

EVENT STUDY CONCERNING INTERNATIONAL BOND PRICE EFFECTS OF CREDIT RATING ACTIONS

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ABSTRACT

The influence of credit ratings on eurobond prices has been neglected for a long time. It is questionable whether non-US investors relate their investment decisions on US ratings and whether ratings from US agencies are relevant information sources for international capital markets. This paper examines daily excess eurobond returns associated with announcements of watchlistings and rating changes by Standard & Poor's and Moody's. Significant bond price reactions are observed for announcements of downgradings and negative watchlistings while upgradings and positive watchlistings do not cause announcement effects. Distinct from the results on national capital markets the international evidence shows that besides actual yield level and issuer type the issuer nationality is a key factor that determines the intensity of price reactions after downgrades. The price reaction is also significantly stronger for downgrades into speculative grade. This indicates, that the announcement effects can in part be explained by price pressure effects due to regulatory constraints rather than original information content of rating changes. Copyright © 2001 John Wiley & Sons, Ltd.

KEY WORDS: credit rating; downgrade; eurobond; event study; international market; watchlisting

1. INTRODUCTION

This paper examines daily excess eurobond returns driven by two major types of credit rating agency announcements: warnings of possible rating changes (watchlistings) and actual rating changes by Standard & Poor's and Moody's between 1985 and 1996. The effects of these rating actions on national bond prices are well documented, especially in the US.¹ Though older studies question the information content of bond ratings,² later work finds significant bond price reaction associated with rating actions.³ In contrast, international or national non-US bond markets have been neglected in this issue for a long time.⁴ This is astonishing since on the one hand informational asymmetries are expected to be more evident on the international market due to issuer specific differences in language, accounting, publication or regulation. On the other hand it is uncertain, whether eurobond investors outside the US relate their investment decisions on ratings from US agencies. This study augments several shortcomings of similar US studies because it is the first to analyse:

- a large sample of 546 rating changes and 182 watchlistings
- of both Standard & Poor's and Moody's simultaneously,
- on the basis of daily bond price data for the German eurobond market,
- with application of four parametric and non-parametric test statistics,
- and with an investigation of the key factors determining the bond price reaction.

Wansley *et al.* (1992) only use rating changes from Standard & Poor's and weekly bond prices. Hand *et al.* (1992) use only the watchlistings from Standard & Poor's. Thus, they cannot make inferences for

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the informational value of the ratings and the watchlistings from Moody's, respectively. The study of Hite and Warga (1997) does not analyse watchlistings at all. Moreover they only use monthly data which makes it infeasible for them to look at daily market reactions. The results found in this study show that the observation of daily bond prices is elementary for the explanation of the market reactions to rating actions. In contrast to all existing studies we use two parametric and two robust non-parametric test statistics. To our knowledge the Corrado rank sum test has never been used in bond event studies so far.

The following section describes the theory on bond price reactions to rating changes. Besides the pure information content of rating actions there may be several relevant factors that can influence the observable excess returns. We hypothesize that especially regulations may contribute to price pressure initiated by rating changes which would question the original information content of these announcements. Section 3 reports the results of the empirical analysis. We first perform an event study on the interesting announcement events. Univariate tests on a portfolio basis analyse the influence of several hypothesized factors on the measured excess bond return associated with downgradings. Finally, these factors are validated in a cross-sectional regression analysis of the excess bond returns. Concluding remarks are in Section 4.

2. THEORY ON BOND PRICE REACTIONS TO RATING ACTIONS

2.1. Information Content Hypothesis

In an efficient international bond market prices reflect all relevant information in any point of time.⁵ If the international bond market is efficient in the semi-strong form and credit risk is valued, any new information on the credit risk of bonds should result in a bond price reaction. In turn, if rating actions contain valuable and non-public credit information, any announcement of these rating actions should result in a subsequent price change of the respective bond.

Evidence on the informational efficiency of bond markets is mixed. Empirical analyses conjecture, that national bond markets are highly but not completely efficient in the semi-strong form.⁶ Following Solnik (1991) there is little evidence on the efficiency of the international bond markets. It can be stated that the international market as a whole lacks efficiency since not all publicly available information in one national market may also be available for market participants in other national markets. Rating actions concerning international markets may then be informative if they convey information that is publicly available for some but not all market participants.

Under the *information content hypothesis* we expect significant positive bond price reactions on the announcement day of rating actions. The move in price should be permanent, since there is a new risk level associated with a down- or upgraded bond. If the assessment of rating agencies is correct, the price reaction should be stronger the more notches were crossed in case of a rating change. Since we measure price reactions on the basis of daily excess bond returns, there should be no more price moves on the consecutive days unless the market is not efficient.

2.2. Differential Information due to Issuer Type or Rating Competition

Ho and Michaely (1988) demonstrate that if marginal costs of collecting and processing additional public information exceed its marginal benefit to the investor, market prices will not incorporate all publicly available information. If international investors believe that rating agencies can provide information on international issuers at lower cost, the processed information leading to a rating change or watchlisting can constitute new information to the international market.

On this rationale Schweitzer *et al.* (1992) hypothesize that there may be informational differences in the market due to the regulatory environment of some issuers. They argue that banks are closely monitored by regulatory institutions and thus there is more processed credit information available in contrast to non-monitored issuers. If issuing banks in the international market work in a more regulated national environment, the *issuer hypothesis* states a stronger price move after rating actions compared to non-banks.

The observable price reaction on a rating announcement can also be influenced by preceding rating actions of the same or the competing rating agency. If the market always expects the agency to change the rating once the title is set on watchlist, the respective information is already conveyed in the announcement of the watchlisting and there is no more information in the rating change itself.⁷ Under the *competition hypothesis* the excess bond return associated with rating changes is expected to be lower, if the bond has previously been watchlisted or changed in rating by the same or the competing rating agency.

2.3. Differential Information due to Issuer Nationality or Agency Reliability

Agency theory analyses the financial relationship between lender and borrower under existence of asymmetric information. Ratings are proposed to mitigate agency problems by fulfilling a quality revelation function and a certification function.⁸ Credit ratings do not only reveal the credit risk of the issuer but they also serve as a certification tool, if there is no moral hazard risk on the side of the rating agency itself. If the latter can not be excluded, new agency problems may emerge.

One possible agency problem between the rating agency and the lender as the user of ratings may be, that the agency minimizes its costs instead of maximizing rating quality. If US based rating agencies acting on the international market lack the acquisition of knowledge about country-specific credit standards, then ratings of non-US bonds can be expected to be less informative than ratings of US bonds. Chamberlain *et al.* (1995) analyse this aspect for the Value Line Ranking System. They find a systematic superiority in the performance assessment of US stocks in comparison to non-US stocks. They argue 'that Value Line, like most members of the US investment community, is not particularly familiar with the primary markets for most foreign stocks'. Possible explanations are difficulties in estimating political risks, lack of access to information sources, institutional and cultural differences and problems with the reliance on US-GAAP for the valuation of non-US firms. If the *nationality hypothesis* is true for the international bond market, rating changes for US issuers convey more information and thus cause a stronger price reaction than for non-US issuers.

Another possible moral hazard risk on behalf of the rating agency might be a systematic overrating of the issuer in order to gain market share or keep the rating mandate. This quality reduction should dampen the reliability of the rating agency in the market. Rating actions of this rating agency would in turn not cause price movements due to a lack of market following. Empirically, Holthausen and Leftwich (1986) and Hite and Warga (1997) found equal stock price reactions on rating changes from Standard & Poor's and Moody's. There is no reason to believe that there are reliability differences in the international bond ratings between Standard & Poor's and Moody's. Thus, under the *reliability hypothesis*, we expect the excess bond returns associated with rating actions to be independent of the announcing rating agency.

2.4. Price Pressure due to Institutional Regulation

As ratings have gained greater acceptance in national bond markets, regulators and institutions have increasingly used ratings to simplify the task of prudential oversight. The first and most common use of ratings in investment restrictions, capital requirements or disclosure requirements is the distinction between investment grade securities and speculative securities.⁹ These regulatory uses can influence the observable excess bond return following a bond rating change even if there is no 'original' information content in the change.¹⁰ This is a possible explanation for the phenomenon of significant price reactions associated with downgrades while upgrades do not cause any significant effects. Downgrades into the speculative class force institutional bond selling while upgrades do not force buying activities. Empirical evidence on this issue is mixed at best. While regression coefficients in the studies of Holthausen and Leftwich (1986), Cornell *et al.* (1989), Hand *et al.* (1992), Schweitzer *et al.* (1992) and Matolcsy and Lianto (1995) are insignificant, Wansley *et al.* (1992) and Hite and Warga (1997) find a significant influence of this rating border.

If the *price pressure hypothesis* is true, we expect a significant stronger price reaction if the rating change crosses the border line between investment and speculative grade bonds. This hypothesis is contrary to the information content hypothesis because price effects are explained by regulation constraints and not necessarily by the informational value of ratings.

3. EMPIRICAL ANALYSIS OF GERMAN EUROBOND PRICES

3.1. Data and Descriptives

The sample of actual rating change announcements consists of bond rating changes by Standard & Poor's and Moody's during the period March 1984–December 1996. The announcement dates (day 0) were supplied by the agencies.¹¹ Only rating changes for plain vanilla bonds are included in the study (i.e. floating rate notes, convertible debt, index and currency bonds are excluded). To diminish the problem of event date clustering we restricted the number of bonds of an issuer per announcement date: no issuer has more than one bond per announcement day in the sample. The sample includes only bonds that have prices both before and after the announcement dates. These restrictions result in a sample of 546 rating changes starting on 21 June 1985 until 23 December 1996. Table 1 shows the distribution of differences between the original and the revised rating categories.

Grades is a variable that measures the number of rating categories changed. Therefore the ratings were transformed into cardinal variables on a scale of 1 (for rating AAA resp. Aaa) to 15 (for rating B resp. B2). There are 356 downgrades and only 190 upgrades. This documents the general increase of credit risk in the German eurobond market.

Daily bond prices and issue characteristics were obtained from the German Finance Database (DFDB) and Euromoney Bondware. We use trader quotes from the market making bookrunners of the eurobonds. Traders have a strong incentive to provide accurate bid quotes. If the rating actions announced are a valuable information for the eurobond market traders will take this into account in their quoted bid prices. Thus observed prices should be affected even if there is no positive trading volume.¹² The rating changes affect 216 international bonds issued by 111 issuers. Descriptive statistics for the bonds are summarized in Table 2. Rating changes are distributed roughly equally on both rating agencies. We isolated the rating induced price effect by determining a duration equivalent government bond ('Bund') for each of the affected bonds. By this we can control for variations in term structure. To accomplish this we matched for an appropriate equivalency in the remaining maturity on the announcement date and the original coupon. Since no perfect matching was possible we accepted a mean difference in maturity (coupon) of 14.4 trading days (0.15%).

The default free yield to maturity in Table 2 is the yield to maturity of the duration equivalent government bond ('Bund') on the announcement day of the rating change. This variable captures the state of the business cycle at the time of the change. Since the level of yield spreads is also influenced by the yield level of riskless securities, the significance of measured excess bond returns can also vary over time.¹³ Most event studies do not address this issue.¹⁴ The sample in this study spans over a time period with varying economic conditions and can thus control for this effect. Maturity (years) shows the remaining maturity on the announcement day of the rating change in years. The sample is tabled for issuer nationality and issuer type to test the nationality hypothesis and the issuer hypothesis. IGSG crossing is a dummy variable that has the value 1 if the rating change crosses the border from investment grade to/from speculative grade, and the value 0 otherwise.

Table 1. Distribution of rating changes 1985 until 1996

Grades	Upgrades	Downgrades	Total
1	163	243	407
2	21	96	119
3	1	7	11
4	4	3	11
5	1	1	7
6	—	4	10
7	—	2	9
Total	190	356	546

Table 2. Descriptive statistics for bonds with rating changes

Variable	Downgrades ($N = 356$)				Upgrades ($N = 190$)			
	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max
Default free yield to maturity (%)	7.39	2.01	3.33	14.60	6.86	1.97	3.25	11.06
Maturity (years)	4.41	2.48	0.30	22.88	3.42	2.34	0.24	10.66
Coupon (%)	7.20	1.54	5.00	11.00	6.82	1.04	4.75	10.50
US issuer			81 (22.75%)				100 (52.63%)	
Supranational			5 (1.40%)				5 (2.63%)	
Governments			95 (26.69%)				54 (28.42%)	
Banks			141 (39.61%)				24 (12.63%)	
Corporations			108 (30.34%)				104 (54.74%)	
Utilities			7 (1.97%)				1 (0.53%)	
IGSG crossing	Yes: 35 (9.83%)		No: 321 (90.17%)		Yes: 24 (12.63%)		No: 165 (86.84%)	
Agency	Moody's: 186		Standard & Poor's: 170		Moody's: 100		Standard & Poor's: 90	

3.2. Measurement of Excess Bond Returns

Excess or abnormal returns are calculated from trading day -180 to day $+180$. The starting point is the calculation of holding period returns for each trading day. Older event studies like Katz (1974), Hetttenhouse and Sartoris (1976) and Ingram *et al.* (1983) use yield to maturity, while later work like Hand *et al.* (1992), Hawley and Walker (1992), Wansley *et al.* (1992), Hite and Warga (1997) also calculate holding period returns.¹⁵

Daily holding period returns are calculated by:

$$R_{it} = \ln\left(\frac{F_{it}}{F_{it-1}}\right) \quad \text{and} \quad F_{it} = K_{it} + \frac{C_i}{365} V_i \quad (1)$$

where R_{it} is the holding period return of bond i between closing day $t-1$ to closing day t , F_{it} is the flat price of bond i at day t , C_i is the coupon payment paid to holders of bond i , K_{it} is the closing day price of bond i at day t , and V_i is the number of days elapsed since the last coupon payment of bond i .¹⁶

The abnormal return associated with the rating action of interest is calculated as the difference between the bond's return and the return of the benchmark:

$$AR_{it} = R_{it} - R_{Bt} \quad (2)$$

where R_{Bt} is the holding period return of the benchmark bond between closing day $t-1$ to closing day t , and AR_{it} is the abnormal return of bond i between closing day $t-1$ to closing day t .

This eliminates the influence of daily changes in the expectations of real rates of inflation and of daily changes in the form of the yield curve. Holding period returns of the benchmark bonds are also calculated using (1). To eliminate the influence of estimation errors we calculate mean abnormal returns and cumulative mean abnormal returns for the whole sample and for specific portfolios:¹⁷

$$DAR_t = \frac{1}{N} \sum_{i=1}^N AR_{it} \quad \text{and} \quad CDAR_{km} = \sum_{i=k}^m \frac{1}{N} \sum_{i=1}^N AR_{it} \quad (3)$$

where DAR_t is the mean abnormal return at day t , N is the number of observations in the portfolio, $CDAR_{km}$ is the cumulative mean abnormal return between day $t=k$ and day $t=m$.

For the statistical testing of significant non-zero abnormal returns we utilize four different test statistics. While most studies only use simple t-tests or Wilcoxon's sign rank test we also perform the t -test of Brown and Warner (1985) and the rank sum test of Corrado (1989). To our knowledge the latter statistic has not been used in bond event studies so far. Both parametric tests rely on the assumption of normal

Table 3. Abnormal returns and test statistics for rating changes

Day resp. period	Downgrades (N = 356)				Upgrades (N = 190)					
	DAR, resp. CDAR _{ken}	Percent positive ^a	t-Test ^b	t _{BW} -Test ^c	z _C -Test ^d	DAR, resp. CDAR _{ken}	Percent positive ^a	t-Test ^b	t _{BW} -Test ^b	z _C -Test ^d
-180 to -31	-0.802	44.66**	-3.70**	-3.02**	-1.56	1.219	64.74**	5.12**	3.65**	0.82
-30 to -11	-0.403	43.26**	-3.49**	-5.20**	-1.68	0.366	64.21**	4.40**	3.16**	1.88
-10	-0.011	50.56	-0.48	-0.60	0.21	0.0004	53.68	0.02	0.18	0.40
-9	-0.034	52.53	-0.66	0.70	0.53	-0.030	48.42	-1.17	-1.42	-0.74
-8	-0.050	48.31	-1.83	-0.72	-0.48	0.008	48.42	0.31	0.58	-0.39
-7	0.016	49.44	0.72	2.98**	-0.17	0.004	48.42	0.18	0.08	-0.39
-6	0.004	52.25	0.15	0.71	0.15	0.038	56.84*	1.78	1.24	1.69
-5	-0.011	48.60	-0.38	0.35	-0.43	0.004	48.95	0.14	-0.13	-0.52
-4	-0.055	46.63*	-1.91	-3.83**	-1.61	-0.014	45.79	-0.54	-0.73	-1.55
-3	0.006	53.37	0.21	0.49	0.80	0.002	53.16	0.07	-0.26	-0.05
-2	-0.030	52.25	-1.05	0.25	0.40	-0.005	56.32	-0.23	0.41	0.35
-1	-0.011	49.16	-0.41	-0.23	-0.04	0.037	53.63	1.71	1.40	0.63
0	-0.061	43.54**	-2.33*	-3.61**	-2.41*	0.018	51.58	0.69	0.51	-0.11
1	-0.125	37.64**	-5.07**	-8.45**	-5.05**	0.019	51.58	0.71	0.94	0.21
2	-0.046	46.07*	-1.96	-3.76**	-1.45	-0.008	49.47	-0.36	-1.01	-1.49
3	-0.076	43.68**	-2.74**	-3.73**	-2.30*	0.041	50.00	1.56	1.62	0.48
4	-0.056	46.40	-2.33*	-3.23**	-1.56	-0.027	48.65	-1.21	-0.85	-1.11
5	-0.032	51.30	-1.30	-2.18*	0.06	0.041	56.42*	2.14*	1.87	1.27
6	-0.011	52.45	-0.40	1.16	0.04	0.052	55.87*	2.24*	2.00*	1.17
7	-0.020	50.72	-0.87	-0.49	-0.19	0.026	52.51	1.10	0.79	0.51
8	0.004	49.57	0.12	-0.87	-0.18	0.016	51.96	0.67	0.40	0.44
9	0.027	54.34	1.31	1.44	0.78	-0.048	46.37	-2.00*	-2.21*	-1.89
10	0.036	53.76	1.46	1.43	0.75	-0.005	45.25	-0.25	-0.50	-1.70
11 to 30	0.619	58.09**	3.53**	5.86**	3.54**	-0.007	53.07	-0.08	-0.32	-1.12
31 to 180	0.151	63.58**	0.64	1.01	1.92	0.852	78.09**	6.61**	2.08*	-0.91
0 to 1	-0.185	36.24**	-4.56**	-8.52**	-5.28**	0.036	53.16	0.997	0.71	0.07
0 to 5	-0.395	41.47**	-4.95**	-10.18**	-5.17**	0.083	54.74	1.66	1.26	-0.32
-180 to -91	-1.124	49.72	-1.07	-0.33	-0.69	0.431	57.89**	1.85	2.08*	-0.30
-90 to -1	-1.256	41.85**	-5.23**	-6.02**	-2.19*	1.167	76.32**	6.12**	4.27**	2.18*
1 to 90	0.526	55.34**	1.91	3.24**	2.53*	0.385	60.00**	3.17**	1.22	-1.18
91 to 180	-0.081	57.49	-0.39	-1.24	0.62	0.580	67.26**	4.69**	1.65	-0.73
-180 to 180	-0.990	55.34	-3.19**	-2.34*	0.00	2.543	78.42**	7.55**	4.58**	0.00
-30 to 30	-0.335	48.03	-1.52	-2.51*	-0.52	0.526	66.84**	3.90**	2.26*	0.10

^a Wilcoxon sign rank test; ^b simple t-test statistic; ^c Brown and Warner (1985) t-statistic; ^d Corrado (1989) rank sum test.
 * Significant at the 5% level.
 ** Significant at the 1% level.

distribution of returns. The non-parametric Wilcoxon test does not require normality but a symmetric distribution around the median. The Corrado statistic is also correctly specified in case of a skewed distribution. Mathematics of the test statistics can be found in Appendix A.

3.3. Results

3.3.1. Rating Changes. The results for the entire sample of rating changes are shown in Table 3. The left side of the table provides evidence on excess bond returns associated with *downgrade* announcements. The mean abnormal holding period return at day 0 is -0.061% , which is significant in all test statistics used here. Moreover, even on days 1–4 there are significantly negative abnormal returns. The strongest reaction can be seen at day 1. This can be explained by the practice of rating agencies to announce rating actions after closing.

These results support the information content hypothesis of downgradings. They are also in line with Hite and Warga (1997), who find significant US bond price reactions after downgradings. On the other hand Hand *et al.* (1992) find a much stronger price reaction with -1.27% . It has to be mentioned though that in their sample 13 observations show an abnormal return of less than -10% with a minimum of -63.3% .¹⁸ If we exclude all 17 extreme observations with cumulative abnormal returns of less than -1.5% between day 0 and day 1 from our sample, abnormal returns are reduced to -0.03% on day 0 and -0.08% on day 1. Nevertheless all statistics remain significant.¹⁹

Figure 1 shows the development of cumulative returns over the whole period of 361 days. It can be seen very well, that changes in the valuation of downgraded bonds do not only occur on the announcement day and the following days. There are price movements up to 100 trading days before the actual rating change, this results in a significant negative cumulative excess return of -1.256% from day -90 to day -1 . On the whole it can be seen that most of the change in credit risk is already incorporated in prices before the rating change announcement, albeit this announcement itself causes significant short term price reactions. This may lead to the conclusion that rating agencies tend to lag and not to lead the market on the one hand, and they tend to influence the market by their announcements on the other hand. This supports the results found by Reisen and von Maltzan (1999) in their Granger Causality test for the US eurobond market.

It can also be seen from Figure 1 that there are significant positive excess returns between trading day 15 and 21. A possible explanation for this rebound can be found in the overreaction hypothesis first stated by De Bondt and Thaler (1985) for the stock market. Probably investors in the international market first overreact on downgrades and correct this roughly between day 15 and day 45. After this time cumulative excess returns oscillate at a level of -1% . The original price loss has thus been reduced by about the half of its size.

A contrary explanation for the rebound may be the price pressure hypothesis. The fact that price movements induced by the downgrade announcement are only temporary would be supportive for this view. If downgrades were new information for the market there should be a permanent price change to

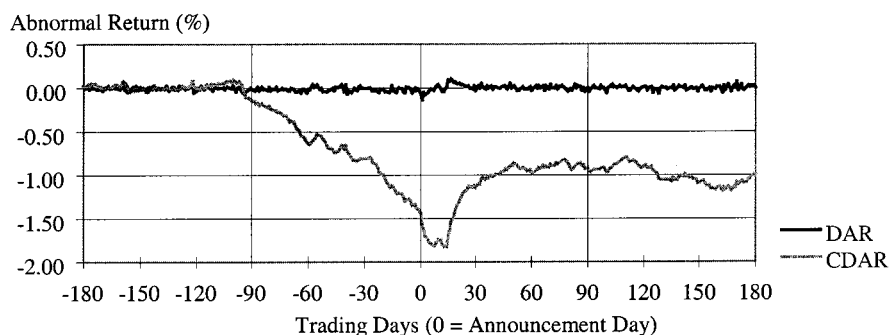


Figure 1. Downgrade abnormal returns over the 361-day window.

the new information price level. Following this view there would be no information content in rating changes. Rating agencies lag the market in announcing downgradings and regulation forces regulated investors to sell the downgraded bonds. Prices rise again when price pressure induced by massive selling is over and non-regulated investors find these bonds undervalued.

Our results are essential for portfolio managers operating in the international bond markets and using credit ratings as investment tools. A selling decision based on a downgrade announcement is suited to avoid losses from credit changes only in the short run. In the long run the investor is better off not to sell the bond on the announcement day because there is a positive cumulative excess return from day 1 to day 90 of 0.526%. The following negative excess return of -0.081% from day 91 to day 180 is insignificant, thus bond prices remain stable.

The results for the announcements of *upgrades* are shown in the right part of Table 3 and in Figure 2. There is no significant excess return in the announcement window from day 0 to day -1 or on other days before or after the change. Only on days 5 and 6 there seems to be a weak positive abnormal return. In contrast to the downgrade analysis there is no significance in the Corrado (1989) rank sum test. Consistent with the former results is the observation of anticipation effects. The total cumulative excess return of 2.543% from day -180 to day 180 is reached by roughly two thirds on day 0. Obviously the rating agencies also lag the market in the announcements of positive rating changes.

Two explanations can be proposed for the asymmetric behaviour of bond prices in reaction to down- and upgrades. Holthausen and Leftwich (1986) state that rating agencies face asymmetric loss functions and that they allocate more resources on revealing negative credit information than on positive ones.²⁰ The reason is that a loss in reputation is more severe when a rating is falsely too high than when it is falsely too low. The other explanation is again price pressure. While downgrades force selling transactions, upgrades do not force buying transactions. Transaction costs rather encumber subsequent buying activities after upgrades.

3.3.2. Watchlistings. A total of 192 rating changes in the former sample were preceded by watchlistings. Requirements of available bond prices for both watchlisted bonds and equivalent benchmarks reduced the number of observations to 182, that can be subdivided into 125 (57) 'possible downgrades' ('possible upgrades'), of which 63 (27) came from Moody's and 62 (20) from Standard & Poor's.²¹

The event study results of the *negative watchlistings* are displayed in the left half of Table 4. There are significant price reactions on trading days 1, 3, 4 and 5. The 6-day cumulative return of -0.3765% from day 0 to day 5 is highly significant in all test statistics used here. This is a strong support for the information content hypothesis of negative watchlistings. Moreover, the information content of negative watchlistings seems to be relatively high, since the international market reacts with a delay of 1 day and over a time of more than one trading day. These results are in line with Liu (1985) and Hand *et al.* (1992) for the US market. The development of cumulative excess returns in Figure 3 shows that there also seem to be less pre-announcement price movements in comparison to rating downgrades.

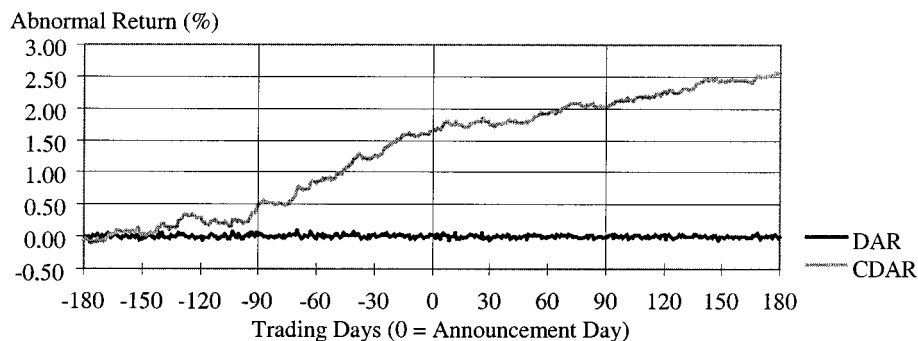


Figure 2. Upgrade abnormal returns over the 361-day window.

Table 4. Abnormal returns and test statistics for watchlistings

Day resp. period	Possible downgrades ($N = 125$)					Possible upgrades ($N = 57$)				
	DAR, resp. CDAR _{km}	Percent positive ^a	t -Test ^b	t_{BW} -Test ^c	z_C -Test ^d	DAR, resp. CDAR _{km}	Percent positive ^a	t -Test ^b	t_{BW} -Test ^c	z_C -Test ^d
-180 to -31	-0.515	54.40	-1.46	-0.20	-1.33	1.575	73.68**	2.93**	3.47**	0.41
-30 to -11	-0.150	46.40	-1.21	-1.40	0.02	0.935	71.93**	3.21**	3.47**	2.72**
-10	-0.037	53.60	-1.10	-1.50	-0.06	0.003	47.37	0.05	-0.10	-0.58
-9	-0.004	52.00	-0.11	-0.11	0.06	0.047	56.14	0.97	0.87	0.41
-8	-0.027	51.20	-0.89	-1.15	-0.04	-0.025	40.35	-0.67	-1.19	-1.25
-7	-0.003	51.20	-0.12	-1.51	-0.20	0.050	49.12	1.02	0.96	-0.01
-6	0.006	48.80	0.17	-0.21	-0.13	-0.039	36.84	-0.75	-1.59	-1.65
-5	0.008	48.80	0.23	0.55	0.36	0.009	36.84	0.24	-0.41	-1.15
-4	-0.074	40.00**	-2.11*	-2.86**	-2.07*	0.037	52.63	0.90	0.53	0.18
-3	-0.057	52.00	-1.94	-2.19*	-0.96	-0.011	45.61	-0.32	-0.09	-0.63
-2	-0.50	52.80	-1.51	-1.27	-0.44	0.059	50.88	1.78	0.98	0.54
-1	-0.059	44.80*	-1.98*	-1.73	-1.79	-0.059	40.35	-1.65	-1.66	-1.88
0	0.048	56.80	2.01*	1.70	1.42	0.024	47.37	0.37	0.86	0.03
1	-0.082	38.40**	-2.87**	-2.98**	-2.30*	0.111	59.65*	1.80	1.88	1.67
2	-0.001	47.20	-0.05	-0.29	-0.56	-0.016	54.39	-0.30	-0.97	-0.21
3	-0.099	43.20**	-3.56**	-3.92**	-2.76**	0.016	50.88	0.32	-0.90	-0.51
4	-0.104	40.00**	-3.20**	-3.72**	-2.18*	0.015	43.86	0.42	0.30	-0.96
5	-0.138	40.80**	-3.26**	-5.38**	-2.47*	0.023	57.89	0.60	0.70	0.45
6	-0.005	47.20	-0.08	0.48	-1.03	0.049	52.63	0.92	0.55	-0.10
7	-0.024	50.40	-0.78	-0.46	-0.44	0.029	63.16*	0.75	0.65	1.30
8	-0.028	45.60	-1.04	-1.35	-0.98	0.019	59.65	0.46	-0.98	0.68
9	0.067	57.60	2.04*	2.67**	1.41	-0.036	49.12	-0.72	-1.40	-0.32
10	0.026	55.20	0.77	-0.28	0.84	0.041	57.89	0.86	-0.28	1.06
11 to 30	-0.102	48.00	-0.95	-0.33	-0.02	0.200	63.16	1.73	1.03	-0.39
31 to 180	0.852	78.09**	6.61**	2.08*	-0.91	0.846	80.70**	3.69**	1.86	-1.02
0 to 1	-0.034	48.00	-0.81	-0.91	-0.62	0.135	56.14	1.31	1.94	1.20
0 to 5	-0.376	36.00**	-3.91**	-5.98**	-3.61**	0.173	56.14	1.12	0.77	0.19
-90 to -1	-0.335	49.60	-0.89	-1.24	-0.59	1.513	82.46**	3.45**	2.22*	0.28
1 to 90	0.491	62.40*	1.57	0.97	0.893	0.893	78.95**	4.26**	1.93	-0.14
91 to 180	-0.053	58.12	-0.22	0.34	0.54	0.480	79.17**	4.35**	0.99	-1.13
-180 to 180	-0.474	55.20	-1.27	-0.35	0.00	3.900	87.72**	6.51**	4.43**	0.00
-30 to 30	-0.889	40.00**	-4.35**	-4.27**	-1.84	1.479	77.19**	3.23**	2.42*	0.97

^a Wilcoxon sign rank test; ^b simple t -test statistic; ^c Brown and Warner (1985) t -statistic; ^d Corrado (1989) rank sum test.

* Significant at the 5% level.

** Significant at the 1% level.

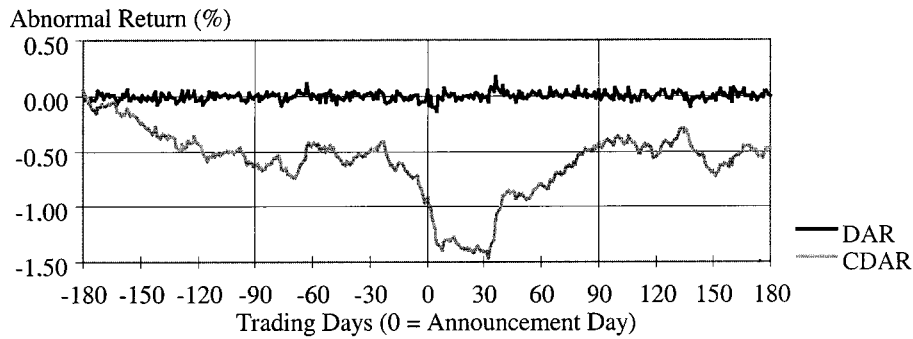


Figure 3. Possible downgrade abnormal returns over the 361-day window.

Significant positive abnormal returns between days 33 and 40 again support the overreaction hypothesis. Roughly 90 trading days after the announcement of the negative watchlisting bond prices are one the same level as on day 30 before the announcement.

To provide a sufficient explanation for the whole price development, the price pressure hypothesis has to be completed by an expectation assumption. Watchlistings themselves are normally not used by regulators for regulatory purposes. Thus, there are no direct transaction forces related to watchlistings. But, regulated investors may expect a subsequent actual downgrading on the day of the watchlist announcement and sell in advance to avoid losses. In this sample all watchlistings were followed by rating actions in the expected direction. Thus, in expectation of a following selling coercion investors may already sell at the time of the watchlisting.

The results for positive watchlistings in the right half of Table 4 hardly show any reliably significant abnormal returns. Significant values of Wilcoxon's sign rank test are dampened by the fact that no other of the test statistics used shows any significance. Like actual upgrades, the announcements occur during times of longer upward price movements, as can be seen in Figure 4. These results indicate that the information content hypothesis has to be rejected for positive watchlistings, too.

3.4. Univariate Testing of Hypotheses

The following tests analyse the key factors that explain the intensity of price movements observable in conjunction with the announcement of rating downgrades. In order to do this, we first analyse the hypotheses isolatedly by building specific subsamples. The subsamples are built in dependence of the variables that are listed in Table 5.

We conduct mean comparisons and use the t-test for independent samples and Wilcoxon's rank sum test as tests for significance of mean differences. Table 6 shows all mean sample abnormal returns in the upper part and the results of mean comparisons in the lower part of the table. The mean values of

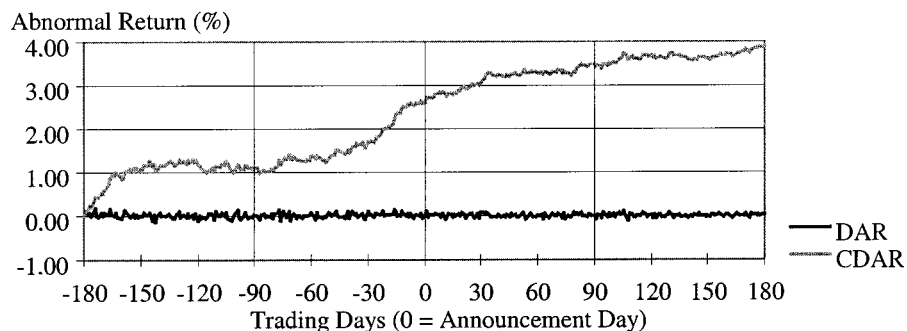


Figure 4. Possible upgrade abnormal returns over the 361-day window.

Table 5. Definition of variables

Variable	Definition
RLEV	Dummy with value 0 (1), if rating level before the announcement is AAA (BBB)
RDIFF	Difference in rating scale before/after the announcement, with a cardinal scale of 1 (Aaa/AAA) to 15 (B2/B)
YIELD	Yield to maturity of duration equivalent default free benchmark bond on the announcement day
ISSUER	Variable with value 1 (2, 3, 4, 5), if the issuer type is supranational (government, bank, corporate, utility)
COMP	Dummy with value 1 (0), if there is any (no) other rating action up to 180 trading days before the rating change announcement
USA	Dummy with value 1 (0), if issuer is (not) settled in the US
AGENT	Dummy with value 0 (1), if the downgrade is announced by Moody's (Standard & Poor's)
IGSG	Dummy with value 0 (1), if the bond is (not) downgraded into speculative grade

cumulative abnormal returns are computed over the 2-day window from day 0 to day 1. Since there were downgrade induced abnormal returns on more than 1 day we also compute abnormal returns over the 6-day window from day 0 to day 5. All tests were also conducted neglecting extreme values. These results are only reported if there are any differences in significance compared to the results displayed here.

First, the observed abnormal return is always highly significant independently of the composition of the subsamples. This is again a strong support of the *information content hypothesis* of downgradings. We tested the influence of the rating level on bond prices by comparing the excess returns observed in the highest and the lowest investment grade class. For this we took one sample of only AAA bonds ($RLEV = 0$) before the rating change and compared it to the sample with only BBB bonds ($RLEV = 1$) before the announcement of a downgrade. The bond price reaction is four times stronger for BBB bonds than for AAA bonds. The difference between the excess returns over the 2-day window and over the 6-day window is highly significant. The market obviously values downgradings of BBB bonds stronger than downgradings of AAA bonds.

To test whether the size of the rating change is also reflected in abnormal returns, the sample is divided into two portfolios, one with rating changes of one notch (value of $RDIFF = 1$) and one with rating changes of at least two notches ($RDIFF \geq 2$). The mean comparisons in Table 6 show no significant difference in the mean abnormal returns of portfolio 1 and 2. The market seems to value only the rating change itself, the size of the change seems to carry no information, even if the 6-day windows is calculated. The same is true for the default free yield level on day 0. Abnormal returns caused by rating changes at the time of low default free yield levels ($YIELD = 1$) are indifferent from abnormal returns at the time of high non-default yield levels ($YIELD = 2$).

Testing of the *issuer hypothesis* requires subsamples built by issuer type. For means of sufficient sample size we only compare between the subsamples of governments (2), banks (3) and corporates (4). All subsample abnormal returns are highly significant independently of issuer type, but downgrades cause a significantly stronger price change of corporate bonds (-0.344%) than government (-0.152%) and bank bonds (-0.096%). Abnormal returns of banks and governments do not differ significantly in the 2-day window. But, downgrade analysis in the full sample shows that relevant information is processed on more than 1 day and that there might be significant excess returns on the following days. Accordingly there are significant differences in the 6-day windows between all groups. The results indicate, that the information content of rating changes in the international market is highest for corporate bonds and lowest for bank bonds, which is supportive of the issuer hypothesis.

Under the *competition hypothesis* we expect the price reaction to be weaker, if the downgrade is preceded by any rating action ($COMP = 1$) than if there is none ($COMP = 0$). Unexpectedly there is no difference in abnormal returns. The information content of downgradings is obviously not mitigated by any preceding rating event, competition hypothesis has thus to be rejected.

We test the *nationality hypothesis* by dividing the sample into two portfolios depending on whether the issuer is settled in the USA (value of USA = 1) or not (USA = 0). Mean excess returns are significant for both portfolios and Wilcoxon's sign rank test indicates a stronger price reaction by 0.037% for US downgradings. While all other tests are stable against the elimination of extreme values, t -values and U -values indicate a significant mean difference here. If we eliminate observations with abnormal returns less than -1.5% we have to exclude 8 (13) observations from portfolio 0 (1). The mean difference of 0.144% is significant on the 5% level with a t -value of 2.080 and Wilcoxon z of -2.344 . These results are supportive of the nationality hypothesis.

The sample is divided into rating changes announced by Moody's (AGENT = 0) and Standard & Poor's (AGENT = 1) for tests of the *reliability hypothesis*. As expected, abnormal announcement returns are significantly non-zero for both agencies and their mean difference is insignificant. Thus, the international market does not differentiate between the two rating agencies, which can be seen as a confirmation of the reliability hypothesis.

Finally, we test the *price pressure hypothesis* by dividing the sample in downgrades into the speculative class (IGSG = 0) and downgrades within the speculative and investment grade class (IGSG = 1). In the 2-day window we measure abnormal returns that are twice as high for downgrades into the speculative class than for all the other downgrades. Wilcoxon's z indicates that this difference is weakly significant at the 10% level.²² Calculated over the 6-day window the price reaction on downgrades into the speculative class is about four times stronger compared to other downgrades. This difference is highly significant according to both tests, corroborating the price pressure hypothesis. Probably there are numerous institutional investors with large selling orders. Because of thin trading it requires more than 1 day and larger price changes to incite other investors to purchase these issues.

To refine our analysis of the price pressure hypothesis we analysed the rebound effect in detail. If the price pressure hypothesis is a possible explanation for the price movement, the rebound should be only significant for the bonds falling out of investment grade compared with all other rating changes. To test this we compared the announcement movement and the rebound movement for those bonds that were downgraded into speculative grade and those bonds that were downgraded within investment grade or within speculative grade. We measured the rebound effect from day 11 to day 45 and from day 1 to day 90.

The results in Table 7 show that there are announcement effects for both samples. Bonds falling out of investment grade show a significantly stronger announcement effect than bonds downgraded within investment or speculative grade. This may be not only be due to a regulation effect, but also to the expectation of a greater downward price reaction, the lower the rating of the bond. In contrast, the latter group does not show a rebound effect, while the bonds falling out of investment grade show a significant rebound. Consistently the mean differences in excess returns over both rebound windows are significantly different from zero. Together with the observation of a higher excess return over the 6-day window this is a strong support for the price pressure hypothesis as an additional explanation of the whole price movement of bonds falling out of investment grade.

3.5. Cross-sectional Analysis of Excess Bond Returns

We estimate multiple regressions to explain the cross-sectional variation in the abnormal returns induced by downgrade announcements. To avoid multicollinearity we first calculate Spearman's correlation coefficients (Table 8) for the variable set in Table 5. Here, in contrast to the univariate analysis performed before, the variable ISSUER is set on value 1 (0), if the issuer is (not) a bank. There is some correlation between some of the variables, so that not all variables of interest can be included in the regression.²³ We have to exclude the variables RLEV and USA from the estimation because of high correlation with most of the other variables. Thus we are not able to test the nationality hypothesis. Moreover it has to be kept in mind that some of the level effect of ratings is picked up by the variables RDIFF and IGSG.²⁴

Table 6. Mean sample abnormal returns and mean comparisons

Mean sample abnormal returns								
Variable	Window	Variable value	Mean	S.D.	Percent positive ^a	<i>t</i> -Test ^b	<i>t</i> _{BW} -Test ^c	<i>z</i> _C -Test ^d
RLEV	CDAR <i>t</i> [0, 1]	0	-0.083	0.305	45.10	-1.93*	-1.76*	-1.69*
		1	-0.340	0.826	28.33***	-3.19***	-5.19***	-3.04***
RDIFF	CDAR <i>t</i> [0, 1]	1	-0.137	0.680	37.45***	-3.14***	-4.83***	-4.27***
		>2	-0.289	0.920	33.63***	-3.35***	-8.04***	-3.66***
YIELD	CDAR <i>t</i> [0, 1]	1	-0.124	0.523	36.52***	-3.17***	-5.66***	-3.75***
		2	-0.246	0.947	35.96***	-3.47***	-6.39***	-4.14***
ISSUER	CDAR <i>t</i> [0, 1]	2	-0.152	0.554	38.95**	-2.67***	-4.44***	-2.39**
		3	-0.096	0.581	38.30***	-1.97*	-4.13***	-3.54***
		4	-0.344	1.092	28.70***	-3.28***	-6.33***	-3.81***
COMP	CDAR <i>t</i> [0, 1]	0	-0.160	0.870	41.67**	-2.29**	-4.30***	-2.77***
		1	-0.205	0.676	32.00***	-4.29***	-7.58***	-4.74***
USA	CDAR <i>t</i> [0, 1]	0	-0.177	0.707	37.09***	-4.14***	-7.95***	-4.89***
		1	-0.214	0.943	33.33***	-2.041**	-3.22***	-2.44**
AGENT	CDAR <i>t</i> [0, 1]	0	-0.195	0.866	35.48***	-3.07***	-5.10***	-3.98***
		1	-0.175	0.641	37.06***	-3.55***	-6.99***	-3.89***
IGSG	CDAR <i>t</i> [0, 1]	0	-0.346	0.744	22.86***	-2.751***	-3.72***	-2.21**
		1	-0.168	0.768	37.69***	-3.916***	-7.75***	-5.05***
Mean comparisons of samples								
	Window	Value	<i>N</i>	∅-Diff.	<i>t</i> -Test ^e	Wilcoxon <i>z</i> ^f		
RLEV	CDAR <i>t</i> [0, 1]	0/1	51/60	0.258	2.25**	-2.47**		
	CDAR <i>t</i> [0, 5]	0/1	51/60	1.029	4.506***	-3.69***		
RDIFF	CDAR <i>t</i> [0, 1]	1/2	243/113	0.153	1.57	-0.75		
	CDAR <i>t</i> [0, 5]	1/2	243/113	0.259	1.29	-0.47		
YIELD	CDAR <i>t</i> [0, 1]	1/2	178/178	0.122	1.50	-1.03		
	CDAR <i>t</i> [0, 5]	1/2	178/178	0.192	1.20	-0.08		
ISSUER	CDAR <i>t</i> [0, 1]	2/3	95/141	-0.055	-0.730	-0.018		
		2/4	95/108	0.193	1.612	-2.009**		
		3/4	141/108	0.248	2.138**	-2.356**		
	CDAR <i>t</i> [0, 5]	2/3	95/141	-0.280	-2.014**	-1.595		
		2/4	95/108	0.416	1.684*	1.63*		
		3/4	141/108	0.697	3.053***	-3.070***		
COMP	CDAR <i>t</i> [0, 1]	1/2	156/200	0.046	0.556	-1.605		
	CDAR <i>t</i> [0, 5]	1/2	156/200	0.138	0.860	-0.996		
USA	CDAR <i>t</i> [0, 1]	0/1	275/81	0.037	0.33	-1.67*		
	CDAR <i>t</i> [0, 5]	0/1	275/81	0.356	1.527	1.564		
AGENT	CDAR <i>t</i> [0, 1]	0/1	186/170	-0.020	-0.25	-0.54		
	CDAR <i>t</i> [0, 5]	0/1	186/170	0.142	0.894	-0.973		
IGSG	CDAR <i>t</i> [0, 1]	0/1	35/321	-0.178	-1.308	-1.80*		
	CDAR <i>t</i> [0, 1]	0/1	35/321	-0.981	-3.805***	-4.28***		

^a Wilcoxon sign rank test; ^b simple *t*-test statistic; ^c Brown and Warner (1985) *t*-statistic; ^d Corrado (1989) rank sum test; ^e *t*-test for independent samples; ^f Wilcoxon rank sum test.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

Table 7. Announcement and rebound effects of rating downgrades

Mean sample abnormal returns						
Downgrade	Window	IGSG value	Mean	S.D.	<i>t</i> -Test ^a	Explanation
Not into speculative grade	CDAR <i>t</i> [0, 1]	0	-0.116	-0.164	-4.766***	Information content hypothesis
	CDAR <i>t</i> [0, 5]	0	-0.200	-0.312	-3.519***	
	CDAR <i>t</i> [15, 45]	0	0.166	-0.003	1.625	
	CDAR <i>t</i> [1, 90]	0	0.109	-0.355	0.464	
Into speculative grade	CDAR <i>t</i> [0, 1]	1	-0.253	0.507	-2.906***	Price pressure hypothesis
	CDAR <i>t</i> [0, 5]	1	-1.184	1.349	-5.117***	
	CDAR <i>t</i> [15, 45]	1	2.586	5.752	2.622**	
	CDAR <i>t</i> [1, 90]	1	3.071	7.132	2.511**	
Mean comparisons of samples						
Variable	Window	Variable value	<i>N</i>	∅-Diff.	<i>t</i> -test ^b	Wilcoxon <i>z</i> ^c
IGSG	CDAR <i>t</i> [0, 1]	0/1	305/34	0.136	1.737*	-1.759*
	CDAR <i>t</i> [0, 5]	0/1	305/34	0.983	4.128***	-4.378***
	CDAR <i>t</i> [15, 45]	0/1	305/34	-2.420	-2.440**	-2.938***
	CDAR <i>t</i> [1, 90]	0/1	305/34	-2.961	-2.377**	-1.371

^a Simple *t*-test statistic; ^b *t*-test for independent samples; ^c Wilcoxon rank sum test.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

Table 8. Spearman correlation matrix

	RLEV	RDIF	YIELD	ISSUER	COMP	AGENT	USA	IGSG
RLEV	1.000	0.224**	0.012	-0.427**	0.200**	0.114*	0.328**	0.301**
RDIF		1.000	0.030	-0.113*	0.058	-0.072	0.124*	0.321**
YIELD			1.000	0.043	-0.276**	-0.067	0.311**	-0.055
ISSUER				1.000	-0.014	-0.119*	-0.330**	-0.267**
COMP					1.000	-0.017	0.047	0.159**
AGENT						1.000	-0.063	0.005
USA							1.000	0.226**
IGSG								1.000

* Coefficient significant on the 5% level (two-tailed).

** Coefficient significant at the 1% level (two-tailed).

The cross-sectional analysis of the abnormal returns associated with the 356 downgrade announcements is done by the estimation of the following regression equation:

$$CAR \ t[t_1, t_2]_i = b_0 + b_1 RDIF_i + b_2 YIELD_i + b_3 ISSUER_i + b_4 COMP_i + b_5 AGENT_i + b_6 IGSG_i \quad (4)$$

where b_n are the regression coefficients of variable n .

The results of the estimation are displayed in Table 9. The first row shows the expected sign of the coefficients. A positive (negative) sign indicates a stronger (weaker) price reaction with higher variable value. We changed signs to facilitate the interpretation of the results. All regressions are significant for the full sample, indicating a valid relationship between the variables and the cumulated abnormal returns. Adjusted R^2 reports that the regressions explain between 1.8% and 12.8% of the variance. These low values are comparable with those found in studies for the US bond market. Wansley *et al.* (1992) have

Table 9. Regression tests on cumulative abnormal returns for eurobonds with downgrades by Moody's and/or Standard & Poor's (1988–1996)

Window	b_0	RDIFF +	YIELD –	ISSUER –	COMP –	AGENT	IGSG +	Adj. R^2 F-value
CAR $t[0, 1]$	-0.482*** (-2.427)	0.047 (0.089)	0.087*** (4.247)	-0.126 (-1.479)	-0.121 (1.439)	-0.014 (-0.171)	0.067 (0.420)	0.044 3.745***
CAR $t[0, 1]$ w.e.	-0.091 (-0.771)	-0.042 (-1.353)	0.029** (2.312)	-0.028 (-0.551)	0.081 (1.647)	0.033 (0.702)	0.163* (1.723)	0.018 2.051*
CAR $t[0, 5]$	-0.811** (-2.122)	-0.114 (-1.117)	0.164*** (4.155)	-0.316* (-1.932)	0.232 (1.441)	0.134 (0.867)	0.916*** (2.979)	0.099 6.375***
CAR $t[0, 5]$ w.e.	-0.135 (-0.489)	-0.247*** (-3.421)	0.076*** (2.585)	-0.198* (-1.699)	0.161 (1.400)	0.202* (1.829)	1.221*** (5.545)	0.128 9.301***

The t -value of regression coefficients is shown in brackets.

*** Significant on the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.

w.e., Analysis without extreme values.

an adjusted R^2 of only 7.7% while including only four variables. Hand *et al.* (1992) even have a negative R^2 in their equation with six variables.²⁵ Because of delayed information processing due to thin and infrequent trading on the international bond market we also estimate a regression for the 6-day window and repeat this excluding extreme values (i.e. $CAR < -1.5\%$). The results show that the significance of some variables is dependent on the inclusion or exclusion of extreme values.²⁶

It is obvious from the analysis that the level of the *default free yield* (YIELD) is a relevant variable if all factors are investigated simultaneously. While univariate tests did not show any relationship between the default free yield level and abnormal returns, the regression coefficients of YIELD are highly significant and robust against changes of the sample. Since the sign of the coefficient is positive, there is a larger price reaction after downgrades the higher the default free yield level on the day of the announcement. This issue has not been investigated in rating event studies so far. It shows that a crucial point is to analyse a wide time range of rating changes to cover at least a full business cycle not to over- or underestimate abnormal returns associated with rating announcements.

The insignificance of the *size of the downgrading* (RDIFF) confirms the univariate results, as the market does not react in a stronger way on a larger rating change in the short run. Unexpectedly the coefficient is significantly negative in the 6-day window in contrast to the results for the US market, where this variable was the most significant one.

There is weak support of the *issuer hypothesis* in the regression. The coefficient ISSUER is significant at the 10% level in the extended announcement window and has the expected sign. So even under simultaneous consideration of relevant factors the issuer type seems to influence the extent of the price change.

As in the univariate analysis, the *competition hypothesis* is rejected by the cross-sectional regressions, too. None of the coefficients is significant, indicating that the abnormal return is definitely independent of the existence of a preceding rating action of the same or the other rating agency.

The coefficient of AGENT is weakly significant in the 6-day window without extreme values. There seems to be a stronger market reaction on downgrades announced by Standard & Poor's. Nevertheless we are reluctant to conclude that this should be interpreted as a rejection of the *reliability hypothesis*. Since none of the other regressions shows significant coefficients and because of the univariate results we further believe that both agencies have the same market influence and that each one enjoys the same market confidence.

Finally, there is again strong evidence of the *price pressure hypothesis*. The coefficient of the variable IGSG is highly significant, has the expected sign and its magnitude exceeds by far every other coefficient in every regression. In addition to the univariate tests we observe the strongest price change for bonds downgraded into the speculative grade class compared to any downgrade within speculative or investment grade class, independently of the size of the downgrading. We explain this observation by rating based regulation that forces institutional investors to sell the respective bonds. The temporary price change is thus not a result of economic rationale and information but a result of regulatory constraints.

4. SUMMARY AND CONCLUSION

The relevance of credit ratings in international markets is growing, especially in the single currency Euro market. This study investigates the effect of announcements of watchlistings and rating changes by Standard & Poor's and Moody's on the prices of German eurobonds. The key results found on the basis of a broad sample, daily bond prices and refined test statistics are the following:

1. Announcements of downgradings and negative watchlistings induce significant abnormal returns on the announcement day and the following trading days. This is true for the full sample and any subsample built in this study.
2. Yet, upgrades and positive watchlistings do not cause any significant price changes. Explanations can be found in the asymmetric loss functions of rating agencies or the asymmetric risk aversion of investors who place more weight on bad news than on good news.
3. All rating actions are announced during phases of price changes that started at least 90 trading days before. Thus, some part of the credit-induced price movement is already over when the rating actions are published.
4. Downgradings and negative watchlistings cause market overreaction. Negative abnormal returns are followed by significant positive abnormal returns approximately 3 weeks after the announcement. Moreover, the permanent after-announcement price level is higher than the price level on the announcement day. From this point of view the application of ratings for regulatory purposes may cause suboptimal transactions of restricted institutional investors.
5. The abnormal return induced by the announcement of downgradings is influenced by several relevant factors, analysed by means of univariate tests and cross-sectional regressions. The price reaction is larger the higher the default free yield level.
6. Abnormal returns also depend on issuer type. Lowest price reactions are observed on bank bonds, while government bonds show stronger and corporate bonds the strongest price reaction. We explain this by a higher availability of credit information concerning banks as a result of prudential regulation.
7. Abnormal returns are not influenced by any preceding rating event or by the announcing rating agency. The international market does not place more weight on either rating agency Standard & Poor's or Moody's. Yet, univariate tests indicate a slightly stronger price reaction, if the issuer is of US nationality. US rating agencies possibly have a comparative advantage in analysing Anglo-American firms.
8. Finally, we believe that some part of the abnormal returns can be explained by price pressure, contradicting the information content hypothesis of rating actions. Downgrades into the speculative grade class cause significantly stronger price reactions induced by regulated institutional investors. Abnormal returns resulting from transactions that were caused by investment restrictions are not informationally driven but a sign of price pressure. Thus, further studies will have to consider the structure of investors involved in announcement day trading to confirm this issue. Moreover, rating change reactions of bond trading volume or of stock prices of the affected issuer should be investigated in the unified European market.

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Table 10. Applied parametric and non-parametric t -test statistics

Statistical test	Statistic for daily abnormal returns	Statistic for cumulative abnormal returns
Simple t -test	$t = \sqrt{N} \frac{\text{DAR}_t}{\sqrt{\frac{1}{N-1} \sum_{i=1}^N (\text{AR}_{it} - \text{DAR}_t)^2}}$	$t = \sqrt{N} \frac{\text{CDAR}_{km}}{\sqrt{\frac{1}{N-1} \sum_{i=1}^N (\text{CAR}_{ikm} - \text{CDAR}_{km})^2}}$
Brown and Warner (1985) t -statistic	$t_{\text{BW}} = \frac{\sum_{i=1}^N \frac{\text{AR}_{it}}{\sqrt{\sum_{t=k}^{t=m} \left(\text{AR}_{it} - \frac{1}{ m-k +1} \sum_{t=k}^{t=m} \text{AR}_{it} \right)^2}}}{\sqrt{N}}$	$t_{\text{BW}} = \frac{\sum_{i=1}^N \frac{\text{AR}_{it}}{\sqrt{\sum_{t=k}^{t=m} \left(\text{AR}_{it} - \frac{1}{ m-k +1} \sum_{t=k}^{t=m} \text{AR}_{it} \right)^2}}}{\sqrt{(m-k+1)N}}$
Wilcoxon sign rank test	$z = \frac{W^+ - \frac{N(N+1)}{4}}{\sqrt{\frac{N(N+1)(2N+1)}{24}}}$	
Corrado (1989) rank sum test	$z_c = \frac{\frac{1}{\sqrt{N}} \sum_{i=1}^N \left(\frac{K_{it}}{1+M_i} - 0.5 \right)}{\sqrt{\frac{1}{G} \sum_{t=1}^G \left(\frac{1}{N} \sum_{i=1}^N \left(\frac{K_{it}}{1+M_i} - 0.5 \right) \right)^2}}$	$z_c = \frac{\frac{1}{\sqrt{N}} \sum_{t=1}^G \sum_{i=k}^m \left(\frac{K_{it}}{1+M_i} - 0.5 \right)}{\sqrt{(m-k+1) \frac{1}{G} \sum_{t=1}^G \left(\frac{1}{N} \sum_{i=1}^N \left(\frac{K_{it}}{1+M_i} - 0.5 \right) \right)^2}}$

Where t , statistic of simple t -test; t_{BW} , Brown and Warner (1985) t -statistic; z , Wilcoxon z ; W^+ , sum of ranks belonging to positive abnormal returns; N , number of observations; z_c , Corrado (1989) z ; K_{it} , individual rank K of abnormal return of bond i on day t ; M_i , number of non missing values of bond i ; G , maximum rank.

APPENDIX A

Formulas for the parametric and non-parametric test statistics used for the significance tests of abnormal returns are shown in Table 10. We always test the null hypothesis of a zero abnormal return.

We use the interval from day -180 to day -90 as estimation period to avoid possible distortions related to an estimation period close to the announcement date. The first three tests are well documented concerning the application to bonds. To our knowledge the Corrado (1989) rank sum test has to date only been applied for event studies of stocks. The correction for missing values used here is shown in Corrado and Zivney (1992). In contrast to the parametric tests and the Wilcoxon test this statistic is correctly specified even in the absence of normality and if the distribution is not symmetric. This test assigns every bond specific abnormal return in the test period (361 trading days) a rank K_{it} in ascending order and tests for a mean rank over all observations. For the statistic applied to cumulative returns we refer to Campbell and Wasley (1993).

NOTES

1. The latest studies for the US bond market are Hand *et al.* (1992), Wansley *et al.* (1992) and Hite and Warga (1997).
2. See Hetttenhouse and Sartoris (1976), Weinstein (1977), Schneeweis and Branch (1981), Hawley and Walker (1992).
3. See Hand *et al.* (1992) and Hite and Warga (1997).
4. See for example Matolcsy and Lianto (1995) resp. Barron *et al.* (1996) for the Australian resp. British stock market and Kaserer (1995) resp. Reisen and von Maltzan (1999) for the German resp. US eurobond market.
5. See Fama (1970).
6. See Sharpe and Alexander (1990, p. 378)
7. See Holthausen and Leftwich (1986, p. 79).
8. See Hsueh and Liu (1993), Hsueh and Kidwell (1988) and Stover (1996).
9. Over time regulators also drew on other grades as well. See Cantor and Packer (1994, p. 6).
10. See West (1973, p. 159 ff.) and Van Horne (1990, p. 188 f).
11. We are grateful to the officials of Standard & Poor's and Moody's for providing this information.
12. See also Hite and Warga (1997) for this argumentation.

13. Insignificant results in event studies may also result from sample selection time. The sample of Schneeweis and Branch (1981) for example is only taken from a time period with very low credit spreads. This can explain the insignificant price reactions found in that study.
14. This is usually done only in the analysis of credit spreads in the primary bond market. See for example Reiter and Ziebart (1991, p. 54).
15. An analytical comparison of both methods used in event studies is shown by Swidler (1990).
16. See Handjinicolaou and Kalay (1984).
17. See for example Brown and Warner (1985, p. 8) and Hawley and Walker (1992, p. 279).
18. See Hand *et al.* (1992, p. 744).
19. The results of these tests can be obtained from the authors upon request.
20. See Holthausen and Leftwich (1986, p. 71), Schweitzer *et al.* (1992, p. 255) and Ederington *et al.* (1996, p. 19).
21. To our knowledge past US studies only use watchlist announcements by Standard & Poor's. See for example Liu (1985), Wansley *et al.* (1992) and Hand *et al.* (1992).
22. Elimination of extreme values also yields a significant t -value of $t = 1.737$.
23. Comparable studies for the US-market never investigate or publish correlation coefficients, so we are not able to relate our results to any existing empirical evidence.
24. We also tested regressions under omission of other variables. But these regressions all have less explanatory power. Specifically the influence of the IGSG variable is not diminished by taking the RLEV variable into the equation.
25. It has to be mentioned that the authors reach a higher adjusted R^2 of 17.7% and 37.7% by dividing the cases into contaminated and non-contaminated rating changes.
26. We cannot relate this fact to comparable US studies of Wansley *et al.* (1992) or Hand *et al.* (1992), since there is no documentation on the relevance of extreme values. Especially in the latter study there might be a non-zero influence of extreme values.

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