Charles University in Prague

Faculty of Social Sciences
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MASTER THESIS

Credit rating agencies and their impact on the bond markets of EU countries

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Declaration of Authorship

The author hereby declares that he compiled this thesis independently, using only the listed resources and literature.

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Prague, January 7, 2013

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Signature

Acknowledgments

Abstract

This thesis analyses long and short-term perception of announcements issued by leading credit rating agencies (Fitch, Moody's and S&P) in sovereign bond markets. Using three empirical approaches we assess the nature of impact of CRAs on 10Y sovereign bond yields and 5Y CDS of 24 countries of EU between 2002 and 2012. We find significant response of sovereign bond yield and CDS spreads to downgrades and negative outlooks. Furthermore there is evidence of anticipative power of sovereign bond markets in foreseeing negative events implying CRAs lag the market. The spillover effect from credit rating announcements has been revealed between both EMU and non-EMU parts of EU implying the financial integration is not limited only to countries with common currency. Well performing economies outside EMU are resistant to contagion.

JEL Classification	C23, F34, G10, G14, G15
Keywords	credit rating; credit default swap; rating agency; sovereign bond; EU
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Abstrakt

Tato studie zkoumá dlouhodobý a krátkodobý vliv oznámení o změně úvěrového hodnocení předních ratingových agentur (Fitch, Moody's a S&P) na trhy se státními dluhopisy. Za pomocí třech empirických přístupů hodnotíme vliv ratingových agentur na desetileté vládní dluhopisy a pětileté instumenty na zajištění vládních dluhopisů na vzorku 24 zemí EU mezi lety 2002 a 2012. Závěry šetření ukazují, že snížování hodnocení dlouhodobých závazků a negativní výhledy mají vliv na na trhy s vládními dluhopisy a jejich pojištěním. Dluhopisové trhy navíc mají schopnost předvídat negativní zprávy ratingových agentur, což implikuje, že agentury trhy nevedou, ale spíše jsou ve svých výnosech vůči trhům opožděné. Efekt nákazy způsobený výnosy ratingových agentur funguje nejen v rámci eurozóny ale i mezi zeměmi eurozóny a zeměmi mimo ni. Jednotná měna tak není nutnou podmínkou pro propojení dluhopisových trhů. Země s doboru ekonomickou výkonností a mimo eurozónu jsou více odolné vůči nákaze.

| **Klasifikace** | C23, F34, G10, G14, G15 |
| **Klíčová slova** | Úvěrové hodnocení; pojištění proti nesplacení dluhopisu; ratingové agentury; vládní dluhopis; Evropská unie |

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Acronyms

APEC	Asia Pacific Economic Cooperation
APT	Arbitrage pricing theory
bp	basis point (i.e. 1/100 of percentage point)
CAPM	Capital asset pricing model
CDS	Credit default swap
CRA	Credit rating agency
EMU	European Monetary Union
ESMA	European Securities and Markets Authority
EU	European Union
Fitch	Fitch Ratings Ltd.
Moodys	Moody's Investors Service, Inc.
PIIGS	Portugal, Ireland, Italy, Greece and Spain
SnP, S&P	Standard & Poor's Financial Services LLC

Master Thesis Proposal

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Proposed Topic:

Sovereign credit ratings' impact on the European bond markets: A link between East and West

Topic Characteristics:

Sovereign bond yields and credit default swaps are in the center of attention following their increase caused by events of 2008 and rising suspicion of markets about the real explicative power of countries' macroeconomic fundamentals. The responsiveness of capital markets to changes in credit ratings has been usually depicted on data from stock markets. However credit announcements might influence sovereign bond markets too (according to existing research). This was already shown especially in case of emerging economies. In this thesis I would like to examine the presence of this effect for the European markets and evaluate its causality, contagion power, spillover effect and persistence. Furthermore I will try to describe the means of reaction of Eastern European government bond yields to changes in Western European sovereign credit ratings. In addition we make comparison between the sensitivity of government bond yields to sovereign credit rating announcements before and after the start of recent financial crisis. We fell those findings could serve to enhance understanding of the role of rating agencies and the response to their signals in bond markets.

Hypotheses:

1. Sovereign bond yield spreads of Eastern European countries are sensitive to changes in Western European sovereign credit ratings and vice versa.
2. The sensitivity is stronger in case of Eastern European bond yields.
3. Responsiveness of government bond yields to sovereign credit rating announcements increased after the events of 2008.
4. Bond yield spreads have the power to anticipate the credit rating announcements.
5. There is a contagion effect of changes in Hungarian credit rating on other countries in the area.
6. Reaction to the signals (watch, outlook) usually implies stronger reaction than the actual credit rating changes.

Methodology:

Concerning the topic of the impact of credit rating announcements on sovereign bond yields and CDS spreads, we would summarize the up to now literature. We would cover the basic determinants affecting the sovereign bond yield too. Based on the daily data for EU countries from mid-90's to date we perform an event analysis observing the impact of sovereign credit rating changes of three well known rating agencies (Fitch, Moody's and Standard & Poor's) in a time window of up to several weeks before and after the announcement (to correct our estimates for external economic factors we would track the short-term 1 day window too). Testing for causality in panel data (e.g. using Granger causality) we would like to explain the possibility for contagion effect between the eastern and western parts of Europe and to find evidence of contagion from lower to higher rated countries. The effect of persistence should be explained by simple comparison of countries with same rating valuation obtained in different time with respect to their sovereign bond yield spreads. The construction of sovereign bond yield spreads or/and CDS spreads would be done with respect to chosen benchmark country (i.e. Germany). The common market indicators (such as stock market indices) should be used to improve our estimates if needed and to account for other bond yield determinants.

Outline:

The expected outline is as follows

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Author   Supervisor

1   Introduction

European governments nowadays struggle with big fiscal deficits even though they all share the ambition to trim them down. Large public debts as a result of recent financial turmoil drew attention to bond markets and raised awareness in both sovereign bond yields and credit default swaps as important players in the market for financial instruments. According to some authors (e.g. Jablecki, 2012) previous capital-adequacy regulations in European banking sector led banks privilege highly rated asset-backed securities such as mortgage backed securities or sovereign debts (through bonds). Concentrated sovereign risk on European banks' balance sheet might have actually worsen sovereign debt problem since government bailouts in fact widened fiscal deficits while banks continued to hold the sovereign bonds in their portfolios.

Countries usually issue bonds to raise necessary funds for their operations (e.g.: to finance their deficits). Since they are issued by national governments they are usually denominated in country's own currency. Sovereign bonds are normally considered as government bonds issued in foreign currency. However since the existence of Euro zone this strict division line has been broken.

Bonds issued by national authorities are widely considered as a safe investment (also referred to as *risk-free*[1]) because they are backed by governments which should be able to redeem the bond at maturity. Exceptionally, countries may default on their debts, which is an additional portion of risk an investor should account for. Government bonds are issued with different maturities ranging from short-term (e.g. 1 year) to long-term (e.g. 20 years). In some countries authorities use different terminology for government bonds (such as *bunds*, *treasuries* or *gilts*). Bond yields are used to value government bonds as they express their return (yield) to maturity in percentage points. This yield tells us the total return we receive if the bond is held until a specific future date (maturity).

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[1] This could hold in terms of credit risk. However one has to consider other factors such as currency risk or inflation risk.

To protect investors from the risk of default of a bond a financial swap agreement called credit default swap (CDS) exists. This instrument compensates the buyer in case of unfavorable credit event (e.g. default) in exchange for a fee associated with the risk of protecting the investment in bond.

Credit default swaps are commonly priced in basis points, so the price for the protection buyer is derived as a portion of protected debt[2]. This portion is in fact a measure of the credit risk. The market for CDSs has rapidly grown since the introduction in the 1990s. According to Stulz (2009:13), the notional amount of CDSs was $180 billion in 1998 while 10 years after it amounted to $57 trillion. However the market for CDSs has slackened significantly during the recent crisis.

Credit rating agencies (CRAs) in this environment issue recommendations basically describing credit worthiness of debt issuing institutions (i.e. ability of those institutions to pay the loan back). The basic logic of credit rating is that CRAs should make it easier for an investor to distinguish low-risk investment (with highest rating, such as AAA) from high-risk securities (usually near or within the speculative grade).

Furthermore some parties such as institutional investors are directly obliged to take positions in investment grade securities only, whereas the quality of security is taken as granted from assessment of CRAs. Despite the alleged status of benchmark, CRAs have been recently heavily criticized for lacking both anticipatory and explicative power or for being biased[3].

CRAs use variety of information resources including their own risk-assessing models to evaluate institutions or instruments. Based on the findings, rating agencies typically signal their intention of rating adjustment (prior to the actual downgrade or upgrade). CRAs issue *outlook* in case of long-term possibility of rating adjustment or *watch* in case of possible adjustment in short term. Despite the traditional chain process of rating change (outlook – watch – rating change) more than one type of adjustment can occur within a single announcement[4] or some announcements can be omitted[5].

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[2] For example CDS valued at 100 basis points means that we are obliged to pay 1 euro to protect 100 euro of debt for certain period of time.
[3] Frost (2006), Poon (2003)
[4] For example downgrade and outlook revision

Recent financial crisis put all European countries under the pressure. Sovereign bond yield and a credit default swap spreads steeply widened as the debt service of national authorities in tight fiscal conditions became a major issue. With rising suspicion about the real explicative power of traditional macroeconomic fundamentals, the debate on the importance of CRA's emerged (Arezki et al., 2011).

The sovereign credit rating assessments influence the decision making process of certain investors, however it has independent impact on market spreads too (Cantor and Packer, 1996). There seems to be an influence of sovereign credit rating issued by the three biggest rating agencies[6] on country's sovereign bond yield and credit default swap spreads. According to Cantor and Packer (1996) this impact exhibits expected direction of influence but goes above and the macroeconomic fundamentals. Therefore credit rating assessments carry added value with effect on the financial markets.

The previous research on credit rating agencies and their impact on bond markets have been primarily focused on emerging economies. One explanation is that debt crisis of governments hasn't been much common issue in developed countries (Reinhart, 2010 in Afonso, 2011). Another reason (although not mutually exclusive) could be the low number of credit rating events for western European countries[7] - the stability of their AAA status[8].

This thesis would like to focus on EU member countries and the interaction of European interconnected bond markets in particular. We use daily data for sovereign bond yields and CDS spreads to measure the impact of sovereign debt rating announcements issued by three major credit rating agencies Fitch, Moody's and Standard and Poor's.

We can distinguish two contributing parts of this thesis. First, our analysis uses short and medium term span to look at the consequences of different credit rating events

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[5] Such as positive (negative) watch/outlook prior to an upgrade (downgrade)
[6] Fitch, Moody's and Standard & Poor's
[7] For example France, Germany, Netherlands and United Kingdom haven't experienced single long term credit rating upgrade or downgrade between 1995 and 2010.
[8] For example Austria experienced first downgrade after more than 10 years in January 2012 from Standard and Poor's and yet other two rating agencies haven't proceed to the same rating action. Germany, Denmark, France, Netherlands and UK haven't experienced a single rating adjustment within the observed period, keeping their AAA ranking.

(downgrades, upgrades and outlooks) across the three major CRAs. With the focus on government bond yield and credit default swap spreads we would like to compare the impact of rating across European countries. In addition we try to assess the persistence of this impact and the anticipative ability of bond markets.

The second part of the analysis is dedicated to spillover or contagion effects between countries in our sample. Converting the character based rating scale into a numerical one (while accounting for credit outlooks) we discuss whether the effect of contagion rating event countries to other (non-event) is present and significant. Given the interrelated market environment in terms of trade linkages and integrity of financial markets we expect the spillover effect of credit rating announcements to be affirmed. However we expect Western European[9] credit rating announcements to have different power in affecting the Eastern European bond markets and vice versa.

The remainder of the thesis is organized as follows. The very next section provides a comprehensive summary of up to date literature related to the research on credit rating agencies and consequences of their operation. Following part explains the origin of datasets used for further analytical insight, their description and reason of their application. Apart from data description this section provides reader with methodological introduction. Section 4 offers a detailed description of the empirical analysis and depicts first outcomes. Finally, Section 5 concludes with recapitulative roundup of our observations and possible generalizations for European bond markets.

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[9] We distinguish Austria, Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia as Eastern European countries while the rest of our EU-24 sample falls in the Western part. This split is primarily based on geographical position, however Austria could be regarded as a part of Western bloc of countries as well as Greece could be treated (according to some authors such as Mackintosh, 2012) as a developing market.

2 Literature overview

Literature dealing with credit rating agencies has grown quite extensively as a result of strong influence of and reliance on CRAs in the world of finance. So did research on sovereign bonds and CDS as the debt financing of fiscal deficits became a threat to stability. In this section we try to summarize relevant up to date literature covering research on CRAs, their rating assessment methods and practices and previously observed linkages to markets for sovereign bond yields and credit default swaps. This part is organized in three sections summing up the factors behind the sovereign rating itself (1), discussing the impact of rating announcements (2) and concluding the up to date findings relevant for this thesis.

2.1 What hides behind the sovereign debt ratings?

Although all three major rating agencies provide an insight on their rating methodologies, the terminal assessment is to some extent subjective[10]. First group of the existing studies dealing with sovereign debt ratings unveils the determinants that yield the rating notation or its change.

Cantor and Packer (1996a) were among the first to conduct a systematic analysis of the determinants and impact of the sovereign credit ratings coming from Moody's and Standard and Poor's. They've found out that credit ratings appear to have independent influence on yields above their correlation with publicly available information. They concluded that six factors appear to play an important role in determining the sovereign rating: *per capita income, GDP growth, inflation, external debt, level of economic development, and default history* (Cantor and Packer, 1996a:49).

According to Bissoondoyal-Bheenick (2005) economic and financial indicators alone do not determine ratings. Authors claim that economic variables don't bare the same importance for highly rated stable economies as they do for the low rated

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[10] For example, despite Moody's in its rating methodology handout on sovereign bond ratings (Moody's, 2008) reveals the economic indicators to be accounted for in the assessment, the relative weights of those factors are virtually untraceable.

countries undergoing structural reforms (where the importance of economic variables is intuitively much higher). In addition the relative weights of each variable alter both across countries and in time.

Afonso et al. (2011) distinguished long run and short run determinants of sovereign credit ratings. They claim the GDP per capita, real growth rate of GDP, government debt and government deficit to be the core variables in the short run. On the other hand the cross country differentiators such as government effectiveness, external debt, foreign reserves and sovereign defaults bare the long-run impact.

Alexopoulou et al. (2009) observed selected European countries that joined EU in 2004 or later with an assumption that those countries move towards equilibrium due to the obligation to fulfill criteria set by the Maastricht Treaty. They've found that external debt-to-GDP measure, inflation, exchange rates, openness to trade, changes of relative short term interest rates and volatility of equity markets in the Euro zone are the main determinants of spreads in the long run. They've succeeded to explain majority of variation in spreads in Czech Republic, Latvia, Lithuania, Bulgaria and Poland using macroeconomic fundamentals. Furthermore authors identified a group of countries which is more vulnerable to external conditions: Bulgaria, Latvia, Hungary and Romania.

Finally Afonso and his colleagues (2007) employ random effects ordered probit approach to study determinants of sovereign debt credit rating for the 10 year period since 1995. They find evidence for different approaches of the agencies in their usage of rating thresholds. For Moody's countries close to speculative grade rating are given wider range before they cross to investment grade area. In case of Fitch authors found that the thresholds for higher ratings are wider than those for lower rated countries while no particular switching pattern was affirmed in case of Standard & Poor's approach. Furthermore authors claim that external debt and external reserves variables are important for determination of low rating levels while inflation is a big clincher for high rated investment grade countries.

2.2 Sovereign debt rating and its impact on financial markets

The other branch of research papers studies the explanatory power of sovereign debt ratings. For instance Brooks et al. (2004) examine the own-market consequences of sovereign market changes between 1973 and 2001. They find downgrade rating announcements to have significant effect on domestic stock market. Furthermore the negative rating announcements are said to deteriorate the value of country's currency against the dollar. According to their conclusions there is no evidence to affirm sensitivity of emerging markets to rating changes.

Kaminsky and Schmukler (2002) uncover again the direct affection of domestic stock market through sovereign debt rating changes and point out the rating announcements generate cross-country contagion too. In addition they observe the effect of rating events being stronger in particular conditions: *during economic downturns, in non-transparent economies, and in neighboring countries*. They support the idea that CRAs foster the instability in emerging economies.

Cantor with Packer (1996a) were probably among the first to mention that sovereign credit ratings supplement the information contained in macroeconomic indicators and are hence strongly correlated with market-determined credit spreads. On the other hand their event study analysis confirmed that CRAs independently affect market spreads. Surprisingly, according to Cantor and Packer more anticipated rating announcements lead to stronger impact on spreads.

Kraussl (2005) investigates whether sovereign rating changes during the period of crisis had an impact on financial stability in emerging economies. He argues that the influence of government bond spreads is not a good approach since emerging market economies don't have well developed financial markets. Due to this reason he presents an indicator of speculative market pressure specified as a weighted average of daily nominal exchange rate changes, short term interest rate changes as well as stock market changes. With the data sample on sovereign debt ratings[11] from January 1997 to December 2000, he concludes that CRAs have substantial influence on the size and

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[11] From Moody's and Standard & Poor's

instability of emerging markets lending with significantly stronger results for unpredicted downgrades and other imminent negative rating events (compared to positive rating announcements).

Reisen and von Maltzan (1998) claim that rating agencies react to events rather than succeed in anticipating them and therefore shouldn't be taken too seriously by investors. They use data for 49 countries and Granger causality test which yields to evidence of a two-way causality. Contrary to their expectations, rating adjustments proved to have significant influence on both bond yield spreads[12] and stock markets. Again, the downgrades bare stronger effect than positive announcements and rating outlooks mitigate the effect of terminal adjustment.

Sy (2002) uses sovereign bond yield spread data and credit ratings for 17 emerging market countries to emphasize stylized facts on the relationship between spreads and ratings. He argues that despite the criticism of credit rating agencies as unsuccessful anticipators of a crisis, the significant differences between rating agencies, spreads and political fundamentals could be used as a signal that further market adjustments are to come. An interesting takeaway from this paper is Sy's flexible framework that controls for technical factors and disagreements with rating agencies by correcting the ratings.

As for the more current research, Isamailescu and Kazemi (2009) study the impact of sovereign credit rating announcements on CDS spreads of countries themselves and on other emerging countries' CDS premiums – the spillover effect. Using dataset of 22 emerging economies during the years 2001 – 2008 they find evidence for an asymmetric instantaneous reaction of CDS spreads to credit rating announcements. In this case, positive rating events have more consistent impact in markets for CDS. Furthermore they provide verification for anticipation of credit rating news in CDS premiums. Concerning the spillover impact into other emerging markets, authors find evidence that positive events are more likely to do so. They underline that the magnitude of a spillover effect in case of positive event is affected by the current credit rating of the home country. On the other hand the degree of spillover in case of negative event is subordinated to the rating of the event country. Positive events yield

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[12] Relative to the U.S. Treasuries

higher change in the CDS spread of non-event high-rated country than do for low-rated economies. On the contrary the reception of negative rating event for non-event countries is stronger when the announcement comes from the country of low credit quality. Finally Imailescu with Kazemi conclude that negative events are more likely to be predicted and that percentage changes of CDS spreads provide good signal to anticipate a negative rating announcement.

Afonso et al (2011b) examine sovereign credit rating announcements (downgrades, upgrades and outlooks) on sovereign bond yield spreads and credit default swaps for EU countries using data from January 1995 until October 2010. They provide evidence for significant response of government bond yields on both credit rating changes and outlook announcements, particularly for negative events. According to their conclusions sovereign bond yield spreads respond weakly to positive events in European monetary union, while the effect for countries outside the Euro zone is more mitigated. They find CDS spreads more responsive to negative announcements during the sub-period following the fall of Lehman Brothers[13] than in the period prior to financial turmoil. They haven't confirmed the market anticipation of rating announcements in the long run but approved for the bi-directional causality in short term window. Furthermore, according to their research lower rated economies of EU cause spillover effect on higher rated ones.

Recent paper from Bissoondoyal-Bheenick (2012) focuses its analysis of spillover effect of Standard & Poor's and Moody's rating announcements on Asia Pacific Economic Cooperation (APEC) countries between January 1990 and December 2001. According to her results there is enough evidence for contamination effect from downgrades. Concerning the transmission mechanism for spill over, the international financial linkages between observed countries lead to stronger contagion, while trade links between APEC economies yield less significant results. Although rating downgrades bare significant consequences for domestic bond yields (whereas upgrades fail to carry informative value of the same impact), Bissoondoyal-Bheenick stresses out that we can't attribute this ability to both agencies.

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[13] 15th of September 2008

Claeys with Vašíček (2012) examine EU sovereign markets using forecast-error variance decomposition to conclude, that the spillover effect is more important than the domestic factor among the eurozone countries. The impact of spillover is generally stronger for downgrades of lower rated countries. More specifically, the variance of bond spreads in EMU countries is from two thirds attributable to spillover effect, while the mutual influence in CEE countries is much weaker. Finally countries such as Denmark, Sweden and the UK are resistant to rating news in EU countries.

Several studies take into consideration whether the country of interest holds investment grade or speculative grade long-term government debt rating. Jaramillo and Tejada (2011) use panel framework for 35 emerging economies between 1997 and 2010 to conclude, that investment grade status itself reduces sovereign bond spreads by 36 % above and beyond macroeconomic fundamentals. Further rating upgrades within the non-speculative range bring up to 10% reduction while there is no significant impact for one notch movements within the speculative grade. Kamin with von Kleist (1999) show on that while spreads of speculative grade countries were during the 90s sensitive to crises such as the Mexican one of 1994[14], investment grade economies enjoyed steady decline throughout the major part of that decade. In addition they estimate the one notch decrease in credit rating within the investment grade to account for 21% increase of sovereign bond yield spread while the same rating deterioration in the speculative grade yields to 26 percent increase in spreads[15]. On the contrary Cavallo et al. (2012) based on their test on the importance of rating changes across the rating scale conclude that changes between the asset classes have no additional explanatory power in comparison with all the other credit rating adjustments[16].

Some authors also question the endogeneity of ratings. Gonzalez-Rozada and Yeyati (2008) are trying to explain the variation in bond yield spreads for 33 emerging economies. According to their findings the large fraction of variability is explained by global factors (i.e. risk appetite, global liquidity and contagion from systemic events – e.g. defaults). On the other hand the credit rating changes seem to lag spread

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[14] They reported increase in spreads followed with decline
[15] Kamin and von Kleist (1999:16-17)
[16] Cavallo et al. (2012:3)

movements and have little if any additional effect on the pricing of sovereign debts – thus being rather endogenous.

2.3   Key takeaways from relevant up to date literature

According to the previous studies there is evidence for existence of factors with strong influence on sovereign ratings. However the importance of each factor substantially varies across time and different countries. GDP per capita, inflation, external debt and level of economic development belong to the most quoted determinants. Some authors break them down to short-run and long run factors (e.g. Afonso et al., 2011), while others distinguish internal and external determinants (e.g. Alexopoulou et al., 2009). According to Sy (2002) the informational asymmetry between credit rating agencies, bond spreads and economic fundamentals increases the probability of rating change. There is also a discussion about the endogeneity of credit rating as the CRAs tend to lag the market and use the same publicly available information (e.g. Gonzalez-Rozada and Yeyati, 2008 or Mora, 2005). More importantly these factors, along with other risk elements common for the international financial markets, overlap extensively with determinants of sovereign bond yield spreads, which is an important fact for this study as we take credit rating events as one of the sources of volatility in the bond markets.

While less recent branch of literature addresses the explanatory abilities of sovereign credit ratings for the development of stock markets, the more up-to-date research focuses on the impact of rating on bond markets (i.e. bonds or CDSs). The influence of credit rating changes on stocks is described by Brooks (2004), Kaminisky and Schmukler (2002), Cantor and Packer (1996a), Kraussl (2005) or Reisen and von Maltzan (1998). Brooks (2004) describes a significant effect of downgrade rating announcements on domestic stock market, but disapproves this sensitivity in emerging economies, while Kaminsky with Schmukler (2002) conclude the CRAs foster the instability in emerging markets. Canton with Packer (1996a) elaborate that CRAs bring additional information, while Reisen with von Maltzan (1998) claim rating agencies lag the market. Furthermore Canton with Packer (1996a) found out that anticipated rating

adjustments have stronger impact on spreads whilst Riesen and von Maltzan (1998) suspect outlooks of mitigating the effect of eventual credit rating grade adjustment.

Sy (2002), Isamailescu and Kazemi (2009), Afonso et al (2011b) or Jaramillo and Tejada (2011) focus on the stylized facts regarding the relationship between spreads and sovereign rating. They find evidence to support the general consensus already seen in the stock-markets: credit rating downgrades and negative outlooks are more influential compared to positive events. Furthermore some focus in more detail on contagion. For instance Alexopoulou et al. (2009) distinguished countries with spreads more vulnerable to external conditions, Isamailescu with Kazemi (2009) broke down the different magnitudes of spillover according to the credit ratings of both the impacted country and the event country and Afonso et al. (2011b) claimed lower rated EU countries to cause spill over towards higher rated. This is supported by Isamailescu and Kazemi (2009) – according to them emerging countries are usually behind spillover. Bissoondoyal-Bheenick (2012) stresses out that the impact differs with each agency and that the transmission mechanism is rather built up on financial linkages than on trade links or geographical proximity. Finally Claeys with Vašíček point out there is a strong spillover effect between EMU countries and less influential among CEE countries while Denmark, Sweden and the UK are unaffected by EU rating announcements.

3 Data and methodological overview

As depicted in the introduction, we are about to survey the impact of various credit rating events (both sovereign credit rating changes and outlook announcements) on sovereign bond yield spreads and credit default swap spreads. We use dataset of 24 EU countries (EU-27 excluding Cyprus, Luxembourg and Malta).

3.1 Selection and distribution of rating events

Concerning the ratings, we use data obtained from the top three rating agencies: Standard and Poor's, Moody's, and Fitch ratings. Between January 1, 2002 and April 18, 2012, we have collected 479 rating events in total. Actual rating changes account for almost half of those events (233). That is further composed of 132 downgrades and 101 upgrades. Apart from the rating changes, we are going to examine 178 negative and 68 positive outlook events. Outlook events consist of both short-term (credit watch) and long-term announcements (outlook). We are going to treat them as equal while observing the immediate impact on sovereign bond yield or CDS spreads. However, their respective anticipative terms (as given by each agency's guidelines) are exploited in the assessment whether the rating change was predicted or not. We can qualify rating change (downgrade or upgrade) as being anticipated under the condition that an outlook of the same direction (i.e. positive before upgrade or negative before downgrade) has been issued prior to the rating event by the same agency. Under this condition more than 75 % of downgrades are anticipated, while less than 40 % of upgrades are being signaled with positive outlook announcements.

The dataset for credit rating events is aggregated from websites of respective rating agencies. We follow long-term foreign currency denominated obligations rating as it is commonly used in comparable studies (see e.g. Cantor, 1996a), although the demand for domestic rating of sovereign obligations is on the rise (Packer, 2003). Some countries in our sample presumably hold debt denominated in foreign currency and some of the EMU countries hold debt in EUR which wasn't historically (i.e. in the

earlier parts of the dataset) their domestic currency[17]. Negative and positive outlooks are included in the dataset as well

Rating events are unequally distributed throughout the 10 years with 2007 as the period with only 13 events and 2011 as the imaginary peak year with 99 observations. The annual average is 40 announcements. 48 percent of rating announcements was issued between October and January while another four of months – May, June, August and September, accounts for less than 20 % (Figure 3.1).
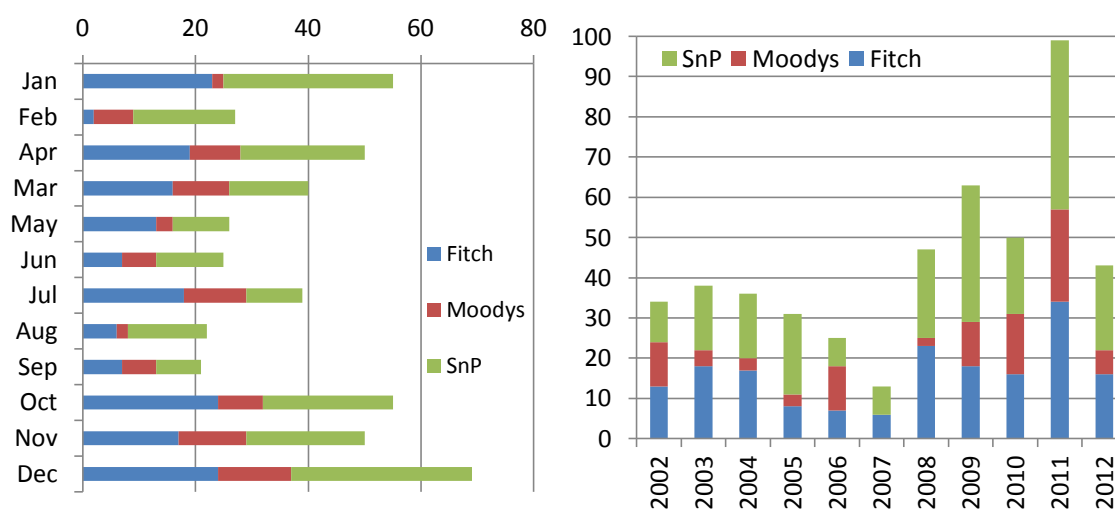

Figure 3.1 - Rating events between 2002 and 2012 – monthly and annual distributions by CRA

Standard & Poor's seems to be effectively the most active agency with 214 rating announcements. Moody's is much more modest in its communication with only 89 rating events. The number of rating announcements for the Eastern bloc dominates with 285 observations (50 downgrades, 85 upgrades, and 75 negative and 65 positive outlooks) whereas Western bloc comprises of 204 announcements (82 downgrades, 16 upgrades, and 103 negative and 3 positive outlooks). This simple summary suggests that recent 10 years were rather positive, in terms of rating activity, for Eastern bloc of economies (improving their creditworthiness according to upgrades) whilst Western part of EU has lost a significant portion of its reputation in the sovereign bond markets[18].

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[17] i.e. Estonia, Slovakia or Slovenia.
[18] Notably there are two reasons for the decline: 1.) the Western European countries were enjoying high rating grades prior to the crisis; 2.) The descent was driven predominantly by a small group of countries: southern countries and Ireland, also known under the acronym PIIGS (Portugal, Italy, Ireland, Greece and Spain).

Looking at the distribution of credit rating announcements among the observed countries[19] we find out a big portion of them is represented by Greece (55 events), Lithuania (42 events), Latvia (37 events) and Portugal (35 events). On the other hand countries like Austria, Czech Republic, Denmark, Finland, France, Germany, Netherlands, Sweden and the UK all account for less than 10 observations each.

Since each agency has in many ways similar rating scale, we are able to unify the rating notations in 20 groups as shown in Table 3.1.

Risk band	Fitch	Moody's	SNP	Notation	
Prime	AAA	Aaa	AAA	1	investment grade
High grade	AA+	Aa1	AA+	2	investment grade
High grade	AA	Aa2	AA	3	investment grade
High grade	AA-	Aa3	AA-	4	investment grade
Upper medium grade	A+	A1	A+	5	investment grade
Upper medium grade	A	A2	A	6	investment grade
Upper medium grade	A-	A3	A-	7	investment grade
Lower medium grade	BBB+	Baa1	BBB+	8	investment grade
Lower medium grade	BBB	Baa2	BBB	9	investment grade
Lower medium grade	BBB-	Baa3	BBB-	10	investment grade
Non-investment grade	BB+	Ba1	BB+	11	non-investment grade
Non-investment grade	BB	Ba2	BB	12	non-investment grade
Non-investment grade	BB-	Ba3	BB-	13	non-investment grade
Highly speculative	B+	B1	B+	14	non-investment grade
Highly speculative	B	B2	B	15	non-investment grade
Highly speculative	B-	B3	B-	16	non-investment grade
High risk	CCC	Caa1	CCC+	17	non-investment grade
Substantially risky	CCC	Caa2	CCC	17	non-investment grade
Default with some chances of recovery	CCC	Caa3	CCC-	17	non-investment grade
Default with some chances of recovery	CC	Ca	CC	17	non-investment grade
Default with some chances of recovery	C		C/CI/R	17	non-investment grade
Selective Default	D	C	SD	17	non-investment grade
Default	D		D	17	non-investment grade

Table 3.1 - Fitch, Moody's and Standard & Poor's by rating logic

Some adjustments were made within the substantially risky part of non-investment group where, for instance, Moody's and S&P have three different grades[20] while Fitch has only one (C). As the number of observations in the high-risky zone is

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[19] For detailed overview please refer to Appendix B
[20] Caa1, Caa2, and Caa3 for Moody's and CCC+, CCC, and CCC- for S&P

notably small we merge all the sub-B grades in one basket. This allows us to measure the impact of one-notch move on the rating scale being 1 the prime rating for highly creditworthy countries (such as Germany) , and 17 the worst notation used in case of default.

3.2 Sovereign bond yields and credit default swaps

For the sovereign bond yield quotations we use daily data for 10-year government bonds obtained from Reuters Wealth Manager. This allows us to employ 50.418 observations for further analysis. We use daily spread as a proxy for bond yield, computed as a simple difference between daily end-of-day quotation of particular country's government 10-year note yield and it's German equivalent[21]. We don't have enough observations to observe the bond yield movements throughout the full 10 year period for every country in the sample. In fact we have the complete datasets for 12 of them. Some of the missing daily observations were linearly interpolated from the preceding and following day to balance the panel.

Data description – spreads of 10Y government bonds (bp)						*Assigned rating (as of Dec 2012)*		
Country	*Obs.*	*Mean*	*St.dev.*	*Min*	*Max*	*Moody's*	*SnP*	*Fitch*
Austria	3,159	27.85	30.06	-23.57	183.83	Aaa	AA+	AAA
Belgium	2,225	48.53	61.48	-2.00	360.48	Aa3	AA	AA
Bulgaria	2,476	207.92	134.15	12.28	530.86	Baa2	BBB	BBB-
Czech R.	2,518	61.55	67.22	-41.57	271.86	A1	AA-	A+
Denmark	2,639	17.21	13.73	-32.35	72.35	Aaa	AAA	AAA
Finland	2,639	20.28	23.58	-9.49	110.54	Aaa	AAA	AAA
France	2,639	21.81	29.02	-2.76	188.88	Aaa	AA+	AAA
Greece	2,640	339.70	694.65	7.88	3,804.9	C	CCC	CCC
Hungary	2,639	391.31	146.33	149.73	959.14	Ba1	BB+	BB+
Ireland	1,620	224.84	263.01	-4.37	1,180.4	Ba1	BBB+	BBB+
Italy	2,639	77.74	101.89	8.88	550.12	Baa2	BBB+	A-
Latvia	1,925	339.74	364.33	-461.43	1,338.0	Baa3	BBB-	BBB-
Lithuania	2,354	215.84	281.76	-225.01	1,161.2	Baa1	BBB	BBB
Netherlands	2,639	16.22	17.54	-6.59	86.68	Aaa	AAA	AAA
Poland	2,639	234.57	80.43	51.90	440.80	A2	A-	A-
Portugal	2,639	155.11	294.24	-5.30	1,554.3	Ba3	BB	BB+
Romania	1,189	542.07	149.45	241.04	897.54	Baa3	BB+	BBB-
Slovenia	1,282	227.15	158.34	-26.19	551.89	Baa2	A+	A-
Spain	2,639	65.56	102.96	-8.48	470.29	Baa3	BBB-	BBB

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[21] German bonds are widely looked at as the less risky and less volatile in the region, therefore they are frequently used in construction of spreads to allow for corrections in global market factors causing the movements in bond markets.

Sweden	2,639	11.41	25.82	-62.22	69.05	Aaa	AAA	AAA
UK	2,640	56.58	30.10	-13.80	117.34	Aaa	AAA	AAA
Total	50,418	139.68	253.78	-461.43	3,804.9			

Note: Sovereign bond yield spreads are denoted in basis points.

Table 3.2 - Data description – sovereign bond yield spreads (Source: Reuters)

The limited availability is significant[22] especially for Ireland, Latvia, Romania, and Slovenia. Main reason for the lack of data is the historical low liquidity in bond markets of the above mentioned economies[23].

Data description – CDS spreads						*Assigned rating (as of Dec 2012)*		
Country	*Obs.*	*Mean*	*St.dev.*	*Min*	*Max*	*Moody's*	*SnP*	*Fitch*
Austria	2,157	23.59	33.58	-4.40	178.48	Aaa	AA+	AAA
Belgium	2,157	37.47	58.03	-3.50	284.07	Aa3	AA	AA
Bulgaria	2,157	144.96	126.19	10.10	604.39	Baa2	BBB	BBB-
Czech R.	2,157	34.20	40.44	0.40	262.08	A1	AA-	A+
Denmark	2,157	9.42	19.15	-19.84	198.76	Aaa	AAA	AAA
Estonia	1,613	113.64	148.10	-0.80	657.65	A1	AA-	A+
Finland	1,064	-6.57	10.15	-37.67	23.52	Aaa	AAA	AAA
France	1,739	19.18	30.38	-3.10	137.91	Aaa	AA+	AAA
Greece	2,156	1207.2	4738.89	1.20	37003.1	C	CCC	CCC
Hungary	2,157	154.31	154.18	5.00	621.68	Ba1	BB+	BB+
Ireland	2,157	157.53	236.68	-3.70	1188.48	Ba1	BBB+	BBB+
Italy	2,149	72.28	101.31	0.50	490.82	Baa2	BBB+	A-
Latvia	1,631	253.83	247.08	-1.75	1096.46	Baa3	BBB-	BBB-
Lithuania	1,790	169.70	167.63	-1.80	758.70	Baa1	BBB	BBB
Netherlands	1,723	6.36	12.69	-10.78	82.96	Aaa	AAA	AAA
Poland	2,157	66.37	64.03	3.70	337.65	A2	A-	A-
Portugal	2,145	177.65	331.84	-4.10	1512.67	Ba3	BB	BB+
Romania	2,157	168.36	143.15	14.10	699.55	Baa3	BB+	BBB-
Slovakia	2,157	37.81	47.49	0.80	202.15	A2	A+	A+
Slovenia	2,157	42.38	66.14	0.80	340.22	Baa2	A+	A-
Spain	1,818	86.04	106.54	-1.70	401.89	Baa3	BBB-	BBB
Sweden	2,157	7.66	24.38	-53.35	159.60	Aaa	AAA	AAA
UK	1,154	22.96	22.07	-18.18	93.00	Aaa	AAA	AAA
Total	44,866	137.46	1076	-53.35	37,003			

Note: CDS spreads are denoted in basis points.

Table 3.3 - Data description - CDS spreads (Source: Thomson One)

The data for CDS were acquired using Thomson One. We use 5-year senior debt credit default swaps, which is the same instrument Afonso et al. (2011) employ in their analysis. Despite the daily dataset in some cases start as late as in 2007 (UK) or

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[22] We reach about 50 % of data coverage

[23] Please refer to Appendix A for detailed overview of data availability

2006 (Latvia), we've still collected almost 45.000 observations until October 2012. Due to form of data available through Thomson One the time series is derived from two separate instruments for each country[24]. As the separate time series enjoy more or less the same volatility we use 120 days long transition period in the middle of the overlapping section of the two to smoothly approximate the switch between instruments.

Fitch			Moody's			SnP			Average spread		
	Spread			Spread			Spread			Spread	
Rating	Bond (%)	CDS (bp)	Rating	Bond (%)	CDS (bp)	Rating	Bond (%)	CDS (bp)		Bond (%)	CDS (bp)
AAA	0.27	18	Aaa	0.26	16	AAA	0.23	13	1	0.25	16
AA+	0.59	67	Aa1	0.63	53	AA+	0.51	54	2		
AA	0.64	21	Aa2	0.90	53	AA	1.15	60	3	0.99	55
AA-	1.57	103	Aa3	2.13	45	AA-	0.78	40	4		
A+	1.37	82	A1	1.60	64	A+	0.89	68	5		
A	0.51	40	A2	1.73	92	A	1.77	66	6	1.48	84
A-	1.89	75	A3	2.08	190	A-	1.45	81	7		
BBB+	2.68	161	Baa1	3.27	305	BBB+	2.54	144	8		
BBB	3.06	172	Baa2	3.25	242	BBB	3.51	232	9	3.49	225
BBB-	4.01	295	Baa3	4.66	233	BBB-	4.40	239	10		
BB+	6.60	422	Ba1	4.27	298	BB+	5.10	330	11		
BB	2.66	131	Ba2	4.28	498	BB	8.35	407	12	5.85	477
BB-	6.36	N/A	Ba3	11.00	244	BB-	3.98	1,227	13		
B+	N/A	1,915	B1	4.73	1,238	B+	11.12	N/A	14		
B	13.26	N/A	B2	N/A	N/A	B	N/A	1,536	15	13.17	13,358
B-	N/A	36,960	B3	18.34	N/A	B-	N/A	N/A	16		
CCC - D	23.31	7,526	Caa1 - C	25.17	9,898	CCC+ - D	22.96	10,199	17	23.81	9,208

Table 3.4 - Data description – Bond yield and CDS spreads (Source: Reuters, Thomson One)

Several countries out of this sample managed to keep the CDS yield very well aligned with Germany – e.g. Finland, Netherlands or UK. Only one country – Finland - had historically negative mean of basic spread between its own and German CDS on sovereign bonds. This only approves the reasonability of choosing German CDS as one of the best performing instruments in the sample as a benchmark.

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[24] For example we take instruments denoted (on Thomson One) as *HELLENIC REPUBLIC SNR CR 5Y $* and *GREECE SEN 5YR CDS* to construct benchmark 5Y CDS for Greece. The latter spans from January 9, 2004 to September 30, 2010, while the former covers the period from December 14, 2007 until now.

According to the preliminary analysis of bond yield (and CDS) spreads, we can already conclude that position on the rating scale affects the size of the spread vis-à-vis Germany (see Table 3.4 for detailed overview). For instance, a move from investment (e.g. BBB or Baa2) to non-investment (e.g. BB or Ba2) grade widens sovereign bond spreads by approximately 2 percentage points and CDS spreads by around 200 basis points (on average). Costs related to debt-service for AAA rated countries are therefore multiple times lower in comparison with AA rated countries, for who the same costs are substantially lower in comparison with A rated countries and so on and so forth. Interestingly, the average spread for CDS is lower than the bond spread within the investment grade, but exceeds the bond spread as the rating grade deteriorates.

3.3 Methodology

This section provides the reader with overview of our approach to examination of the impact of credit rating announcements on bond markets. It is divided in three sections according to different techniques employed: event study, panel regression and simple regression focused on the effect of spillover.

3.3.1 Event study

In the first part of analysis we would like to employ standard event study approach (comparable to the one used by Ismailescu and Kazemi (2009)). Standard event study method assesses the impact of an event (e.g. announcement) on chosen variable (usually value of a firm, in our case value of a bond/CDS measured by its yield spread to a German bond instrument of the same kind). The classic approach to event study (for example MacKinlay, 1997) is to measure an abnormal return and to decide to what extent is this abnormality attributable to the observed announcement. The method was originally introduced by Fama, Fisher, Jensen and Roll in 1969. They observed monthly abnormal stock returns on selected NYSE stocks.

According to Campbell (1997:151) the abnormal return is "*the actual ex post return of the security over the window minus the normal return of the firm*[25]. The abnormal return could be therefore interpreted as:

$$u_{i,t}^* = R_{i,t} - E[R_{i,t} \mid X_t] \tag{1}$$

In this equation, $u_{i,t}^*$ denotes abnormal return, $R_{i,t}$ stands for actual return on instrument i in time t, and $\mathrm{E}(R_{i,t})$ describes so-called normal returns. X_t is the conditional information necessary for modeling the normal return. There are two possibilities when choosing the appropriate condition.

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[25] Or any other subject to valuation (author's note)

The first option – *constant-mean-return model* – assumes X_t to be the mean return of given security, which is constant over time. For μ_i (the mean return of instrument i), the constant-mean-return model takes following form:

$$R_{i,t} = \mu_i + \xi_{i,t} \tag{2}$$
$$E[\xi_{i,t}] = 0 \quad \text{and} \quad Var[\xi_{i,t}] = \sigma_{\xi_i}^2$$

The second approach to event study is *market model* where X_t denotes the market return. This model assumes linear relation between the market return and observed variable return as well as joint normality of asset returns. Market model takes following form:

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \epsilon_{i,t} \ , \tag{3}$$
$$\text{where } E[\epsilon_{i,t}] = 0 \quad \text{and} \quad Var[\epsilon_{i,t}] = \sigma_{\epsilon_i}^2$$

Stock market indices (such as S&P 500) are commonly used as market portfolio measure. Although other statistical (such as factor model) end economic (CAPM or APT) models are suitable for conducting an event study, *constant-mean-return* and *market* models are the two common choices for normal return modeling.

We index our set of observations using *t*, where *t = 0* indicates the event date. To examine how CDS and bond yield spreads react to change in credit quality (implied by rating notation, outlook or both), we measure the market reaction one day before the event, the event day, and one day after. This way we are able to avoid some contamination of the yields by other factors. We expect bond yield spreads to tighten (expand) every time the positive (negative) announcement comes out (plus shortly before and after). Furthermore we use wider window prior to the event to examine anticipative power of bond-market investors[26] and another one past the event to account for the effect of persistency[27].

As explained above, the standard version of event study approach starts with comparison of model generated and actual yields to connect explanatory variable with measured abnormal returns. We use market model, where $R_{i,t}$ should be calculated

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[26] i.e. 20 to 10 days and 9 to 1 days before the announcement takes place
[27] i.e. 1 to 9 days and 10 to 20 days after the announcement

using observations, where no rating event takes place. Since we don't have enough observations to estimate coefficients for that model, we have to work with reduced market model of following form:

$$R_{i,t} = R_{m,t} + \epsilon_{i,t} \qquad (4)$$

To control for changes in the EU market conditions we further derive an adjusted measure of sovereign bond yield and CDS spreads. This is done by subtracting the country specific mean of spread from $\epsilon_{i,t}$. An adjustment of this kind is in alignment with previous studies on credit rating events (e.g. Afonso et al., 2011b).

3.3.2   Panel regression

The above described event study approach, based on the observation and statistical significance estimation of the mean spreads, may fail to account for patterns of sovereign bond yield (or CDS) spreads as we select only particular observations from the complete time series. Therefore our model could be misspecified, biased or inconsistent (see Leamer, 2008 for detailed discussion).

To deal with potential misspecification we employ country fixed effect panel regression to account for an unmodeled heterogeneity in our sample of countries (for details please refer to Baltagi, 2001). We regress adjusted spreads on several rating dummies to identify types of rating events, rating agency of origin or both. Simple panel regression is specified by following model:

$$AdjS_{i,t} = \alpha_i + \rho AdjS_{i,t-1} + \beta D_{i,t} + \varepsilon_{i,t} \ , \qquad (5)$$
$$\text{where } AdjS_{i,t} = S_{i,t} - \overline{S_i}$$

The coefficient α_i refers to country fixed effects of panel estimation and $D_{i,t}$ is a dummy for country and time specific credit rating announcement. $S_{i,t}$ stands for spread to German instrument, while $S_{i,t}$ refers to adjusted measure of spread (demeaned by country specific average).

For easy implementation of lagged variable in this model we have to include separate trading days into consideration regardless weekends or holidays. In addition, and to control for better explicative power of this model, rating events issued during holidays or weekends are regarded as if they took place during the next available trading session (i.e. day). Unfortunately we were unable to distinguish the particular hour of

origin of a rating announcement. Due to this reason, ratings issued after the market close might be regarded as issued during the trading day they couldn't affect yet. However, the two day event window (surrounding the event) used for estimation should account for those potentially mistaken rating announcements.

Dummies included in panel data are presented in the Table 3.5 below:

Dummy variable	Value	Condition for value assignment
$upgrade_{i,t}$	1	if an upgrade occurs for country i in time t (regardless the agency)
	0	Otherwise
$downgrade_{i,t}$	1	if a downgrade occurs for country i in time t (regardless the agency)
	0	Otherwise
$neg\_outlook_{i,t}$	1	if a negative outlook occurs for country i in time t (regardless the agency)
	0	Otherwise
$pos\_outlook_{i,t}$	1	if a positive outlook occurs for country i in time t (regardless the agency)
	0	Otherwise
$downS_{i,t}$	1	if a downgrade from SnP occurs for country i in time t
	0	Otherwise
$downM_{i,t}$	1	if a downgrade from Moodys occurs for country i in time t
	0	Otherwise
$downF_{i,t}$	1	if a downgrade from Fitch occurs for country i in time t
	0	Otherwise
$upS_{i,t}$	1	if an upgrade from SnP occurs for country i in time t
	0	Otherwise
$upM_{i,t}$	1	if an upgrade from Moodys occurs for country i in time t
	0	Otherwise
$upF_{i,t}$	1	if an upgrade from Fitch occurs for country i in time t
	0	Otherwise
$negS_{i,t}$	1	if a negative outlook announcement from SnP occurs for country i in time t
	0	Otherwise
$negM_{i,t}$	1	if a negative outlook announcement from Moodys occurs for country i in time t
	0	Otherwise
$negF_{i,t}$	1	if a negative outlook announcement from Fitch occurs for country i in time t
	0	Otherwise
$posS_{i,t}$	1	if a positive outlook announcement from SnP occurs for country i in time t
	0	Otherwise
$posM_{i,t}$	1	if a positive outlook announcement from Moodys occurs for country i in time t
	0	Otherwise
$posF_{i,t}$	1	if a positive outlook announcement from Fitch occurs for country i in time t
	0	Otherwise

Table 3.5 - Dummy variables used in panel regression

There is a possibility that we are dealing with some outliers (e.g. considering abrupt increase in the Greek spreads). To account for this, we should employ robust standard errors estimation in the model. In addition we repeat regressions with sample excluding Greece, because we suspect it could bias our result. The suspicion yields even from the initial data overview, where one can see that while mean of CDS spreads of all sample countries but Greece falls into the area of -7 to 254 basis points, the sample mean of Greek CDS spread totals to more than 1200 basis points.

3.3.3 Spillover effect

Previous research suggested that we may observe rating events affect neighboring or other bond markets too (e.g. Kaminsky and Schmukler (2002), Ismailescu and Kazemi (2009) or Afonso (2011b)). There is wide discussion about the nature of the transmission mechanism of the rating spillovers. Frequently suggested transmission mechanisms comprise: common lending center, competition in trade markets or simple geographical proximity.

We regress the adjusted measure of bond yield (and CDS) spreads on their lagged values and on dummy variables signifying a rating event occurrence in another country. This should give us a simple approval or disapproval of the one way spillover effect –the impact of a rating event on bond market of another country. The written form of the regression is as follows:

$$AdjS_{i,t} = \alpha_{ij} + \rho AdjS_{i,t-1} + \beta D_{j,t} + \varepsilon_{ij,t} \qquad (6)$$

$AdjS_{i,t}$ denotes the adjusted measure of spread for country i in time t (as explained in equation (5)). α_{ij} is a constant specific for particular country to country[28] relation and $D_{j,t}$ is a dummy variable indicating the occurrence of rating announcement in country j. We are looking for significant β coefficient to approve our hypothesis of one way spillover effects between two countries.

As these country specific regressions are based on only several rating events (compared to the total number of observations where no rating announcement takes place), we have to choose wisely the countries to be included in estimation.

Based on the number of rating events and on geographic location, we've chosen 4 countries to represent Eastern and Western parts of Europe (and respective bond markets): Greece, Hungary, Lithuania and Portugal. This way we can use more than 30 rating event observations for each of those countries to base the estimation on. More specifically, we base the spillover study in bond markets on:

- 4 upgrades, 25 downgrades, 2 positive and 23 negative outlooks for Greece as the originator of a spillover,

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[28] Country j to country i

- 12 downgrades and 18 negative outlooks for Hungary as the originator of a spillover,
- 11 upgrades, 8 downgrades, 10 positive and 13 negative outlooks for Lithuania and
- 16 downgrades and 19 negative outlooks for Portugal as the originator of a spillover.

Due to the different weights of types of credit rating announcements across selected countries and low explicative power of separate types of announcements by country, there is a good reason to introduce a separate rating valuation variable accounting for all rating notations and events across all three agencies.

An appropriate measure was previously used by Afonso (2011b:16) for purpose of Granger causality tests in a panel framework. It approximates the mean of current rating grades by all three major agencies adjusted downwards by positive outlook and upwards by negative one. In our case the definition of adjusted rating grade reads:

$$R_{i,t} = \frac{RS_{it}+RF_{it}+RM_{it}}{3} + \frac{posS_{i,t}+posF_{i,t}+posM_{i,t}-negS_{i,t}-negF_{i,t}-negM_{i,t}}{2} \qquad (7)$$

$R_{i,t}$ denotes the adjusted measure of rating grade while RS_{it}, RF_{it} and RM_{it} imply the rating grade from each agency for country i in time t, and the rest of the variables correspond with the list of dummies presented in Table 3.5.

The highest rated country (i.e. AAA) across all agencies with neither positive nor negative outlook should end up with $R_{i,t}$ equal to 1; meanwhile the worst rated country (i.e. in case of default) could end up with $R_{i,t}$ of 17.

$$AdjS_{i,t} = \alpha_{ij} + \rho AdjS_{i,t-1} + \beta R_{j,t} + \varepsilon_{ij,t} \qquad (8)$$

The adjusted measure of rating grade as presented in equation (7) provides us with better tool to look into the effect of spillover using the regression presented in equation (8). However it is not a reliable tool for evaluation of the size of impact on spreads.

4 Empirical analysis and estimation results

This part provides the overview of findings yielding from the analysis conducted using the previous - methodological part. It is organized in three parts according to the models described above.

4.1 Event study – graphic interpretation

Baseline for our event study is the set of plots describing the movements (changes) in the sovereign bond yield and CDS spreads as presented in Appendix C[29]. Each plot is based only on observations related to particular type of rating announcement (i.e. downgrade/upgrade, negative/positive outlook). The plot explains the daily movements in the sample average spread over Germany in time period from 20 days before the rating announcement until the post-announcement 20th day.
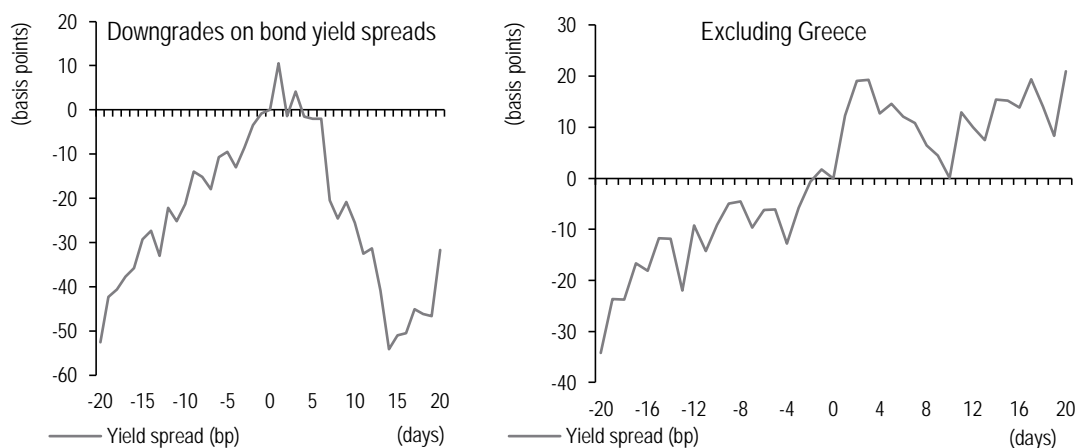
Figure 4.1 - Impact of downgrades on sovereign bond yield spreads

We present neither breakdown of results according to rating agency nor per country results as the number of rating events per country could significantly bias their comparison. In addition the series of average spreads is adjusted by subtracting of the

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[29] We present only selected outcomes in this chapter.

value at t=0 to centralize the plot around horizontal axis for better interpretation. Furthermore, we construct each plot two times to compare our results with and without data from Greece.

Figure 4.1 suggests that exclusion of Greece from our sample could actually enhance the sense of obtained results. Even though the plot on the left reads that the spread increases in the process of anticipation of the rating downgrade towards t=0 to decrease by approximately the same pace in the post-announcement period, the plot on the right hand side would more likely be the bond market common practice. According to the second plot the bond yield spread increases by approximately 0.3 percentage point in 20 day long period preceding the event date. Furthermore the spread spikes upside by 0.2 percentage point in first days following the event to correct back by the 10th day and continue with the upward sloping pace. The overall upward sloping curve on the right hand side of Figure 4.1 is consistent with comparable studies.
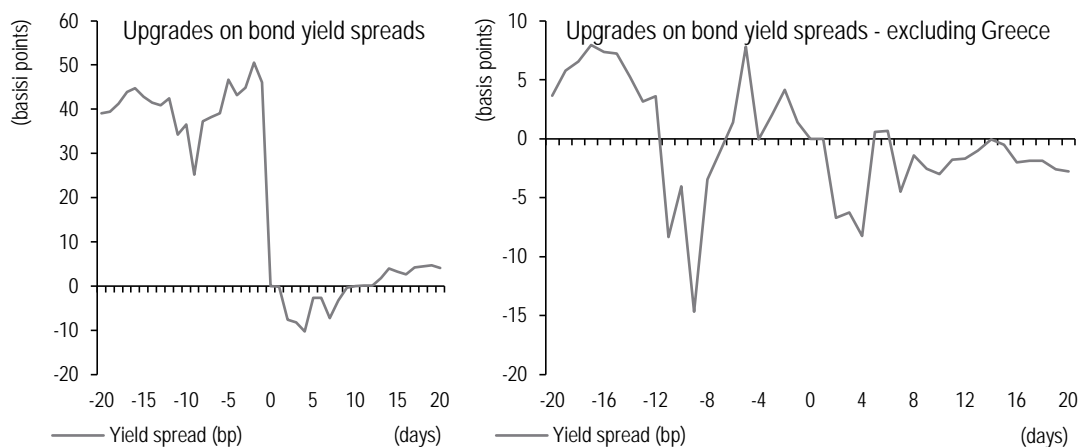
Figure 4.2 - Impact of upgrades on sovereign bond yield spreads

There are more or less the same conclusions about the impact of upgrade announcements on sovereign bond yield spreads. The plot on the left hand side of Figure 4.2 suggests that, on average, rating upgrades wipe off 50 basis points of spread

during the day on announcement. This result is heavily biased by the rating upgrade from Fitch on March 13, 2012[30].

The right hand side of Figure 4.2 presents the more likely scenario with rather minor overall movement in spread (comparing day t=-20 and t=+20). We can still distinguish a little downward movement in spread following the date of upgrade. Despite the movement is in the anticipated direction need more rigid estimation to decide whether we are dealing with significant relationship.

The impact of negative outlooks on sovereign bond yield spreads (as depicted in Figure 4.3) clearly follows an expected path (spread is increasing in time). Both panels (with and without Greece in sample) show the upward sloping curve but the changes in spread on left hand side plot are more amplified implying bigger risk premium associated with the more risky Greek bond market.
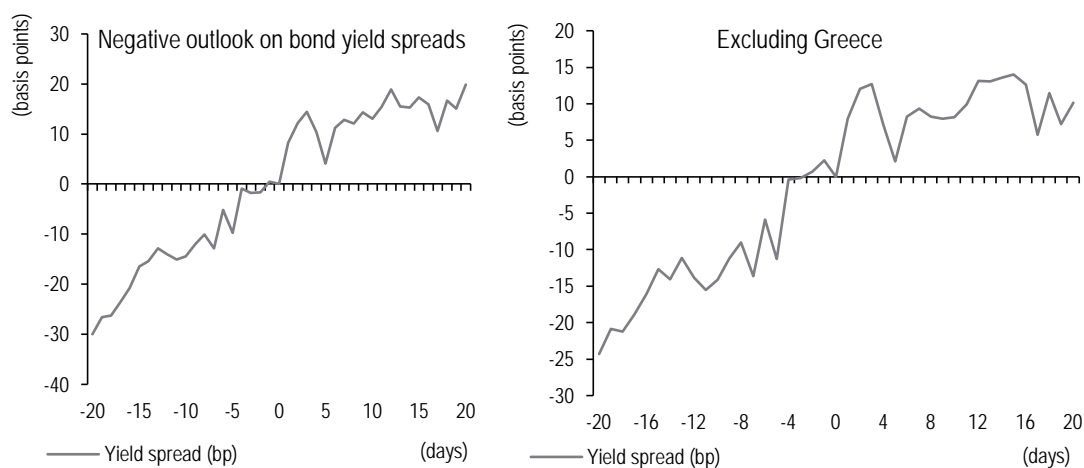
Figure 4.3 - Impact of negative outlooks on sovereign bond yield spreads

The impact of positive outlooks on sovereign bond yield spread is very ambiguous and virtually untraceable. Low volatility may suggest that we have no evidence of any relationship between positive outlooks and bond yield spreads[31].

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[30] Fitch upgraded Greece's long-term foreign and local currency issuer default ratings from "restricted default" to B- following the successful exchange of its almost EUR 177 billion of bonds for new securities.

[31] For the actual plot please refer to Appendix C

We continue with the same graphic interpretation of movements in spreads around rating events using data for credit default swaps. We inspect the same four categories of rating announcements to come up with a pattern CDS spreads exhibit around the event days.
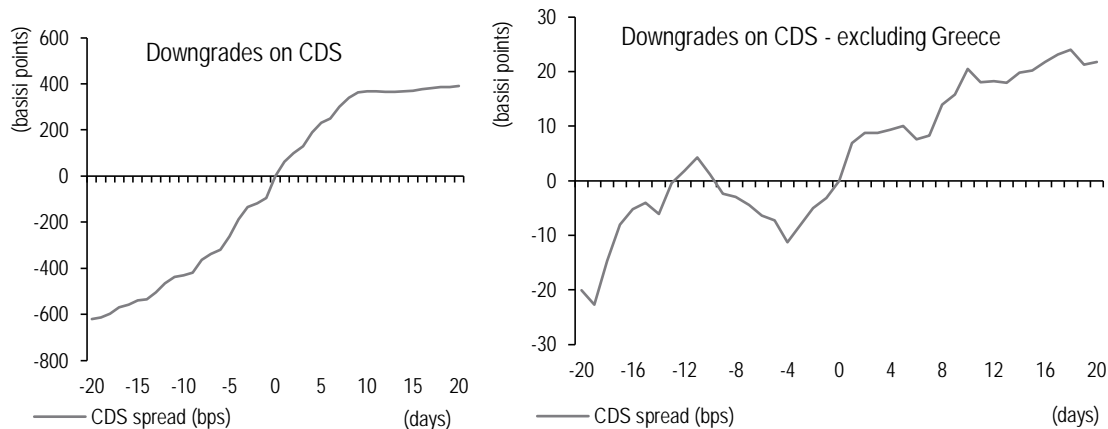
Figure 4.4 - Impact of downgrades on CDS spreads

Downgrades do have upward sloping influence on CDS spreads; however it is not as strong as the first part of Figure 4.4 suggests. Graphic interpretation with Greece left in the sample suggests that CDS spreads increase by 1000 basis points (i.e. 10 percentage p.) in the [-20; 20] window. That is unlikely given that the average spread for countries in any of the rating areas within the investment grade zone of our sample barely exceeds 300 basis points. The second part of Figure 4.4 seems more legit (but significance of depicted relationship still has to be proven in following sections). It suggests that CDS spreads tend to increase in the anticipative period of 20 days prior to the rating event by 20 basis points on average. The spread increases by another 20 basis points during the post-announcement period.

The results for upgrades are again strongly influenced by Greece (presumably again due to the Greek upgrade from March 2012 issued by Fitch). Results from the sample excluding Greece yield more trustworthy results implying the CDS spread decreases by around 4 basis points during the period preceding upgrade and by another 4 during the post-announcement period. The graphic interpretation of the relationship between upgrades and movements in CDS spread is more straightforward compared to the movements in sovereign bond yield spreads.

Negative outlooks help to widen CDS spreads predominantly in the period preceding the rating announcement (approximately 28 basis points). Spreads grow further in the post-announcement period, but only by 5 – 10 basis points. Including Greece in the sample amplifies the growth in the period following the event date. Analysis of positive outlooks failed to provide reliable graphic interpretation of their impact on CDS spreads. Exclusion of Greece from the sample improves the results (see Figure 4.5) which then suggest potential decline in spread of 4 basis points during the whole 40 day period surrounding the event date. This is also different from the impact on sovereign bond yields, where the relationship remained ambiguous even without Greece in the sample.
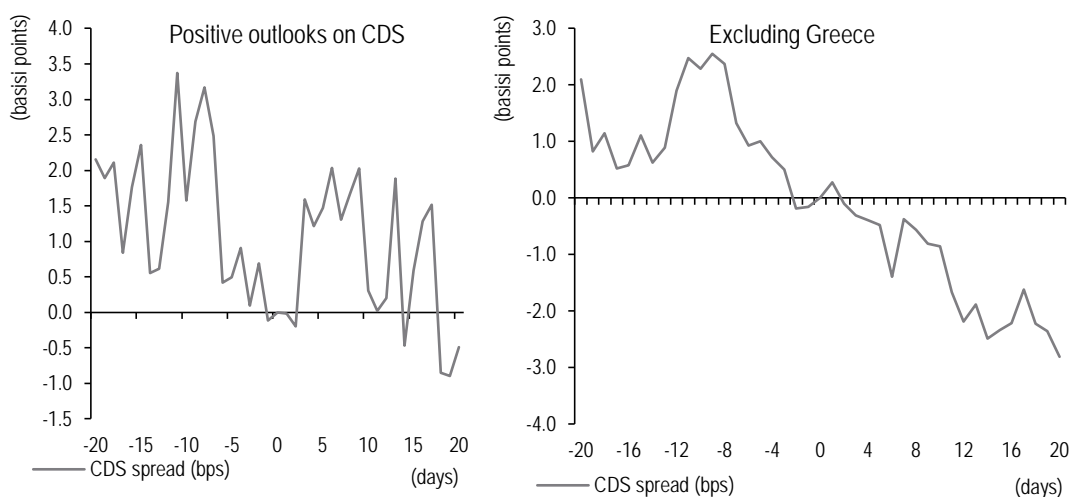
Figure 4.5 - Positive outlook on CDS spreads

4.2 Event study – market model results

In this section we sum up the findings from the event study conducted as laid out in the methodological overview. We've performed multiple estimations using different types of rating announcements (downgrades/upgrades, negative/positive outlooks and negative/positive events[32]). We follow 3 short term and 4 long-term periods as outlined in Table 4.1 below:

Timespan	Type	Area of interest
[-1;1]	Short-term	Immediate reaction
[-1;0]	Short-term	Immediate reaction
[0;1]	Short-term	Immediate reaction
[-20;10]	Long-term	Anticipation
[-9;1]	Long-term	Anticipation
[2;9]	Long-term	Persistency
[10;19]	Long-term	Persistency

Table 4.1 - Timespans of interest for event study analysis

We have tried to unveil some of the relationships between sovereign rating announcements and bond market spreads in the graphic interpretation section. But we still need to quantify this relation and to verify its significance. Although the event study was conducted for two data samples – with and without Greece, only results from the sample without Greece are presented in this section. This is because the Greek dataset has certain specifications [33] qualifying Greece to be treated as outlier. Nevertheless, results for both datasets are available in Appendix E.

4.2.1 Impact of downgrades on sovereign bond yield and CDS spreads

The analysis of 81 (106 for CDS) rating events across the three rating agencies and seven different time frames indicates that downgrades have some power to widen both bond yield and CDS spreads (see Table 4.2 for detailed results). Regarding the

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[32] Negative event refer to either downgrade or negative outlook (or even both at one time). Positive events accordingly comprise upgrades and positive outlooks.
[33] Abnormally high mean of spreads and extreme values and value changes in general.

agency non-specific results, the relation seems to be stronger for bond yield spreads. They increase on average by 18 basis points within the [-1,1] window. This increase is predominantly driven by market behavior during [-1,0] window where yield spreads appreciate by 12 basis points. We find some evidence for market's anticipation of rating downgrade as bond yield spreads grow by 21 basis points between the 20th and 10th day prior to the rating event.

Downgrades from S&P have strong influence on sovereign bonds in short timespan contributing to the increase in spreads by almost 29 basis points during the [-1,1] window. We find little significance for the anticipative power of bond market participants regarding downgrades issued by Moody's.

Downgrades on bonds	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,19]
S&P	0.287	0.189	0.098	0.104	0.127	-0.113	-0.013
32 obs.	(2.429)**	(1.877)*	(1.432)	(1.341)	(0.778)	(-1.07)	(-0.10)
Moody's	0.141	0.134	0.006	0.317	-0.171	-0.401	-0.001
26 obs.	(1.551)	(1.441)	(0.048)	(1.777)*	(-0.82)	(-1.20)	(-0.00)
Fitch	0.064	-0.002	0.066	0.237	0.138	-0.082	0.215
23 obs.	(0.775)	(-0.03)	(1.362)	(1.506)	(0.712)	(-0.94)	(1.394)
All	0.177	0.117	0.059	0.210	0.035	-0.197	0.056
81 obs.	(2.943)***	(2.232)**	(1.167)	(2.679)***	(0.320)	(-1.68)*	(0.756)
Downgrades on CDS	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,19]
S&P	9.520	3.966	5.553	27.007	27.447	-6.349	11.963
41 obs.	(1.305)	(0.745)	(1.596)	(1.683)*	(1.635)	(-0.53)	(0.879)
Moody's	15.527	4.700	10.827	30.905	-27.934	5.706	-1.397
31 obs.	(1.845)*	(1.380)	(1.437)	(1.742)*	(-1.49)	(0.399)	(-0.11)
Fitch	5.190	0.506	4.684	3.786	-10.903	26.080	-10.167
31 obs.	(1.207)	(0.157)	(1.682)	(0.321)	(-1.16)	(1.430)	(-0.87)
All	10.025	3.146	6.879	21.191	-0.763	7.039	1.282
103 obs.	(2.477)**	(1.245)	(2.484)**	(2.345)**	(-0.08)	(0.835)	(0.172)

Note: Changes of CDS spreads are expressed in basis points, bond yields in percentage points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Table 4.2 - Event study: impact of downgrades on sovereign bond yield and CDS spreads

CDS spreads are less sensitive to downgrades, however they tend to increase on average by 10 basis points in the short term [-1,1] window and by more than 21 basis points in long-term window preceding the event date. Despite the joint significance of all three agencies together, we find little evidence for short-term impact of Moody's and long-term anticipation in case of S&P and Moody's.

4.2.2 Impact of upgrades on sovereign bond yield and CDS spreads

Upgrades	Short window			Longer period			
on bonds	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	-0.033	-0.011	-0.021	-0.251	-0.087	-0.051	-0.047
13 obs.	(-1.52)	(-1.08)	(-1.45)	(-0.89)	(-1.15)	(-1.08)	(-0.82)
Moody's	-0.202	0.101	-0.303	-0.078	-0.048	0.219	0.032
10 obs.	(-0.94)	(1.031)	(-0.98)	(-0.89)	(-0.39)	(0.797)	(0.875)
Fitch	-0.014	-0.026	0.012	-0.246	0.185	0.005	-0.029
16 obs.	(-1.32)	(-2.55)**	(1.277)	(-1.35)	(1.209)	(0.243)	(-0.61)
All	-0.068	0.011	-0.080	-0.204	0.035	0.041	-0.020
39 obs.	(-1.25)	(0.439)	(-1.00)	(-1.71)*	(0.457)	(0.571)	(-0.68)
Upgrades	Short window			Longer period			
on CDS	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	-3.668	-1.803	-1.865	-1.912	-1.865	0.089	-3.977
19 obs.	(-2.61)**	(-2.01)*	(-1.80)*	(-0.92)	(-0.90)	(0.054)	(-2.43)**
Moody's	-3.550	-2.836	-0.714	-3.918	-1.504	0.751	-1.448
9 obs.	(-2.02)*	(-1.80)	(-1.51)	(-1.87)*	(-1.12)	(0.291)	(-0.68)
Fitch	-1.428	-0.554	-0.875	-0.085	-1.984	0.490	-4.410
16 obs.	(-2.39)**	(-1.45)	(-2.44)**	(-0.03)	(-1.63)	(0.374)	(-2.29)**
All	-2.740	-1.496	-1.244	-1.558	-1.844	0.378	-3.668
47 obs.	(-3.89)***	(-3.00)***	(-2.76)***	(-1.24)	(-1.87)*	(0.395)	(-3.4)***

Note: Changes of CDS spreads are expressed in basis points, bond yields in percentage points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Table 4.3 - Event study: impact of rating upgrades on sovereign bond yield and CDS spreads

As shown in Table 4.3, rating upgrades don't affect sovereign bond yield spreads to greater extent. We find significant relation for Fitch in the short-term [-1,0] window where spreads respond to rating announcement with less than 3 basis points decline. There is also a little evidence for joint significance of all three agencies within the [-20,-10] window – spreads are expected to decrease by more than 20 basis points.

More surprisingly we find a significant response of bond markets to rating upgrades. The results show it is in anticipated direction (trimming down the spread) and the joint responsiveness works for both short term and long-term windows. Rating upgrades can lower the average CDS spread by almost 3 basis points within the [-1;1] window. The effect is strongest for rating grades issued by S&P (-3.7bp) and weakest for Fitch (-1.4bp). The results for long term windows suggest a strong joint persistency

reception by markets in [10,20] window showing Fitch as the most influential agency. There is no evidence of persistence triggered by Moody's.

4.2.3 Impact of negative outlook on sovereign bond yield and CDS spreads

Negative	Short window			Longer period			
o.- bonds	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	0.172	0.111	0.060	0.087	0.025	0.004	-0.078
63 obs.	(2.390)**	(1.806)*	(1.650)	(1.778)*	(0.255)	(0.069)	(-1.11)
Moody's	0.103	0.100	0.003	0.078	0.238	-0.213	0.038
11 obs.	(1.239)	(1.348)	(0.077)	(0.420)	(1.793)	(-0.94)	(0.274)
Fitch	0.046	0.024	0.023	0.116	0.149	-0.077	0.117
41 obs.	(0.920)	(0.742)	(0.735)	(1.191)	(1.361)	(-1.39)	(1.260)
All	0.120	0.079	0.041	0.097	0.090	-0.046	0.002
115 obs.	(2.733)***	(2.174)**	(1.793)*	(2.063)**	(1.319)	(-1.06)	(0.044)
Negative	Short window			Longer period			
o. - CDS	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	6.700	4.869	1.831	19.167	13.027	-1.118	-0.267
79 obs.	(1.539)	(1.479)	(0.815)	(2.040)**	(1.353)	(-0.16)	(-0.03)
Moody's	19.719	17.462	2.257	23.770	31.155	-11.473	6.562
14 obs.	(2.137)*	(2.505)**	(0.563)	(2.109)*	(3.050)***	(-0.80)	(0.596)
Fitch	1.688	0.801	0.888	1.230	4.731	11.936	-5.640
52 obs.	(0.537)	(0.318)	(0.519)	(0.148)	(0.755)	(1.038)	(-0.78)
All	6.160	4.626	1.534	13.179	11.802	2.564	-1.534
145 obs.	(2.211)**	(2.164)**	(1.085)	(2.183)**	(2.035)**	(0.450)	(-0.31)

Note: Changes of CDS spreads are expressed in basis points, bond yields in percentage points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Table 4.4 - Event study: impact of negative outlook on sovereign bond yield and CDS spreads

Negative outlooks affect the bond markets in anticipated direction widening sovereign bond yield spreads by 12 basis points in [-1;1] window and CDS spreads by more than 6 basis points. There is evidence for market anticipation of negative outlook announcements for both bond instruments within [-20,-10] window.

As per the results in Table 4.4, the reaction to negative outlook announcements in short term is significant for S&P regarding the sovereign bond yields spreads and for Moody's regarding the CDS spreads. There is no evidence of market response to negative outlook announcements issued by Fitch, while the anticipation of the event in CDS market is exceptionally strong for Moody's within the [-9,-1] window – CDS spreads grow by more than 31 basis points in this time span.

4.2.4 Impact of positive outlook on sovereign bond yield and CDS spreads

According to our analysis positive outlook announcements don't influence the bond markets in the short-run and the mean change of spread given by the computation doesn't have the anticipated direction (negative) in several cases. Furthermore the responsiveness to this type of announcements regarding anticipation or persistency for sovereign bond yield markets in the long run is very weak or/and opposite, although identified as significant (S&P, Fitch – see Table 4.5). Regarding the results for CDS market we can conclude that markets foresee to some extent positive outlook announcements issued by S&P and Fitch.

Positive o. – on bond	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	-0.014	-0.073	0.059	-0.089	-0.008	0.013	-0.073
14 obs.	(-1.42)	(-0.93)	(0.741)	(-2.12)*	(-0.17)	(0.320)	(-1.79)*
Moody's	-0.031	-0.001	-0.030	0.157	-0.062	-0.013	-0.083
5 obs.	(-1.32)	(-0.06)	(-2.00)	(2.298)*	(-1.51)	(-0.16)	(-0.74)
Fitch	-0.006	0.034	-0.041	0.047	0.052	-0.077	0.035
6 obs.	(-0.10)	(0.644)	(-0.85)	(0.444)	(0.634)	(-2.03)*	(0.206)
All	-0.016	-0.033	0.017	-0.007	-0.004	-0.014	-0.049
25 obs.	(-1.01)	(-0.71)	(0.373)	(-0.17)	(-0.12)	(-0.48)	(-0.99)
Positive o. – on CDS	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	-1.354	-0.509	-0.845	2.571	-3.238	5.132	-0.305
19 obs.	(-1.23)	(-1.07)	(-0.94)	(1.123)	(-2.18)**	(1.305)	(-0.19)
Moody's	1.348	0.628	0.720	-1.732	-3.254	1.722	-0.346
8 obs.	(1.435)	(1.040)	(1.581)	(-0.70)	(-1.78)	(0.865)	(-0.13)
Fitch	1.966	1.020	0.947	-6.006	-2.052	-2.981	-2.411
obs.	(0.872)	(0.709)	(1.091)	(-1.98)*	(-0.96)	(-1.08)	(-0.60)
All	0.077	0.126	-0.049	-0.530	-2.945	2.346	-0.841
36 obs.	(0.090)	(0.275)	(-0.09)	(-0.32)	(-2.93)	(1.036)	(-0.60)

Note: Changes of CDS spreads are expressed in basis points, bond yields in percentage points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Table 4.5 - Event study: impact of positive outlook on sovereign bond yield and CDS spreads

4.2.5 Negative and positive events vs. sovereign bond yield and CDS spreads

The results for negative and positive events in Table 4.6 and Table 4.7 are intended to present the joint effect of both upgrades and positive outlooks (regarded as positive events); or downgrades and negative outlooks (negative events). Generally, both analyses come up with better explicative power than the separate - detailed event studies (with fewer observations). Therefore we may approve the common trend of impact of the two categories of combined explanatory variables. However the absolute value of change in the mean spread computed using either both downgrades and negative outlooks or both upgrades and positive outlooks tend to underestimate the power of rating notation changes and overestimate the power of outlooks.

Negative e. - bond	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	0.210	0.138	0.073	0.093	0.060	-0.035	-0.056
95 obs.	(3.398)***	(2.597)**	(2.193)**	(2.238)**	(0.697)	(-0.68)	(-0.91)
Moody's	0.130	0.124	0.005	0.246	-0.049	-0.345	0.011
37 obs.	(1.911)*	(1.812)*	(0.057)	(1.797)*	(-0.32)	(-1.42)	(0.122)
Fitch	0.053	0.014	0.038	0.159	0.145	-0.079	0.152
64 obs.	(1.213)	(0.499)	(1.458)	(1.904)*	(1.481)	(-1.68)*	(1.884)*
All	0.144	0.095	0.049	0.143	0.067	-0.108	0.024
196 obs.	(4.014)***	(3.122)***	(1.956)*	(3.372)***	(1.123)	(-1.98)**	(0.563)
Negative e. - CDS	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	7.663	4.561	3.103	21.846	17.954	-2.905	3.912
120 obs.	(2.026)**	(1.620)	(1.637)	(2.654)***	(2.105)**	(-0.48)	(0.577)
Moody's	16.831	8.670	8.161	28.685	-9.551	0.361	1.080
45 obs.	(2.623)**	(2.650)**	(1.528)	(2.269)**	(-0.69)	(0.033)	(0.118)
Fitch	2.996	0.691	2.305	2.185	-1.108	17.219	-7.331
83 obs.	(1.184)	(0.351)	(1.541)	(0.323)	(-0.20)	(1.744)*	(-1.17)
All	7.765	4.011	3.754	16.506	6.583	4.423	-0.365
248 obs.	(3.321)***	(2.462)**	(2.638)***	(3.208)***	(1.272)	(0.918)	(-0.08)

Note: Changes of CDS spreads are expressed in basis points, bond yields in percentage points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Table 4.6 - Event study: impact of negative rating events on sovereign bond yield and CDS spreads

Despite the more favorable condition given by the joint effect of two categories of announcement, Fitch still shows no big power to influence sovereign bond yield or CDS markets. There are few exceptions: the [2,9] persistency effect for negative events (with exceptionally strong influence of CDS spreads by more than 17 bp), [-9,-1]

anticipation of positive event in CDS markets (bringing down the spread by 2bp on average) and long term [10,20] persistency effect on positive events in market for CDS.

Positive e. – on bond	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	-0.023	-0.043	0.020	-0.167	-0.046	-0.018	-0.061
27 obs.	(-2.01)*	(-1.07)	(0.484)	(-1.23)	(-1.07)	(-0.57)	(-1.77)*
Moody's	-0.145	0.067	-0.212	0.001	-0.053	0.142	-0.006
15 obs.	(-1.02)	(1.018)	(-1.03)	(0.008)	(-0.65)	(0.770)	(-0.14)
Fitch	-0.012	-0.009	-0.002	-0.166	0.149	-0.017	-0.012
22 obs.	(-0.66)	(-0.56)	(-0.15)	(-1.21)	(1.317)	(-0.92)	(-0.21)
All	-0.048	-0.006	-0.042	-0.127	0.019	0.020	-0.031
64 obs.	(-1.41)	(-0.24)	(-0.81)	(-1.69)*	(0.409)	(0.435)	(-1.20)
Positive e. – on CDS	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	-2.511	-1.156	-1.355	0.329	-2.551	2.611	-2.141
38 obs.	(-2.79)***	(-2.26)**	(-1.99)*	(0.210)	(-2.03)**	(1.220)	(-1.83)*
Moody's	-1.245	-1.206	-0.039	-2.889	-2.327	1.208	-0.929
17 obs.	(-1.06)	(-1.26)	(-0.10)	(-1.83)*	(-2.12)**	(0.751)	(-0.58)
Fitch	-0.337	-0.048	-0.289	-1.988	-2.005	-0.626	-3.768
28 obs.	(-0.39)	(-0.09)	(-0.73)	(-1.11)	(-1.91)*	(-0.49)	(-2.09)**
All	-1.518	-0.793	-0.726	-1.112	-2.321	1.232	-2.442
83 obs.	(-2.70)***	(-2.24)**	(-2.07)**	(-1.12)	(-3.29)***	(1.101)	(-2.8)***

Note: Changes of CDS spreads are expressed in basis points, bond yields in percentage points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Table 4.7 - Event study: impact of positive rating events on sovereign bond yield and CDS spreads

As for the other agencies and dealing with negative events in short term window, S&P has the strongest influence on the mean of sovereign yield spreads while Moody's strongly outperforms the market average of change in CDS spreads.

Regarding the positive events, S&P influences both sovereign bond and CDS markets the most. The interesting result comes from the analysis of longer periods. We find strong evidence for CDS markets anticipating the positive event in the [-9,-1] window and for persistency in CDS markets during the [10,20] window. While the former is driven by all three agencies together, the latter effect is dominated by Fitch and supported by S&P.

4.3 Panel regression - short term impact

As described in the methodological overview, the introduction of panel regression in this study is driven by the concern about the proper specification of

analysis used in the event study above. We perform panel regression following the same impulses as in the section above (except for joint negative and positive effects). Again, there are two data samples used for regressions – with and without Greece. We present results excluding Greece only, following our approach in treating it as an outlier due to abrupt volatility and extreme values of spreads. Estimations based on both datasets are included in separate section of Appendix D. Although the panel fixed effect estimator with lagged dependent variable is biased, this bias should be very small given the amount of daily data we use and very high t-statistics associated with the results.

Sample size: 37 933 obs.	Downgrades – sovereign bonds			Upgrades – sovereign bonds		
	[-1;1]	[-1;0]	[0;1]	[-1;1]	[-1;0]	[0;1]
S&P	0.260	0.132	0.141	-0.051	-0.032	-0.035
	(6.24)***	(3.91)***	(4.13)***	(-0.75)	(-0.58)	(-0.62)
Moody's	0.123	0.074	0.119	0.081	0.094	0.025
	(2.71)***	(2.01)**	(3.21)***	(1.18)	(1.69)*	(0.45)
Fitch	0.061	0.002	0.060	-0.002	-0.008	0.006
	(1.47)	(0.05)	(1.75)*	(-0.03)	(-0.15)	(0.12)
All	0.152	0.070	0.107	0.009	0.016	-0.001
	(6.07)***	(3.43)***	(5.22)***	(0.23)	(0.53)	(-0.02)
Sample size: 34 137 obs.	Downgrades - CDS			Upgrades - CDS		
	[-1;1]	[-1;0]	[0;1]	[-1;1]	[-1;0]	[0;1]
S&P	8.04	4.51	4.79	-2.43	-2.13	-1.13
	(4.25)***	(2.88)***	(3.07)***	(-0.94)	(-1.00)	(-0.53)
Moody's	13.45	4.77	15.72	-1.14	-2.83	-0.62
	(6.44)***	(2.76)***	(9.13)	(-0.34)	(-1.02)	(-0.22)
Fitch	0.81	-1.13	3.13	-0.53	-0.61	-0.62
	(0.43)	(-0.73)	(2.04)**	(-0.21)	(-0.29)	(-0.30)
All	7.02	2.61	7.31	-1.38	-1.68	-0.81
	(6.19)***	(2.78)***	(7.82)***	(-0.87)	(-1.28)	(-0.62)

Note: CDS spreads are expressed in basis points, bond yield spreads in percentage points. Z-statistics is reported in brackets and asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Table 4.8 - Panel regression of rating downgrades and upgrades on sovereign bond yield and CDS spreads

Results presented in Table 4.8 support our findings from the previous section. Downgrades significantly widen both sovereign bond yield and CDS spreads. On average, downgrades lead sovereign bond yield spread to increase by approximately 15 basis points during the [-1;1] window surrounding the event date. Furthermore they help CDS spreads to increase on average by 7 bp during the [-1,1] window. The absolute changes in spreads are lower compared to our event study results. On the other hand the z-statistics reported in brackets suggest the panel regression results are more precise in terms of significance.

There is relatively big improvement in the significant relationship between S&P, Moody's and used bond market spreads. Interestingly, the influence of Fitch remain insignificant but for [0,1] window, implying immediate but weak reaction to rating announcements and no evidence of anticipation in the markets.

The previous findings: short term reaction of sovereign bond yield and CDS spreads to upgrades from Fitch and generally good responsiveness to upgrades - are disapproved by the panel regression. The most likely reason for the switchover is the very low value of impact (as per event study) that is eventually undistinguishable from other daily movements (using panel regression).

Sample size: 37 933 obs.	Negative outlooks – sovereign bonds			Positive outlooks - sovereign bonds		
	[-1;1]	[-1;0]	[0;1]	[-1;1]	[-1;0]	[0;1]
S&P	0.211	0.112	0.110	0.012	-0.086	0.052
	(6.45)***	(4,24)***	(4.11)***	(0.19)	(-1.76)*	(1.06)
Moody's	0.060	0.085	0.033	-0.029	-0.001	-0.027
	(0.99)	(1.74)*	(0.66)	(-0.30)	(-0.01)	(-0.33)
Fitch	0.064	0.013	0.055	0.010	0.027	-0.014
	(2.06)**	(0.50)	(2.17)**	(0.14)	(0.48)	(-0.24)
All	0.114	0.061	0.069	0.004	-0.030	0.015
	(5.32)***	(3.49)***	(3.91)***	(0.09)	(-0.91)	(0.43)
Sample size: 34 137 obs.	Negative outlooks – CDS			Positive outlooks - CDS		
	[-1;1]	[-1;0]	[0;1]	[-1;1]	[-1;0]	[0;1]
S&P	5.92	9.43	0.54	0.06	-0.39	0.022
	(3.96)***	(7.64)***	(0.44)	(0.02)	(-0.19)	(0.01)
Moody's	7.96	16.81	2.24	1.29	0.58	0.59
	(2.97)***	(7.59)***	(1.01)	(0.37)	(0.20)	(0.20)
Fitch	1.69	2.08	1.65	1.24	1.14	0.95
	(1.20)	(1.79)*	(1.43)	(0.35)	(0.39)	(0.32)
All	2.93	5.88	0.81	0.66	0.23	0.40
	(3.00)***	(7.30)***	(1.01)	(0.37)	(0.16)	(0.27)

Note: CDS spreads are expressed in basis points, bond yield spreads in percentage points. Z-statistics is reported in brackets and asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Table 4.9 - Panel regression of negative and positive outlooks on sovereign bond yield and CDS spreads

Results of panel regressions as presented in Table 4.9 generally correspond with the main findings of preceding event study. Panel regression further underlines the relationship between the negative outlook announcements and bond markets. The explanatory power of credit outlook, determined by significance, improves, so that each agency has some influence on the markets (in contrast with previous findings). However, we confirm the overall insignificance of positive outlook announcements.

There is one exception - positive outlook announcements from S&P. They are reported to be weakly significant and to decrease spread of sovereign bond yield by almost 9 bp within the [-1,0] window.

4.4 Country specific regressions

The following part continues with the evaluation of rating events on sovereign bond yield and CDS spreads. The aim of this section is to unveil the possible linkages between the credit rating events of one country and the consequences on the bond markets for other countries. More specifically we observe four selected countries of interest to comment on their influence (i.e. influence of rating actions assigned to them) on other European markets.

In contrast with the initial methodological overview, we adjust our regression by lagging the explanatory variable (i.e. the adjusted measure of rating grade) with one lag to prevent endogeneity issues. The regression therefore takes following form:

$$AdjS_{i,t} = \alpha_{ij} + \rho AdjS_{i,t-1} + \beta R_{j,t-1} + \varepsilon_{ij,t} \qquad (9)$$

$R_{j,t-1}$ indicates the lagged measure of rating grade (for country j) which we test for significance in terms of impact on non-lagged adjusted measure of spread (of country i[34]). We repeat the regressions for each country and for both sovereign bond yields and CDS spreads using both lagged and current value of the measure of rating grade. The results from the adjusted regression[35] are presented in Table 4.10 and Table 4.11 below. The results from unadjusted model (i.e. with current value of rating grade) are not included for comparison since the outcomes were significantly overlapping (implying the same extent of reaction on the day of event and the day after).

The results based on Hungarian credit rating grades (presented in Table 4.10) suggest that 3 groups of country specific sovereign bond markets react to changes in Hungarian creditworthiness. The first group is composed of countries comparable with Hungary according to economic conditions or geographical proximity within the

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[34] Where i comprise all countries available in the sample except for Germany and the country of origin
[35] Based on equation (9)

Eastern Europe. The affected entities comprise Bulgaria, Czech Republic, Latvia, Lithuania and Slovenia.

Effect of Hungarian rating on bond spreads

	Coef.	t-stat	P>|t|	
Austria	0.001297	2.54	0.011	**
Belgium	0.00207	2.28	0.023	**
Bulgaria	0.027981	5.35	0	***
Czech R.	0.002628	2.34	0.019	**
Denmark	-0.00031	-1.01	0.315	
Finland	0.000539	1.39	0.164	
France	0.001924	3.47	0.001	***
Greece	0.025919	2.83	0.005	***
Ireland	0.014284	3.49	0	***
Italy	0.002829	2.19	0.028	**
Latvia	0.0482	4.92	0	***
Lithuania	0.045118	4.15	0	***
Netherlands	0.000984	3.06	0.002	***
Poland	0.000665	0.63	0.526	
Portugal	0.00694	2.72	0.007	***
Romania	0.005211	1.4	0.163	
Slovenia	0.012668	4.91	0	***
Spain	0.004332	2.88	0.004	***
Sweden	-0.00073	-1.48	0.139	
UK	-8.6E-05	-0.15	0.884	

Effect of Portuguese rating on bond spreads

	Coef.	t-stat	P>|t|	
Austria	0.0008907	3.09	0.002	***
Belgium	0.0026915	4.11	0	***
Bulgaria	0.0074231	2.71	0.007	***
Czech R.	0.0011215	2.01	0.045	**
Denmark	-0.0003418	-1.68	0.092	*
Finland	0.0003295	1.38	0.168	
France	0.0021606	5.51	0	***
Greece	0.065449	5.9	0	***
Hungary	0.003864	2.89	0.004	***
Ireland	0.0049682	1.82	0.069	*
Italy	0.0059588	5.18	0	***
Latvia	0.0016608	0.69	0.488	
Lithuania	0.0104699	2.04	0.042	**
Netherlands	0.0004209	2.42	0.015	**
Poland	0.0006141	0.92	0.36	
Romania	0.0010844	0.71	0.481	
Slovenia	0.0049823	4.27	0	***
Spain	0.0061789	4.89	0	***
Sweden	-0.0003071	-1.02	0.307	
UK	-0.0002251	-0.6	0.551	

Effect of Lithuanian rating on bond spreads

	Coef.	t-stat	P>|t|	
Austria	-5.8E-05	-0.18	0.857	
Belgium	-8.3E-05	-0.2	0.841	
Bulgaria	-0.00083	-0.23	0.82	
Czech R.	-0.00037	-0.53	0.599	
Denmark	0.000535	1.72	0.086	*
Finland	0.000416	1.19	0.234	
France	-2.1E-05	-0.07	0.943	
Greece	0.00145	0.27	0.787	
Hungary	-0.0011	-0.68	0.496	
Ireland	0.000135	0.07	0.941	
Italy	-4.8E-05	-0.07	0.942	
Latvia	-0.0009	-0.28	0.78	
Netherlands	-4.8E-05	-0.22	0.826	
Poland	0.000595	0.4	0.688	
Portugal	0.000123	0.08	0.934	
Romania	-0.00278	-1.42	0.157	
Slovenia	-0.00028	-0.28	0.78	
Spain	-5.5E-05	-0.08	0.936	
Sweden	0.000952	2.11	0.035	**
UK	-0.00353	-4.17	0	***

Effect of Greek rating on bond spreads

	Coef.	t-stat	P>|t|	
Austria	0.00064	3.24	0.001	***
Belgium	0.001922	4.39	0	***
Bulgaria	0.00501	2.68	0.007	***
Czech R.	0.000731	1.93	0.054	*
Denmark	-0.00023	-1.65	0.098	*
Finland	0.000243	1.48	0.139	
France	0.001394	5.34	0	***
Hungary	0.002394	2.68	0.007	***
Ireland	0.005704	2.67	0.008	***
Italy	0.004483	5.65	0	***
Latvia	0.000635	0.38	0.707	
Lithuania	0.00611	1.76	0.079	*
Netherlands	0.000277	2.35	0.019	**
Poland	0.000384	0.83	0.404	
Portugal	0.023244	7.47	0	***
Romania	0.000555	0.53	0.596	
Slovenia	0.00319	4.04	0	***
Spain	0.006864	5.95	0	***
Sweden	-0.00017	-0.86	0.389	
UK	-0.00022	-0.85	0.397	

Note: Changes of bond yields are denoted in percentage points. Coefficients are reported with associated t-statistics and p-value. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Table 4.10 - Spillover effect on bond markets triggered by credit rating announcements: Greece, Hungary, Lithuania and Portugal.

The second group of countries is known under the acronym PIIGS. We have found significant spillover effects (of anticipated direction) in sovereign bond yield markets for all of them: Greece, Ireland, Italy, Portugal and Spain.

The third group comprises other countries – mostly well developed economies. There is some evidence for significant spillover effect from Hungary to Austria, Belgium, France and Netherlands.

Generally, rating events related to Hungarian long-term obligations impact significantly great portion of other countries' sovereign bond yield spreads. However one should take into consideration the extent of each particular impact. When only coefficients suggesting the increase in bond yield spreads by more than 1 basis point following the rating event are taken into consideration, we may identify a significant relationship only for Bulgaria, Greece, Ireland, Latvia, Lithuania and Slovenia.

The results based on Portuguese credit rating grades (presented in Table 4.10) identified significant relationship with sovereign bond yield spreads of 14 countries from our sample that could be decomposed again to three groups of countries as shown in the Hungarian case. The greatest extent of the spillover effect is traceable in connection with Greece and Lithuania.

Concerning the impact of Lithuanian credit rating events, there is some evidence for linkages to sovereign bond markets in Denmark, Sweden and UK. However the extent of the Lithuanian spillover effect is very small. In addition we found UK sovereign bond yield spreads react to Lithuanian rating events in the opposite direction, which is not consistent with general bond market consensus or relevant literature.

Finally the spillover effect of Greek rating grades on sovereign bond spreads in other countries is (in term of significance) comparable to the Portuguese one. There is evidence for spillover to other PIIGS countries, Eastern European countries and well developed/rated economies (including Austria, Belgium, Denmark, France and Netherlands).

Effect of Hungarian rating on CDS spreads

	Coef.	t-stat	P>|t|	
Austria	0.09075	1.46	0.145	
Belgium	0.170046	1.61	0.108	
Bulgaria	0.021493	0.13	0.896	
Czech R.	0.030051	0.41	0.683	
Denmark	0.195655	1.57	0.117	
Finland	-0.321	-1.8	0.073	*
Estonia	-0.1663	-2.19	0.029	**
France	0.102302	1.56	0.119	
Greece	6.588727	1.57	0.116	
Ireland	0.476963	1.52	0.128	
Italy	0.315428	1.81	0.071	*
Latvia	-0.46204	-1.42	0.156	
Lithuania	-0.16362	-0.69	0.49	
Netherlands	0.165764	1.61	0.108	
Poland	0.132869	1.12	0.262	
Portugal	0.837366	2.18	0.029	**
Romania	0.022299	0.12	0.901	
Slovakia	0.123518	1.57	0.117	
Slovenia	0.088318	1.2	0.229	
Spain	0.555829	2.11	0.035	**
Sweden	-0.54478	-3.41	0.001	***
UK	-0.09427	-1.61	0.108	

Effect of Portuguese rating on CDS spreads

	Coef.	t-stat	P>|t|	
Austria	0.057029	2.02	0.043	**
Belgium	0.272238	3.55	0	***
Bulgaria	0.035852	0.46	0.648	
Czech R.	0.008794	0.24	0.813	
Denmark	0.146308	2.06	0.04	**
Finland	-0.04743	-0.56	0.576	
Estonia	-0.04694	-1.92	0.055	*
France	0.230268	4.58	0	***
Greece	8.121095	2.97	0.003	***
Hungary	0.242529	2.19	0.029	**
Ireland	0.029602	0.14	0.89	
Italy	0.5553	4.36	0	***
Latvia	-0.08468	-0.59	0.554	
Lithuania	-0.0291	-0.28	0.781	
Netherlands	0.03773	0.75	0.452	
Poland	0.059326	1.1	0.27	
Romania	0.035344	0.4	0.689	
Slovakia	0.136079	3.04	0.002	***
Slovenia	0.201899	3.95	0	***
Spain	0.479995	3.35	0.001	***
Sweden	-0.68156	-6.62	0	***
UK	-0.05199	-2.04	0.042	**

Effect of Lithuanian rating on CDS spreads

	Coef.	t-stat	P>|t|	
Austria	0.05427	0.73	0.464	
Belgium	0.1949	1.78	0.075	*
Bulgaria	-0.16236	-0.76	0.447	
Czech R.	0.001459	0.02	0.988	
Denmark	0.053814	0.32	0.75	*
Estonia	-0.42066	-2.18	0.029	**
Finland	-0.21703	-2.68	0.008	***
France	0.101591	1.67	0.095	*
Greece	3.66706	0.69	0.491	
Hungary	0.029802	0.11	0.913	
Ireland	0.564766	1.71	0.088	*
Italy	0.274903	1.48	0.139	
Latvia	-0.55771	-1.51	0.131	
Netherlands	0.144292	1.22	0.221	
Poland	0.060333	0.42	0.672	
Portugal	0.762161	1.84	0.066	*
Romania	-0.15125	-0.63	0.529	
Slovakia	0.059963	0.67	0.502	
Slovenia	0.071191	0.84	0.4	**
Spain	0.432917	1.81	0.071	*
Sweden	-0.91462	-4.1	0	***
UK	-0.08515	-1.35	0.177	

Effect of Greek rating on CDS spreads

	Coef.	t-stat	P>|t|	
Austria	0.037211	1.96	0.05	**
Belgium	0.326153	5.02	0	***
Bulgaria	0.031424	0.59	0.554	
Czech R.	0.009101	0.37	0.715	
Denmark	0.064152	1.36	0.175	
Estonia	-0.03956	-0.68	0.494	
Finland	-0.05801	-2.99	0.003	***
France	0.212211	5.44	0	***
Hungary	0.186708	2.44	0.015	**
Ireland	0.187218	1.07	0.285	
Italy	0.464992	4.92	0	***
Latvia	-0.06752	-0.7	0.485	
Lithuania	-0.01456	-0.21	0.837	
Netherlands	0.013961	0.41	0.68	
Poland	0.047638	1.31	0.19	
Portugal	2.786752	6.62	0	***
Romania	0.028985	0.49	0.628	
Slovakia	0.08793	3.07	0.002	***
Slovenia	0.124098	4	0	***
Spain	0.583071	4.27	0	***
Sweden	-0.5112	-7.25	0	***
UK	-0.04159	-2.4	0.016	**

Note: Changes of CDS spreads are denoted in basis points. Coefficients are reported with associated t-statistics and p-value. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Table 4.11 - Spillover effect on CDS markets triggered by credit rating announcements: Greece, Hungary, Lithuania and Portugal

Taking into account the results for regressions estimated with CDS spread (as outlined in Table 4.11, there is evidently a different perception of rating announcements (and associated risk in particular) compared to standard sovereign bond markets. For instance we find Italy, Portugal and Spain to respond in CDS spreads to Hungarian rating changes while for Estonia, Finland and Sweden we obtained inconclusive results (a significant relationship of opposite direction has been revealed). This is in contrast with our results for sovereign bond spreads where we revealed high level of interlinks (of anticipated direction) between EU countries supporting the presence of spillover effect from Hungary, albeit only Bulgaria, Greece, Ireland, Latvia, Lithuania and Spain responded with an increase in spreads exceeding 1 bp

Results from estimation analyzing contagion effect triggered by Portuguese rating grades are more similar to those provided in previous section (reaction in bond spreads), except for Bulgaria and Czech Republic, implying that EU sovereign bond markets are integrated even with countries outside EMU. The regression suggest the most extensive contagion effect on Greece, while Italy, Spain, Belgium, Hungary and France follow will less extensive, yet still significant reception of Portuguese sovereign rating announcements.

There is a slight improvement in contagion regarding the CDS spreads' sensitivity to Lithuanian rating announcements[36]. Although some of the results lead to inconclusive reaction (implying presumable independence of CDS spreads for Estonia, Finland, Sweden and UK), there is a pattern of contagion effect on Belgium, France, Ireland, Portugal and Spain. The most extensive reception of Lithuanian rating movements is to be seen for Portuguese, Spanish and Irish CDS spreads.

As for the results for the most downgraded country of the sample – Greece, we can see that CDS spreads in Finland, Sweden and the UK are most probably independent of Greek rating events (more precisely they react in an opposite direction, which couldn't be justified by the logic of perception of the sovereign credit risk changes in the EU). On the other hand CDS spreads of countries such as Portugal, Spain, Italy, Belgium, France and Hungary respond extensively to movements in credit

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[36] As compared with the results for sovereign bond yield spreads

rating grade of Greece (Portugal being the most dependent). CDS spreads of Austria, Slovakia and Slovenia could be also considered as recipients of Greek spillover, however the extent of the effect on those three countries is rather marginal.

5 Conclusion

The objective of our study was to assess the extent of influence of credit rating announcements on sovereign bond yield and CDS spreads. We used data on 10Y sovereign bonds and 5Y credit default swaps for 24 countries of EU during ten year period between 2002 and 2012. We estimated the consequences of credit rating announcements – changes in rating grades and outlooks, made by the three leading agencies (i.e. Standard&Poor's, Moody's and Fitch) throughout the period. We focused on three basic topics: general responsiveness of sovereign bonds and CDSs to rating announcements; breakdown of impact by type, agency and time chart; and cross border contagion in selected countries. In order to examine our areas of interest we employed a standard market approach to event study, panel regressions with dummy variables for different events and simple regressions using adjusted rating grade notation to estimate the effect of spillover.

Our main contribution is in providing an updated study on the impact of credit rating agencies on both sovereign bond a CDS markets in almost complete set of EU countries. Contrary to other papers, we don't limit our study to selected countries (such as PIIGS) or smaller sub-areas with common characteristic (EMU). Furthermore we use the full extent of the sample to test for contagion in both sovereign bond and CDS markets.

The main findings from the three empirical parts of this study are as follows:

- Negative events significantly increase both sovereign bond yield and CDS spreads in short term, with Standard & Poor's being the most influential agency in the former market and Moody's in the latter. Negative outlooks cause smaller changes in spreads compared to downgrades, but are more significant in CDS markets. The behavior of the market is therefore not fully rational as ¾ of the downgrades are preceded with negative outlook.
- Upgrades and positive rating outlooks are generally not of significant influence on bond yield spreads, however upgrades revealed to be significant within the event study of CDS spreads in the short run. This outcome was then disapproved

in the panel regression implying the significant response of correct direction in CDS spreads is too small to be accounted for as abnormal return.

- Both downgrades and negative outlooks are anticipated in the sovereign bond markets during the period of 20 to 10 days before the announcement – implying the CRAs lag the market. Markets experience less significant correction of the initial spike of spread during the period of 2 to 9 days following the downgrade. CDS markets don't reflect the anticipation of downgrade announcement in spreads however there is evidence for the anticipative power of CDS spreads concerning negative outlooks. Sovereign bond market doesn't anticipate positive events (according to spreads); on the contrary, there is some evidence for both anticipation and persistency in the CDS market.

- Not only emerging economies outside EMU (with some exceptions) cause spillovers to EMU countries, but this relation holds vice versa as well.

- In the bond markets, we found evidence for cross border contagion from Hungarian, Portuguese and Greek ratings predominantly to PIIGS, CEE countries and little but significant spillovers to other countries as well (e.g. Belgium, France and Netherlands). There is no significant response of Polish and Romanian bond markets to any of the selected countries' sovereign grade movements.

- Market for CDS show less diversity in the effect of spillover between countries of different kind. More interestingly, Belgian spreads are significantly influenced by rating grades in Greece, Lithuania and Portugal, while Irish CDS spreads are sensitive only to Lithuanian rating changes which differs Ireland from other members of PIIGS .

- Denmark, Finland, Sweden and UK are moving in spreads against the market and are presumably independent of most of rating grade changes in the EU.

Our results have shown that credit rating agencies have significant impact on European sovereign bond markets and beyond the country borders. Furthermore this impact is relevant for both developed and developing countries of EU and investors should be therefore fully aware of possible consequences of a rating announcement. On the other hand the entities operating in the bond markets have to realize, that CRAs exist because they entitled to provide others with information, not because investors need to trust them. However reliability on their assessments is still extensive in 2012.

The question is whether the rating agencies are here to predict bond yield spreads based on fundamentals or to assess the current situation according to market data such as bond yield spreads. One way or the other, although sovereign debt crisis could have been accelerated by CRAs, it is impossible to get out of it through stronger regulation of CRAs (as proposed by ESMA) or creation of a new non-profit European rating agency to compete with the commercial ones. Investors, policymakers and other entities dealing with the outputs of rating agencies should rather beware of macroeconomic fundamentals and evidence from the markets before taking the assigned rating notation as granted and unquestionable to subordinate their decision making to CRAs.

The possible extensions of this study and of examination of spreads of sovereign bond market instruments are diverse. Given our results we suggest often forgotten bond markets of emerging countries to get into the center of attention in further research. Finally, there are several suggested adjustments that could improve the informative value of the analysis conducted in this paper. A different benchmark could be used (instead of Germany) to allow for results from German bond markets too and to remove potential bias brought into by assumption of German bunds being equivalent to risk-free rate. Some of the analyses in this study were inconclusive unless Greece was excluded from the sample. To account for the abrupt bond-market movements related to Greek sovereign debt, logs or other adjustments for correction of extreme values could help. We have examined only reactions of spreads to particular rating event in this study. However an analysis of the relation of CDS spreads and sovereign bond yields between EU countries could help to shed some more light on the contagion effect in Europe. Movements of spreads could also be regarded in connection with the respective rating grades of countries.

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Appendix A: Data availability

Good data coverage (> 2000 observations)　Sufficient dataset (1500 – 2500 observations)

Less than 1500 variables　Insufficient data
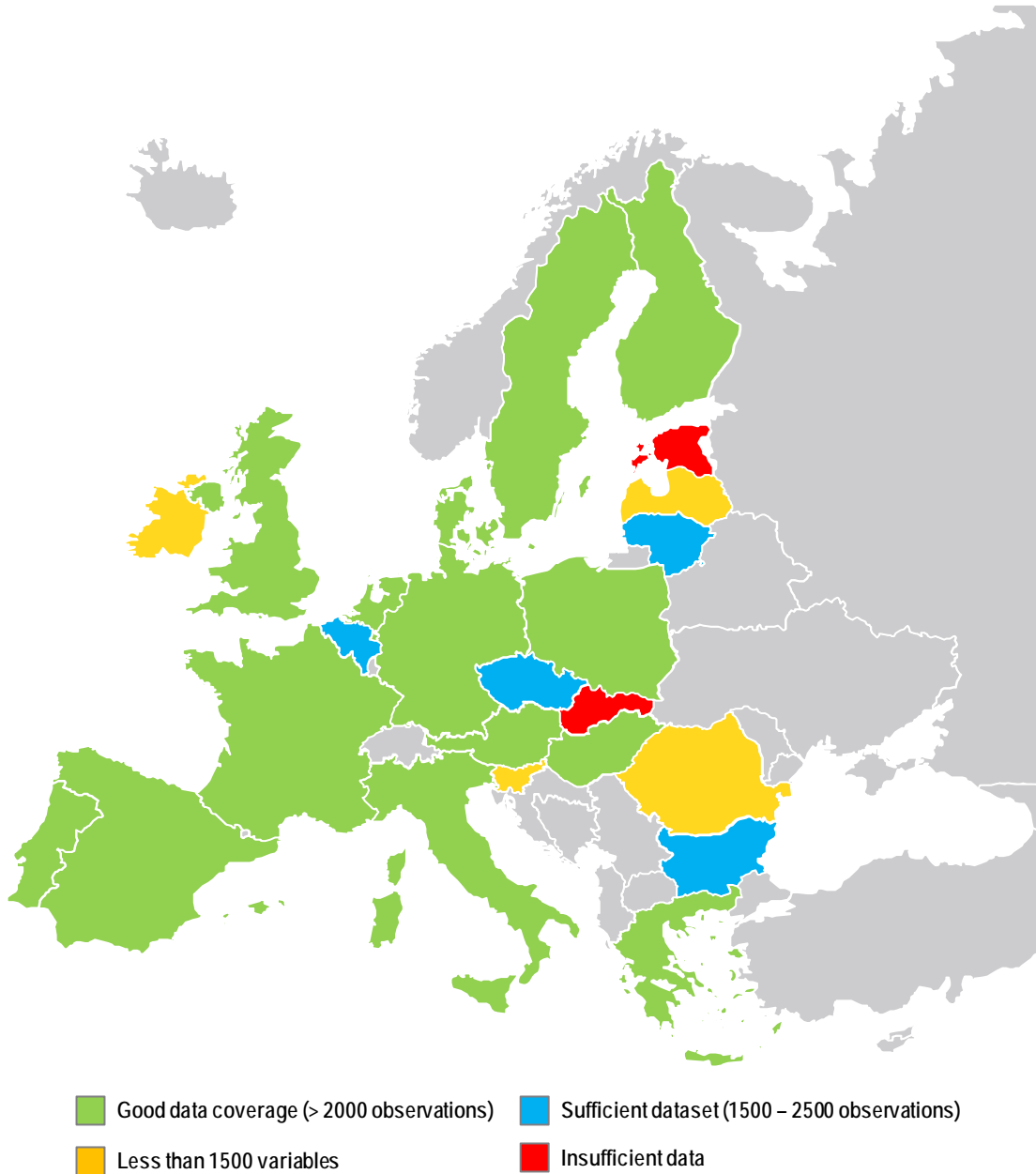
Appendix B: Rating events by country (2002 – 2012)
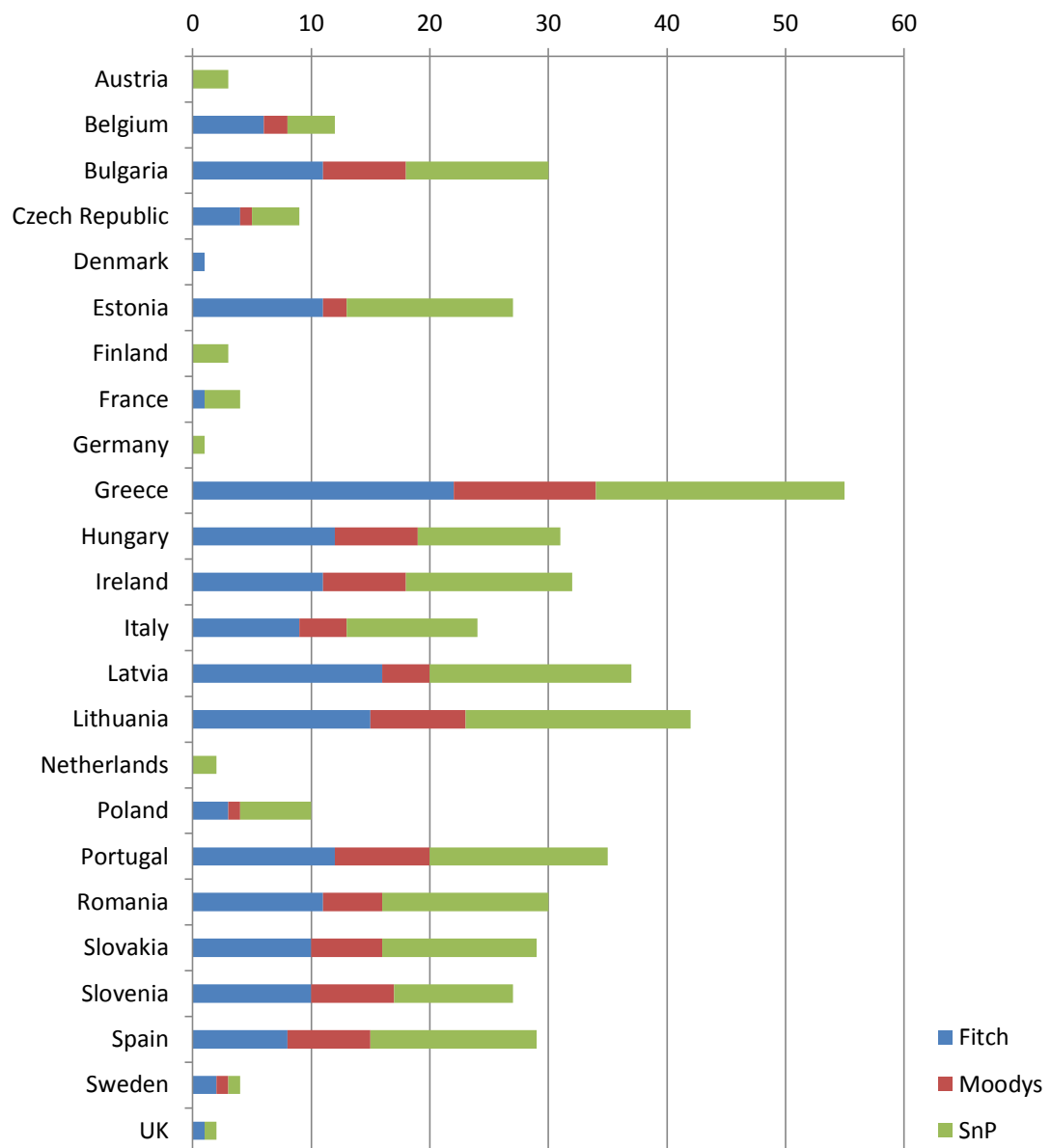
Appendix C: Graphic interpretation

Figure 1: Impact of various rating events on sovereign bond yield spreads in [-20;20] days window

Full sample **Excluding Greece**
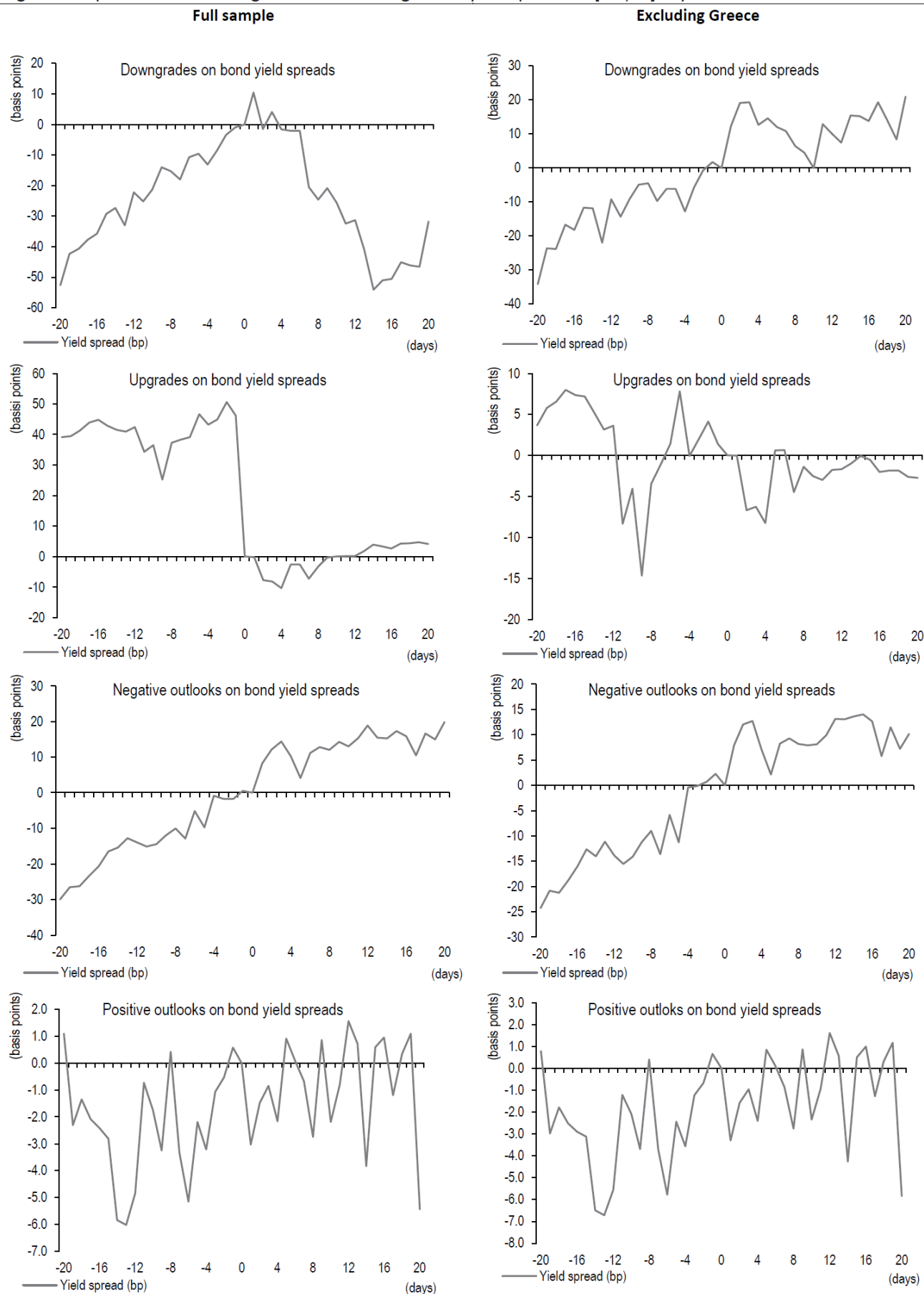
Figure 2: Impact of various rating events on CDS spreads in [-20;20] days window
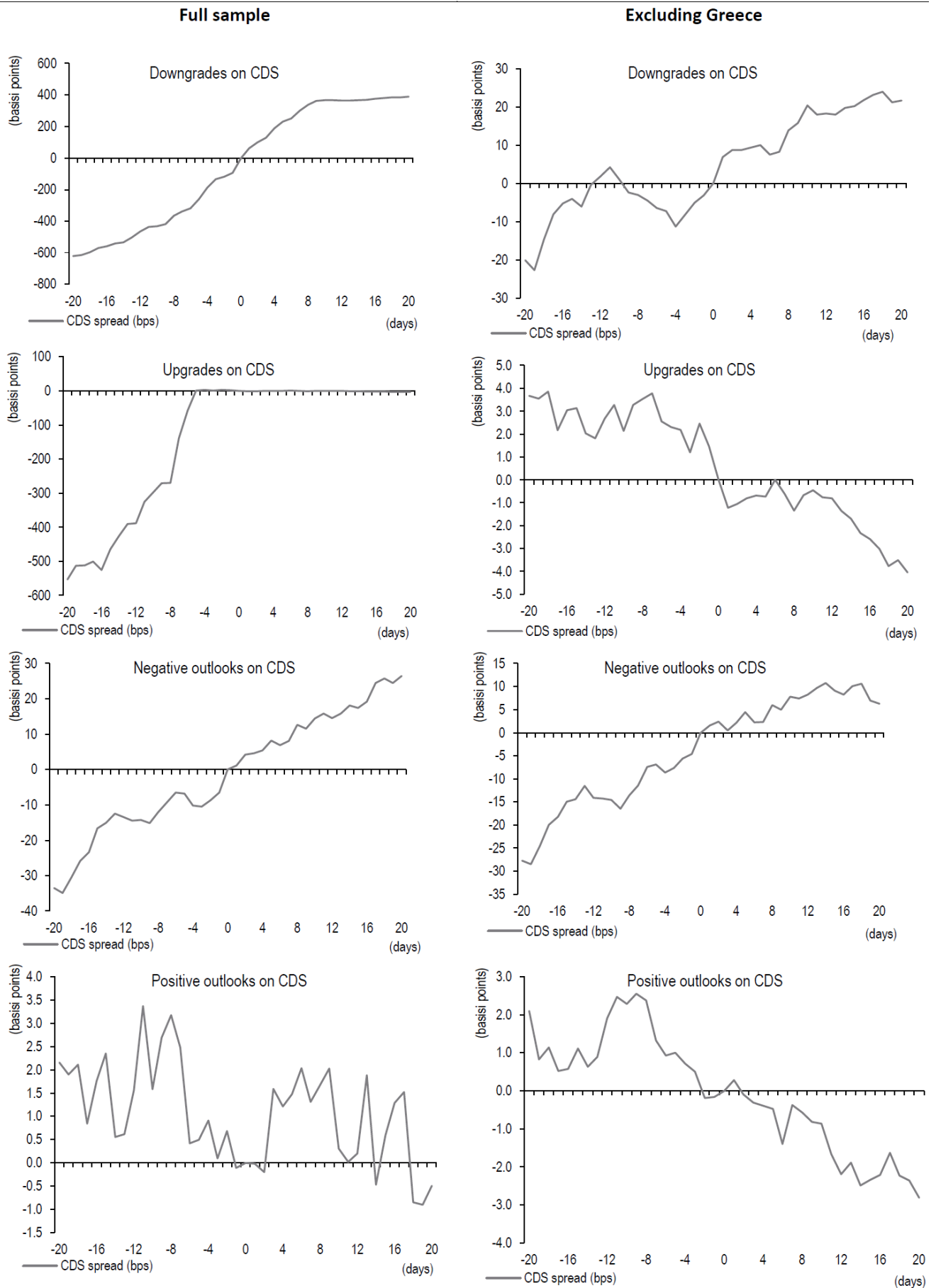
Appendix D: Panel regressions

Impact of upgrades and downgrades on sovereign bond yield spreads (panel regression)

Sample size: 40 009 obs.	Downgrades			Upgrades		
	[-1;1]	[-1;0]	[0;1]	[-1;1]	[-1;0]	[0;1]
S&P	0.204	0.130	0.104	-0.049	-0.029	-0.033
	(4.68)***	(4.05)***	(2.83)***	(-0.65)	(-0.53)	(-0.52)
Moody's	0.151	0.063	0.133	0.082	0.095	0.021
	(3.14)***	(1.77)*	(3.27)***	(1.03)	(1.63)	(0.31)
Fitch	-0.481	0.018	-0.469	0.339	-0.290	-0.041
	(-11.52)***	(0.57)	(-13.38)***	(4.86)***	(-5.64)***	(-0.71)
All	-0.07	0.070	-0.107	0.137	-0.091	-0.020
	(-2.71)***	(3.67)***	(-4.9)***	(3.18)***	(-2.89)***	(-0.56)

Note: Bond yield spreads are expressed in percentage points. Z-statistics is reported in brackets and asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of upgrades and downgrades on sovereign bond yield spreads (panel regression) - excluding Greece

Sample size: 37 933 obs.	Downgrades			Upgrades		
	[-1;1]	[-1;0]	[0;1]	[-1;1]	[-1;0]	[0;1]
S&P	0.260	0.132	0.141	-0.051	-0.032	-0.035
	(6.24)***	(3.91)***	(4.13)***	(-0.75)	(-0.58)	(-0.62)
Moody's	0.123	0.074	0.119	0.081	0.094	0.025
	(2.71)***	(2.01)**	(3.21)***	(1.18)	(1.69)*	(0.45)
Fitch	0.061	0.002	0.060	-0.002	-0.008	0.006
	(1.47)	(0.05)	(1.75)*	(-0.03)	(-0.15)	(0.12)
All	0.152	0.070	0.107	0.009	0.016	-0.001
	(6.07)***	(3.43)***	(5.22)***	(0.23)	(0.53)	(-0.02)

Note: Bond yield spreads are expressed in percentage points. Z-statistics is reported in brackets and asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of positive and negative outlooks on sovereign bond yield spreads (panel regression)

Sample size: 40 009 obs.	Negative outlooks			Positive outlooks		
	[-1;1]	[-1;0]	[0;1]	[-1;1]	[-1;0]	[0;1]
S&P	0.177	0.113	0.084	0.010	-0.086	0.055
	(5.03)***	(4.39)***	(2.84)***	(0.14)	(-1.69)*	(0.94)
Moody's	0.081	0.116	0.035	-0.030	-0.002	-0.027
	(1.29)	(2.51)**	(0.66)	(-0.26)	(-0.02)	(-0.28)
Fitch	0.070	0.022	0.060	0.007	0.026	-0.015
	(2.11)**	(0.91)	(2.13)**	(0.10)	(0.46)	(-0.23)
All	0.107	0.070	0.061	0.002	-0.029	0.015
	(4.66)***	(4.14)***	(3.17)***	(0.04)	(-0.85)	(0.37)

Note: Bond yield spreads are expressed in percentage points. Z-statistics is reported in brackets and asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of positive and negative outlooks on sovereign bond yield spreads (panel regression) – excluding Greece

Sample size: 37 933 obs.	Negative outlooks			Positive outlooks		
	[-1;1]	[-1;0]	[0;1]	[-1;1]	[-1;0]	[0;1]
S&P	0.211	0.112	0.110	0.012	-0.086	0.052
	(6.45)***	(4,24)***	(4.11)***	(0.19)	(-1.76)*	(1.06)
Moody's	0.060	0.085	0.033	-0.029	-0.001	-0.027
	(0.99)	(1.74)*	(0.66)	(-0.30)	(-0.01)	(-0.33)
Fitch	0.064	0.013	0.055	0.010	0.027	-0.014
	(2.06)**	(0.50)	(2.17)**	(0.14)	(0.48)	(-0.24)
All	0.114	0.061	0.069	0.004	-0.030	0.015
	(5.32)***	(3.49)***	(3.91)***	(0.09)	(-0.91)	(0.43)

Note: Bond yield spreads are expressed in percentage points. Z-statistics is reported in brackets and asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of upgrades and downgrades on CDS spreads (panel regression)

Sample size: 35 838 obs.	Downgrades			Upgrades		
	[-1;1]	[-1;0]	[0;1]	[-1;1]	[-1;0]	[0;1]
S&P	3.02	6.94	-0.22	-2.22	-2.74	-0.84
	(0.29)	(0.80)	(-0.03)	(-0.14)	(-0.21)	(-0.07)
Moody's	209.74	244.45	67.76	-0.22	-3.05	-0.06
	(17.97)***	(25.41)***	(7.05)***	(-0.01)	(-0.18)	(0.00)
Fitch	-7.18	27.40	30.31	-0.16	-0.87	-0.62
	(-0.73)	(3.34)***	(3.77)***	(-0.01)	(-0.07)	(-0.05)
All	56.59	81.47	30.466	-0.93	-2.03	-0.58
	(9.160***	(15.94)***	(6.03)***	(-0.1)	(-0.26)	(-0.07)

Note: CDS spreads are expressed in basis points. Z-statistics is reported in brackets and asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of upgrades and downgrades on CDS spreads (panel regression) – excluding Greece

Sample size: 34 137 obs.	Downgrades			Upgrades		
	[-1;1]	[-1;0]	[0;1]	[-1;1]	[-1;0]	[0;1]
S&P	8.04	4.51	4.79	-2.43	-2.13	-1.13
	(4.25)***	(2.88)***	(3.07)***	(-0.94)	(-1.00)	(-0.53)
Moody's	13.45	4.77	15.72	-1.14	-2.83	-0.62
	(6.44)***	(2.76)***	(9.13)	(-0.34)	(-1.02)	(-0.22)
Fitch	0.81	-1.13	3.13	-0.53	-0.61	-0.62
	(0.43)	(-0.73)	(2.04)**	(-0.21)	(-0.29)	(-0.30)
All	7.02	2.61	7.31	-1.38	-1.68	-0.81
	(6.19)***	(2.78)***	(7.82)***	(-0.87)	(-1.28)	(-0.62)

Note: CDS spreads are expressed in basis points. Z-statistics is reported in brackets and asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of positive and negative outlooks on CDS spreads (panel regression)

Sample size: 35 838 obs.	Negative outlooks			Positive outlooks		
	[-1;1]	[-1;0]	[0;1]	[-1;1]	[-1;0]	[0;1]
S&P	1.76	10.11	-4.45	0.07	-0.84	-0.26
	(0.21)	(1.44)	(-0.65)	(0.00)	(-0.07)	(-0.02)
Moody's	3.08	22.06	-6.79	1.15	0.19	0.001
	(0.21)	(1.80)*	(-0.57)	(0.05)	(0.01)	(0.00)
Fitch	-0.20	0.34	0.67	0.64	0.52	0.14
	(-0.02)	(0.05)	(0.10)	(0.03)	(0.03)	(0.01)
All	-0.001	6.22	-2.53	0.48	-0.24	-0.09
	(-0.00)	(1.37)	(-0.57)	(0.04)	(-0.03)	(-0.01)

Note: CDS spreads are expressed in basis points. Z-statistics is reported in brackets and asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of positive and negative outlooks on CDS spreads (panel regression) - excluding Greece

Sample size: 34 137 obs.	Negative outlooks			Positive outlooks		
	[-1;1]	[-1;0]	[0;1]	[-1;1]	[-1;0]	[0;1]
S&P	5.92	9.43	0.54	0.06	-0.39	0.022
	(3.96)***	(7.64)***	(0.44)	(0.02)	(-0.19)	(0.01)
Moody's	7.96	16.81	2.24	1.29	0.58	0.59
	(2.97)***	(7.59)***	(1.01)	(0.37)	(0.20)	(0.20)
Fitch	1.69	2.08	1.65	1.24	1.14	0.95
	(1.20)	(1.79)*	(1.43)	(0.35)	(0.39)	(0.32)
All	2.93	5.88	0.81	0.66	0.23	0.40
	(3.00)***	(7.30)***	(1.01)	(0.37)	(0.16)	(0.27)

Note: CDS spreads are expressed in basis points. Z-statistics is reported in brackets and asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Appendix E: Event study analysis

Impact of downgrades on sovereign bond yield spreads:

Downgrades	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	0.203	0.148	0.055	0.228	0.238	-0.053	0.163
41 obs.	(1.989)*	(1.808)*	(0.915)	(2.630)**	(1.390)	(-0.46)	(1.074)
Moody's	0.199	0.136	0.063	0.378	-0.103	-0.810	0.018
33 obs.	(2.499)**	(1.770)*	(0.590)	(2.606)**	(-0.55)	(-1.22)	(0.107)
Fitch	-0.525	0.006	-0.531	0.303	0.266	-0.077	-0.256
32 obs.	(-0.80)	(0.104)	(-0.85)	(1.730)*	(1.454)	(-0.56)	(-0.38)
All	-0.018	0.102	-0.120	0.297	0.140	-0.296	-0.009
106 obs.	(-0.08)	(2.337)**	(-0.62)	(3.879)***	(1.344)	(-1.37)	(-0.03)

Note: Bond yield spreads are expressed in percentage points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of downgrades on sovereign bond yield spreads (excluding 25 downgrades for Greece):

Downgrades	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	0.287	0.189	0.098	0.104	0.127	-0.113	-0.013
32 obs.	(2.429)**	(1.877)*	(1.432)	(1.341)	(0.778)	(-1.07)	(-0.10)
Moody's	0.141	0.134	0.006	0.317	-0.171	-0.401	-0.001
26 obs.	(1.551)	(1.441)	(0.048)	(1.777)*	(-0.82)	(-1.20)	(-0.00)
Fitch	0.064	-0.002	0.066	0.237	0.138	-0.082	0.215
23 obs.	(0.775)	(-0.03)	(1.362)	(1.506)	(0.712)	(-0.94)	(1.394)
All	0.177	0.117	0.059	0.210	0.035	-0.197	0.056
81 obs.	(2.943)***	(2.232)**	(1.167)	(2.679)***	(0.320)	(-1.68)*	(0.756)

Note: Bond yield spreads are expressed in percentage points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of upgrades on sovereign bond yield spreads:

Upgrades	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	-0.031	-0.010	-0.022	-0.235	-0.081	-0.047	-0.047
14 obs.	(-1.56)	(-0.99)	(-1.58)	(-0.90)	(-1.16)	(-1.08)	(-0.88)
Moody's	-0.180	0.097	-0.277	-0.076	-0.051	0.199	0.028
11 obs.	(-0.93)	(1.097)	(-0.99)	(-0.95)	(-0.45)	(0.797)	(0.837)
Fitch	-0.052	-0.031	-0.021	-0.112	-0.795	0.132	0.096
18 obs.	(-1.28)	(-2.82)**	(-0.61)	(-0.55)	(-0.81)	(1.025)	(0.741)
All	-0.078	0.009	-0.087	-0.143	-0.372	0.091	0.032
43 obs.	(-1.50)	(0.359)	(-1.19)	(-1.20)	(-0.91)	(1.082)	(0.560)

Note: Bond yield spreads are expressed in percentage points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of upgrades on sovereign bond yield spreads (excluding 4 upgrades for Greece):

Upgrades	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	-0.033	-0.011	-0.021	-0.251	-0.087	-0.051	-0.047
13 obs.	(-1.52)	(-1.08)	(-1.45)	(-0.89)	(-1.15)	(-1.08)	(-0.82)
Moody's	-0.202	0.101	-0.303	-0.078	-0.048	0.219	0.032
10 obs.	(-0.94)	(1.031)	(-0.98)	(-0.89)	(-0.39)	(0.797)	(0.875)
Fitch	-0.014	-0.026	0.012	-0.246	0.185	0.005	-0.029
16 obs.	(-1.32)	(-2.55)**	(1.277)	(-1.35)	(1.209)	(0.243)	(-0.61)
All	-0.068	0.011	-0.080	-0.204	0.035	0.041	-0.020
39 obs.	(-1.25)	(0.439)	(-1.00)	(-1.71)*	(0.457)	(0.571)	(-0.68)

Note: Bond yield spreads are expressed in percentage points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of negative outlooks on sovereign bond yield spreads:

Negative outlook	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	0.157	0.107	0.050	0.157	0.056	-0.001	0.022
74 obs.	(2.529)**	(2.015)**	(1.522)	(2.859)***	(0.575)	(-0.01)	(0.244)
Moody's	0.137	0.132	0.005	0.123	0.255	-0.045	-0.262
14 obs.	(1.742)	(1.837)*	(0.164)	(0.778)	(2.106)*	(-0.21)	(-0.96)
Fitch	0.064	0.032	0.032	0.135	0.124	-0.024	0.166
49 obs.	(1.200)	(1.035)	(1.028)	(1.564)	(1.248)	(-0.36)	(1.545)
All	0.122	0.082	0.039	0.146	0.101	-0.014	0.045
137 obs.	(3.092)***	(2.618)***	(1.846)*	(3.211)***	(1.559)	(-0.31)	(0.651)

Note: Bond yield spreads are expressed in percentage points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of negative outlooks on sovereign bond yield spreads (excluding 22 negative outlooks for Greece):

Negative outlook	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	0.172	0.111	0.060	0.087	0.025	0.004	-0.078
63 obs.	(2.390)**	(1.806)*	(1.650)	(1.778)*	(0.255)	(0.069)	(-1.11)
Moody's	0.103	0.100	0.003	0.078	0.238	-0.213	0.038
11 obs.	(1.239)	(1.348)	(0.077)	(0.420)	(1.793)	(-0.94)	(0.274)
Fitch	0.046	0.024	0.023	0.116	0.149	-0.077	0.117
41 obs.	(0.920)	(0.742)	(0.735)	(1.191)	(1.361)	(-1.39)	(1.260)
All	0.120	0.079	0.041	0.097	0.090	-0.046	0.002
115 obs.	(2.733)***	(2.174)**	(1.793)*	(2.063)**	(1.319)	(-1.06)	(0.044)

Note: Bond yield spreads are expressed in percentage points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of positive outlooks on sovereign bond yield spreads:

Positive outlook	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	-0.014	-0.073	0.059	-0.089	-0.008	0.013	-0.073
14 obs.	(-1.42)	(-0.93)	(0.741)	(-2.12)*	(-0.17)	(0.320)	(-1.79)*
Moody's	-0.031	-0.001	-0.030	0.157	-0.062	-0.013	-0.083
5 obs.	(-1.32)	(-0.06)	(-2.00)	(2.298)*	(-1.51)	(-0.16)	(-0.74)
Fitch	-0.005	0.026	-0.032	0.026	0.038	-0.060	0.023
8 obs.	(-0.11)	(0.670)	(-0.89)	(0.325)	(0.616)	(-1.98)*	(0.183)
All	-0.015	-0.030	0.016	-0.009	-0.004	-0.014	-0.047
27 obs.	(-1.02)	(-0.71)	(0.365)	(-0.25)	(-0.14)	(-0.50)	(-1.01)

Note: Bond yield spreads are expressed in percentage points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of positive outlooks on sovereign bond yield spreads (excluding 2 positive outlooks for Greece from Fitch):

Positive outlook	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	-0.014	-0.073	0.059	-0.089	-0.008	0.013	-0.073
14 obs.	(-1.42)	(-0.93)	(0.741)	(-2.12)*	(-0.17)	(0.320)	(-1.79)*
Moody's	-0.031	-0.001	-0.030	0.157	-0.062	-0.013	-0.083
5 obs.	(-1.32)	(-0.06)	(-2.00)	(2.298)*	(-1.51)	(-0.16)	(-0.74)
Fitch	-0.006	0.034	-0.041	0.047	0.052	-0.077	0.035
6 obs.	(-0.10)	(0.644)	(-0.85)	(0.444)	(0.634)	(-2.03)*	(0.206)
All	-0.016	-0.033	0.017	-0.007	-0.004	-0.014	-0.049
25 obs.	(-1.01)	(-0.71)	(0.373)	(-0.17)	(-0.12)	(-0.48)	(-0.99)

Note: Bond yield spreads are expressed in percentage points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of negative events on sovereign bond yield spreads

Negative events	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	0.173	0.122	0.052	0.182	0.121	-0.019	0.072
115 obs.	(3.222)***	(2.718)***	(1.731)*	(3.893)***	(1.383)	(-0.35)	(0.908)
Moody's	0.181	0.135	0.046	0.302	0.003	-0.582	-0.065
47 obs.	(2.994)***	(2.341)**	(0.607)	(2.683)**	(0.025)	(-1.24)	(-0.45)
Fitch	-0.169	0.022	-0.190	0.201	0.180	-0.045	-0.001
81 obs.	(-0.65)	(0.736)	(-0.77)	(2.328)**	(1.924)*	(-0.67)	(-0.00)
All	0.061	0.091	-0.030	0.212	0.118	-0.137	0.021
243 obs.	(0.667)	(3.502)***	(-0.35)	(5.011)***	(2.028)**	(-1.40)	(0.212)

Note: Bond yield spreads are expressed in percentage points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of negative events on sovereign bond yield spreads (excluding 22 negative outlooks negative outlooks and 25 downgrades for Greece):

Negative events	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	0.210	0.138	0.073	0.093	0.060	-0.035	-0.056
95 obs.	(3.398)***	(2.597)**	(2.193)**	(2.238)**	(0.697)	(-0.68)	(-0.91)
Moody's	0.130	0.124	0.005	0.246	-0.049	-0.345	0.011
37 obs.	(1.911)*	(1.812)*	(0.057)	(1.797)*	(-0.32)	(-1.42)	(0.122)
Fitch	0.053	0.014	0.038	0.159	0.145	-0.079	0.152
64 obs.	(1.213)	(0.499)	(1.458)	(1.904)*	(1.481)	(-1.68)*	(1.884)*
All	0.144	0.095	0.049	0.143	0.067	-0.108	0.024
196 obs.	(4.014)***	(3.122)***	(1.956)*	(3.372)***	(1.123)	(-1.98)**	(0.563)

Note: Bond yield spreads are expressed in percentage points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of positive events on sovereign bond yield spreads:

Positive events	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	-0.023	-0.041	0.019	-0.162	-0.045	-0.017	-0.060
28 obs.	(-2.05)**	(-1.06)	(0.463)	(-1.24)	(-1.08)	(-0.58)	(-1.82)*
Moody's	-0.134	0.066	-0.200	-0.003	-0.054	0.132	-0.007
16 obs.	(-1.00)	(1.082)	(-1.04)	(-0.04)	(-0.71)	(0.770)	(-0.16)
Fitch	-0.038	-0.013	-0.024	-0.070	-0.539	0.073	0.074
26 obs.	(-1.21)	(-0.90)	(-0.94)	(-0.49)	(-0.79)	(0.805)	(0.763)
All	-0.054	-0.006	-0.047	-0.091	-0.230	0.050	0.002
70 obs.	(-1.65)	(-0.29)	(-0.99)	(-1.22)	(-0.91)	(0.959)	(0.045)

Note: Bond yield spreads are expressed in percentage points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of positive events on sovereign bond yield spreads (excluding 2 positive outlooks and 4 upgrades for Greece):

Positive events	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	-0.023	-0.043	0.020	-0.167	-0.046	-0.018	-0.061
27 obs.	(-2.01)*	(-1.07)	(0.484)	(-1.23)	(-1.07)	(-0.57)	(-1.77)*
Moody's	-0.145	0.067	-0.212	0.001	-0.053	0.142	-0.006
15 obs.	(-1.02)	(1.018)	(-1.03)	(0.008)	(-0.65)	(0.770)	(-0.14)
Fitch	-0.012	-0.009	-0.002	-0.166	0.149	-0.017	-0.012
22 obs.	(-0.66)	(-0.56)	(-0.15)	(-1.21)	(1.317)	(-0.92)	(-0.21)
All	-0.048	-0.006	-0.042	-0.127	0.019	0.020	-0.031
64 obs.	(-1.41)	(-0.24)	(-0.81)	(-1.69)*	(0.409)	(0.435)	(-1.20)

Note: Bond yield spreads are expressed in percentage points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Analysis of impact of various rating events on CDS spreads

Impact of downgrades on CDS spreads:

Downgrades	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	101.334	69.746	31.588	122.824	178.233	268.768	40.699
50 obs.	(1.136)	(1.139)	(1.121)	(1.564)	(1.089)	(0.999)	(2.078)**
Moody's	294.748	176.353	118.395	172.940	297.438	21.167	8.564
38 obs.	(1.073)	(1.049)	(1.111)	(1.281)	(0.898)	(1.406)	(0.474)
Fitch	95.343	46.721	48.622	289.032	531.445	482.819	13.149
40 obs.	(1.043)	(0.993)	(1.095)	(1.342)	(1.271)	(1.009)	(0.707)
All	156.882	94.200	62.682	189.642	324.001	262.152	22.550
128 obs.	(1.693)*	(1.653)	(1.737)*	(2.268)**	(1.856)*	(1.440)	(2.051)**

Note: Changes of CDS spreads are expressed in basis points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of downgrades on CDS spreads (excluding 25 downgrades for Greece):

Downgrades	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	9.520	3.966	5.553	27.007	27.447	-6.349	11.963
41 obs.	(1.305)	(0.745)	(1.596)	(1.683)*	(1.635)	(-0.53)	(0.879)
Moody's	15.527	4.700	10.827	30.905	-27.934	5.706	-1.397
31 obs.	(1.845)*	(1.380)	(1.437)	(1.742)*	(-1.49)	(0.399)	(-0.11)
Fitch	5.190	0.506	4.684	3.786	-10.903	26.080	-10.167
31 obs.	(1.207)	(0.157)	(1.682)	(0.321)	(-1.16)	(1.430)	(-0.87)
All	10.025	3.146	6.879	21.191	-0.763	7.039	1.282
103 obs.	(2.477)	(1.245)	(2.484)	(2.345)	(-0.08)	(0.835)	(0.172)

Note: Changes of CDS spreads are expressed in basis points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of upgrades on CDS spreads:

Upgrades	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	-3.668	-1.803	-1.865	-1.912	-1.865	0.089	-3.977
19 obs.	(-2.61)**	(-2.01)*	(-1.80)*	(-0.92)	(-0.90)	(0.054)	(-2.43)**
Moody's	-3.550	-2.836	-0.714	-3.918	-1.504	0.751	-1.448
9 obs.	(-2.02)*	(-1.80)	(-1.51)	(-1.87)*	(-1.12)	(0.291)	(-0.68)
Fitch	-1.067	-0.430	-0.637	628.901	669.355	0.460	-4.392
20 obs.	(-1.58)	(-1.12)	(-1.53)	(0.999)	(0.997)	(0.370)	(-2.41)**
All	-2.562	-1.425	-1.138	260.551	277.878	0.368	-3.675
48 obs.							(-
	(-3.59)***	(-2.89)***	(-2.51)**	(0.994)	(0.993)	(0.393)	3.45)***

Note: Changes of CDS spreads are expressed in basis points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of upgrades on CDS spreads (excluding 1 upgrade for Greece (Fitch)):

Upgrades	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	-3.668	-1.803	-1.865	-1.912	-1.865	0.089	-3.977
19 obs.	(-2.61)**	(-2.01)*	(-1.80)*	(-0.92)	(-0.90)	(0.054)	(-2.43)**
Moody's	-3.550	-2.836	-0.714	-3.918	-1.504	0.751	-1.448
9 obs.	(-2.02)*	(-1.80)	(-1.51)	(-1.87)*	(-1.12)	(0.291)	(-0.68)
Fitch	-1.428	-0.554	-0.875	-0.085	-1.984	0.490	-4.410
16 obs.	(-2.39)**	(-1.45)	(-2.44)**	(-0.03)	(-1.63)	(0.374)	(-2.29)**
All	-2.740	-1.496	-1.244	-1.558	-1.844	0.378	-3.668
47 obs.	(-3.89)***	(-3.00)***	(-2.76)***	(-1.24)	(-1.87)*	(0.395)	(-3.37)***

Note: Changes of CDS spreads are expressed in basis points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of negative outlooks on CDS spreads:

Negative outlook	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	8.351	7.224	1.126	30.498	6.986	2.965	18.077
90 obs.	(2.137)**	(2.225)**	(0.512)	(2.898)***	(0.537)	(0.392)	(1.583)
Moody's	26.585	24.323	2.262	24.526	29.843	2.215	-4.633
17 obs.	(2.626)**	(2.702)**	(0.684)	(1.986)*	(3.351)***	(0.150)	(-0.30)
Fitch	1.180	0.282	0.898	0.954	5.179	15.269	7.701
60 obs.	(0.347)	(0.114)	(0.477)	(0.125)	(0.857)	(1.421)	(0.611)
All	7.630	6.471	1.160	19.276	8.663	7.309	12.037
167 obs.	(2.844)***	(2.925)***	(0.829)	(2.974)***	(1.173)	(1.260)	(1.548)

Note: Changes of CDS spreads are expressed in basis points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of negative outlooks on CDS spreads (excluding 22 negative outlooks for Greece):

Negative outlook	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	6.700	4.869	1.831	19.167	13.027	-1.118	-0.267
79 obs.	(1.539)	(1.479)	(0.815)	(2.040)**	(1.353)	(-0.16)	(-0.03)
Moody's	19.719	17.462	2.257	23.770	31.155	-11.473	6.562
14 obs.	(2.137)*	(2.505)**	(0.563)	(2.109)*	(3.050)***	(-0.80)	(0.596)
Fitch	1.688	0.801	0.888	1.230	4.731	11.936	-5.640
52 obs.	(0.537)	(0.318)	(0.519)	(0.148)	(0.755)	(1.038)	(-0.78)
All	6.160	4.626	1.534	13.179	11.802	2.564	-1.534
145 obs.	(2.211)**	(2.164)**	(1.085)	(2.183)**	(2.035)**	(0.450)	(-0.31)

Note: Changes of CDS spreads are expressed in basis points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of positive outlooks on CDS spreads:

Positive outlook	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	-1.354	-0.509	-0.845	2.571	-3.238	5.132	-0.305
19 obs.	(-1.23)	(-1.07)	(-0.94)	(1.123)	(-2.18)**	(1.305)	(-0.19)
Moody's	1.348	0.628	0.720	-1.732	-3.254	1.722	-0.346
8 obs.	(1.435)	(1.040)	(1.581)	(-0.70)	(-1.78)	(0.865)	(-0.13)
Fitch	1.699	0.848	0.852	-5.426	-1.896	-2.682	-2.180
10 obs.	(0.835)	(0.653)	(1.090)	(-1.95)*	(-0.99)	(-1.08)	(-0.60)
All	0.056	0.103	-0.048	-0.521	-2.879	2.283	-0.821
37 obs.	(0.067)	(0.232)	(-0.09)	(-0.33)	(-2.93)***	(1.036)	(-0.61)

Note: Changes of CDS spreads are expressed in basis points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of positive outlooks on CDS spreads (excluding 1 positive outlook for Greece from Fitch):

Positive outlook	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	-1.354	-0.509	-0.845	2.571	-3.238	5.132	-0.305
19 obs.	(-1.23)	(-1.07)	(-0.94)	(1.123)	(-2.18)**	(1.305)	(-0.19)
Moody's	1.348	0.628	0.720	-1.732	-3.254	1.722	-0.346
8 obs.	(1.435)	(1.040)	(1.581)	(-0.70)	(-1.78)	(0.865)	(-0.13)
Fitch	1.966	1.020	0.947	-6.006	-2.052	-2.981	-2.411
obs.	(0.872)	(0.709)	(1.091)	(-1.98)*	(-0.96)	(-1.08)	(-0.60)
All	0.077	0.126	-0.049	-0.530	-2.945	2.346	-0.841
36 obs.	(0.090)	(0.275)	(-0.09)	(-0.32)	(-2.93)	(1.036)	(-0.60)

Note: Changes of CDS spreads are expressed in basis points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level.

Impact of negative events on CDS spreads:

Negative events	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	41.559	29.554	12.005	63.472	68.146	97.895	26.156
140 obs.	(1.300)	(1.345)	(1.180)	(2.195)**	(1.153)	(1.018)	(2.580)**
Moody's	211.861	129.362	82.499	127.066	214.727	15.309	4.485
55 obs.	(1.117)	(1.114)	(1.119)	(1.361)	(0.940)	(1.350)	(0.338)
Fitch	38.845	18.858	19.987	116.185	215.685	202.289	9.881
obs.	(1.060)	(0.999)	(1.121)	(1.339)	(1.284)	(1.057)	(0.937)
All	72.390	44.536	27.854	93.197	145.488	117.885	16.599
295 obs.	(1.793)*	(1.794)*	(1.769)*	(2.538)**	(1.909)*	(1.488)	(2.559)**

Note: Changes of CDS spreads are expressed in basis points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level. Negative events comprise both negative outlooks and downgrades.

Impact of negative events on CDS spreads (excluding 22 negative outlooks and 25 downgrades for Greece):

Negative events	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	7.663	4.561	3.103	21.846	17.954	-2.905	3.912
120 obs.	(2.026)**	(1.620)	(1.637)	(2.654)***	(2.105)**	(-0.48)	(0.577)
Moody's	16.831	8.670	8.161	28.685	-9.551	0.361	1.080
45 obs.	(2.623)**	(2.650)**	(1.528)	(2.269)**	(-0.69)	(0.033)	(0.118)
Fitch	2.996	0.691	2.305	2.185	-1.108	17.219	-7.331
83 obs.	(1.184)	(0.351)	(1.541)	(0.323)	(-0.20)	(1.744)*	(-1.17)
All	7.765	4.011	3.754	16.506	6.583	4.423	-0.365
248 obs.	(3.321)***	(2.462)**	(2.638)***	(3.208)***	(1.272)	(0.918)	(-0.08)

Note: Changes of CDS spreads are expressed in basis points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level. Negative events comprise both negative outlooks and downgrades.

Impact of positive events on CDS spreads:

Positive events	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	-2.511	-1.156	-1.355	0.329	-2.551	2.611	-2.141
38 obs.	(-2.79)***	(-2.26)**	(-1.99)*	(0.210)	(-2.03)**	(1.220)	(-1.83)*
Moody's	-1.245	-1.206	-0.039	-2.889	-2.327	1.208	-0.929
17 obs.	(-1.06)	(-1.26)	(-0.10)	(-1.83)*	(-2.12)**	(0.751)	(-0.58)
Fitch	-0.145	-0.004	-0.141	417.459	445.605	-0.587	-3.654
30 obs.	(-0.17)	(-0.00)	(-0.35)	(0.995)	(0.995)	(-0.49)	(-2.17)**
All	-1.423	-0.760	-0.663	146.908	155.666	1.201	-2.433
85 obs.	(-2.56)**	(-2.19)**	(-1.91)*	(0.992)	(0.985)	(1.100)	(-2.86)***

Note: Changes of CDS spreads are expressed in basis points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level. Negative events comprise both positive outlooks and upgrades.

Impact of positive events on CDS spreads (excluding 1 positive outlook and 1 upgrade for Greece from Fitch):

Positive events	Short window			Longer period			
	[-1,1]	[-1,0]	[0,1]	[-20,-10]	[-9,-1]	[2,9]	[10,20]
S&P	-2.511	-1.156	-1.355	0.329	-2.551	2.611	-2.141
38 obs.	(-2.79)***	(-2.26)**	(-1.99)*	(0.210)	(-2.03)**	(1.220)	(-1.83)*
Moody's	-1.245	-1.206	-0.039	-2.889	-2.327	1.208	-0.929
17 obs.	(-1.06)	(-1.26)	(-0.10)	(-1.83)*	(-2.12)**	(0.751)	(-0.58)
Fitch	-0.337	-0.048	-0.289	-1.988	-2.005	-0.626	-3.768
28 obs.	(-0.39)	(-0.09)	(-0.73)	(-1.11)	(-1.91)*	(-0.49)	(-2.09)**
All	-1.518	-0.793	-0.726	-1.112	-2.321	1.232	-2.442
83 obs.	(-2.70)***	(-2.24)**	(-2.07)**	(-1.12)	(-3.29)***	(1.101)	(-2.81)***

Note: Changes of CDS spreads are expressed in basis points. Mean is reported with associated t-statistics in brackets. Asterisks denote significance at 1 % (***), 5 % (**) and 10 % (*) level. Negative events comprise both positive outlooks and upgrades.