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MARKET PRICING OF CREDIT RATING SIGNALS

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Abstract

This paper contributes new evidence on market pricing of rating changes. We examine the relation between spreads and ratings for a very large and comprehensive sample of corporate bonds, which allows us to test for country- and industry-specific effects, as well as to explore the differences between the calm and distressed market conditions. The results show that the effects of rating actions on market prices are significant and depend on the current state of the market. While during favourable market conditions rating actions are not crucial for market pricing, they become very significant in the periods of crisis.

Keywords: corporate bond spreads; credit ratings; pricing of risk;
JEL classification: G12; G14; G01; G21;

Non-technical summary

This paper contributes new evidence on market pricing of credit signals released by the rating agencies. We examine the relation between market pricing and rating actions for a very large and comprehensive sample of corporate bonds, covering the developments in ratings and prices of over 16.5 thousand bonds during over 12 years. Our data allows us to abstract from particular rating actions, which recently enjoyed increased attention in the markets, and test systematically whether there is a pricing pattern following rating downgrades and upgrades. Also, due to the length of our sample and its broad coverage, we are able to test for country- and industry-specific effects, as well as explore the differences in the market pricing of credit signals during crisis and non-crisis periods.

The results of this paper show that the effects of rating actions on market prices are significant and depend on the current state of the market. In particular, when market conditions are very favourable, the changes in credit ratings are not crucial for the pricing. However, in the periods of stress in the financial markets, rating actions are a significant factor influencing market pricing. Country-specific effects are significant for bond pricing, but they don't change the main findings of the paper.

1 Introduction

During the recent financial crisis a debate about the relevance of information provided by the rating agencies increased. On the one hand, many market commentators claim that the ratings lag market information, and thus in many cases they cease to be a basis for investment decisions. On the other hand, the institutional importance of ratings increased due to credit- and liquidity-related reforms in the financial system. From the perspective of this debate, this paper examines empirically the role of rating actions for market pricing in periods characterised by different market conditions.

We use a very large and comprehensive sample of corporate bonds covering the developments in ratings and prices of over 16.5 thousand bonds during over 12 years. Our data allows us to abstract from the most recent rating actions in the markets, which recently enjoyed increased attention, and test systematically whether there is a pattern following rating downgrades and upgrades. Also, due to the length of our sample and its broad coverage, we are able to test for country- and industry-specific effects, and examine the changes in pricing reaction during crisis and non-crisis periods.

The paper finds that the reaction of market prices to rating changes is significant and depends on the state of the market. In the phase of favourable market conditions, the changes in credit ratings are not crucial for the bond pricing. In the phase of crisis, the changes in credit ratings are significantly priced by the markets. The pricing impact of rating actions is stronger in case of downgrades, as compared to upgrades. Furthermore, we find several country-specific effects, which, however, do not influence the main findings.

The results of the paper contribute new evidence to the literature on market pricing of credit signals released by the rating agencies, making it possible to test for different price reactions to downgrades and upgrades, as well as distinguishing between calm and distressed market conditions. Previous literature on the impact of ratings on the pricing of financial instruments includes the evidence of a short-term reaction to rating announcements for the bond markets (e.g., Hand, Holthausen, and Leftwich (1992))

as well as for the CDS and stock markets (e.g., Norden and Weber (2004) and Micu, Remolona, and Wooldridge (2006)). Analysing the market reactions depending on the type of the rating news releases, Hsueh and Liu (1992), Goh and Ederington (1993), as well as Kliger and Sarig (2000) show that the reaction of market prices to ratings is only focused on the more precise and new pieces of rating information. However, differentiating between the direction of the rating changes and their market impact, Hull, Predescu, and White (2004) and Di Cesare (2006) find no significant price effects in the CDS markets after the downgrades or upgrades.[1] In view of these findings, our paper examines the impact of ratings on bond pricing using a long observation period. This allows us to examine the differences in market reactions depending on the conditions in the markets. The broad coverage of our sample enables to explore industry- and country-specific effects as well as to test for differences in reactions to downgrades and upgrades in particular market segments and periods.

This paper focuses on the market reaction to the rating actions, without taking a view on the usefulness and institutional relevance of the credit ratings for market functioning. As a possible future extension to this work, however, time-varying sensitiveness of market pricing to ratings could be modeled more specifically, taking into account changes in the institutional aspects related to ratings, e.g. regulatory reforms. For a broader discussion on institutional and market issues, see for example Gonzalez et al. (2004).[2]

The remainder of the paper is organized as follows. Section 2 presents the data and descriptive statistics, including the evolution of price and rating properties of the market. Section 3 describes the methodology and results of exploring the relation between rating changes and changes in spreads. It also tests for the differences between the impact of downgrades and upgrades, between the crisis and non-crisis periods, as well as discusses

[1] In general, Chava, Ganduri, and Ornthanalai (2012) find evidence that CDS include some information beyond credit ratings, while Wojtowicz (2011) shows that credit ratings are not sufficient for pricing of certain financial instruments.

[2] For some evidence that ratings may be not a purely objective reflection of the issuer's credit risk see, e.g., Fulghieri, Strobl, and Xia (2013), Xia (2013), Bongaerts, Cremers, and Goetzmann (2012) or Blochlinger, Leippold, and Maire (2012). On the other hand, for some evidence of institutional significance of ratings for market pricing, see, e.g., White (2010), Pagratis (2005) or Chen, Lookman, Schurhoff, and Seppi (2012).

country-specific effects. Section 4 concludes.

2 Data and descriptive statistics

2.1 Data

The data comprises a novel set of monthly information on all bonds included in the Merrill Lynch Global Corporate Index, accessed via the Merrill Lynch Global Index System on Bloomberg. The observations on the bond universe, as well as bond yields and ratings, refer to the last Friday of each month. The index tracks investment grade bonds with the following specifications: all issues must be publicly placed, all issues must have a maturity of at least one year, a fixed coupon schedule, and the par amount outstanding on each issue must be at least EUR 250 million for euro area bonds, USD 250 million for US bonds and GBP 100 million for UK bonds.[3] The methodology of the composition of the index was adjusted twice during the observation period, in August 1999 and December 2004.[4] We exclude all observations in these both months from the sample. We restrict the database to include only bonds from the euro area countries, UK and US, and only issued by the companies from the financial and industrial sectors, with unique bond ISINs (i.e., bond re-openings are excluded). Overall, the sample covers 16601 bonds in the period of 150 months from January 1999 to June 2011, resulting in 359405 bond-month observations.

Data on bond ratings refers to composite ratings calculated by Merrill Lynch, based on an average of Moodys, S&P and Fitch ratings.[5] Data on bond yields is used to calculate spreads with respect to the underlying risk-free rates, which allows controlling for monetary policy rates, and thus for broader economic developments. As the benchmark, we use the OIS rates in the euro area, US, and UK, respectively, for the maturity corresponding to the maturity of each bond in each month. These rates are

[3]For more specific regulations regarding the criteria for inclusion in the Merrill Lynch Global Corporate Index, see Bank of America Merrill Lynch (2011).

[4]The adjustment in the index composition regarded the filter size and inclusion of specific kinds of bonds in the index.

[5]For the exact methodology of the composite rating calculation, see Bank of America Merrill Lynch (2012).

least affected by credit and liquidity premia during the crisis. For the period when OIS data is not available, i.e., until April 2008 for the euro area, July 2008 for the US and August 2008 for the UK, we use euro swap curves, and US and UK Treasury curves, respectively. However, these curves overlap with the OIS data before the financial crisis, so that no jump in spreads is caused. The data on OIS, swap and Treasury curves is from Bloomberg.

An overview of spreads and ratings for the analyzed sample of bonds is presented in Table 1. The countries with the largest number of bonds are US, Netherlands and Germany for the financial sector and US, UK and France for the industrial sector. In most cases, bonds are on average around 2-3 years in the database and have a median rating of Aa3-A2. For several countries, the bonds are distributed only among some rating classes, which is due to a small number of companies using the capital market for financing. The changes in ratings are mostly by one notch, and downgrades are more frequent than upgrades. On average, there is one downgrade per two bonds and one upgrade per five bonds. Median spread differs across countries and industries even within the same rating class. The differences are more pronounced when the number of all bonds is rather low. Across the rating classes, spreads tend to increase monotonically, on average.

2.2 Evolution of the dataset structure

To assess the development of the sample over time, Figures 1 and 2 show the number of bonds per rating class and per country. Generally, the number of bonds per rating class is broadly balanced, but the number of higher-rated bonds decreases over time, especially during the financial crisis of 2008-2009. The jumps in the number of bonds observed in August 1999 and December 2004 are related to the amendments in the index composition. Observations related to these dates are removed from the sample.

Comparing the country structure of the data, Figure 2 shows that in the recent years the share of financial bonds issued by the euro area companies has become larger than that

Table 1: Summary statistics of the corporate bond dataset

Country	Number of bonds	Number of months (avg per bond)	Median bond rating	Average number of upgrades		Average number of downgrades		Median spread per rating									
				by 1 notch	by > 1 notches	by 1 notch	by > 1 notches	Aaa	Aa1	Aa2	Aa3	A1	A2	A3	Baa1	Baa2	Baa3
							Financials										
Austria	66	40.6	4.1	0.2	0.0	0.6	0.1	0.2	0.3	0.3	0.4	0.5	0.9	1.2	2.0	1.8	4.7
Belgium	29	26.0	5.0	0.2	0.0	0.8	0.1	-	-	0.7	1.2	2.2	2.7	2.5	-	-	-
Finland	15	15.8	4.8	0.1	0.0	0.3	0.0	-	-	-	1.2	0.2	1.5	3.0	-	0.4	-
France	409	33.5	3.9	0.2	0.0	0.5	0.0	0.9	0.4	0.5	1.1	0.8	1.2	0.9	0.9	1.6	4.6
Germany	967	28.8	3.9	0.2	0.0	0.4	0.1	0.5	0.6	0.3	0.9	1.0	1.0	0.8	1.3	3.4	1.3
Greece	9	9.3	7.7	0.0	0.0	0.9	0.7	-	-	-	-	-	1.9	2.6	4.4	-	14.3
Ireland	103	23.3	1.6	0.1	0.0	0.3	0.2	0.9	0.5	0.8	1.2	1.2	1.2	2.4	16.4	1.5	23.1
Italy	191	27.1	5.0	0.2	0.0	0.4	0.0	-	0.8	0.3	1.1	1.3	1.2	1.8	2.8	0.8	2.9
Luxembourg	51	28.4	3.4	0.2	0.0	0.2	0.0	0.7	0.4	0.2	1.0	0.7	1.9	1.8	1.1	1.5	3.1
Netherlands	1056	32.0	1.0	0.1	0.0	0.2	0.0	0.4	0.6	0.4	0.5	0.6	0.5	1.1	2.2	4.1	3.9
Portugal	15	25.2	5.5	0.3	0.0	1.5	0.3	-	-	-	1.4	0.7	2.0	0.5	8.7	-	9.1
Spain	126	24.8	4.2	0.3	0.0	0.2	0.0	0.8	-	1.8	1.9	0.5	2.6	4.1	5.0	-	-
Euro area	3037	30.2	3.0	0.1	0.0	0.3	0.0	0.4	0.5	0.4	0.8	0.9	1.1	1.2	1.6	1.5	3.7
United Kingdom	705	25.4	4.3	0.2	0.0	0.5	0.1	-0.0	0.0	0.4	0.8	1.0	1.1	1.4	3.3	3.1	4.5
United States	4096	25.5	5.0	0.2	0.0	0.4	0.1	0.4	0.7	0.7	0.8	0.9	1.2	1.3	1.7	2.1	2.6
							Industrials										
Austria	15	24.3	8.2	0.2	0.0	0.1	0.0	0.5	-	-	-	-	-	2.1	1.0	1.8	3.7
Belgium	41	15.2	7.0	0.1	0.0	0.1	0.0	-	1.3	-	-	-	1.0	-0.6	2.3	2.1	1.1
Finland	29	43.8	9.0	0.0	0.1	1.3	0.0	-	-	-	-	-0.0	2.1	0.9	0.7	1.3	1.9
France	485	25.3	7.0	0.1	0.0	0.3	0.1	-0.1	-0.3	0.6	0.2	0.0	0.3	0.6	0.5	0.3	1.5
Germany	251	21.7	7.5	0.1	0.0	0.4	0.0	-	1.3	0.5	0.4	0.8	0.2	0.6	0.9	0.7	1.7
Greece	5	0.0	-	0.0	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-	-
Ireland	8	29.6	7.2	0.0	0.3	0.6	0.8	-	2.1	-	-	1.7	2.2	2.8	2.5	3.3	2.3
Italy	61	12.2	8.5	0.0	0.0	0.1	0.0	-	-	0.4	0.5	-	-	1.6	2.5	3.2	2.8
Luxembourg	75	10.1	8.0	0.1	0.0	0.2	0.1	-	-	-	-	1.4	0.8	0.4	1.1	0.6	2.7
Netherlands	334	25.6	7.0	0.2	0.0	0.4	0.1	0.9	0.1	0.6	1.9	0.1	1.0	0.6	1.0	1.1	1.5
Portugal	3	9.3	9.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-	-	-	3.0	-
Spain	36	18.7	7.3	0.2	0.0	0.2	0.0	-	-1.2	-	-	-	1.0	1.6	1.6	1.2	1.7
Euro area	1343	23.1	7.2	0.1	0.0	0.3	0.1	0.2	1.0	0.5	0.3	0.2	0.7	0.6	0.9	0.8	1.6
United Kingdom	749	25.9	7.0	0.1	0.0	0.4	0.1	0.6	0.3	0.2	0.9	0.6	0.9	1.0	1.1	1.1	1.5
United States	6671	25.5	8.0	0.1	0.0	0.4	0.0	0.8	0.4	0.8	0.9	1.0	1.1	1.2	1.6	1.7	2.0

NOTE: This table reports summary statistics for the sample of bonds used in the paper, grouped by countries and industries. The rating scale presented in the column "Median bond rating" corresponds to: $Aaa = 1$, $Aa1 = 2$, $Aa2 = 3$, $Aa3 = 4$, $A1 = 5$, $A2 = 6$, $A3 = 7$, $Baa1 = 8$, $Baa2 = 9$, $Baa3 = 10$. Spreads are presented in percentage points.

of US or UK companies. Among euro area countries, Netherlands, Germany and France are the largest financial sector issuers, with Italy increasing its share steadily over time. Industrial bonds are mostly issued by the companies located in the United States. This reflects a traditionally higher reliance of US corporates on the market-based financing, as opposed to more bank lending-dependent euro area corporates. Within the euro area, bonds from Netherlands and France used to dominate the industrial sector of the market before 2005, but afterwards the share of German bonds has grown significantly.

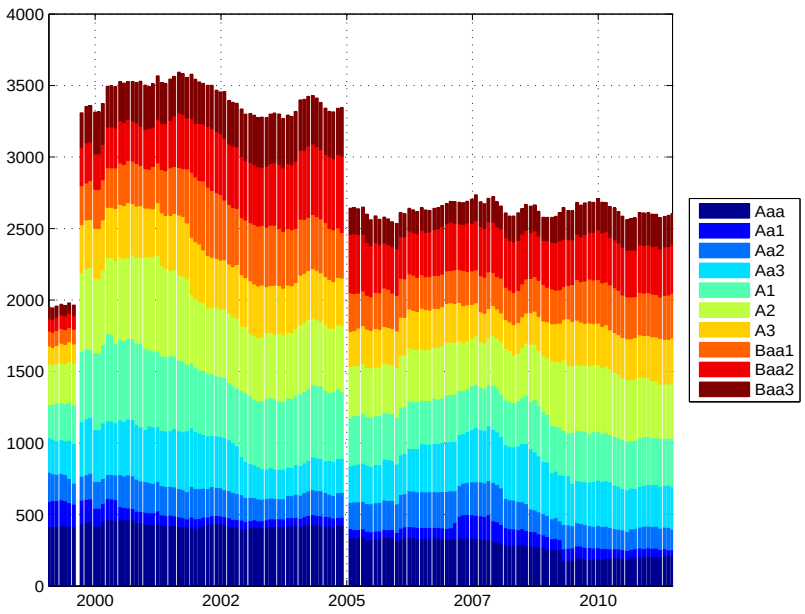

Figure 1: Number of bonds per rating

NOTE: The figure shows the number of bonds in each rating class in particular month. The sample period is January 1999 to June 2011.

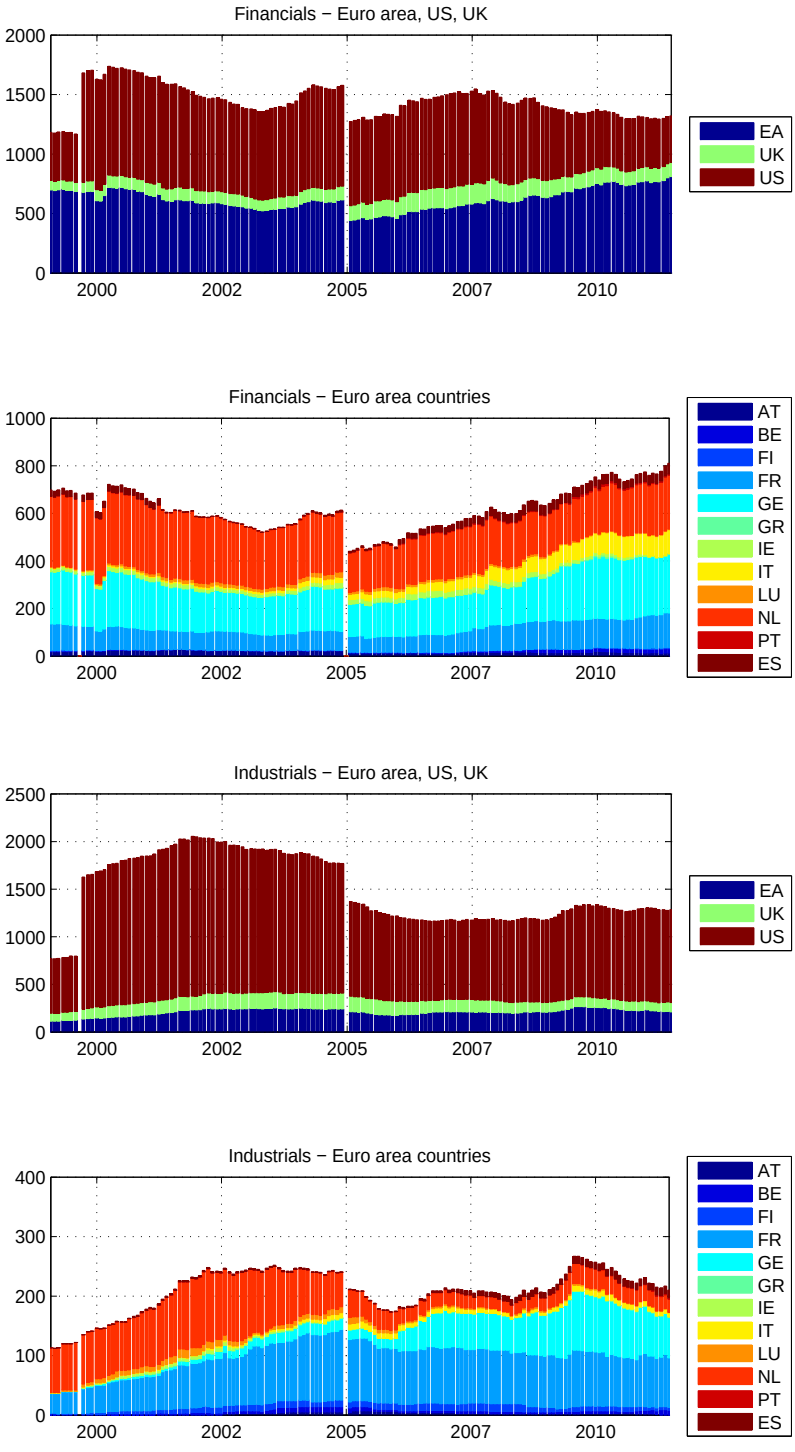

Figure 2: Number of bonds per region and country

NOTE: The figure shows the number of bonds in the financial and industrial sectors per region and country, comparing euro area, US and UK, and also giving an overview over particular euro area countries. The sample period is January 1999 to June 2011.

2.3 Evolution of price and rating properties of the market

The data used in this paper covers a period of 12.5 years. During this time, the markets went through a number of developments, experiencing phases of favourable investor conditions as well as a severe financial crisis. This section illustrates the developments in spreads and ratings over the sample period, motivating the need to also consider two exemplary subsamples, i.e. a crisis and a non-crisis period, in the further analysis.

2.3.1 Distribution of spreads in crisis and non-crisis periods

Following the market developments over time, Figure 3 presents the average yield spread for various rating classes. It shows that not only the level of spreads, but also the dispersion among the rating classes differs over time, and is particularly large during the periods of market tensions. During the period between 2000 and 2002, when the dot-com bubble burst, the differentiation among the risk classes was relatively large and the spreads on lower-rated bonds increased. In the following years, until the beginning of 2007, the spreads tightened and the dispersion among the yields on various rating classes declined substantially. This period is sometimes described as being characterized by low risk aversion (see, e.g., Trichet (2009) or Obstfeld and Rogoff (2009)). In this period, the spreads on rating classes were so compressed that in some months the monotonic relation between the credit rating and pricing were not clearly observed any more. Towards the end of our sample, during the global financial crisis, the spreads increased substantially on all rating classes, while the dispersion in many cases exceeded 5000 basis points.

In the following analysis, we choose two similarly long periods to show the differences in the pricing relationships. The crisis period covers the time between August 2008 and June 2011, while the non-crisis period spans from January 2004 to December 2006. Note that the exact definition of the periods, e.g. the start of the crisis period, does not influence the findings. For these subsamples, we consider only financial sector bonds, as this sector has a more balanced country structure and was more affected during the recent financial crisis. Figure 4 presents a comparison of spread distributions across

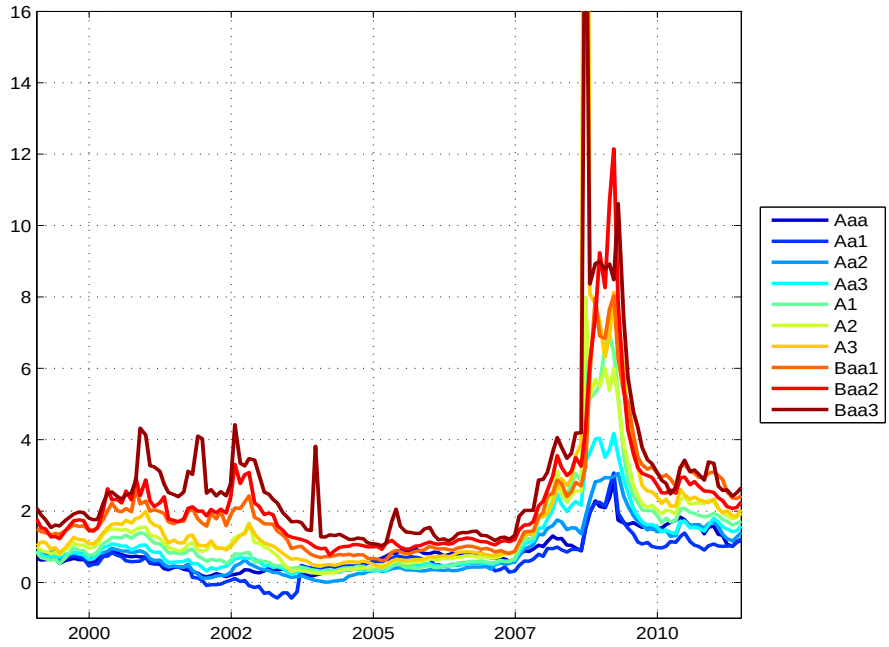

Figure 3: Average spread per rating

NOTE: The figure shows the average yield spreads of bonds in a given rating class. Spreads are presented in percentage points. The sample period is January 1999 to June 2011.

rating classes for the crisis and non-crisis periods. During the non-crisis period, the dispersion within the rating classes is relatively small. There is also a visible lack of price differentiation among the ratings. In contrast, during the crisis period, the differentiation among rating classes is much stronger and the distributions are significantly skewed, with high spreads dominating in the tails. For a more detailed picture, Figure 5 presents an example of empirical distributions for one of the middle rating classes (A1) in the two subperiods. During the financial crisis, the mode of the spread distribution is significantly higher than in the non-crisis period, with a higher variance and a fat tail in the range of high spreads.

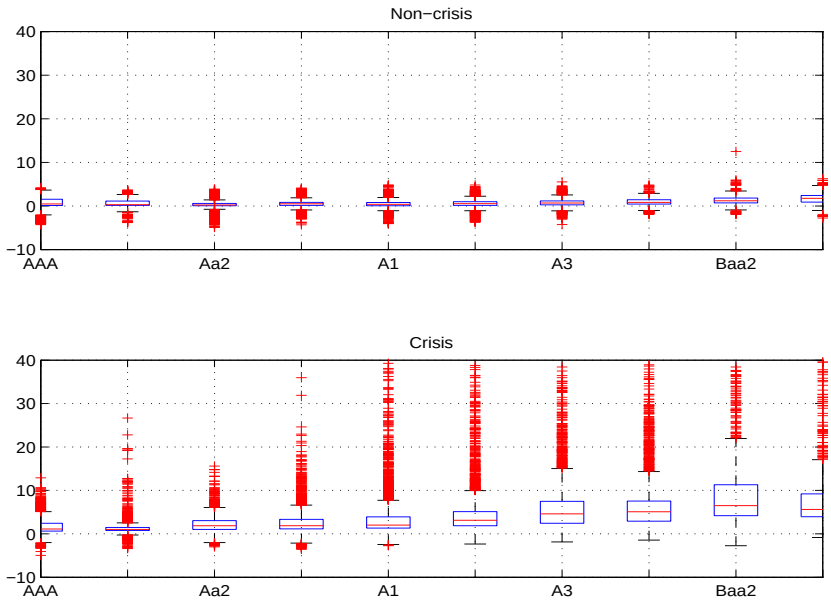

Figure 4: Spread distributions in various rating classes

NOTE: The figure shows financial spread distributions across the rating classes for the crisis and non-crisis periods. Spreads are presented in percentage points. X-axis corresponds to the following rating scale: Aaa, $Aa1$, $Aa2$, $Aa3$, $A1$, $A2$, $A3$, $Baa1$, $Baa2$, $Baa3$. On each box, the central mark is the median, the edges of the box are the 25th and 75th percentiles, the whiskers extend to the most extreme data points not considered outliers, and outliers are plotted individually. Points are drawn as outliers if they are larger than $q_3 + 1.5(q_3 - q_1)$ or smaller than $q_1 - 1.5(q_3 - q_1)$ where q_1 and q_3 are the 25th and 75th percentiles, respectively. This corresponds approximately to $+/-2.7\sigma$ and 99.3 coverage if the data are normally distributed. The crisis period is defined as: August 2008 to Jun 2011, while the non-crisis period is defined as: January 2004 to December 2006. Both periods cover a similar number of observations.

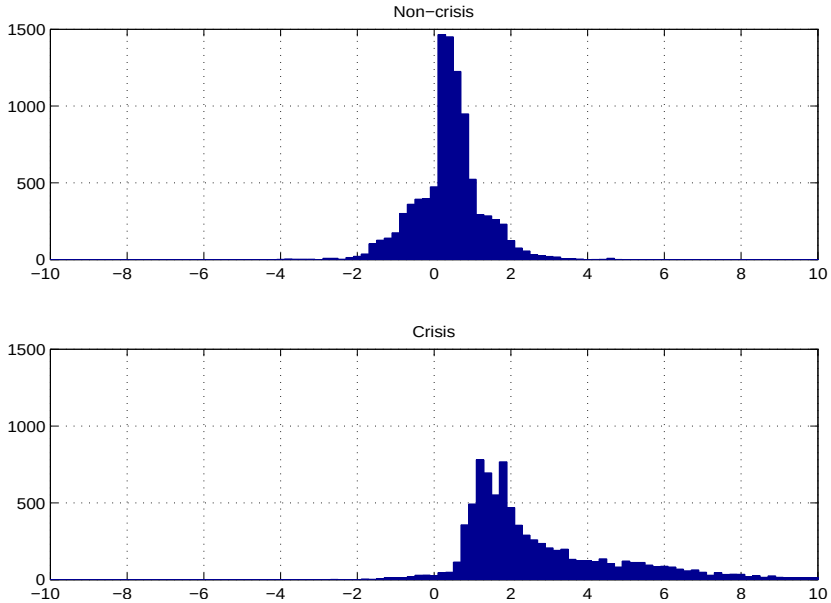

Figure 5: Spread histograms of A1-rated bonds

NOTE: The figure shows financial spread distributions for the A1 rating class for the crisis and non-crisis periods. Spreads are presented in percentage points. The crisis period is defined as: August 2008 to Jun 2011, while the non-crisis period is defined as: January 2004 to December 2006. Both periods cover a similar number of observations.

2.3.2 Transition of ratings in crisis and non-crisis periods

The dynamics of changes in the bond ratings also evolved substantially over time, mostly reflecting the economic situation (see Figure 6). While downgrades are generally more frequent than upgrades, they occurred particularly often during the period 2001-2003, i.e., following the burst of the dot-com bubble, and during the global financial crisis, mostly in 2009. Comparing the crisis and non-crisis periods, Table 2 shows that the rating patters were quite different in these groups. We can see that the crisis period was characterised by far more frequent downgrades in the financial sector than the non-crisis period. In particular, 44% of bonds were downgraded during the crisis (over half of them by more than one notch), which compares to downgrades of 3.8% of all bonds during the non-crisis period. While only half of the financial bonds managed to keep their rating throughout the crisis period, during the non-crisis period it was possible for almost 75% of bonds.

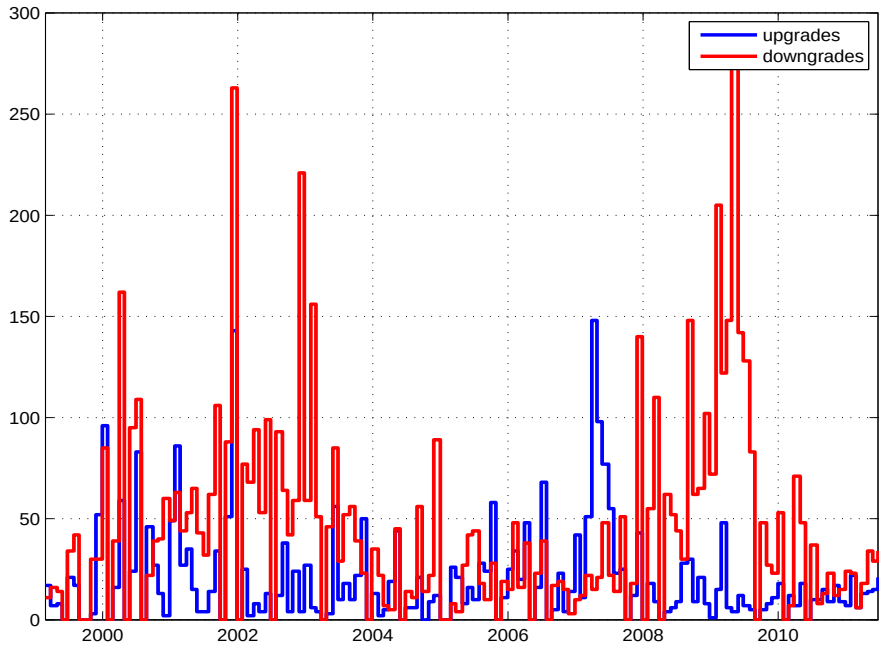

Figure 6: Number of upgrades and downgrades per month

NOTE: The figure shows the number of rating upgrades and downgrades in each month. The sample period is from January 1999 to June 2011.

Table 2: Transition of ratings

(a) Whole sample

	Aaa	**Aa1**	**Aa2**	**Aa3**	**A1**	**A2**	**A3**	**Baa1**	**Baa2**	**Baa3**
Aaa	20.4	0.5	1.3	0.0	.	0.1	.	0.0	.	.
Aa1	0.3	2.2	1.4	0.6	0.1	0.1	.	.	.	0.0
Aa2	.	0.9	4.3	2.7	1.5	0.6	0.2	0.3	0.0	0.0
Aa3	.	0.1	1.6	9.2	3.8	1.6	0.5	0.3	0.1	0.1
A1	0.1	0.0	0.5	3.3	9.4	2.9	0.9	0.5	0.3	0.5
A2	0.0	.	0.1	0.8	2.5	5.4	1.4	0.5	0.6	0.5
A3	0.2	.	0.1	0.2	0.6	1.6	3.7	0.8	0.3	0.6
Baa1	.	0.0	0.1	0.0	0.0	0.3	0.6	1.3	0.5	0.3
Baa2	0.0	.	0.0	0.1	0.0	0.1	0.1	0.2	0.9	0.4
Baa3	.	.	.	.	0.0	0.0	0.1	0.1	0.4	1.2

(b) Non-crisis

	Aaa	**Aa1**	**Aa2**	**Aa3**	**A1**	**A2**	**A3**	**Baa1**	**Baa2**	**Baa3**
Aaa	21.7	0.4	0.3	.	.	.	.	.	.	.
Aa1	0.5	2.4	0.5	0.1	.	.	.	.	.	.
Aa2	.	0.5	9.8	0.2	.	0.0	.	.	.	.
Aa3	.	0.2	2.0	9.2	0.5	.	.	.	.	.
A1	.	.	0.0	7.2	12.4	0.7	0.1	.	0.2	.
A2	.	.	.	1.0	3.9	9.2	0.3	0.1	0.0	.
A3	.	.	0.1	.	0.3	2.2	4.5	0.1	.	.
Baa1	.	.	0.0	.	0.0	0.1	1.6	2.2	0.1	.
Baa2	.	.	.	0.3	.	0.0	0.3	0.5	1.7	0.2
Baa3	.	.	.	.	0.0	.	0.0	0.2	0.4	1.5

(c) Crisis

	Aaa	**Aa1**	**Aa2**	**Aa3**	**A1**	**A2**	**A3**	**Baa1**	**Baa2**	**Baa3**
Aaa	13.8	0.2	3.3	0.0	.	.	.	.	.	.
Aa1	0.1	2.6	0.6	0.9	0.4	.	.	.	.	.
Aa2	.	0.0	3.5	4.0	2.1	0.2	0.0	0.0	.	0.1
Aa3	.	.	0.0	12.7	6.6	5.5	0.4	1.4	0.2	0.4
A1	.	.	.	1.1	9.7	3.3	2.2	1.1	0.3	1.2
A2	.	.	.	0.0	0.6	4.2	1.9	1.0	1.0	0.4
A3	.	.	.	.	.	0.5	2.6	1.1	0.9	0.8
Baa1	.	.	.	.	.	.	0.2	1.7	0.8	0.4
Baa2	.	.	.	.	.	0.1	0.0	0.0	1.3	1.0
Baa3	.	.	.	.	.	.	.	0.0	.	1.0

NOTE: This table reports the transition of bonds among rating groups in the financial sector. The numbers reported are percentages of all bonds observed during the respective period which existed in the sample at least 5 months (i.e., all numbers in the table sum to 100%). The rows report the first rating of the bond observed in the respective period, the columns report the last rating observed in the period. Dots denote transition percentages equal to zero. The crisis period is defined as: August 2008 to Jun 2011, while the non-crisis period is defined as: January 2004 to December 2006. Both periods cover a similar number of observations.

3 Methodology and results

This section presents the analysis of the impact of rating changes on bond pricing. We analyse changes in spreads and account for time series properties of their dynamics. We also allow for differently strong effects of downgrades and upgrades, analyse the changes in price reaction for financial bonds for crisis and non-crisis periods and explore whether the results are robust to accounting for possible country-specific effects.

We first test whether rating actions influence spread developments, modeling the spread changes in the following way:

$$dS_t = \alpha_0 + \alpha_1 dS_{t-1} + \alpha_2 dS_{t-2} + \beta dR_t + \varepsilon_t, \tag{1}$$

where dS_t denotes an absolute change in bond yield spread in a given month t, dR_t denotes an absolute change in bond rating in a given month t, and ε_t is a white noise error term. We take all bond-month observations into account, for which dS_{t-1} and dS_{t-2} exist. To allow for differently strong effects of downgrades and upgrades, we also include the following modification of the model:

$$dS_t = \alpha_0 + \alpha_1 dS_{t-1} + \alpha_2 dS_{t-2} + \beta_D D_t dR_t + \beta_U U_t dR_t + \varepsilon_t, \tag{2}$$

where D_t (or U_t) equals 1 when a rating change dR_t is a downgrade (or an upgrade, respectively) and zero otherwise.

Exploring market pricing, it has to be noted that some other effects, beyond purely credit-related, can be included in bond spreads, for example liquidity premia or trading-related effects (see, e.g. Krishnamurthy (2010), or Ejsing, Grothe, and Grothe (2012)). However, several studies show that the most significant part of the yield spread on a particular corporate bond is related to its risk profile (see, e.g., Longstaff, Mithal, and Neis (2005) or Ericsson and Renault (2006)). Moreover, the broad coverage, monthly frequency and the length of our sample helps us avoiding the focus on short-term liquidity patterns. In the periods when there might be strong fixed effects, we report only results based on a large number of bond-month observations.

The results are presented in Table 3. The columns report regression coefficients for the pure autoregressive process, the autoregressive process including rating changes (eq. 1) and a regression differentiating between the direction of rating changes (eq. 2). Due to the specification of the rating scale, the downgrades are positive numbers and upgrades are negative numbers.[6] Therefore, positive coefficients for β_D mean an increase in spread, while positive coefficients for β_U mean a decrease in spread.

Table 3: Influence of rating changes on spreads

	Financials			**Industrials**		
α_0	0.03^{***}	0.03^{***}	0.03^{***}	0.01^{***}	0.01^{***}	0.01^{***}
α_1	0.02^{***}	0.02^{***}	0.02^{***}	0.03^{***}	0.03^{***}	0.03^{***}
α_2	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
β		0.09^{***}			0.16^{***}	
β_D			0.14^{***}			0.23^{***}
β_U			-0.00			0.02

NOTE: This table reports the regression coefficients corresponding to equations 1 and 2 for bonds in financial and industrial sectors. Due to the specification of the rating scale, the downgrades are positive numbers and upgrades are negative numbers. Therefore, positive coefficients for β_D mean an increase in spread in response to a downgrade, while positive coefficients for β_U mean a decrease in spread in response to an upgrade. The sample period is from January 1999 to June 2011.

The results show that the significance of rating changes for the spread developments is large, both for financial and industrial bonds. The specification differentiating between the direction of rating changes shows that the systematic and statistically significant reaction of spreads to rating changes is driven by downgrades. For both groups of bonds, there is a strong market reaction to unfavourable rating moves, while no significant reaction can be detected for upgrades. This result is in line with the usual findings regarding information processing in financial markets, which show that bad news tend to move the markets more strongly than good news (e.g. Andersen, Bollerslev, Diebold, and Vega (2003)).

In the second step, we test for the differences in market reaction to rating changes between the crisis and non-crisis periods. For this purpose, we conduct regressions corresponding to equations 1 and 2 for the financial sector bonds in these two different periods. The crisis period is defined as: August 2008 to Jun 2011, while the non-crisis

[6]The rating scale used for the regressions corresponds to: $Aaa = 1$, $Aa1 = 2$, $Aa2 = 3$, $Aa3 = 4$, $A1 = 5$, $A2 = 6$, $A3 = 7$, $Baa1 = 8$, $Baa2 = 9$, $Baa3 = 10$.

period is defined as: January 2004 to December 2006. The exact start and end dates of the periods do not influence the results. We only estimate coefficients for variables, for which there are more than 200 observations. In this way, we are able to avoid reporting results driven by possible fixed effects occurring in a particular month, in which they might have been a large number of downgrades or upgrades. This restriction enables us to estimate separately coefficients for the strength of the market reaction to downgrades in the crisis period and to upgrades in the non-crisis period, but leaves us with too few observations to estimate the coefficient corresponding to upgrades during the crisis period and downgrades in the non-crisis period.

Table 4: Influence of rating changes on financial spreads in non-crisis and crisis periods

	Non-crisis			**Crisis**		
α_0	0.00^{**}	0.00^{**}	0.00^{**}	0.07^{***}	0.07^{***}	0.06^{***}
α_1	-0.01^{***}	-0.01^{***}	-0.01^{***}	0.02^{***}	0.02^{***}	0.01^{**}
α_2	0.01^{**}	0.01^{**}	0.01^{**}	-0.00	-0.01	-0.01
β		-0.00			0.20^{***}	
β_D						0.26^{***}
β_U			-0.00			

NOTE: This table reports the regression coefficients corresponding to equations 1 and 2 for bonds during the non-crisis and crisis periods. Due to the specification of the rating scale, the downgrades are positive numbers and upgrades are negative numbers. Therefore, positive coefficients for β_D mean an increase in spread, while positive coefficients for β_U mean a decrease in spread. The crisis period is defined as: August 2008 to Jun 2011, while the non-crisis period is defined as: January 2004 to December 2006. The number of observations underlying the analysis: 1260 downgrades in the crisis period, 238 upgrades in the non-crisis period. 124 downgrades in the non-crisis period as well as 105 upgrades in the crisis period are considered as too few to significantly estimate the coefficients representing several different months.

The results presented in Table 4 show that the market reaction to rating actions is indeed dependent on the current state of the market. During the crisis period, a strong significant reaction of the spreads to rating changes can be observed. During the non-crisis period, however, market participants seem to put less weight on the rating changes as a relevant piece of pricing information. Such an asymmetric reaction could be, for example, a reflection of a stronger sensitivity to any bad news during the periods of unfavourable market conditions. Another explanation of the strong price reaction to ratings during the crisis could be the higher importance of bond ratings for financial investors during the period of deleveraging. In particular, in the crisis period, when banks and possibly other financial investors need to reduce the risks on their balance

sheets, every rating downgrade can lead to a portfolio reallocation towards the better-rated assets, which should be reflected in the spreads of the downgraded entity.

In the final step, we control for the possible country-specific effects in the evolution of spreads, also specifically in crisis and non-crisis periods, checking in this way the robustness of the results. We introduce country-related dummies to equation 1, accounting only for countries with at least 20 observations. Due to the size and internationality of the market, we set United States as a benchmark. We test the significance of the country-related variables separately, as well as conduct F-tests for their joint significance. The results are reported in Table 5. The bottom row of the table reports F-statistics for the significance of the country coefficients.

Table 5: The robustness of results with respect to country-specific effects in spread changes

	Whole sample		**Non-crisis**		**Crisis**	
α_0	0.03^{***}	0.03^{***}	0.00^{**}	0.00^{***}	0.07^{***}	0.07^{***}
α_1	0.02^{***}	0.02^{***}	-0.01^{***}	-0.01^{***}	0.02^{***}	0.01^{**}
α_2	-0.00	-0.00	0.01^{**}	0.01^{**}	-0.01	-0.01
β	0.09^{***}	0.08^{***}	-0.00	-0.00	0.20^{***}	0.17^{***}
Austria		-0.03		-0.00		-0.06
Belgium		-0.00		-0.02		-0.05
Finland		-0.04		0.01		-0.11
France		-0.03^{***}		-0.00		-0.07^{*}
Germany		-0.03^{***}		-0.01^{**}		-0.06^{*}
Greece		0.91^{***}				1.60^{***}
Ireland		0.10^{***}		-0.01		0.57^{***}
Italy		-0.01		0.00		-0.06
Luxembourg		-0.03		-0.02^{***}		-0.00
Netherlands		-0.04^{***}		-0.00^{*}		-0.06^{*}
Portugal		0.09		-0.01		0.10
Spain		-0.01		0.00		-0.04
United Kingdom		0.08^{***}		-0.01^{***}		0.23^{***}
F-stat countries		0.00		0.00		0.00

NOTE: This table reports the coefficients corresponding to the equation 1, also including the country-specific dummies. Due to the specification of the rating scale, positive coefficients for β mean an increase (decrease) in spread following a downgrade (upgrade). The bottom row of the table report F-statistics for the significance of β-coefficients and country-specific dummies. The sample period is January 1999 to June 2011. The crisis period is defined as: August 2008 to Jun 2011, while the non-crisis period is defined as: January 2004 to December 2006. Countries with less than 20 observations are excluded.

The results show that country-specific effects are significant but do not change the results regarding the impact of rating changes on bond spreads. During the crisis period, the bonds of issuers from some of the countries, most notably France, Germany and the Netherlands, were characterized by lower yields than the average. The bonds of issuers

from Greece, Ireland and the UK, on the other hand, had relatively higher yields. Additionally, in the non-crisis period, there is some evidence for tighter spreads of bonds from Luxembourg, Germany and the UK.

4 Conclusion

This paper contributes new evidence on market reaction to the information on credit signals released by the rating agencies. The results are important from the perspective of recent discussions, where some market commentators claim that the ratings lag market intelligence, and therefore in most cases they cease to be a relevant information source.

We examine the relation between market pricing and rating actions for a very large and comprehensive sample of corporate bonds. Our data allows us to test systematically whether there is a pattern following rating downgrades and upgrades. Also, due to the length of our sample and its broad coverage, we are able to test for country- and industry-specific effects, as well as to show the change of these relationships depending on the state of the markets.

The results show that for both financial and industrial bonds, significant movements in spreads are systematically observed in response to the rating actions. However, only downgrades tend to move the markets substantially. Moreover, we show that the effects of rating actions on market prices depend on the current market conditions. In the period of crisis, there is stronger evidence of systematic reaction of spreads to the rating downgrades. In the period of favourable market conditions, rating actions tend to be less important for market pricing. Finally, we show that although some country-specific effects are significant, they do not change our main findings. As a possible future extension to this work, time-varying sensitiveness of market pricing to ratings could be modeled more specifically.

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