before it happens or the rating agencies often react on an specific event concerning the default risk, which is processed by the markets more quickly.

<Insert Figure 3 here>

Nevertheless the watchlist changes alone are seen as significant events and stimulate a significant market reaction, although it is far weaker than the change in the pre-event period. There is an average change of -11.7bp for b1 and of 33.4bp for b2 at the announcement period. This trend continues several days after the rating announcement. Several days after that, however, we observe a notable countermovement. This is evidence for an overreaction of the market to negative watchlistings, which is corrected shortly after the rating event.

The results suggested by the charts are again confirmed mostly by the statistical tests (see Table AIII). All tests reject the null-hypothesis of no significant price reaction at the announcement date [0;1] at least at the 10%-level. Also, for the single day [0] all tests show significant price movements. However, for the pre-event period we find statistically significant changes in almost all cases.[9] This means, the watchlistings are significantly anticipated by the markets, or the underlying information is processed faster than by rating agencies. Again, the results for the after-event periods are ambiguous. For the shorter after-event periods we find

[9] Only for the day immediately before the announcement the results are somewhat mixed; the parametric test yield significant changes, whereas the non-parametric tests do not. For the Corrado test this again can be explained by the trend in the returns for time window [-180,180], so the excess returns of the announcement day are relatively weak distinctive towards this whole period. One reason for this negative trend is that the watchlisting is often followed by an announced rating change, i.e. the factual rating downgrade, which in turn results in negative excess returns. Missing significance of our non-parametric tests with simultaneous significance of both t-tests indicates that the results are driven by fat tails of the distribution or even by some outliers.

evidence for significant price changes in the direction in which the rating event points, i.e. decreasing holding period returns and increasing spreads, whereas for longer periods no significance is detected. This may be related to the countermovement, which starts several days after the rating event. Thus, the longer windows include both positive and negative movements, which blurs the significance of the tests. This is emphasized by the findings for later periods. For the observation window [5;15], e.g., all tests (except the Wilcoxon test for redemption yields) find a significant positive price movement for both redemption yields and returns. For other observation windows we also find some significance in the tests.

C.2. Positive Watchlist Changes

Similar as for the *rating changes* also for positive *watchlisings* the price movements are much lower than for the negative watchlistings (note the scaling of the axis in Figures 3 and 4). However, considering the results of holding period return b1, one can observe a distinct positive trend starting about 25 days before the positive watchlist change, which leads to an excess return of 4.9bp for the 30-day pre-event period. The announcement-period shows a change of 3.2bp. After the watchlist change, we again observe an increase in the first few days that is followed by a slight decrease until day 25. The average redemption yield spread change b2 shows the expected – however only slight – negative trend, which is followed by drop at the watchlist date. The total pre-event spread change amounts to -9.0bp whereas the change in spread at the announcement date is approximately -7.6bp. After the positive watchlisting, we observe a strong reversion for the redemption yield, which starts around four days after the rating event.

<Insert Figure 4 here>

Some of our qualitative observations are confirmed by our statistical tests, but in other cases the results are mixed (see Table AIV). We observe significant abnormal returns and yield spread changes on the *announcement date [0;1]*, which is confirmed by all test results except the Corrado test for b2, while for the single days [0] and [1] the changes are significant in some cases and not in others. For the *pre-event period* the statistical results provide only very weak evidence for significant changes; we find some significance for some exceptions, but in the most cases the changes are not significant. This may result since the observed trends are quite small in relation to the high volatility of the time series. It can be interpreted as evidence that positive watchlistings come by surprise to the markets. For the *after-event* period the results are ambiguous. For the holding period returns we detect significant after-event changes that indicate a continuation of the pre-event trend. A significant countermovement cannot be detected by the tests (which is in line with the observations in the Figure 4). For redemption yields the results are different. We do not find a significant change for the after-event period in either direction. This can be explained by the fact that we have a considerable downward movement in the first days after the event and a strong upward movement afterwards. Surprisingly our tests do not provide strong evidence for such a correction. Only for some time spans we find some significance for counter movements but not for all tests. Only the t-test is significant for the periods [5;10], [5;15] and [5;25]. Though we observe a strong upward trend of the average redemption yield spreads several days after the rating event, this trend is always interrupted by several downward movements, which are driven by strong outliers. Thus, the other tests provide no significant results. The insignificance of the non-parametric tests indicates that there are some outliers responsible for the considerable countermovement. These results underpin that it is important to apply statistical tests to check qualitative observations and moreover, to apply several tests in order to provide a comprehensive picture.

D. *Results for Outlook Changes*

D.1. Negative Rating Outlook

Besides rating changes and watchlisting for possible changes, we can also distinguish a third type of rating event: changes in the rating outlook. One could consider the outlook as part of the rating, which implies a finer rating scale, but the outlooks can provide a special type of information. In order to provide a comprehensive and detailed picture, we consider outlook changes separated from "normal" rating changes. As for watchlistings, one may argue that markets are forewarned of possible rating changes (in the narrow sense) by changes in the outlook, and for this reason the markets anticipate the rating change. However, for negative outlook changes we also find negative abnormal holding-period-returns and an increase in spreads of redemption yields in the pre-event periods. Again, the larger part of the price reaction takes place before the rating event. We have an average change for our holding period returns of about -32.5bp for the 30-day period before the announcement but only an average change in prices for the announcement period of -6.8bp. For the redemption yield spread the change in the 30-day pre-event period is 102.4bp compared to 19.8bp on the event date. During the after-event-period we observe a distinct reverse development for the holding period returns (b1) and also a slight countermovement of the redemption yield spreads (b2).

<Insert Figure 5 here>

These observations are proven to be statistically significant in most cases (see Table AV). On the *announcement date* [0;1] we detect abnormal returns with all applied tests for the redemption yields; for the holding period returns, only the parametric tests show significance, whereas the non-parametric tests provide no evidence of significant changes. Here the information is mostly processed on day [0], whereas on day [1] no significant change occurs. Again, we can observe distinct price reactions for all *pre-event periods*, which are strongly confirmed by all tests for both benchmark terms. For the *after-event-period* we find almost no significance of a continuation of a trend, which fits our qualitative observation in Figure 5. There we see that the trend in the curves is broken, and we even observe a slight reverse movement. However, the statistical evidence for such a countermovement is mixed. We find a reverse reaction for the holding period returns for the window [5;10] proven by the normal t-test and the Wilcoxon-test; for [5;20] it is confirmed by the t-test, but not for the other test.

D.2. Positive Rating Outlook

The most striking difference between the positive and negative outlook changes is that the positive trend (negative trend for the spread) in the curves continuous after the outlook change. However, more importantly in regards to our research question is: statistically significant market movements precede positive rating outlooks in the expected direction. Our results also clearly show that positive rating outlook changes influence market returns. These changes are, however, small in relation to the changes in the pre-event-period. In the 30-day time period [-30;-1] we observe an average change in holding period returns of 19.4bp (b1) and of -39.9bp in redemption yield spread (b2), whereas during the announcement period [0;1] we have an abnormal price reaction of only 2.0bp for b1 and -1.1bp for b2.

<Insert Figure 6 here>

The statistical evidence for the event period is mixed (see Table AVI). We find significant changes for the holding period returns but no significance of the redemption yields for [0;1]. For the pre-event periods we find abnormal price reactions for both holding period returns and redemption yield spreads significant (in most cases); only the Corrado test leads to some exceptions. Only on the day before the announcement of the outlook change we do not find any significance. This indicates that the date itself comes by surprise although the change itself is foreseen, or the information that caused the rating event is processed in advance. For the after-event-periods we also find significant changes in most cases. This confirms the observation that the trend continues – most likely in relation to rating upgrades that follow the outlook change.

III. Conclusion

We analyze the question of whether country ratings of two leading rating agencies, S&P and Moody's, are good indicators of country default risk. We tackle this issue by asking whether the ratings provide new information to the market and lead market changes or whether rating events simply follow market trends. This question is controversially debated in public as well as in scientific literature. Several interesting papers analyze this question by considering the ratings of corporate borrowers and their relation to stock and bond prices, whereas only few papers concentrate on country ratings and government bond market spreads. We contribute to this literature in several ways. *Firstly*, we apply several types of statistical tests, in addition to the t-test typically used in the literature. This accounts for the fact that the data do not fulfill the distributional assumptions required by the t-test. In particular, we apply non-parametric tests, such as the Wilcoxon test and the Corrado test, in addition to the – parametric – t-test and the Modified t-test. *Secondly*, we contribute to the literature by considering not only redemption yields, as it is done in the literature, but by considering holding period returns as well. Since investors in government bonds typically trade these securities actively, the consideration of holding period returns matches the perspective of investors more than redemption yields. Thus, applying both approaches provides a clearer and more comprehensive picture of the information content of market data. Because of the empirically observed features of the holding period return data we apply an ARMA(1,1) framework and account for heteroscedasticity using a GARCH (1,1) model for the volatility. Additionally, we account for time varying beta factors by using the Dynamic Conditional Correlation Model (DCC) of Engle (2002).

Because of these contributions we complement the existing interesting literature by providing a broader and more comprehensive picture of the relation between rating changes and market movements. Additionally, we complement the literature by considering data from a broad country sample with 36 EMBI Bond Indices for a longer time period (from January 1994 to March 2011), i.e. including data from the current financial crisis. In the analysis, we distinguish between several types of rating events. In addition to rating changes in the narrow sense, we also separately consider changes in the rating outlook and in the watchlisting of borrowers.

Our analysis obtains interesting and robust results by using several specifications and test methods. Firstly, rating events are generally anticipated by significant market movement in the expected direction that starts many days or even weeks before the rating event. This holds true for 5 out of 6 types of events: positive or negative rating changes and outlook changes as well as negative wachlistings. The only exceptions are positive watchlistings. All in all, our results provide overwhelming evidence that ratings follow the markets, or ratings process information on country default risk much slower than markets.

On the other hand, markets also show a significant reaction at the announcement date of rating events regardless of the type and in which direction the rating is changed (again for positive watchlistings the results are somewhat mixed). The significant price reaction can be interpreted as evidence that market participants do consider ratings as signals, which provide new information to the market that is not already included in market prices. For positive rating events, in particular rating changes and outlook changes, we observe significant continuation of these trends (this is not the case for positive watchlistings). However, there is also evidence that ratings stimulate overreactions of the markets: several days after the rating announcement we observe a significant reverse market movement, which drives the market prices back to the level observed before the rating event took place. Such reverse movements are especially observed for negative rating events – negative rating changes and watchlistings in particular. Observed overreactions can be interpreted as such: ratings do not only add information to the market but also confuse market participants.

With respect to the strength of the changes, we find the strongest changes for rating changes in the narrow sense, whereas watchlist changes and changes in outlook are related to smaller market movements. When comparing positive and negative rating events, we find that market changes related to negative events are generally much stronger than changes related to the corresponding positive events.

Concerning our research question we can conclude that rating changes are, on average, anticipated by significant changes in market prices, which can be interpreted as evidence that rating agencies follow the market trend, or that they process information that finally leads to the rating event more slowly than bond markets. Nevertheless, the rating events seem to be considered as an important price signal that stimulates a significant market reaction in most cases (perhaps by confirming the hypothesis of market participants). However, there is also some evidence that (negative) rating events stimulate overreactions of the markets, which the markets correct afterwards.

Figures

Figure 1: Excess Return Rate and Cumulative Yield Spread around the Rating Downgrade

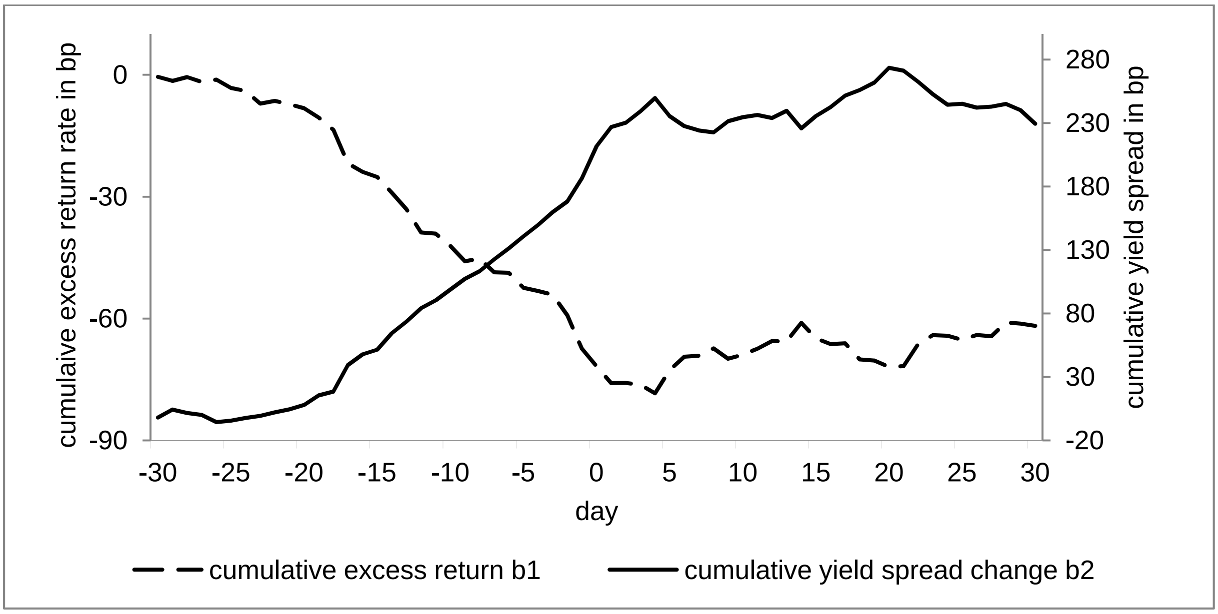


Figure 2: Excess Return Rate and Cumulative Yield Spread around the Rating Upgrade

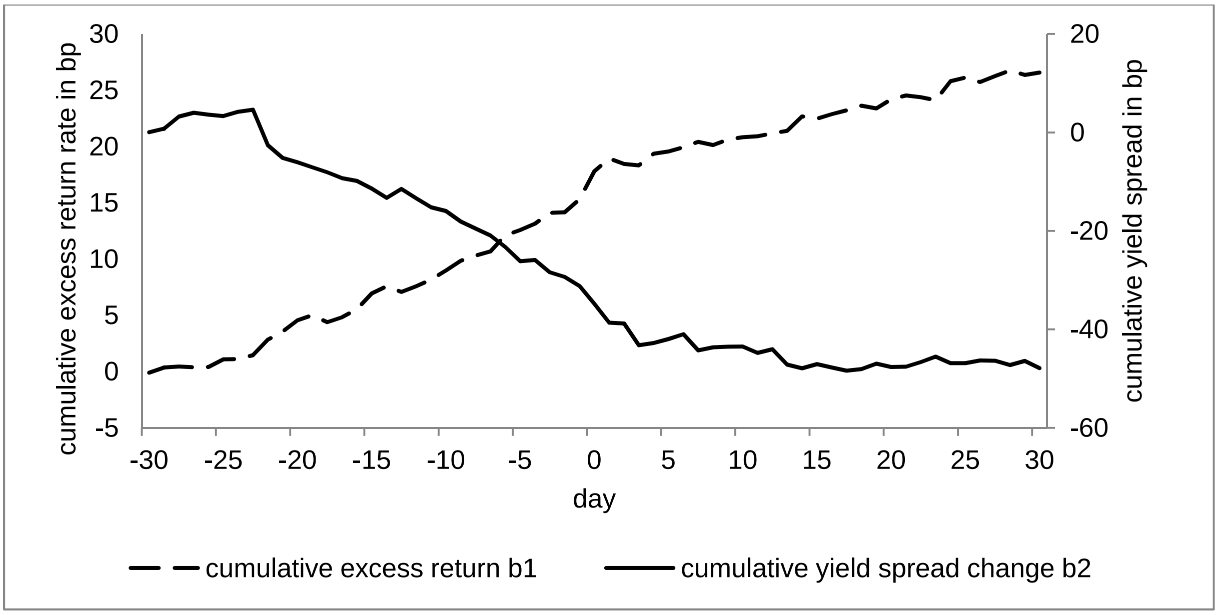


Figure 3: Excess Return Rate and Cumulative Yield Spread around the Negative Watchlisting

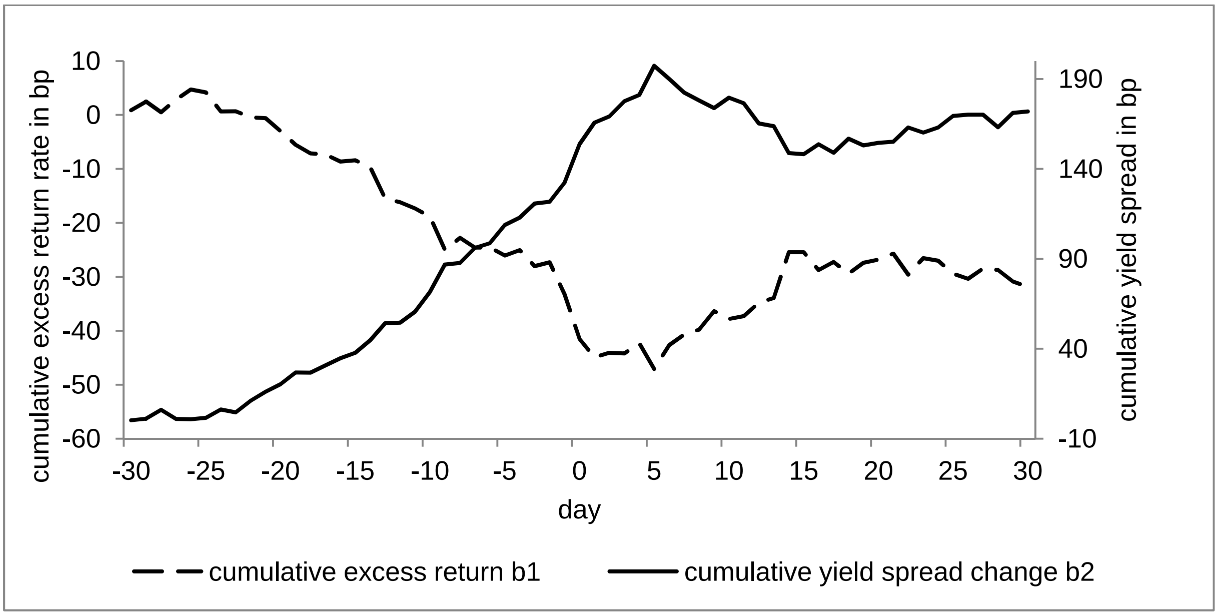


Figure 4: Excess Return Rate and Cumulative Yield Spread around the Positive Watchlisting

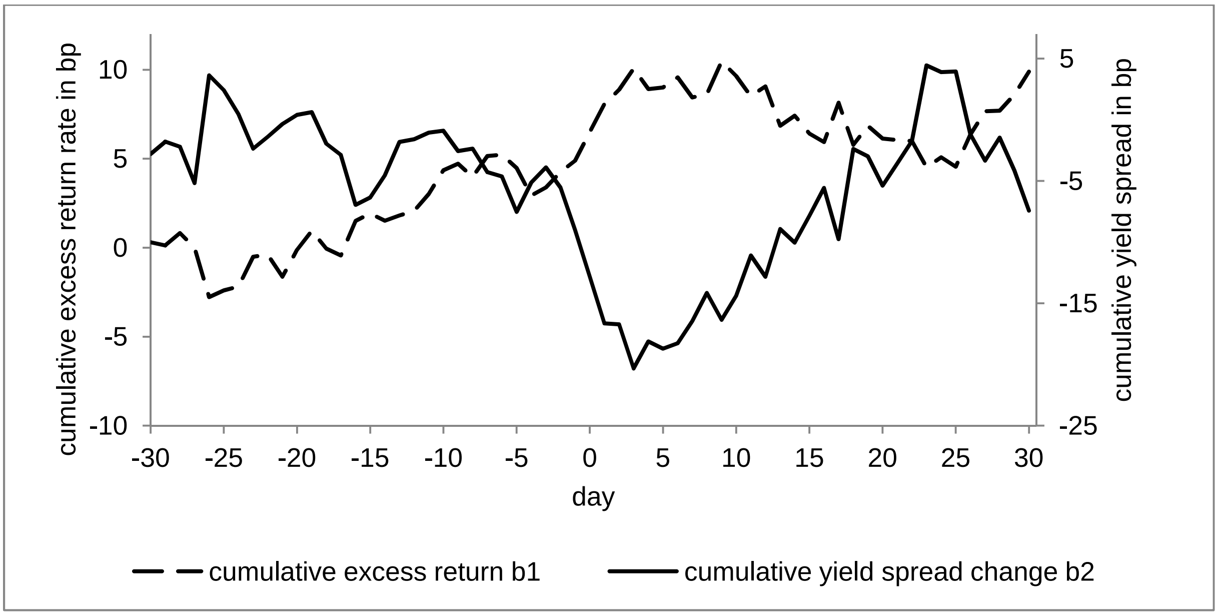


Figure 5: Excess Return Rate and Cumulative Yield Spread around the Negative Rating Outlook

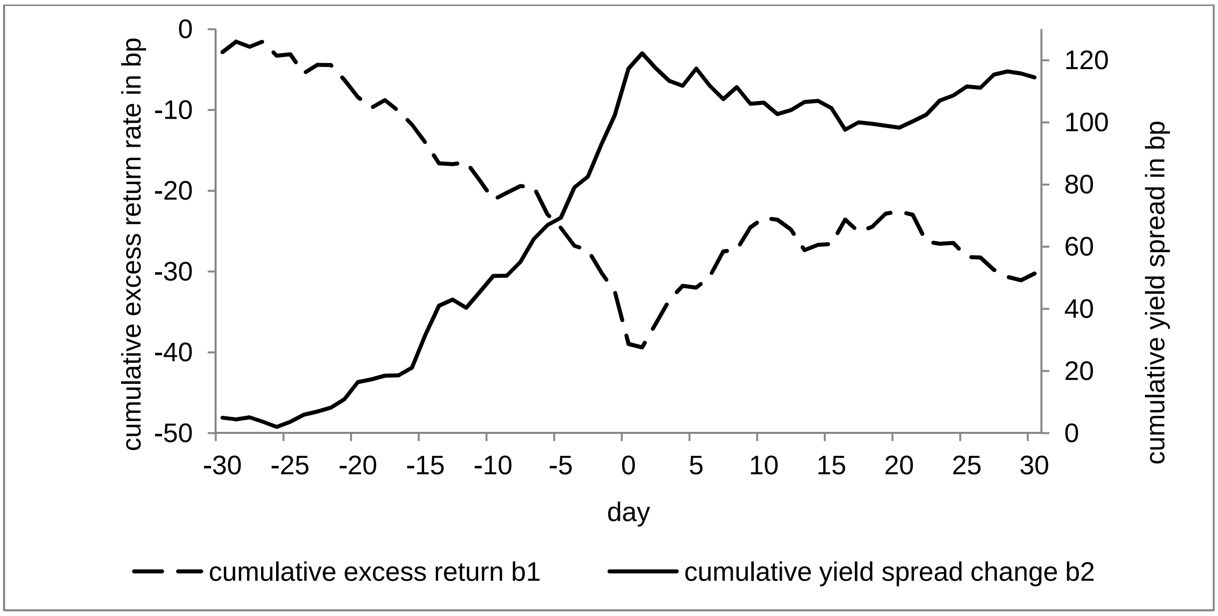
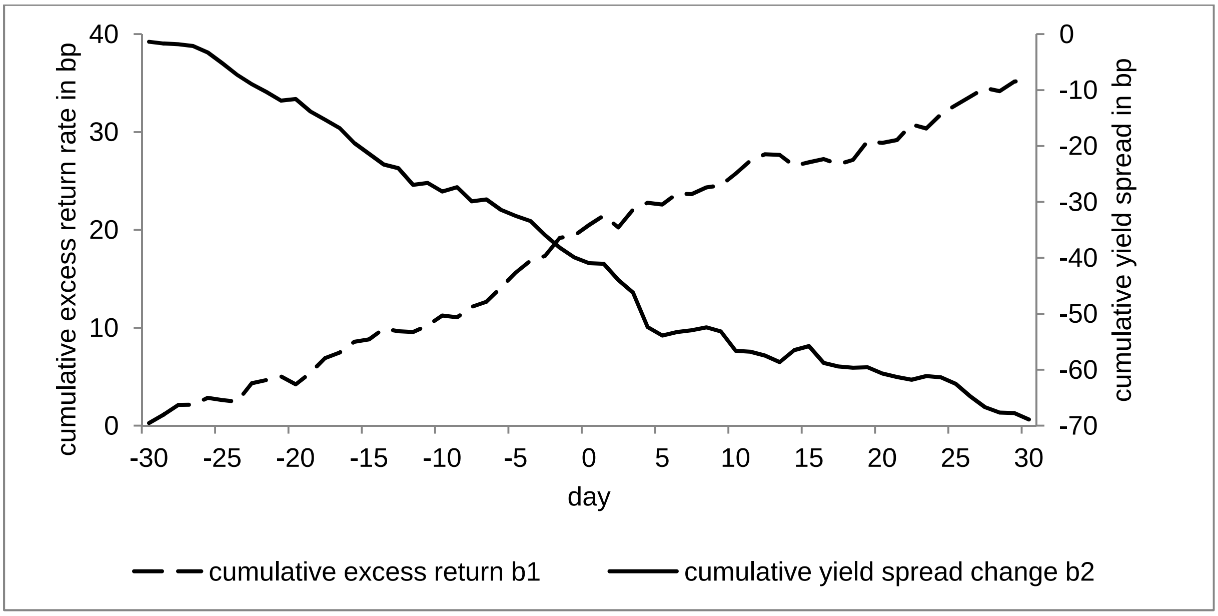


Figure 6: Excess Return Rate and Cumulative Yield Spread around the Positive Rating Outlook



Appendix

Table AI: Test-Results for Rating-Downgrades

Time	Holding Period Returns				Redemption Yield Spreads			
	Test 1	Test 2	Test 3	Test 4	Test 1	Test 2	Test 3	Test 4
-1	-2.41**	-3.71***	-1.87*	-2.3**	1.56	x	2.11**	1.71*
0	-1.42	-2.74***	-2.35**	-3.03***	2.53**	x	3.69***	3.89***
1	-1.63	-6.05***	-1.41	-2.21**	2.62***	x	3.2***	2.9***
[0;1]	-2.09**	-6.07***	-2.62***	-3.71***	3.46***	x	3.99***	4.8***
[-30;-1]	-5.63***	-6.63***	-3.9***	-4.6***	5.51***	x	4.88***	5.88***
[-10;-1]	-3.82***	-4.71***	-2.74***	-2.14**	4.47***	x	3.72***	4.08***
[-5;-1]	-3.68***	-4.63***	-2.4**	-2.57**	3.61***	x	2.71***	3.83***
[0;5]	-1.08	-3.35***	-1.41	-0.42	2.58**	x	3.13***	2.41**
[0;10]	-0.34	-2.82***	-0.49	0.44	2.23**	x	2.59***	1.88*
[0;30]	0.3	-1.09	0.17	1.95*	1.47	x	1.35	0.64
[5;10]	1.95*	0.38	2.12**	2.21**	-1.04	x	-0.41	-0.55
[5;15]	1.99**	0.46	2.64***	1.81*	-0.71	x	-0.76	0.07
[5;20]	0.92	-0.37	1.41	2**	0.74	x	0.41	-0.17
[5;25]	1.52	0.38	2.03**	2.71***	-0.15	x	-0.53	-0.84
[5;30]	1.76*	0.87	2.03**	3.23***	-0.55	x	-0.44	-0.88
[10;20]	-0.29	-1.12	0.59	0.56	1.78*	x	0.62	0.19
[10;30]	0.93	0.43	1.7*	1.68*	0.11	x	-0.14	-0.44
[15;30]	0.43	0.29	1.37	2.24**	-0.09	x	0.06	-0.93

Test 1 is the t-test, Test 2 is the modified t-test, Test 3 is the Wilcoxon-test, and Test 4 is the Corrado-test.

Time means the dates/intervals before or after the rating events.

*/**/*** means significant at the 10%/5%/1% level.

Table AII: Test-Results for Rating-Upgrades

Time	Holding Period Returns				Redemption Yield Spreads			
	Test 1	**Test 2**	**Test 3**	**Test 4**	**Test 1**	**Test 2**	**Test 3**	**Test 4**
-1	2.19**	2.31**	2.62***	1.58	-1.25	x	-1.33	-0.91
0	4.9***	7.14***	5.19***	4.93***	-3.06***	x	-4.78***	-3.86***
1	2.3**	2.77***	1.58	0.25	-1.45	x	-0.57	-0.22
[0;1]	4.99***	6.98***	5.02***	3.66***	-2.51**	x	-4.07***	-2.89***
[-30;-1]	5.35***	5.36***	5.11***	1.3	-3.23***	x	-4.08***	-1.38
[-10;-1]	4.51***	4.31***	4.76***	1.03	-3.75***	x	-3.87***	-2.05**
[-5;-1]	2.82***	3.81***	3.3***	1.03	-2.7***	x	-2.97***	-0.98
[0;5]	3.44***	4.46***	4.26***	1.49	-1.78*	x	-2.77***	0.2
[0;10]	3.76***	4.14***	4.28***	0.28	-1.94*	x	-1.68*	0.96
[0;30]	3.86***	5.01***	4.33***	-1.08	-1.55	x	-2.56**	0.9
[5;10]	1.58	1.17	2.13**	-1.13	-0.25	x	0.83	1.64
[5;15]	1.92*	2.23**	2.58***	-1.41	-1.19	x	-0.36	1.23
[5;20]	2.54**	2.28**	3.18***	-1.61	-1.31	x	-0.86	1.29
[5;25]	2.98***	3***	3.14***	-1.62	-0.83	x	-1.45	1.3
[5;30]	2.97***	3.36***	2.94***	-2.12**	-0.92	x	-1.56	1.27
[10;20]	2.09**	2.43**	2.53**	-0.62	-1.18	x	-1.49	0.3
[10;30]	2.67***	2.9***	3.16***	-1.09	-0.81	x	-2.28**	0.36
[15;30]	2.14**	2.63***	2.39**	-1.37	-0.14	x	-2.44**	0.36

Test 1 is the t-test, Test 2 is the modified t-test, Test 3 is the Wilcoxon-test, and Test 4 is the Corrado-test.
Time means the dates/intervals before or after the rating events.
*/**/*** means significant at the 10%/5%/1% level.

Table AIII: Test-Results for Negative Watchlistings

Time	Holding Period Returns				Redemption Yield Spreads			
	Test 1	**Test 2**	**Test 3**	**Test 4**	**Test 1**	**Test 2**	**Test 3**	**Test 4**
-1	-4.13***	-4.62***	-1.05	-1.2	3.73***	x	1.12	1.13
0	-4.89***	-5.08***	-2.73***	-2.54**	6.19***	x	3.77***	3.99***
1	-2.2**	-0.86	0.41	-0.11	3.55***	x	1.73*	1.68*
[0;1]	-4.73***	-4.2***	-1.84*	-1.87*	5.49***	x	3.22***	4.01***
[-30;-1]	-6.23***	-6.29***	-3.48***	-3.91***	7.59***	x	4.81***	4.95***
[-10;-1]	-4.55***	-4.76***	-2.43**	-2.37**	5.97***	x	3.49***	3.94***
[-5;-1]	-3.25***	-3.97***	-1.19	-1.76*	4.74***	x	2.37**	3.15***
[0;5]	-3.62***	-3.34***	-1.8*	-0.28	5.6***	x	2.87***	2.57**
[0;10]	-1.09	-1.14	-0.26	0.66	4.11***	x	1.84*	1.35
[0;30]	0.06	-0.96	0.48	2.01**	2.58**	x	1.23	0.06
[5;10]	1.96*	0.87	1.33	2.24**	-0.14	x	-0.45	-1
[5;15]	3.85***	1.88*	2.56**	3.08***	-3.06***	x	-1.29	-2.02**
[5;20]	3.7***	1.39	2.33**	2.63***	-2.45**	x	-1.25	-1.64
[5;25]	2.14**	0.86	1.63	2.31**	-0.8	x	-0.65	-1.4
[5;30]	1.35	0.2	1.63	2.68***	-0.53	x	-0.52	-1.44
[10;20]	2.46**	0.73	1.75*	1.54	-1.66*	x	-0.83	-0.89
[10;30]	0.57	-0.38	0.93	1.58	-0.1	x	0.04	-0.74
[15;30]	-1.13	-1.13	0.44	0.76	2.2**	x	0.38	0.02

Test 1 is the t-test, Test 2 is the modified t-test, Test 3 is the Wilcoxon-test, and Test 4 is the Corrado-test.

Time means the dates/intervals before or after the rating events.

*/**/*** means significant at the 10%/5%/1% level.

Table AIV: Test-Results for Positive Watchlistings

Time	Holding Period Returns				Redemption Yield Spreads			
	Test 1	Test 2	Test 3	Test 4	Test 1	Test 2	Test 3	Test 4
-1	0.54	-0.63	0.83	-0.11	-1.71*	x	-1.22	-0.54
0	2.62***	2.71***	1.09	0.81	-1.85*	x	-0.43	-0.01
1	1.89*	3.81***	2.55**	3***	-2.61**	x	-1.44	-1.48
[0;1]	3.24***	4.55***	2.72***	2.69***	-3.2***	x	-2.09**	-1.05
[-30;-1]	1.37	1.93*	0.67	1.28	-1.2	x	-1.03	-1.02
[-10;-1]	0.98	1.61	1.67*	1.55	-1.43	x	-1.29	-1.3
[-5;-1]	-0.14	0.65	1.61	0.94	-1.08	x	-1.46	-1.46
[0;5]	2.77***	3.13***	2.25**	0.84	-3.23***	x	-2.36**	-1.18
[0;10]	2.82***	3.45***	1.67*	0.85	-1.7*	x	-1.32	-0.37
[0;30]	1.16	2.53**	2.43**	-0.53	0.13	x	-1.58	-0.12
[5;10]	0.57	1.8*	0.85	0.25	1.94*	x	0.74	0.43
[5;15]	-0.94	1.57	0.57	-0.81	1.85*	x	0	0.86
[5;20]	-0.8	1.36	1.27	-0.86	1.59	x	-0.25	0.35
[5;25]	-1.05	0.93	1.17	-1.21	2.04**	x	-0.59	0.51
[5;30]	0.22	1.38	1.89*	-1.12	1.06	x	-1.41	0.35
[10;20]	-1.31	0.16	0.7	-1.04	1.55	x	-0.03	0.06
[10;30]	-0.16	0.38	1.67*	-1.17	0.97	x	-1.24	0.09
[15;30]	1.53	0.55	1.76*	-0.77	0.09	x	-0.77	-0.28

Test 1 is the t-test, Test 2 is the modified t-test, Test 3 is the Wilcoxon-test, and Test 4 is the Corrado-test.

Time means the dates/intervals before or after the rating events.

*/**/*** means significant at the 10%/5%/1% level.

Table AV: Test-Results for Negative Rating Outlooks

Time	Holding Period Returns				Redemption Yield Spreads			
	Test 1	**Test 2**	**Test 3**	**Test 4**	**Test 1**	**Test 2**	**Test 3**	**Test 4**
-1	-1.7*	-1.36	-0.12	-0.46	2.46**	x	1.54	1.79*
0	-2.57**	-3.59***	-1.09	-1.78*	3.33***	x	3.09***	3.43***
1	-0.26	0.13	0.73	1	1.53	x	0.5	-0.33
[0;1]	-2.18**	-2.45**	-0.69	-0.54	3.41***	x	3.37***	2.19**
[-30;-1]	-4.24***	-5.62***	-2.63***	-3.52***	5.13***	x	4.39***	5.68***
[-10;-1]	-2.81***	-4.76***	-2.03**	-3.45***	3.95***	x	3.15***	4.59***
[-5;-1]	-3.25***	-3.77***	-1.88*	-2.98***	3.71***	x	3.33***	3.94***
[0;5]	0.02	-0.57	0.54	0.71	1.65	x	1.77*	0.34
[0;10]	1.73*	0.43	1.57	0.94	0.4	x	0.96	-0.29
[0;30]	0.27	-2.49**	-0.22	-0.34	0.6	x	1.55	-0.28
[5;10]	2.87***	0.92	2.15**	0.35	-0.74	x	0.31	-0.76
[5;15]	1.48	-0.74	0.91	-0.68	-0.74	x	0.56	-0.52
[5;20]	1.86*	-1.11	0.62	-0.5	-1.03	x	0.78	0.07
[5;25]	0.66	-2.4**	-0.12	-1.4	-0.06	x	1.29	0.26
[5;30]	0.27	-2.6**	-0.23	-0.91	0.11	x	1.22	-0.53
[10;20]	0.47	-1.86*	0.24	-0.81	-0.78	x	0.39	0.6
[10;30]	-0.84	-2.7***	-0.67	-1.05	0.53	x	0.93	0.01
[15;30]	-0.6	-2.71***	-0.39	-0.31	0.85	x	0.52	-0.43

Test 1 is the t-test, Test 2 is the modified t-test, Test 3 is the Wilcoxon-test, and Test 4 is the Corrado-test.
Time means the dates/intervals before or after the rating events.
*/**/*** means significant at the 10%/5%/1% level.

Table AVI: Test-Results for Positive Rating Outlooks

Time	Holding Period Returns				Redemption Yield Spreads			
	Test 1	Test 2	Test 3	Test 4	Test 1	Test 2	Test 3	Test 4
-1	0.25	0.78	1.47	-0.06	-1.37	x	-1.78*	-0.64
0	2.27**	3.63***	4.07***	3.28***	-1.13	x	-2.2**	-1.56
1	0.96	1.15	1.48	0.56	-0.07	x	-0.79	-0.41
[0;1]	1.81*	3.37***	3.41***	2.72***	-0.65	x	-1.51	-1.4
[-30;-1]	4.2***	6.1***	5.24***	1.33	-6.06***	x	-6.04***	-2.74***
[-10;-1]	3.62***	4.35***	4.97***	1.55	-3.8***	x	-3.47***	-0.83
[-5;-1]	3.36***	3.18***	4.32***	1.79*	-3.13***	x	-1.97**	-0.91
[0;5]	1.47	4.01***	3.54***	2.1**	-2.41**	x	-2.96***	-1.9*
[0;10]	2.22**	4.33***	3.22***	1.64	-2.19**	x	-2.48**	-0.87
[0;30]	4.24***	5.5***	5.05***	1.14	-3.2***	x	-3.73***	-0.69
[5;10]	1.9*	2.1**	2.09**	0.1	-1.22	x	-1.6	0.73
[5;15]	1.83*	2.07**	2.22**	-0.16	-0.81	x	-1.2	0
[5;20]	2.11**	2.92***	2.86***	-0.79	-1.7*	x	-1.9*	0.45
[5;25]	3.15***	3.95***	3.85***	-0.05	-1.98**	x	-2.55**	0.19
[5;30]	3.74***	4.19***	4.41***	0.26	-2.8***	x	-3.21***	0.18
[10;20]	1.82*	2.38**	2.73***	-0.71	-1.88*	x	-2.2**	0.09
[10;30]	3.66***	3.15***	4.29***	0.2	-2.97***	x	-3.18***	-0.1
[15;30]	3.6***	3.64***	4.06***	0.62	-3.1***	x	-3.5***	-0.08

Test 1 is the t-test, Test 2 is the modified t-test, Test 3 is the Wilcoxon-test, and Test 4 is the Corrado-test.
Time means the dates/intervals before or after the rating events.
*/**/*** means significant at the 10%/5%/1% level.

References

Afonso, A., 2002. Understanding the Determinants of Government Debt Ratings: Evidence for the Two Leading Agencies. Unpublished working paper. Technical University of Lisbon.

Brooks, R., Faff, R.W., Hillier, D., Hillier; J., 2004. The National Market Impact of Sovereign Rating Changes. Journal of Banking and Finance 28, 233-250.

Cantor, R., Packer, F., 1996. Determinants and Impact of Sovereign Credit Ratings. Economic Policy Review 2, 37-52.

Cavanagh, J., Long, R., 1999. Introducing the J.P. Morgan Emerging Markets Bond Index Global (EMBI Global). J.P. Morgan Securities Inc., New York.

Corrado, C. J., 1989. A Nonparametric Test for Abnormal Security Price Performance in Event Studies. Journal of Financial Economics 23, 385-395.

Dichev, I. D., Piotroski, J. D., 2001. The Long-Run Stock Returns Following Bond Ratings Changes. Journal of Finance 56, 173-203.

Engle, R. F., Granger, C. W. J., 1987. Co-integration and Error Correction: Representation, Estimation, and Testing. Econometrica 55, 251-76.

Engle, R. F., 2002. Dynamic Conditional Correlation: A Simple Class of Multivariate Generalized Autoregressive Conditional Heteroskedasticity Models. Journal of Business and Economic Statistics 20, 339-350.

Fender, I., Hayo, B., Neukirch, M. 2012. Daily Pricing of Emerging Market Sovereign CDS before and during the Global Financial Crisis. Journal of Banking and Finance (in press, online available since July 2012).

Ferreira, M.A. Gama, P.M., 2007. Does Sovereign Debt Ratings News Spillover to International Stock Markets?. Journal of Banking and Finance 31, 3162-3182.

Goh, J. C., Ederington, L. H., 1993. Is a Bond Rating Downgrade Bad News, Good News, or No News for Stockholders?. Journal of Finance 48, 2001-2008.

Gonzalez-Rozada, M., Yeyati, E. L., 2008. Global Factors and Emerging Market Spreads. The Economic Journal 118, 1917-1936.

Griffin, P. A., Sanvicente, A. Z., 1982. Common Stock Returns and Rating Changes: A Methodological Comparison. Journal of Finance 37, 103-119.

Güttler, A., Wahrenburg, M., 2007. The Adjustment of Credit Ratings in Advance of Defaults. Journal of Banking and Finance 31, 751-767.

Hand, J. R. M., Holthausen, R. W., Leftwitch, R. W., 1992. The Effect of Bond Rating Agency Announcements on Bond and Stock Pricing. Journal of Finance 47, 733-752.

Hite, G., Warga, A., 1997. The Effect of Bond Rating Changes on Bond Price Performance. Financial Analysts Journal 53, 35-51.

Holthausen, R. W., Leftwich, R. W., 1986. The Effect of Bond Rating Changes on Common Stock Prices. Journal of Financial Economics 17, 57-89.

Hull, J., Predescu, M., White, A., 2004. The Relationship between Credit Default Swap Spreads, Bond Yields and Credit Rating Announcements. Journal of Banking and Finance 28, 2798-2811.

Ismailescu, I., Hossein, K., 2010. The Reaction of Emerging Market Credit Default Swap Spread to Sovereign Credit Rating Changes. Journal of Banking and Finance 34, 2861-2873.

Kaminsky, G., Schmukler, S., 2001. Emerging Markets Instability: Do Sovereign Ratings Affect Country Risk and Stock Returns?. Policy Research Working Paper Series from The World Bank no 2678.

Kliger, D., Sarig, O., 2000. The Information Value of Bond Ratings. Journal of Finance 55, 2879-2902.

Larraín, G., Reisen, H., von Maltzan, J., 1997. Emerging Market Risk and Sovereign Credit Ratings. Unpublished working paper, OECD, Development Centre.

Markowski, C. A., Markowski, E. P., 1990. Conditions for the Effectiveness of a Preliminary Test of Variance. The American Statistician 44, 322-326.

Mulder, C. B., Perrelli, R., 2001. Foreign Currency Credit Ratings for Emerging Market Economies. Unpublished working paper, International Monetary Fund.

Odders-White, E. R., Ready, M. J., 2006. Credit Ratings and Stock Liquidity. The Review of Financial Studies 19, 119-157.

Pinches, G. E., Singleton, J. C., 1978. The Adjustment of Stock Prices to Bond Rating Changes. Journal of Finance 33, 29-44.

Reinhart, C., 2002. Sovereign Credit Ratings Before and After Financial Crises. Unpublished working paper, University Library of Munich.

Reisen, H., von Maltzan, J., 1999. Boom and Bust and Sovereign Ratings. International Finance 2, 273-293.

Rowland, P., Torres, J. L., 2004. Determinants of Spread and Creditworthiness for Emerging Market Sovereign Debt: A Panel Data Study. Unpublished working paper, Banco de la Republica de Colombia.

Rowland, P., 2005. Determinants of Spread, Credit Ratings and Creditworthiness for Emerging Market Sovereign Debt: A Follow-up Study Using Pooled Data Analysis. Unpublished working paper, Banco de la Republica de Colombia.

Sy, A. N. R., 2004. Rating the Rating Agencies: Anticipating Currency Crises or Debt Crises?. Journal of Banking and Finance 28, 2845-2867.

Weinstein, M. I., 1977. The effect of a rating change announcement on bond price. Journal of Financial Economics 5, 329-350.

Wilcoxon, F., 1945. Individual Comparisons by Ranking. Biometrics 1, 80-83.