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THE IMPACT OF SOVEREIGN CREDIT RATING CHANGES ON THE EUROPEAN FINANCIAL SYSTEM

Settore Scientifico Disciplinare

SECS-P/11 - Economia degli intermediari finanziari

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Sintesi

L'obiettivo della tesi è di analizzare l'impatto di una variazione del rating creditizio sovrano sul sistema finanziario europeo. In particolare, si verifica l'impatto di una variazione del rating sovrano sul mercato dei CDS sovrani, sul costo dei prestiti sindacati, e sull'attività delle banche domestiche.

Nel primo capitolo, si analizza l'impatto e il potenziale effetto spillover dell'annuncio di una variazione di rating sul mercato dei CDS dell'area euro. I risultati evidenziano un impatto significativo di downgrade e upgrade. La significatività dell'impatto è dovuta sia all'introduzione di "nuova" informazione sul mercato in seguito all'annuncio della variazione di rating sia al ruolo dei rating nell'attuale regolamentazione finanziaria. Al contrario, il mercato dei CDS non sembra reagire in modo significativo all'annuncio di un rating warning (outlook e review). Inoltre, si dimostra la presenza di un significativo effetto spillover causato dall'annuncio di un downgrade.

Nel secondo capitolo, si analizza l'impatto di una variazione del rating sovrano sugli spread dei prestiti concessi ad imprese europee. L'analisi dimostra che un downgrade sovrano causa un significativo aumento degli spread applicati alle imprese domestiche. Gli effetti negativi connessi all'annuncio di un downgrade sono significativi per tutte le imprese, anche le unrated. Una parte rilevante dell'impatto dipende dall'utilizzo dei rating creditizi all'interno della regolamentazione finanziaria (*certification effect*). Questo effetto riduce anche la dimensione dei prestiti e comporta ulteriori oneri per le imprese investment grade. Invece, un upgrade non sembra avere un impatto significativo.

Nel terzo capitolo, si verifica l'effetto di una variazione del rating sovrano sull'attività delle banche europee, esaminando l'impatto sul capitale regolamentare, la profittabilità, la liquidità, e l'offerta di prestiti. I risultati indicano la presenza di un impatto significativo di un downgrade sovrano sull'attività delle banche domestiche, soprattutto sui ratio patrimoniali e l'offerta di prestiti. Al contrario, gli upgrade non sembrano avere un impatto significativo, suggerendo un effetto asimmetrico tra variazioni di rating positive e negative. Inoltre, si dimostra che tre canali di trasmissione (*assets channel*, *funding channel*, e *rating channel*) spiegano una parte rilevante dell'impatto di un downgrade sovrano. Infine, si evidenzia che l'utilizzo dei rating nella regolamentazione finanziaria influenza in modo significativo le variabili adottate per misurare l'attività delle banche domestiche, causando esternalità negative per le istituzioni finanziarie europee.

Abstract

We aim to assess the impact of sovereign credit rating changes on the European financial system. In particular, we analyze the impact of a sovereign rating change on: the sovereign CDS market, the cost of syndicated loans, and the activity of domestic banks.

In the first chapter, we analyze the impact and the spillover effect of a sovereign rating announcement on the euro area CDS market. We show that downgrades and upgrades considerably affect financial markets. The relevance of the impact is due to the introduction of "new" information after a rating change announcement and to the role of rating in the current financial regulation. Conversely, the CDS market does not seem to react significantly to rating warning (outlook and review) announcements. Furthermore, we find evidence of a spillover effect only after a downgrade announcement.

In the second chapter, we analyze the impact of sovereign rating changes on European corporate loan spreads. We demonstrate that sovereign downgrades lead to significant increases in the spread of loans to domestic firms. We find evidence that the negative effects of a sovereign downgrade are widespread across all firms, also unrated. A relevant part of this impact depends on the reliance of financial regulation on credit ratings (*certification effect*), which reduces also loan size and leads to additional burdens for investment grade firms. Instead, we do not find evidence of a significant impact generated by an upgrade.

In the third chapter, we verify the effects of sovereign rating revisions on the activity of European banks, in terms of their regulatory capital ratio, profitability, liquidity, and lending supply. First, we find that a sovereign downgrade has a

significant impact, primarily on capital ratios and lending supply. In contrast, upgrades do not have a significant impact, indicating an asymmetric effect of sovereign rating changes. Second, we find that three transmission channels (*assets channel*, *funding channel*, and *rating channel*) explain a relevant part of the impact of a sovereign downgrade. Finally, we find strong evidence that the rating-based regulation affects all measures of the activity of domestic banks, causing negative externalities for financial institutions.

Contents

Introduction

The IMF (2010) defines credit ratings as measures of the relative risk that an entity or transaction will fail to meet its financial commitments, such as interest payments and repayment of principal, on a timely basis.

Credit ratings are issued by credit rating agencies (CRAs), which summarize their judgments into rating grades identified by letter designations, such as AAA or BB+. Each agency provides different rating types. The long-term rating is the most know and meaningful, because it expresses the long-term issuer's solvability.

Credit ratings play a significant role in the current financial system. They provide to investors useful information regarding an issuer or a financial instrument in a synthetic and timely manner. Given the high information asymmetry that characterizes financial markets, credit ratings are extensively used by investors. As documented by different surveys (Cantor et al., 2007; SEC, 2003), most institutional investors, as funds, insurance companies and banks, rely on credit ratings to comply with internal and contractual guidelines, to take investment decisions, and to evaluate their policies.

In addition to the use of ratings by private entities, numerous rules and regulations rely on credit ratings. For example, CRAs' judgments are involved in the calculation of banks' minimum capital requirements and are also used by central banks to determine the accepted securities as collateral in market operations.

The over-reliance of regulation on credit ratings has been extensively criticized (Masciandaro, 2013), because there is evidence of not negligible side effects, in

terms of financial instability, associated with the rating-based regulation (IMF, 2010). The main concerns regard the timeliness of rating changes, which may induce pro-cyclicality in prices, and potential "threshold effect", which is an abrupt reduction in market liquidity that triggers further sales when a downgrade leads to an issuer rating category transition.

In addition to corporate credit ratings, CRAs also rate sovereign issuers. Until recently, investors were more interested in evaluations regarding the solvability of developing countries, which were the sovereign issuers most exposed to default.

However, recent financial crises have showed that also developed countries may threaten the international financial stability. Therefore, also developed countries' ratings have attracted an increasing attention.

Numerous authors have examined how sovereign credit ratings can affect financial system, especially after the global financial crisis. Kiff et al. (2012) summarize the ways through which CRAs can affect financial system distinguishing between: the *information discovery effect*, the *monitoring effect,* and the *certification effect*. The first effect regards the capability of CRAs to introduce "new" information through rating revisions into the market, given the potential informational advantage of CRAs. The *monitoring effect* suggests that CRAs may derive their value mainly from their monitoring role. Finally, the *certification effect* refers to the role of rating in financial regulation.

The existent literature underlines the significant financial contagion due to a sovereign rating change. In their seminal contribution, Gande and Parsley (2005) document that a rating change in one country has a significant effect on sovereign

credit spreads of other countries. Therefore, sovereign rating revisions primarily affect sovereign security prices.

In addition, the impact of sovereign rating actions is significantly widespread also across other financial markets. According to Borensztein et al. (2013), sovereign ratings are a main determinant of domestic corporate ratings. Thus, they also affect corporate credit spreads. Similarly, Adelino and Ferreira (2016) show that sovereign rating downgrades may decrease bank ratings, which in turn may negatively affect banks' funding conditions and lending supply. In particular, these papers underline that a main part of the impact of a sovereign rating action on domestic issuers is directly related to the sovereign ceiling "lite" policy. Since CRAs rarely assign to an issuer a rating above its sovereign, sovereign ratings represents a limitation that tends to reduce corporate ratings when these ratings are close to their sovereign rating.

The widespread relevance of sovereign credit rating decisions has sparked an international debate that has questioned the market power attributed to CRAs. In fact, judgments regarding sovereign issuers may be associated with potential significant shortcomings (Lanotte et al., 2016). The accuracy of sovereign rating is questionable: sovereign defaults are rare events; it is difficult to assess the willingness to pay of a sovereign entity; and it is not certain that CRAs have an information advantage compared to other analysts in the assessment of sovereign creditworthiness, especially of developed countries. Despite the importance of sovereign ratings, the effects of these drawbacks are only partly explored.

The aim of this dissertation is to assess the impact of sovereign rating changes on the European financial system. In particular, we analyze the impact of a

sovereign rating change on: the sovereign CDS market, the cost of syndicated loans, and the activity of domestic banks.

In the first chapter, we analyze the reaction of sovereign CDS markets to sovereign rating announcements, verifying whether investors consider credit ratings a relevant measure to assess sovereign creditworthiness. CDS are widely used to assess the credit risk of an issuer; therefore, they are directly comparable to ratings. We focus on EMU Member States to adopt a homogenous sample of sovereign entities.

First, we analyze the impact of a rating announcement on the CDS of the issuer subject to the rating change. We test also how CRAs affect financial markets, assessing whether the impact of a sovereign rating change is due to the CRAs' information advantage, to their monitoring ability, or to the rating-based regulation. We show that downgrades and upgrades have a significant impact on sovereign CDS markets. This effect is due to the introduction of new information on market and to the rating-based regulation. Instead, rating warnings (outlooks and reviews) do not significantly affect sovereign CDS markets.

Afterwards, we verify whether a sovereign rating change represents a financial shock that affects the CDS markets of other EMU countries (spillover effect). We find evidence of a significant spillover effect of downgrades, while upgrades do not affect the CDS market of other countries. Moreover, we analyze the determinants of financial contagion and we highlight that international bank flows represent a relevant transmission channel of the spillover effect.

In the second chapter, we analyze the impact of sovereign rating changes on European syndicated loan spreads. We show that negative rating revisions

significantly affect European firms' borrowing costs. The negative effects of sovereign downgrades are widespread across all firms, also unrated, which are the majority of firms in the European syndicated loan market.

We demonstrate that a relevant part of this impact is due to the rating-based regulation (*certification effect*). In particular, we prove that the *certification effect* leads to a reduction in loan size and to supplementary burdens for investment grade firms.

In the third chapter, we analyze the effect of sovereign rating changes on the activity of European domestic banks. We document a significant impact of sovereign downgrades on the banking sector. Sovereign downgrades, in fact, affect banks' capital ratio; lending supply; and, to a lesser extent, their profitability and liquidity. The impact on capital ratios is due to different channels, defined as *assets channel*, *funding channel*, and *rating channel*. Instead, the effect on lending, profitability, and liquidity almost exclusively depends on the use of credit ratings in the financial regulation (*certification effect*).

Finally, in the last chapter, we present the conclusions.

1. The Impact of a Sovereign Rating Announcement on the Euro Area CDS Market

1.1. Introduction

After the beginning of the 2007 financial crisis, sovereign ratings issued by credit rating agencies (CRAs) attracted an increasing attention from media, public opinion and sometimes also from European prosecutors (Financial Times, 2015). Rating agencies, in fact, have acquired a leading role in financial markets. Since the original work of Cantor and Packer (1996) until few years ago, researchers have paid particular attention to developing countries' ratings. Financial crises have rarely involved developed countries' public debt in past decades (Reinhart, 2010). However, with the intense risk shift observed after the 2007 financial crisis, a greater attention has also been given to developed countries' creditworthiness, especially to euro area financial stability.

In this chapter, we aim to analyze the impact of a sovereign rating announcement on the euro zone financial markets. We measure the impact observing the reaction of the euro area credit default swaps (CDS) market. In the first part of the chapter, we employ an event study methodology to analyze the effect of a rating change on the sovereign CDS market of the changed rating issuer (event country). In the second part, we extend the analysis verifying if a rating announcement has an impact on the CDS market of other EMU countries. We adopt a modified version of the model proposed by Gande and Parsley (2005) to identify a possible spillover effect of a rating announcement.

Our contribution tries to extend the existing literature in different ways. *i)* Numerous papers regarding the impact of a rating announcement on the CDS market are focused on corporate sector or on developing countries, while our analysis regards euro area countries. *ii)* Böninghausen and Zabel (2015) pointed out that the results of different event studies are not easily comparable because they do not focus on specific regional crises and on homogeneous samples. Our dataset, instead, comprehends a sample of countries which share similar political and economic fundamentals, as the same currency, and which were affected by a dramatic financial crisis during the considered time interval. *iii)* Carrying out the event study, we estimate the *AR* (abnormal returns) using the market model method, in order to control for possible systematic factors that could influence the CDS market simultaneously. To the best of our knowledge, we are the first to use this methodology examining the sovereign CDS market. *iv)* We do not just estimate the credit rating impact on the sovereign CDS market but we test empirically three main theoretical approaches proposed in literature (described in Section 1.2) regarding how CRAs affect financial markets. In particular, we show that rating changes have a substantial impact on the sovereign CDS market, and part of this effect is due to regulatory constraints related to ratings. *v)* We find evidence of a significant spillover effect of downgrade announcements on the euro area CDS market. This result holds also using different methods, such as the counterfactual identification strategy proposed by Böninghausen and Zabel (2015) (see Section 1.6). *vi)* We extend previous analyses proposed in literature regarding the spillover effect of a rating announcement identifying international bank flows as a main transmission channel of the spillover effect.

The remaining part of this chapter is organized as follows. In Section 1.2, we review the related literature and present research hypotheses. Section 1.3 describes the dataset. Section 1.4 presents the event study methodology and summarizes the empirical results concerning the impact of a rating announcement on the CDS market. A discussion regarding spillover effect and the related results follow in Section 1.5. Section 1.6 contains robustness checks. Section 1.7 concludes.

1.2. Review of related research and hypotheses

The literature has identified at least three distinct ways through which CRAs can affect financial markets (Kiff et al., 2012): *i) information discovery effect*, *ii) monitoring effect,* and *iii) certification effect*. According to the first approach, CRAs produce and offer "new" information to market, relevant for the bond and other financial instruments pricing process. The market reaction observed after a rating change could reflect a possible CRAs' informational advantage. The second approach focuses on the role of CRAs as monitors of valuable coordination of beliefs in situations where multiple equilibria can be obtained (Boot et al., 2006). According to the *monitoring effect* theory, CRAs derive their value mainly from their monitoring role, which is put in place especially when they start credit watch procedures. The last theory, concerning the *certification effect*, is focused on the role of rating in financial regulation.

Several papers tried to find evidence of *information discovery effect* analyzing the financial markets reaction to a rating announcement. The results have been often contradictory. As regards the stock market, Holthausen and Leftwich (1986)

and Pinches and Singleton (1978) showed that the market anticipates upgrade and downgrade announcements. Brooks et al. (2004), Hand et al. (1992), and Imbierowicz and Wahrenburg (2009), conversely, estimated that only downgrades affect the stock market. Hooper et al. (2008) demonstrated that rating changes, especially downgrades, have an impact on stock returns and on volatility. Same results are obtained by Kräussl (2005) observing the impact of a rating announcement on an index of speculative market pressure that takes into account the stock market reaction. As regards the bond market, Katz (1974) observed that this market does not anticipate rating changes. Weinstein (1977) found that the bond market anticipates by several months rating changes. Wansley et al. (1992) showed that only downgrades have a significant impact around the announcement, while Steiner and Heinke (2001) observed significant reactions also after negative review announcements.

There are also numerous papers regarding the CDS market, but most concerns corporate sector. Daniels and Jensen (2005), Galil and Soffer (2011), Hull et al. (2004), Imbierowicz and Wahrenburg (2009), and Norden and Weber (2004) showed that negative rating events affect the CDS market, while positive events do not seem to have a significant impact. Instead, Finnerty et al. (2013) and Micu et al. (2006), who are among the first to use the market model to estimate daily corporate CDS abnormal returns, observed a significant impact of the announcement of all rating types on the CDS market. As regards the sovereign CDS market, Ismailescu and Kazemi (2010) analyzed the reaction of developing countries sovereign CDS spreads to rating changes. They observed a relevant impact of positive events, while the market seems to anticipate negative events.

Afterwards, Afonso et al. (2012), analyzing European bond and CDS markets, found evidence of a significant reaction of bond yields and CDS spreads to rating changes. Negative events seem to affect markets more than positive events. Kiff et al. (2012), conversely, showed that negative credit warnings have the most significant impact on CDS spreads. Upgrades and downgrades, instead, affect the market only when the announcement changes the issuer rating category: from investment grade to speculative grade or vice versa. In view of described results, our first hypothesis is:

H1. *The announcement of a sovereign rating change has a significant impact on the euro area sovereign CDS market*.

The *monitoring effect* theory, proposed by Boot et al. (2006), relies on rating warnings (outlooks and reviews) that precede downgrade announcements (Kiff et al., 2012). According to this theory, outlooks and reviews allow the creation of an implicit contract between issuer and CRA. The issuer "promises" to take specific actions to avert downgrades. When a CRA announces an outlook or a review, therefore, it provides a signal to investors. If the issuer fails to adopt the recommended measures, CRA downgrades issuer credit rating. If a CRA, monitoring the issuer's creditworthiness, announces a rating warning and if this decision is subsequently confirmed by an actual rating change, we expect to observe a greater downgrade impact. This theory has not found, at the moment, empirical evidence in other studies (Kiff et al., 2012). We express our second hypothesis in the following way:

H2. *The announcement of a downgrade preceded by a rating warning (outlook or review) has a greater impact on the sovereign CDS market than an unanticipated rating change.*

The *certification effect* theory highlights the role of ratings in financial regulation. For example, credit ratings are involved in the calculation of minimum capital requirements for banks (Basel II and III). In this case, CRAs provide a certification service. This theory has gained an increasing importance after the beginning of the recent financial crisis (Kiff et al., 2012), generating an intense debate on the role of CRAs and on the opportunity to eliminate or reduce the use of ratings in financial regulation. According to the most critical view, the excessive use of credit ratings in regulation attributes an unmotivated market power to CRAs. In some cases, an investor could be forced by rating-based rules to change his portfolio choices. In financial regulation, in fact, there are numerous operational limits concerning asset rating categories. The transition from one rating category to another, therefore, could have a greater impact on the CDS market for regulatory constraints. This hypothesis has found empirical evidence when CRAs change rating category of an issuer from investment grade to speculative grade or vice versa (Finnerty et al., 2013; Kiff et al., 2012). Therefore, we assume that:

H3. *The announcement of a rating change has a greater impact if it changes the issuer rating category.*

Previous hypotheses concern the effect of a rating change on the event country CDS market, while our following hypotheses aim to find evidence of a possible spillover effect of rating announcements on the non-event countries CDS markets

included in the sample. In literature, different approaches have been proposed to estimate spillover effects on financial markets (Forbes, 2012). In their seminal paper, Gande and Parsley (2005) found evidence of a spillover effect of sovereign rating announcements on the sovereign bond markets. They find an asymmetric effect because positive announcements do not affect significantly the bond market; downgrades, instead, cause an increase in bond spreads. Numerous contributions used the methodology presented in Gande and Parsley (2005) to identify the spillover effect of rating announcements. Ferreira and Gama (2007) showed a relevant spillover effect of sovereign rating announcements on the stock market. They also found that only downgrades generate a spillover effect, which is stronger if the announcement regards an emerging country rating. Alsakka and ap Gwilym (2013) showed that the spillover effect of a rating announcement on the currency market is more relevant during crises. Böninghausen and Zabel (2015) demonstrated a negative impact of a downgrade on the bond market and that this impact increases if it involves countries belonging to the same region. Upgrades, conversely, seem to have a more limited impact. Wengner et al. (2015) showed that downgrades as well as upgrades affect significantly the corporate CDS market, mainly during the recent financial crisis. As regards the sovereign CDS market, Ismailescu and Kazemi (2010) found evidence of a spillover effect only after positive rating changes and low-rated countries downgrades. Through time series analysis, Arezki et al. (2011) and De Santis (2012) estimated the structural impact of sovereign rating changes on the sovereign CDS market. Afonso et al. (2012) observed a spillover effect of a sovereign rating

announcement only on the European bond market, while the European CDS market seems less responsive.

In addition, it was highlighted that the spillover effect could be twofold (Gande and Parsley, 2005). On one side, a rating change could signal a common trend within event and non-event countries, and consequently could produce a spillover effect with the same sign of the observed rating change (*common information effect*). However, on the other side, we could also observe a flight-to-quality behavior. After a downgrade, for example, the event country debt becomes less attractive for investors. Rebalancing their portfolio, investors might decide to purchase debt securities issued by non-event countries, which are now perceived relatively less risky. The same process, but with an opposite sign, could be observed after an issuer rating improvement. If this hypothesis is true, we could observe a spillover effect with a sign opposite to the sign of the event country rating change (*differential effect*).

In view of previous empirical evidence, we want to verify if a rating change of the *j-th* issuer affects the CDS market of the *i-th* euro zone country. Thus, our fourth research hypothesis is:

H4. *The announcement of a positive or a negative rating change generates a significant spillover effect on the euro area sovereign CDS markets.*

Some papers highlighted that the banking system is one of the main transmission channel of financial contagion. International banking linkages, in fact, seem to facilitate the international propagation of risk (Bolton and Jeanne, 2011). After the theoretical basis proposed by Allen and Gale (2000), this subject has received an increasing attention, particularly since the beginning of the last

financial crisis. Recent researches have demonstrated the existence of a financial contagion between European banks CDS and euro zone sovereign CDS (De Bruyckere et al., 2013), and between sovereign ratings and domestic bank ratings during crises (Alsakka et al., 2014). Alter and Beyer (2014) showed that interventions of ECB and EU mitigated systemic effects of negative shocks that affected the euro area sovereign CDS market and the banking sector during the recent financial crisis. Hasan et al. (2014) demonstrated that a rating change causes a greater impact on international bank flows to public sector and banks of the event country after the implementation of the Basel II rules. Stângă (2014) showed that financial institution bailouts generate risk spillovers between the default risks of banks and governments.

Furthermore, Acharya and Steffen (2015) and Korte and Steffen (2015) demonstrated that the European banking system fragility during the recent crisis could have been caused by a regulatory arbitrage that, on one side, stimulated investments in securities issued by riskier euro area countries, but, on the other side, not encouraged banks to hedge the risk arising from these exposures, creating a "zero risk contagion".

Bolton and Jeanne (2011) highlighted that a result of financial integration is that banks diversify their holdings of sovereign debt to minimize the costs associated with an individual country default. This investment strategy generates, ex ante, risk diversification benefits, but it can also cause damages due to financial contagion ex post. With the progressive European financial integration, in fact, euro area banks are highly exposed to EMU Member States' default risk, in addition to their country's counterparty risk. Moreover banks use government

securities also as collateral for numerous contracts, like interbank loans, repos and transactions with central banks (ECB, 2013). In these contracts, a specified issuer rating is required to use government securities as collateral. Tonzer (2015) found evidence of a trade-off between stability and systemic risk. The potential of cross-border linkages to cause negative spillovers increases when the stability of the financial system is low. Therefore, the results of mentioned studies underline that, when the financial stability of a euro area country is doubted, the default risk can be transmitted to other EMU Members through the banking system, even if the financial situation of other members does not raise concern. The reduction of government securities value has a negative impact on the banks' balance sheet, because banks hold large amounts of sovereign bonds. We assume, therefore, that we can observe a greater impact of a rating announcement if the banking system of an EMU Member State is highly exposed to the event country:

H5. *The spillover effect size of a rating announcement is greater if the i-th country banking system holds a large exposure to the j-th country.*

1.3. Data

Our sample consists of 5-year sovereign CDS daily quotes of mid premium (average between bid and ask) denominated in US dollars of 15 EMU Member States[1] from 2004 to 2015. CDS quotes are obtained from Datastream. In Table 1.1, we provide descriptive statistics of daily CDS spreads included in our sample.

[1] We exclude Luxemburg and Malta because their CDS market liquidity is far below the average liquidity of the other countries. Furthermore, we exclude Lithuania and Latvia because they do not adopt euro for the most of the analyzed period.

In this study, we collect long term foreign currency sovereign ratings issued by Standard & Poor's from 2004 to 2015. We decided to use ratings issued by this CRA because previous studies found that Standard & Poor's updates its ratings more frequently, usually preceding other CRAs (Ismailescu and Kazemi, 2010), and S&P's seems to have greater focus on reputational credibility among market participants (Alsakka et al., 2014).

Table 1.1
Summary statistics of daily CDS spreads (bps).

Country	Mean	Min	I Qu.	Median	III Qu.	Max	Std. Dev.	Obs.	Starting period
Austria	47.8	0.5	2.5	30.3	75.2	273.0	55.0	2,930	06/01/04
Belgium	65.6	1.0	3.2	43.6	82.4	398.8	78.7	2,931	05/01/04
Cyprus	332.1	1.0	14.5	107.0	445.1	1,674.2	432.1	2,931	05/01/04
Estonia	120.6	1.0	60.2	84.4	135.0	736.8	133.9	2,384	08/02/06
Finland	34.7	6.5	23.0	28.7	38.0	93.9	19.0	1,835	18/03/08
France	56.0	0.5	7.5	44.8	77.4	245.3	54.9	2,510	16/08/05
Germany	26.1	0.6	3.0	21.0	38.9	118.4	26.4	2,928	08/01/04
Greece	584.8	4.4	9.8	42.4	526.2	9,764.1	1,411.3	2,187	09/01/04
Ireland	237.8	1.5	45.7	151.2	334.8	1,249.3	251.6	2,201	05/01/04
Italy	129.8	5.3	10.0	96.5	191.0	586.7	138.6	2,920	20/01/04
Netherlands	42.7	1.0	19.0	37.5	54.5	133.8	32.4	2,201	07/09/05
Portugal	250.1	1.9	7.5	91.7	377.1	1,601.0	342.0	2,916	26/01/04
Slovakia	71.5	4.0	11.0	57.0	90.2	306.0	71.1	2,930	06/01/04
Slovenia	114.4	3.8	14.3	71.9	164.3	488.6	123.6	2,931	05/01/04
Spain	170.5	2.4	64.2	119.7	259.1	634.3	145.1	2,201	24/04/05

Table 1.2 shows rating changes broken down by countries and rating typologies included in the sample.[2] We observe that Standard & Poor's sovereign euro area ratings are significantly decreased during the period considered, signaling a remarkably creditworthiness reduction in the euro zone. Negative changes (94) overcome by far positive changes (30). Moreover, no positive reviews have been announced for these countries.

[2] We do not consider the downgrade to "selective default" of Greece (27/02/12) and Greece rating changes announced after this event. The default, in fact, triggered Greece sovereign CDS payments and, therefore, after this event there were not regular sovereign CDS daily quotes.

In the second part of our study, estimating the spillover effect, we consider the comprehensive credit rating (CCR) and not the usual rating level issued by Standard & Poor's. CCR takes into account simultaneous rating change and warning announcements (Gande and Parsley, 2005). In line with Ismailescu and Kazemi (2010), we assign a numerical value to each credit rating issued by Standard & Poor's and we add to this number a second value if the rating change includes a rating warning announcement. We use the rating scale presented in Table 1.3.

Table 1.2
Number of rating changes included in the sample.

Country	Downgrades	Upgrades	Negative Outlooks	Positive Outlooks	Negative Reviews
Austria	1	0	0	1	1
Belgium	1	0	2	1	1
Cyprus	10	4	0	1	1
Estonia	1	2	3	3	2
Finland	1	0	2	1	1
France	2	0	1	0	1
Germany	0	0	0	1	1
Greece	7	0	2	0	2
Ireland	6	2	2	2	1
Italy	5	0	2	0	1
Netherlands	1	0	1	0	1
Portugal	5	0	3	2	4
Slovakia	1	2	0	4	1
Slovenia	4	1	2	1	2
Spain	6	1	1	1	2
Total	51	12	21	18	22

Other data are retrieved from different sources. Macroeconomic variables are extracted from Datastream and IMF databases. The source of monthly bilateral trade flows is the Direction of Trade Statistics (DOTS) published by IMF. The quarterly historical series of international bank flows is retrieved from BIS Consolidated Banking Statistics. We have selected exposures to the Official Sector calculated on the ultimate risk basis and we include all financial

instruments. For the complete variables list, their relative sources and summary statistics see Table A.1 and Table A.2 in Appendix A.

Table 1.3
Numerical values assigned to S&P's ratings.

Rating typology	Numerical value
Ratings	
AAA	17
AA+	16
AA	15
AA-	14
A+	13
A	12
A-	11
BBB+	10
BBB	9
BBB-	8
BB+	7
BB	6
BB-	5
B+	4
B	3
B-	2
CCC+/CCC/CCC-	1
CC	0
SD	-1
Rating warnings	
Positive Outlook	+0.5
Positive Review	+0.25
Stable/Not meaningful	0
Negative Review	-0.25
Negative Outlook	-0.5

1.4. The impact of a rating announcement on the euro area CDS market

1.4.1. Methodology

The methodology chosen to study the effect of a rating change announcement on the euro area CDS market is the event study (MacKinlay, 1997). The "event" is a rating announcement. We include both rating changes and rating warnings (outlooks and reviews) announcements. We distinguish rating announcements into two groups: negative events (downgrades, negative outlooks and negative

reviews) and positive events (upgrades, positive outlooks and positive reviews). We choose five event windows around the event day t_0, following the existing literature (Hull et al., 2004). We denote event windows as $[t_1, t_2]$, indicating the number of working days before or after the event date. So, t_1 and t_2 can be negative or positive depending on the observed event window.

A rating announcement could be anticipated by financial markets or we could observe a delayed market reaction, so we choose to analyze market trends in days preceding and also in days succeeding the announcement date. Since CRAs seek to act upon new information within approximately 90 days, the first window starts from the ninetieth working day preceding the event date. The five event windows considered are: [-90, -8], [-7, -1], [0, +1], [+2, +7], [+8, +60]. We do not consider wider time intervals to prevent contamination by other events that could affect CDS spreads.

Our analysis consists of three phases. For each interval, we calculate, in the first place, the daily CDS abnormal returns (*AR*) of the event country.[3] We estimate the *AR* as the difference between observed returns and expected returns, which are returns that would have been observed if the event had not occurred. In this work, in contrast to other papers regarding sovereign CDS (see Section 1.2), we consider *AR* estimated using the market model and not abnormal CDS spread changes (*ASC*). Using this method, we can take into account market-wide systematic factors that could move all CDS spreads simultaneously. The latter

[3] The market value of a CDS contract depends upon an uncertain stream of premia, so the present value of a CDS contract is affected by changes in spreads, interest and recovery rates. In this work, according to Micu et al. (2006), we assume that CDS returns are much more sensitive to changes in CDS spreads than to changes in other variables. For short horizons, as one day, this hypothesis seems reasonable. Thus, we calculate CDS returns as $S_{i,t}/S_{i,t-1} - 1$, indicating with *S* the CDS spread for issuer *i* on day *t*.

method, instead, is based on the plain difference between CDS spread changes and an index changes.

The market model assumptions contemplate the use of a benchmark. We use an index equal to the median[4] daily euro area CDS spread.[5] For each event, we assess the existing relationship between CDS returns and index returns through the OLS method in an estimation window wide enough to ensure the model stability. We choose to estimate OLS parameters in the six months preceding the first event window, in the estimation window [-270, -90].[6]

The abnormal returns, therefore, are calculated estimating for each event Eq. (1.1):

$$AR_{it} = R_{it} - (\alpha_i + \beta_i R_{mt}) \quad (1.1)$$

Where AR_{it} is the abnormal CDS return for country i on day t; R_{it} is the observed CDS return for country i on day t; R_{mt} is the observed CDS return for index m on day t; $(\alpha_i + \beta_i R_{mt})$ is the expected CDS return estimated for each event using the market model.

In the second stage, after the abnormal returns estimation, we calculate the average of daily AR for each event window and for each event country.

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[4] According to Micu et al. (2006), we use an index based on the median rather than the mean spread, because the latter statistics could be heavily affected by some outliers. We believe, instead, that the median provides a more accurate measure of CDS spread trend.

[5] We choose a benchmark that implies an equally weighted portfolio of the euro area CDS included in our sample. There are not available, in fact, euro-area sovereign CDS market index for the whole sample period. Moreover our sample size and the typology of issuers do not allow the adoption of indices based on issuer nationality (Micu et al., 2006) or on issuer rating category (Norden and Weber, 2004).

[6] We repeated the event study using [-180, -90] as estimation window to control if our results depend on the time horizon choice. We have verified that results obtained through the latter procedure are not statistically different from those presented.

In the third phase, we aggregate mean abnormal returns of countries for each event type (downgrades, upgrades, rating warnings) and we estimate $\overline{AR}$, the overall average of previous values estimated for each event window.

1.4.1.1. Information discovery effect

If a rating change introduces "new" information, as assumed in the *information discovery effect* hypothesis (*H1*), we should find evidence of a statistically significant impact of a rating change around the announcement day. We assess abnormal returns significance through three statistical tests. The first is the cross-sectional *t*-test. We can assume that the abnormal returns are distributed as Student's *t* with *n*–1 degrees of freedom, where *n* denotes the number of observations (Micu et al., 2006). We test whether $\overline{AR}$, the mean CDS abnormal return in $[t_1, t_2]$, is significantly different from zero. Our null hypothesis is:

$$H_0: \{\overline{AR}=0\} \quad (1.2)$$

If we reject the null hypothesis, CRAs introduce "new" information and we confirm the hypothesis *H1*. If a country riskiness perception rises, CDS spreads increase. If negative events occur, therefore, we can assume that $\overline{AR}$ is greater than zero. We assume an opposite effect for positive events. The alternative hypotheses are:

$$H_1: \{\overline{AR}>0\} \text{ for negative events} \quad (1.3)$$

$$H_1: \{\overline{AR}<0\} \text{ for positive events} \quad (1.4)$$

The *t*-test results could be biased for two reasons:

- The insufficient sample size, especially for some rating typologies;

- The presence of high asymmetry levels in the *AR* distribution (all *AR* series present a skewness greater than 5). This asymmetry is also observed in previous studies on the CDS market (e.g. Hull et al., 2004; Micu et al., 2006).

Consequently, we decided to add two nonparametric tests that do not suffer from these biases. The first, as in Micu et al. (2006), is based on the bootstrap technique adopted when the limited sample size causes the violation of the assumptions of normality and symmetry (Efron and Tibshirani, 1993). The second, also used in other works (Ismailescu and Kazemi, 2010), is the Wilcoxon signed ranks test, which does not require the assumption of normal distribution and that seems to be more powerful than the *t*-test (Ederington et. al., 2015).

1.4.1.2. Monitoring effect

As regards the presence of a *monitoring effect* (*H2*), we observe that CRAs do not always anticipate their rating changes issuing outlooks or reviews, therefore, we can divide rating changes in two groups: the first includes rating changes anticipated by a rating warning, and the second group, instead, consists of unanticipated rating changes. We verify only the market reaction to a downgrade announcement because it is the most common event in the analyzed period (approximately 40% of events), it is the most anticipated by a rating warning, and the monitoring service is more required for decreasing creditworthiness issuers (Kiff et al., 2012).

If there is a *monitoring effect*, we assume that anticipated downgrades have a significantly greater impact on the CDS market than unanticipated downgrades. The significance of the difference between these two impacts is assessed by the *t*-

test and by the non-parametric Kolmogorov-Smirnov test. Our null hypothesis is that the means of the two distributions are not statistically different. The alternative hypothesis is that the $\overline{AR}$ observed around an anticipated downgrade announcement is statistically greater than the $\overline{AR}$ observed around an unanticipated downgrade announcement.

1.4.1.3. Certification effect

In literature, one of the most used approach to verify the *certification effect* (*H3*) is based on the analysis of the impact of a rating announcement that changes the issuer rating category, from investment grade to speculative grade or vice versa (IMF, 2010). We cannot use this methodology, because in our sample there are not enough downgrades and upgrades that cause this transition. Thus, we test this hypothesis using the role of credit ratings in financial regulation. For the minimum capital requirements calculation, the Basel Committee established a list of risk weights based on external credit ratings that are applied to bank exposures to sovereigns. For sovereign issuers, the Standardized Approach prescribes the risk weights presented in Table 1.4 (BIS, 2013).

Table 1.4
Credit ratings and sovereign risk weights under the Standardized Approach.

Credit rating	AAA to AA-	A+ to A-	BBB+ to BBB-	BB+ to B-	Below B-	Unrated
Risk weight	0%	20%	50%	100%	150%	100%

Source: BIS (2013)

If CRAs provide a certification service, we hypothesize that a downgrade leading to a cross of regulation category boundaries (crossover) has a greater

impact than a downgrade that does not lead to an issuer rating category change (non-crossover). Also for *certification effect*, we use the *t*-test and the Kolmogorov-Smirnov test. Our null hypothesis is that the means of the two distributions are not statistically different. The alternative hypothesis is that the $\overline{AR}$ observed around a crossover downgrade announcement is statistically greater than the $\overline{AR}$ registered around a non-crossover downgrade announcement.

However, we highlight that financial rules based on external credit ratings have been changed numerous times. National supervisors are allowed to exercise discretion and set a lower risk weight, compared to those presented in Table 1.4, provided that the exposures are denominated and funded in the currency of the corresponding state (BIS, 2013).

In order to avoid discriminatory treatment, bank supervisory authorities in other jurisdictions may also permit their own banks to apply the same risk weights to a given sovereign under certain conditions. EU authorities established a zero risk weight for all exposures denominated in euro and in any other Member State currency (EBA, 2013).[7] Despite these normative changes, we believe that the distinction between crossover and non-crossover is still meaningful:

- During the 2011 capital exercise European banks had to create a capital buffer commensurate with the exposure to sovereign debts (EBA, 2011). The coefficients used to estimate the capital buffer requirements are substantially equal to those presented in Table 1.4. Moreover, approximately 40% of European banks, subjects to the EBA's 2011 stress test, had decided to

[7] In the USA, a zero risk weight for all exposures to OECD Member States was applied, and a 100% weight for exposures to non-OECD States. After the implementation of Basel III, risk weights are based on the Country Risk Classification (CRC) published by the OECD (Office of the Comptroller of the Currency, 2012).

measure sovereign risk and create specific capital buffers, using the IRB approach, even before the stress test (Hannoun, 2011);

- Hasan et al. (2014) found evidence that sovereign rating announcements leading to changes in risk-weight categories have a greater impact on foreign bank lending behavior after the implementation of Basel II;
- Sovereign rating constitutes a rating ceiling for domestic bank (Adelino and Ferreira, 2016) and corporate (Almeida et al., 2016) ratings. CRAs rarely rate a private issuer above the sovereign (Adelino and Ferreira, 2016). After a sovereign downgrade, therefore, private issuers with a rating higher than the sovereign are often downgraded. So, even if rating regulatory constraints are not binding for sovereign exposures, we may observe a significant reaction of the sovereign CDS market due to the investors' choice to hedge or to decrease the country risk associated with their exposures to private issuers that are close to the rating ceiling;
- Central banks use ratings to determine acceptable collateral and margin requirements (ECB, 2013). Bolton and Jeanne (2011) underlined that, during the recent financial crisis, investors have paid great attention to CRAs' decisions for regulatory reasons. A downgrade of a riskier country rating could adversely impact the liquidity of banks because the use of government securities as collateral becomes more expensive (haircuts, margin calls and so on);
- Also institutional investors are often regulatory constrained. These constraints are not always prescribed by law, but are often contractually defined. In fact, rating thresholds are frequently used in investment mandates that dictate the

behavior of various investment funds and other financial institutions. According to a survey (Cantor et al., 2007), almost all of fund managers and plan sponsors introduced operational limits concerning asset rating categories in their internal guidelines. Over 70% of investors interviewed included in its guidelines a given rating threshold as a requirement for bond purchases and over 50% has a contractual obligation to sell financial assets that no longer meet eligibility requirements. In their guidelines, it is not only mentioned a general distinction between investment and speculative grade instruments, but there are also other rating thresholds. The transition trough rating boundaries forces managers to sell securities regardless of their financial valuations or thoughts.

1.4.2. Results

1.4.2.1. The impact of a rating change announcement

The daily mean abnormal returns for each event window observed around a downgrade or an upgrade announcement and their statistically significance are listed in Table 1.5.

The $\overline{AR}$ observed in [-90, -8] and [-7, -1] does not support the thesis whereby the CDS market anticipates a rating change. Around the announcement day we observe an $\overline{AR}$ of 1.43%. The high statistically significance confirms that a rating reduction has a strong informative value for market agents. In the following periods, [+2, +7] and [+8, +60], we note negative $\overline{AR}$. We observe, in fact, increasing spreads immediately after a downgrade and a reduction after a few days. These results imply that the CDS market absorbs rapidly new information.

Also for upgrades, we observe the most significant effect around the event date, with a decrease in the daily mean abnormal returns of 2.26%. We register a decline in perceived risk also in [+2, +7], but this trend is not statistically confirmed.

These results confirm hypothesis *H1* as regards negative and positive rating changes. Investors, in fact, seem to change their risk perception after a rating announcement.

Table 1.5
Daily mean abnormal returns observed around a downgrade or an upgrade announcement.

		Downgrades (n=51)			
Windows	[-90, -8]	[-7, -1]	[0, +1]	[+2, +7]	[+8, +60]
$\overline{AR}$ (%)	0.04	0.21	1.43	-0.05	-0.16
t-test	(0.32)	(0.24)	(0.00)***	(0.59)	(0.98)
Bootstrap	(0.32)	(0.24)	(0.00)***	(0.59)	(0.96)
Wilcoxon test	(0.39)	(0.27)	(0.00)***	(0.56)	(0.98)
		Upgrades (n=12)			
Windows	[-90, -8]	[-7, -1]	[0, +1]	[+2, +7]	[+8, +60]
$\overline{AR}$ (%)	-0.05	0.04	-2.26	-0.17	0.01
t-test	(0.37)	(0.55)	(0.02)**	(0.30)	(0.50)
Bootstrap	(0.45)	(0.54)	(0.00)***	(0.32)	(0.50)
Wilcoxon test	(0.13)	(0.68)	(0.00)***	(0.47)	(0.68)

Notes: p-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

1.4.2.2. The impact of a downgrade across different times and countries

To better understand our previous results, we provide two subsample analyses. In particular, we verify if the impact of a downgrade announcement[8] is different across: *a)* times and *b)* countries.

In our first analysis, we want to verify if our results are driven by the impact of downgrades announced in particular time periods, like financial crises. Thus, we

[8] In this section, we analyze only the impact of downgrade announcements because there are not enough upgrade announcements to split the sample into different groups.

divide our sample of downgrade announcements into two groups**,** distinguishing events announced during a financial crisis from others announced during "normal times". Also for this analysis, we use the *t*-test and the Kolmogorov-Smirnov test. Our null hypothesis is that the means of the two distributions are not statistically different. The alternative hypothesis is that the $\overline{AR}$ observed around a downgrade announced during a crisis is statistically greater than the $\overline{AR}$ registered around a downgrade announced during "normal times".

We determine period of crisis following Euro area turning points identified by OECD (2016).[9] The analyzed period was characterized by two crises: the global financial crisis from 02/2008 to 06/2009 and the euro area sovereign debt crisis from 05/2011 to 02/2013.

Table 1.6
Daily mean abnormal returns observed around a downgrade announced during periods of financial crisis or during "normal times".

	Crisis Downgrades (n=28)				
Windows	[-90, -8]	[-7, -1]	[0, +1]	[+2, +7]	[+8, +60]
$\overline{AR}$ (%)	0.06	-0.08	1.78	-0.45	-0.19
t-test	(0.33)	(0.58)	(0.00)***	(0.91)	(0.93)
Bootstrap	(0.33)	(0.58)	(0.00)***	(0.92)	(0.91)
Wilcoxon test	(0.27)	(0.93)	(0.00)***	(0.86)	(0.96)
	Normal Times Downgrades (n=23)				
Windows	[-90, -8]	[-7, -1]	[0, +1]	[+2, +7]	[+8, +60]
$\overline{AR}$ (%)	0.03	0.56	1.02	0.42	-0.14
t-test	(0.42)	(0.13)	(0.08)*	(0.15)	(0.90)
Bootstrap	(0.42)	(0.11)	(0.10)	(0.13)	(0.87)
Wilcoxon test	(0.39)	(0.30)	(0.02)**	(0.18)	(0.93)
	Tests of hypotheses				
t-test	(0.46)	(0.85)	(0.20)	(0.95)	(0.63)
Kolmogorov-Smirnov test	(0.40)	(0.74)	(0.21)	(0.68)	(0.45)

Notes: p-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

[9] We repeated the event study using different periods of crisis. We have obtained results not statistically different from those presented.

We report in Table 1.6 the daily mean abnormal returns observed around a downgrade announcement separating rating events announced during the two periods of financial crisis from others. In the event window [0, +1] we observe a significant impact in both subsamples. The $\overline{AR}$ of the subsamples is equal to, respectively, 1.78% for downgrades announced during a crisis and to approximately 1% for those announced during "normal times". The first impact is greater than the latter, but the tests of hypotheses indicate that they are not statistically different, as well as in the other event windows. Overall, this result underlines that the impact of downgrade announcements is not statistically different over the analyzed period.

In the second analysis, we verify whether the impact of downgrade announcements is the same across all countries in our sample.[10] We notice that five countries among EMU Members, commonly identified as "GIIPS", were most affected by the financial turmoil: Greece, Ireland, Italy, Portugal and Spain. This group includes EMU Members characterized by high public debt-to-GDP ratios, unstable financial conditions and not negligible systemic importance. Market agents perceive their debt as riskier, so a downgrade of their rating could exacerbate the market reaction. We can assume, therefore, that the $\overline{AR}$ observed around a downgrade of a GIIPS country rating is greater than the $\overline{AR}$ registered around a downgrade of another country rating. Also for this analysis, we use the *t*-test and the Kolmogorov-Smirnov test. Our null hypothesis is that the means of the two distributions are not statistically different.

[10] We have also estimated event studies excluding Greece rating announcements, which could be considered outlier events during the euro area sovereign debt crisis. The conclusions remain unchanged. Results are omitted due to space consideration.

Table 1.7 presents the event study results. The impact of a downgrade in the event window [0, +1] is significant for both GIIPS and other countries, although the latter effect is less significant and not confirmed by the Wilcoxon test. The $\overline{AR}$ observed around a downgrade of a GIIPS country rating are more than twice the $\overline{AR}$ of a downgrade of another country rating. The Kolmogorov-Smirnov test confirms this result, while the *p*-value of the *t*-test is slightly over the considered significance levels, maybe because of an insufficient sample size. This result highlights that financially stressed countries are generally most affected by a negative rating announcement.

Table 1.7
Daily mean abnormal returns observed around a downgrade announcement separating GIIPS from other countries.

GIIPS Countries Downgrades (n=29)					
Windows	[-90, -8]	[-7, -1]	[0, +1]	[+2, +7]	[+8, +60]
$\overline{AR}$ (%)	0.18	0.32	1.89	-0.14	-0.16
t-test	(0.11)	(0.23)	(0.00)***	(0.63)	(0.91)
Bootstrap	(0.11)	(0.22)	(0.01)**	(0.37)	(0.88)
Wilcoxon test	(0.15)	(0.42)	(0.00)***	(0.35)	(0.96)
Other Countries Downgrades (n=22)					
Windows	[-90, -8]	[-7, -1]	[0, +1]	[+2, +7]	[+8, +60]
$\overline{AR}$ (%)	-0.13	0.06	0.83	0.05	-0.17
t-test	(0.84)	(0.44)	(0.07)*	(0.43)	(0.94)
Bootstrap	(0.85)	(0.45)	(0.04)**	(0.43)	(0.95)
Wilcoxon test	(0.81)	(0.93)	(0.21)	(0.39)	(0.91)
Tests of hypotheses					
t-test	(0.06)*	(0.32)	(0.11)	(0.65)	(0.49)
Kolmogorov-Smirnov test	(0.07)*	(0.25)	(0.00)***	(0.30)	(0.54)

Notes: p-values in parentheses. *** significant at 1%, ** significant at 5%, * significant at 10%.

1.4.2.3. The impact of a rating warning announcement

Table 1.8 shows the daily mean abnormal returns observed around a negative or a positive rating warning (outlook and review) announcement and their statistical significance.[11]

Table 1.8
Daily mean abnormal returns observed around a negative or a positive rating warning announcement.

Negative Rating Warnings (n=43)					
Windows	[-90, -8]	[-7, -1]	[0, +1]	[+2, +7]	[+8, +60]
$\overline{AR}$ (%)	0.02	-0.01	0.05	0.34	-0.10
t-test	(0.42)	(0.52)	(0.44)	(0.07)*	(0.87)
Bootstrap	(0.42)	(0.52)	(0.44)	(0.04)**	(0.85)
Wilcoxon test	(0.39)	(0.55)	(0.36)	(0.13)	(0.93)
Positive Rating Warnings (n=18)					
Windows	[-90, -8]	[-7, -1]	[0, +1]	[+2, +7]	[+8, +60]
$\overline{AR}$ (%)	0.08	0.08	-0.34	0.65	-0.04
t-test	(0.74)	(0.70)	(0.22)	(0.95)	(0.34)
Bootstrap	(0.74)	(0.71)	(0.21)	(0.98)	(0.36)
Wilcoxon test	(0.56)	(0.63)	(0.39)	(0.82)	(0.44)

Notes: p-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

We find that these rating typologies do not have a significant impact on the sovereign CDS market. Only in the event window [+2, +7] we observe that negative warnings partly affect the CDS market, but this result is not confirmed by the Wilcoxon signed rank test. In other event windows, we note the lack of statistical significance. Market players do not seem interested in rating warnings announcements. We can assume that the low significance suggests that investors consider not relevant a rating typology that only forecasts a possible future rating event. This interpretation is confirmed by the survey conducted by Cantor et al. (2007). Approximately 70% of fund managers and 83% of plan sponsors do not

[11] We present the $\overline{AR}$ observed around a rating warning announcement, considering outlooks and reviews as a same event. We have also employed an event study analysis separating outlooks and reviews. We did not observe results statistically different from those presented in Table 1.8.

include rating warnings in their internal guidelines for investment decisions. These results lead us to reject hypothesis *H1* as regards outlook and review announcements.

1.4.2.4. Monitoring effect

As seen in the previous section, rating warnings do not seem to affect substantially the euro area sovereign CDS market. However, providing a signal of a possible future rating event, outlooks and reviews might affect the impact of a subsequent rating change announced in the following months.

Table 1.9
Daily mean abnormal returns observed around an anticipated or an unanticipated downgrade announcement.

Anticipated Downgrades (n=28)					
Windows	[-90, -8]	[-7, -1]	[0, +1]	[+2, +7]	[+8, +60]
$\overline{AR}$ (%)	0.13	0.61	1.74	-0.22	-0.22
t-test	(0.18)	(0.06)*	(0.00)***	(0.72)	(0.98)
Bootstrap	(0.18)	(0.03)**	(0.01)**	(0.73)	(0.98)
Wilcoxon test	(0.25)	(0.29)	(0.00)***	(0.68)	(0.98)
Unanticipated Downgrades (n=23)					
Windows	[-90, -8]	[-7, -1]	[0, +1]	[+2, +7]	[+8, +60]
$\overline{AR}$ (%)	-0.06	-0.27	1.06	0.14	-0.09
t-test	(0.65)	(0.72)	(0.03)**	(0.34)	(0.76)
Bootstrap	(0.65)	(0.68)	(0.01)**	(0.35)	(0.74)
Wilcoxon test	(0.61)	(0.94)	(0.04)**	(0.35)	(0.86)
Tests of hypotheses					
t-test	(0.17)	(0.07)*	(0.22)	(0.76)	(0.76)
Kolmogorov-Smirnov test	(0.85)	(0.32)	(0.21)	(0.25)	(0.73)

Notes: p-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

In Table 1.9, we report the daily mean abnormal returns observed around an anticipated or an unanticipated downgrade announcement and the two tests of hypotheses described in Section 1.4.1.2. In both cases, the CDS market does not anticipate rating changes in the window [-90, -8]. In the week preceding an anticipated downgrade announcement, the $\overline{AR}$ is approximately 0.61%. Probably,

issuers are closely monitored, so investors perceive an imminent rating change or they become aware of relevant information about the country's creditworthiness. This result, however, is not confirmed by the Wilcoxon test. For unanticipated downgrades, instead, we do not observe any relevant effect in [-7, -1]. Anyhow, this difference is not confirmed by the non-parametric test. Around the announcement day, in the event window [0, +1], we observe a significant impact for both events, equals to, respectively, 1.74% for anticipated downgrades and to 1.06% for unanticipated downgrades. The first impact is greater than the latter, but they are not statistically different, as well as in the other event windows. These results allow us to reject hypothesis *H2*. A downgrade preceded by an outlook or a review does not have an impact statistically greater on the euro area sovereign CDS market than an unanticipated downgrade.

1.4.2.5. Certification effect

Table 1.10
Daily mean abnormal returns observed around a crossover or a non-crossover downgrade announcement.

Crossover Downgrades (n=16)					
Windows	[-90, -8]	[-7, -1]	[0, +1]	[+2, +7]	[+8, +60]
$\overline{AR}$ (%)	-0.01	0.87	2.39	-0.18	-0.15
t-test	(0.51)	(0.08)*	(0.00)***	(0.66)	(0.86)
Bootstrap	(0.50)	(0.07)*	(0.00)***	(0.65)	(0.83)
Wilcoxon test	(0.52)	(0.22)	(0.01)**	(0.66)	(0.85)
Non-Crossover Downgrades (n=35)					
Windows	[-90, -8]	[-7, -1]	[0, +1]	[+2, +7]	[+8, +60]
$\overline{AR}$ (%)	0.07	-0.09	0.99	-0.01	-0.17
t-test	(0.29)	(0.61)	(0.02)**	(0.50)	(0.94)
Bootstrap	(0.28)	(0.60)	(0.03)**	(0.50)	(0.92)
Wilcoxon test	(0.36)	(0.92)	(0.01)**	(0.60)	(0.97)
Tests of hypotheses					
t-test	(0.64)	(0.09)*	(0.09)*	(0.63)	(0.45)
Kolmogorov-Smirnov test	(0.66)	(0.13)	(0.03)**	(0.27)	(0.98)

Notes: p-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

We report in Table 1.10 the daily mean abnormal returns observed around a crossover or a non-crossover downgrade announcement. Crossover downgrades are partly anticipated by the CDS market in the event window [-7, -1], although this result is not statistically confirmed by the Wilcoxon test. In the event window [0, +1] we observe a significant impact of rating announcement on the CDS market, equals to 2.39% for crossover downgrades and, approximately, to 1% for non-crossover downgrades. A crossover downgrade has a significantly greater impact than a non-crossover downgrade, as confirmed by both tests of hypotheses. These results confirm hypothesis *H3*: CRAs provide a certification service. A downgrade that leads to a change of issuer rating category implies a more intense reaction from investors due to regulatory constraints.

1.5. The spillover effect of a sovereign rating change on the CDS market

1.5.1. Methodology

In the first part, we demonstrated that rating changes have a significant impact on the euro area sovereign CDS market. In particular, downgrades and upgrades significantly affect the CDS market around the announcement day. Rating warnings (outlooks and reviews), instead, are not considered relevant. The analysis presented in the previous section is focused on the impact of a rating announcement on the event country CDS market.

In the second part of the chapter, we extend the analysis, verifying the presence of the spillover effect of a rating announcement on the CDS markets of the EMU Member States included in the sample. We verify the existence of a spillover effect estimating a regression model. We estimate two models to separate negative

events (downgrades) and positive events (upgrades). In contrast to other studies (Gande and Parsley, 2005), we do not extend the analysis to rating warnings because we have demonstrated that outlooks and reviews are not much relevant for investors. The dependent variable of the first (second) model is ΔCDS, cumulative CDS returns of the *i-th* non-event country observed in [0, +1] after a downgrade (upgrade) of the *j-th* (*j* different from *i*) country rating announced in *t*. We choose this event window because in these two days we observe the greatest impact of a rating change on the CDS market. We use the sum of returns to observe the cumulative impact over the considered event window. Moreover, we consider CDS returns instead of abnormal returns because a spillover effect could also affect benchmark returns leading to a biased estimation (Ismailescu and Kazemi, 2010; Jorion and Zhang, 2007). We estimate the following regression for both negative and positive events separately:

$$\begin{aligned}\Delta CDS_{i,\tau} = \beta_0 &+ \beta_1\, Events_{j,\tau} + \beta_2\, Difference_{i,\tau} + \beta_3\, Prior_{j,\tau} \\ &+ \beta_4\, VSTOXX_{\tau} + \beta_5\, Anticipated_{j,\tau} + \beta_6\, ECB_{\tau} \\ &+ \beta_7\, DebtE_{j,\tau} + \beta_8\, \Delta StockE_{j,\tau} + \beta_9\, DebtNE_{i,\tau} \\ &+ \beta_{10}\, \Delta StockNE_{i,\tau} + \sum_k \beta_k X_{k,\tau} + \varepsilon_{i,\tau}\end{aligned} \tag{1.5}$$

Eq. (1.5) is not estimated in the whole time series included in our sample. We consider only the two-day windows [0, +1], identified as τ, around events. The variable *Events* allow us to test hypothesis *H4*. In fact, it indicates the absolute value of the change in CCR[12] observed in *t*. If more rating changes are announced on the same day, we sum values of observed CCR changes. The coefficient of this variable indicates the incremental reaction of the CDS market to a rating change

[12] We use the numerical scale described in Table 1.3 to calculate comprehensive credit rating changes. We can use the absolute value because we estimate the spillover effect of a negative and of a positive rating change separately.

announcement. If there is a spillover effect, we assume that *Events* is statistically significant and that the CDS market reaction is higher (lower) when CRAs issue downgrades (upgrades) of more notches or more events at the same time. If this variable is statistically significant, we accept hypothesis *H4*. Moreover, if the *Events* coefficient is positive (negative) in the first (second) model, we could confirm that the *differential effect* prevails over the *common information effect*.

We also control for the possible effect of other variables. We introduce the variable *Difference*, which represents the difference in absolute value between ratings of the *i-th* and the *j-th* country. This variable allows us to control whether the spillover effect has a different extent on the basis of the distance between the two countries' ratings.

Kaminsky and Reinhart (2000) observed a non-linear contagion probability: financial contagion probability grows when the number of crises in a given cluster is high. Consequently, the spillover effect size could be affected by other rating events regarding the same issuer announced in the previous weeks. We add, therefore, the variable *Prior*, which measures the change in absolute value of the *j-th* event country rating in the month before the announcement day. We include only rating changes having the same sign of the analyzed event (negative rating changes for downgrades and positive rating changes for upgrades).

The spillover effect could also be affected by the presence of a pre-existing financial crisis. Thus, we include the variable *VSTOXX*, which is the value of the volatility outlook index VSTOXX registered on the day preceding the

announcement date.[13] The financial market volatility is higher in financial crisis periods; thus, we assume a positive coefficient sign. Furthermore, since we do not consider abnormal returns but only CDS returns, *VSTOXX* also permits to control for possible factors that influence market volatility.

We can assume that the spillover effect of a rating change could be mitigated by a previous rating warning announcement because it should not be an unexpected event for investors (Böninghausen and Zabel, 2015). The dummy variable *Anticipated*, which is equal to 1 if the observed rating change is anticipated by an outlook or a review and zero otherwise, allows us to control if the spillover effect is affected by a rating warning announced in the previous months.

Since the sample comprehends only EMU Member States, we assume that ECB decisions could have an impact on the spillover effect size. A restrictive (expansive) monetary policy could amplify (reduce) the effect of a negative rating change. Thus, we included the variable *ECB* indicating the ECB interest rate on the main refinancing operations in *t*.

We also control for the possible effect of the economic and financial situation of the event country. *DebtE* measures the one quarter lagged event country public debt to GDP ratio. A high-level debt country could generate a more intense spillover effect because it could be perceived as riskier and, given the strong connection between euro zone countries, investors may reduce their exposure even to other Member States due to increased concerns about the euro area financial stability. The variable *ΔStockE* measures the event country stock index

[13] The index reflects the market expectations of volatility by measuring the square root of the implied variance across all EURO STOXX 50 options over the next thirty days.

percentage change in the previous thirty days.[14] We hypothesize that a stock index decrease, indicating worsening financial conditions, could amplify the spillover effect of a rating announcement. The same considerations could regard non-event countries, thus, we add *DebtNE*, the one quarter lagged non-event country public debt to GDP ratio, and *ΔStockNE*, the non-event country stock index percentage change in the previous thirty days, to control for the economic and financial situation of the non-event country.

In conclusion, we include a dummy variable set, $X_{k,\tau}$, to control for country and year fixed effects. $\varepsilon_{i,\tau}$ represents the error term.

1.5.1.1. Transmission channels of spillover effect

If there is a spillover effect, it could be transmitted through two channels: international trade and bank flows. If the *j-th* country is an important business partner of the *i-th* country, we can assume that a negative (positive) event that concerns the *j-th* country has a relevant negative (positive) impact on the *i-th* country economy. Thus, we add the variable *Trade/GDP*, which represents the one month lagged exports from the *i-th* State to the *j-th* country (as percentage of the *i-th* country GDP).

As assumed formulating hypothesis *H5* in Section 1.2, the international banking system could be also a relevant transmission channel of the spillover effect. To test this hypothesis, we include the variable *Bank/GDP*, which measures the one quarter lagged *i-th* country banking system exposures to the *j-th*

[14] As robustness check, we replaced monthly stock index percentage change with quarterly GDP variation. We do not find significantly different results. Thus, we keep the variable *ΔStockE* because it is registered closer to the event date. In fact, GDP data are available on a quarterly basis, while stock changes are collected daily.

country Official Sector (as percentage of the *i-th* GDP). We can confirm hypothesis *H5* if the spillover effect rises with an increasing bank exposure to the *j-th* country.

The spillover effect transmission, however, could not only be affected by international bank flows, but also by the non-event country banking system instability. We can assume, in fact, that a fragile banking system could amplify, for example, negative effects of a downgrade announcement. Instable financial institutions may not be able to absorb the negative shock generated by a sovereign rating announcement. The lower banks' creditworthiness aggravates the riskiness perception of involved countries, because sovereign institutions, in extreme situations, may be forced to bail out troubled banks. In these situations, bailout costs affect sovereign balance sheet and contribute to the worsening of the sovereign financial instability. Thus, we insert three variables to control for the *i-th* country banking system stability. The variable *Nonperforming* measures the ratio of defaulting loans (payments of interest and principal past due by 90 days or more) to total gross loans of the *i-th* country banking system registered in the year preceding *t*. *LiquidAssets* indicates the ratio of the value of liquid assets (easily converted to cash) to short-term funding plus total deposits of the *i-th* country banking system observed in the year preceding *t*. Finally, *RegCapital* represents the ratio of total regulatory capital to risk-weighted assets (RWA) of the *i-th* country banking system registered in the year preceding *t*. We assume that, for example, a negative rating change causes a greater spillover effect if the non-event country banking system shows a relatively high ratio of nonperforming loans, low ratios of liquid assets and regulatory capital.

The model we use to test for the presence of these two transmission channels is an extension of Eq. (1.5). Also in this case we estimate the regression considering only the two-day windows τ around events:

$$\begin{aligned}\Delta CDS_{i,\tau} = {} & \beta_0 + \beta_1\, Events_{j,\tau} + \beta_2\, Difference_{i,\tau} + \beta_3\, Prior_{j,\tau} \\ & + \beta_4\, VSTOXX_{\tau} + \beta_5\, Anticipated_{j,\tau} + \beta_6\, ECB_{\tau} \\ & + \beta_7\, DebtE_{j,\tau} + \beta_8\, \Delta StockE_{j,\tau} + \beta_9\, DebtNE_{i,\tau} \\ & + \beta_{10}\, \Delta StockNE_{i,\tau} + \beta_{11}\, Trade/GDP_{i,\tau} \\ & + \beta_{12}\, Bank/GDP_{i,\tau} + \beta_{13}\, Nonperforming_{i,\tau} \\ & + \beta_{14}\, LiquidAssets_{i,\tau} + \beta_{15}\, RegCapital_{i,\tau} + \sum_k \beta_k X_{k,\tau} \\ & + \varepsilon_{i,\tau}\end{aligned} \tag{1.6}$$

1.5.2. Results

1.5.2.1. The spillover effect of downgrade and upgrade announcements

Table 1.11 shows the results obtained from the estimation of Eq. (1.5) for downgrades (1) and for upgrades (2). The results obtained estimating the model for downgrade announcements, column (1), confirm the presence of a significant spillover effect. A one notch rating reduction leads to an average euro area CDS spreads increase of 0.72%. Therefore, we can confirm hypothesis *H4* as regards negative rating changes.

We observe that the *Events* coefficient has a positive sign. A wider rating change (or more simultaneous events) amplifies the spillover effect of a downgrade announcement. This result highlights the prevalence of the *common information effect* over the *differential effect*.

We highlight that the CDS market reaction declines with an increasing difference in absolute value between the two countries' rating. The CDS market reaction to a downgrade, conversely, is reduced by an event country rating change

announced in the month before the event day. A one notch downgrade announced in the month preceding *t* reduces euro area CDS spreads by approximately 2.5%.

Table 1.11
The spillover effect of a rating change.

	(1) *Downgrades*	*(2)* *Upgrades*
Events	0.007***	0.067
	(0.000)	(0.275)
Difference	-0.001*	-
	(0.085)	
Prior	-0.025***	-
	(0.000)	
VSTOXX	-0.001**	0.001
	(0.030)	(0.595)
Anticipated	-0.044***	-
	(0.000)	
ECB	0.062***	-
	(0.001)	
DebtE	0.001***	-0.001
	(0.000)	(0.553)
ΔStockE	-0.145***	-0.005
	(0.000)	(0.972)
DebtNE	-0.001	-0.001
	(0.785)	(0.505)
ΔStockNE	-0.044	0.013
	(0.157)	(0.880)
Constant	-0.065	0.050
	(0.356)	(0.380)
Country dummies	*Yes*	*Yes*
Year dummies	*Yes*	*Yes*
Observations	544	152
F-test	7.53***	5.48***
Adj R-squared	0.24	0.28

Notes: The table presents the regression parameters of the Eq. (1.5) estimation. The dependent variable is the cumulative CDS returns of the *i-th* non-event country observed in [0, +1] after a downgrade (1) or an upgrade (2) of the *j-th* country rating on day *t*. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

The *VSTOXX* negative coefficient suggests that a financial crisis does not amplify the CDS market reaction to a downgrade; contrariwise, high market volatility reduces CDS spreads.

We observe that the variable *Anticipated* is significant and presents a negative sign. Thus, the euro area CDS market reaction to a downgrade preceded by a rating warning is lower than the reaction observed after an unanticipated downgrade.

Furthermore, the ECB's monetary policy affects CDS spreads: a restrictive monetary policy, which leads to higher interest rates, increases the CDS market reaction to a downgrade. Also a high level debt and a negative economic and financial conjuncture of the event country affect the CDS market reaction, as proven by the significant *DebtE* and *ΔStockE* coefficients.

Column (2) presents, instead, the results obtained after an upgrade announcement.[15] It should be noted that there is an asymmetric impact on the euro area CDS market between positive and negative rating changes. In contrast to downgrades, in fact, the results show that upgrades do not cause a significant spillover effect. During uncertain financial times, investors maybe perceive differently the two rating announcements. A downgrade could be interpreted as a wake-up call (Ferreira and Gama, 2007), an alert concerning the EMU financial stability, while an upgrade could affect only the event country and could be considered less indicative of the whole euro area financial health.

1.5.2.2. Transmission channels for downgrade announcements

The results of Eq. (1.6) estimation are presented in Table 1.12. We analyze only the CDS market reaction to a downgrade announcement, because it is the only event causing a significant spillover effect. We observe a sample size

[15] We exclude some variables from the model presented in column (2) because of the high correlation with the interest variable *Events*.

reduction due to an incomplete availability of bilateral bank flows data. Thus, considering a more limited sample, we employ a stepwise regression approach to obtain a more parsimonious model, using a 10% significance level cut-off to include or exclude variables from the model.[16]

Table 1.12
The spillover effect of a rating change (extended model).

	(1)	*(2)*
Events	0.010***	0.010***
	(0.001)	(0.001)
Prior	-0.017**	-0.018***
	(0.011)	(0.009)
Anticipated	-0.039**	-0.038**
	(0.041)	(0.047)
ECB	0.069***	0.073***
	(0.002)	(0.002)
ΔStockE	-0.189***	-0.195***
	(0.003)	(0.004)
Trade/GDP	0.205	-
	(0.302)	
Bank/GDP	0.174**	0.176***
	(0.016)	(0.008)
Nonperforming	-	0.005***
		(0.005)
LiquidAssets	-	0.001
		(0.311)
RegCapital	-	-0.008*
		(0.079)
Constant	0.475***	0.512***
	(0.000)	(0.000)
Country dummies	Yes	Yes
Year dummies	Yes	Yes
Observations	101	101
F-test	10.02***	9.35***
Adj R-squared	0.64	0.65

Notes: The table presents the regression parameters of the Eq. (1.6) estimation. The spillover effect of a downgrade announcement is calculated including transmission channels (1) and banking system (2) variables. The dependent variable is the cumulative CDS returns of the *i-th* non-event country observed in [0, +1] after a downgrade of the *j-th* country rating on day *t*. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

[16] Carrying out the stepwise approach, we exclude five variables from the model presented in Eq. (1.6): *Difference*, *VSTOXX*, *DebtE*, *DebtNE*, and *ΔStockNE*.

At first, we estimate a restricted version of Eq. (1.6), including only variables that evaluate the presence of the two transmission channels (see column (1) in Table 1.12). We observe that the variable *Trade/GDP* is not significant, while the variable *Bank/GDP* is significant at 5% level. The euro area CDS spreads rise with an increasing exposure of the *i-th* country banking system to the event country. This result demonstrates that a strong connection among EMU banking systems can lead to a fast transmission of negative financial shocks caused by a downgrade announcement.

Column (2) in Table 1.12 shows the estimation of the model presented in Eq. (1.6) including the *i-th* country banking system variables. The results confirm previous findings: even including the banking system characteristics, we find evidence of a significant spillover effect and we can also confirm the importance of bank flows. We underline that a more fragile banking system with increasing nonperforming loans and declining regulatory capital ratios causes a greater sovereign CDS market reaction.

Liquid asset ratio, instead, does not affect the euro area CDS market reaction. Probably, banks with high liquid asset ratios also hold a substantial exposure to European government bonds, which are traditionally considered highly liquid assets. Thus, we can assume that banks with high *LiquidAssets* values could, on one side, absorb more easily negative shocks taking advantage of their high liquid asset allocation, but, on the other side, their large sovereign bond holdings expose them to a significant systemic risk after a downgrade announcement. The low significance of *LiquidAssets* could be caused by the trade-off between these two components. In conclusion, our results confirm the hypothesis *H5*. A large

exposure of the *i-th* country banking system to the *j-th* State amplifies the spillover effect of a negative rating announcement. This result holds after accounting for banking system characteristics.

1.6. Robustness checks

In previous sections, we adopted credit ratings issued by Standard & Poor's. As a robustness check, we have repeated our analyses adopting credit ratings issued by Moody's and Fitch Ratings. The three CRAs have different rating policies. As mentioned in Section 1.3, Standard & Poor's rating changes often precede other agencies' announcements. Moody's, instead, focuses more on the stability of its rating (Alsakka et al., 2014). These approaches allow users to choose a different rating on the basis of their needs (Boot et al., 2006). Thus, we replicated previous analyses, adopting ratings issued by the other CRAs, to verify if different rating policies affect the impact of rating changes on the euro area CDS market. Re-estimating event studies, unreported, we do not observe relevant differences for downgrade and rating warning announcements. Instead, upgrades issued by Moody's do not have a significant impact on the CDS market, as shown in Table 1.13, in contrast to upgrades issued by S&P and, to a lesser extent, by Fitch.

The spillover effect analysis confirms that also downgrades issued by Moody's and Fitch have a significant impact on the non-event countries CDS markets and that bank flows are a relevant transmission channel of the spillover effect.

Moreover, we have reproduced event studies using two different benchmarks. We substitute the index equal to the median euro area CDS spread, first, with the sovereign CDS spread of USA and, then, with the sovereign CDS spread of

United Kingdom. In both cases, we have verified that previously presented results continue to hold also using a different benchmark. Results are omitted due to space consideration.

Table 1.13
Daily mean abnormal returns observed around an upgrade issued by Moody's or Fitch.

Moody's Upgrades (n=7)					
Windows	[-90, -8]	[-7, -1]	[0, +1]	[+2, +7]	[+8, +60]
$\overline{AR}$ (%)	-0.01	-0.05	-1.53	1.07	-0.13
t-test	(0.48)	(0.44)	(0.16)	(0.96)	(0.24)
Bootstrap	(0.50)	(0.50)	(0.50)	(0.80)	(0.47)
Wilcoxon test	(0.50)	(0.15)	(0.20)	(0.98)	(0.37)
Fitch Upgrades (n=8)					
Windows	[-90, -8]	[-7, -1]	[0, +1]	[+2, +7]	[+8, +60]
$\overline{AR}$ (%)	-0.53	0.03	-2.01	0.28	-0.23
t-test	(0.09)*	(0.55)	(0.10)	(0.75)	(0.26)
Bootstrap	(0.20)	(0.54)	(0.10)	(0.60)	(0.35)
Wilcoxon test	(0.16)	(0.66)	(0.08)*	(0.56)	(0.34)

Notes: p-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

As mentioned in Section 1.4.1, presenting the event study methodology, we adopt the market model to estimate CDS abnormal returns. As a further robustness test, we reproduced the analysis using the most commonly method adopted in literature. In previous works on CDS sovereign, in fact, event studies are based on abnormal CDS spread changes (*ASC*), measured as the plain difference between a CDS and an index spread changes, expressed in basis points. However, spread changes are difficult to compare if they concern different time periods and reference entities because the initial levels of spreads are significantly different across countries. Rating-based (Norden and Weber, 2004) or nationality-based (Micu et al., 2006) indices are often adopted as a remedy. For CDS sovereign, the sample size often does not allow to use these types of indices; therefore, the benchmark is generally based on CDS spreads included in the

sample (Afonso et al., 2012; Ismailescu and Kazemi, 2010). Using this method, however, heteroscedasticity is still a problem.

We reproduced the event study using two different benchmarks to estimate *ASC*. In the first analysis, we adopt the median daily euro area CDS spread, the same index described in Section 1.4.1. To estimate our second benchmark, we divide our sample in two groups, separating countries most affected by financial turmoil during the recent crisis (Greece, Ireland, Italy, Portugal and Spain) from other EMU Member States. For each group we estimate an index equal to the median daily euro area CDS spread for the countries included in that specific group. This sample segmentation gives us the opportunity to create an index pooling countries that share similar characteristics. Results obtained from the analysis of *ASC* using the first benchmark confirm the relevant impact of downgrades and upgrades. Using the second index, based on the segmentation of our sample, we can confirm the impact of downgrades but we do not find evidence of a significant effect produced by an upgrade announcement. In both analyses, we highlight the bias due to spread changes of riskier reference entities (e.g. Greece) that present a relevant size in absolute terms and a small size in percentage terms.

Finally, we employ a different method to estimate the spillover effect. Böninghausen and Zabel (2015) highlighted some possible issues connected with the use of the CCR to identify the spillover effect. They proposed a different strategy, substituting the variable *Events* with *Large*, a dummy equals to one if the event country rating is changed by two notches or more, and zero otherwise. They treat rating changes of two notches or more as one single group. Thus, we

estimate Eqs. (1.5) and (1.6) replacing *Events* with *Large*. We confirm that results obtained employing the method proposed by Böninghausen and Zabel (2015) are not statistically different from those reported in Table 1.11 and Table 1.12.

1.7. Conclusions

In this study, we examine the impact of a sovereign rating change announcement on the euro area sovereign CDS market. In the first part, we confirm that rating changes (downgrades and upgrades) introduce "new" information, affecting investors' riskiness perception. A part of this impact depends on regulatory constraints that affect investment allocation of certain investors' categories, including banks and mutual funds. Rating warnings (outlooks and reviews), conversely, are not relevant for investors; in fact, they do not have a significant effect on the CDS market and do not affect the impact of the subsequent rating changes.

In the second part, we find evidence of a significant spillover effect of a downgrade announcement on the euro area CDS market. The size of this effect is influenced by the difference between countries ratings, previous rating announcements, financial instability, monetary policy, event country macroeconomic and financial determinants and non-event country banking system stability. Our results also show that international bank flows among EMU Member States are a relevant transmission channel of the spillover effect. On the contrary, we do not find the presence of a spillover effect generated by an upgrade.

The obtained results suggest that CRAs play an important role in financial markets. Their decisions, especially negative rating changes, have an impact on the behavior of numerous investors. Credit ratings affect both the event country public budget, whereas growing CDS spreads increase the cost of public debt, and the euro area financial stability, as proven by the presence of a significant spillover effect.

The rating impact on financial markets should imply a serious reflection about the most appropriate role of ratings issued by CRAs in financial regulation. In the current normative context, we observe two major trends. The US lawmakers, with the Dodd-Frank Act approval (SEC, 2015), aim to phase out any regulatory references to credit ratings issued by CRAs. The European legislation, conversely, gives a key role to credit ratings in financial regulations (see Section 1.4.1.3). Our analysis does not permit to assess which regulatory approach generates more benefits, but, in view of the obtained results, we can point out that it is necessary to take into account the consequences of rating changes also from the point of view of public finances and financial stability.

A second policy implication of our analysis concerns the role of international bank linkages as transmission channels of the spillover effect. This result should not be interpreted as an incentive to reduce the integration process between European banking systems, but should encourage a better understanding of financial risks associated with exposures to sovereign issuers. Our results, in fact, confirm that a banking system more stable and adequately capitalized reduces negative effects caused by a downgrade announcement.

Appendix A

Table A.1
Variables description.

Variable	Description	Source
ΔCDS	Cumulative CDS returns of the *i-th* non-event country observed in [0, +1] after a change of the *j-th* (*j* different from *i*) country rating announced in *t*.	Datastream
Events	The absolute value of the change in comprehensive credit rating (CCR) observed in *t*.	S&P
Difference	Difference in absolute value between ratings of the *i-th* and the *j-th* country.	S&P
Prior	Change in absolute value of the event country rating in the month before the announcement day. We include only rating changes having the same sign of the analyzed event.	S&P
VSTOXX	VSTOXX index values observed on the day preceding the announcement date. The index reflects the market expectations of volatility by measuring the square root of the implied variance across all EURO STOXX 50 options over the next thirty days.	Datastream
Anticipated	Dummy variable equals to 1 if the observed rating change is anticipated by a rating warning (an outlook or a review), zero otherwise.	S&P
ECB	ECB interest rate on the main refinancing operations observed in *t*.	ECB
DebtE	One quarter lagged event country public debt to GDP ratio.	Datastream
$\Delta StockE$	Event country stock index percentage change in the previous thirty days.	Datastream
DebtNE	One quarter lagged non-event country public debt to GDP ratio.	Datastream
$\Delta StockNE$	Non-event country stock index percentage change in the previous thirty days.	Datastream
Trade/GDP	One month lagged amount of exports from the *i-th* State to the *j-th* country (as percentage of the *i-th* country GDP).	DOTS (IMF)
Bank/GDP	One quarter lagged *i-th* country banking system exposures to the *j-th* country Official Sector (as percentage of the *i-th* GDP), calculated on the ultimate risk basis and including all financial instruments.	Banking Consolidated Statistics (BIS)
Nonperforming	One year lagged ratio of defaulting loans (payments of interest and principal past due by 90 days or more) to total gross loans of the *i-th* country banking system.	FSI (IMF)
Liquid Assets	One year lagged ratio of the value of liquid assets (easily converted to cash) to short-term funding plus total deposits of the *i-th* country banking system.	GFDD (World Bank)
RegCapital	One year lagged ratio of total regulatory capital to risk-weighted assets of the *i-th* country banking system.	FSI (IMF)

Table A.2
Summary statistics for variables.

Variable	Mean	Min	I Qu.	Median	III Qu.	Max	Std. Dev.	Obs.
ΔCDS	0.004	-0.383	-0.026	0.001	0.033	0.600	0.076	696
Events	2.849	0.000	1.000	1.000	2.000	13.500	4.153	945
Difference	5.085	0.000	2.000	4.000	7.000	18.250	4.273	945
Prior	0.151	0.000	0.000	0.000	0.000	2.250	0.451	945
VSTOXX	26.393	12.360	19.980	23.920	28.550	56.490	9.878	945
Anticipated	0.571	0.000	-	-	-	1.000	-	945
ECB	1.153	0.050	0.750	1.000	1.500	4.000	0.767	945
DebtE	85.965	6.000	56.500	87.400	111.100	157.910	37.133	945
$\Delta StockE$	-0.025	-0.268	-0.081	-0.016	0.022	0.380	0.106	945
DebtNE	81.437	4.330	53.240	79.500	109.430	176.240	38.866	945
$\Delta StockNE$	-0.004	-0.417	-0.044	0.001	0.039	0.469	0.082	945
Trade/GDP	0.003	0.000	0.000	0.001	0.003	0.064	0.006	882
Bank/GDP	0.043	0.000	0.003	0.014	0.040	1.056	0.111	160
Nonperforming	6.245	0.200	2.831	4.295	8.214	33.684	5.753	927
Liquid Assets	32.731	6.209	16.198	32.983	44.133	109.813	17.226	945
RegCapital	13.950	6.648	11.856	13.200	15.827	22.321	3.033	939

2. The Impact of Sovereign Rating Changes on European Syndicated Loan Spreads

2.1. Introduction

The financial soundness of developed countries has attracted a greater attention since the beginning of the euro area sovereign debt crisis. The decreasing developed countries' creditworthiness was confirmed by sovereign credit rating changes announced by credit rating agencies (CRA). In the aftermath of the crisis, in fact, we observed a noticeable increase in sovereign downgrades also of the most developed countries' ratings. The United States and France, for example, have lost for the first time the AAA credit rating assigned by Standard & Poor's, while euro area countries considered most peripheral (Greece, Ireland, Italy, Portugal, Spain) were downgraded numerous times within a few years.

The European crisis has highlighted several structural shortcomings in financial regulation that have amplified and, in some cases, generated a strong financial instability in recent years. Numerous economic and political commentators have pointed out that an over-reliance on credit ratings could represent a major drawback of the current financial regulation (see, for example, Masciandaro, 2013). CRAs, in fact, provide a certification service (Kiff et al., 2012): credit ratings are involved in the calculation of minimum capital requirements for banks (Basel II and III) and represent operational constraints for various investment funds and financial institutions.

Numerous limitations of rating-based regulation were already highlighted in the aftermath of the 2007 financial crisis and the Financial Stability Board had

suggested to reduce reliance on ratings in regulation (Financial Stability Board, 2010). The main concerns of rating-based regulation regard the timeliness of rating changes, which may induce pro-cyclicality in prices, and potential "threshold effect", which consists in an additional negative effect when a rating change leads to an issuer rating category transition.

Analyzing the use of sovereign ratings in regulation, we observe further drawbacks (Lanotte et al., 2016). Sovereign defaults are rare events, so the accuracy of this measure is difficult to establish. Furthermore, for sovereign borrowers we have to consider not only the ability but also the willingness to pay. In addition to methodological issues, it also may be questioned whether CRAs can provide information in a more efficient and comprehensive way than other analysts. If CRAs can have access to confidential information and obtain benefits of scale in information gathering when they rate private issuers, it is not sure that such considerations apply also to sovereigns.

Considering the impact of financial regulation on the economic system and on economic agents' choices, a sovereign rating change is an event of not negligible importance. Given the drawbacks cited above, the rating-based regulation, therefore, could distort significantly agents' behavior.

Our analysis aims to test whether a sovereign rating change has a significant impact on the firm's borrowing cost, in particular on bank loan spreads. The banking sector could be an important transmission channel of the potential negative effects associated with a sovereign rating change. If a sovereign downgrade is relevant for economic agents involved in a loan contract, it could cause an increase in the cost of firm's debt. The firm, therefore, could be forced to

modify its choices to take into account negative effects connected with a sovereign rating change. Furthermore, and foremost, our analysis aims to understand if the impact of a downgrade on the cost of debt is partly due to the role of the rating-based financial regulation.

We analyze the market of syndicated loans granted to firms established in European Union countries. We focus on EU Members to consider a sample of countries which share similar political and economic fundamentals and which attracted an increasing attention in the aftermath of the crisis.

Our contribution tries to extend the existing literature in different ways. First, to the best of our knowledge, we are the first to verify the impact of a sovereign rating change on loan spreads from the domestic firms' point of view. Our findings show that a sovereign rating change has a significant impact on the firms' borrowing cost. A downgrade announcement does not reflect only an increase in the sovereign credit risk but it is an event that influences the financial market and the behavior of economic agents in general. This result is not unexpected given what we know about the transmission of sovereign risk on firms' credit risk (Bedendo and Colla, 2015), but we provide a new empirical evidence of this impact considering the European syndicated loan market.

Second, we demonstrate that a relevant part of this impact is due to the role of rating in the current financial regulation and we verify that the rating-based regulation could cause negative externalities for firms. The measurement of the effects of the rating-based regulation channel is our main contribution. In this

sense, our research expands the study of Almeida et al. (2016)[17] and other works regarding the ways through which sovereign risk affects firms' borrowing cost. Also, for example, Acharya et al. (2014) show that the dramatic increase in the risk of Eurozone sovereign debt caused significant negative real effects for borrowing firms, but the strain of literature concerning the impact of the current rating-based regulation on firms' borrowing cost is only partially explored. In line with Kiff et al. (2012), we define the effect of a rating change not directly associated with new information disclosure as *certification effect*. We observe that the *certification effect* is a main determinant of the impact of a sovereign downgrade on loan spreads and it also affects loan size. A significant impact of the use of sovereign ratings in financial regulation is not an obvious result for the European market given the favorable treatment of European sovereign exposure in the current financial regulation.[18]

In addition, we find evidence that the impact size depends on firm's rating category. We demonstrate that the most encumbered firms by the rating-based regulation are investment grade firms, which are the relatively most creditworthy firms. However, a sovereign downgrade affects significantly also the spread of loans to other firms, especially the most financially dependent on bank loans. These results are further elements of novelty, because previous studies mainly focus on the effect of the sovereign rating ceiling policy (Adelino and Ferreira, 2016; Almeida et al., 2017); while, we find evidence that the additional burdens for domestic firms are not limited to the negative effects connected with the rating

[17] As explicitly mentioned in their work, the sample used by Almeida et al. (2016) is too small to precisely identify the real effects of rating-based regulation on firms' financial policy.

[18] We describe the role of sovereign ratings in the current European financial regulation in Section 2.2.

ceiling but they are widespread across all firms, also unrated, which are the majority of firms in our sample.

Furthermore, we find evidence of an asymmetric impact between negative and positive rating changes; an upgrade, in fact, does not affect significantly loan spreads.

Finally, we demonstrate that the effect of a rating change on the firms' cost of debt is not due to several other processes. Our results, in fact, hold also controlling for the sovereign risk, crisis periods or unobserved heterogeneity of lender banks. We also confirm the validity of our results estimating further robustness checks.

The remaining part of this chapter is organized as follows. In Section 2.2, we review the related literature and present research hypotheses. Section 2.3 describes the dataset. Section 2.4 presents the methodology. Section 2.5 summarizes the empirical results concerning the impact of a sovereign rating change on loan spreads. In Sections 2.6 and 2.7, we verify alternative hypotheses and present robustness checks. Section 2.8 concludes.

2.2. Review of related research and hypotheses

Private and sovereign credit rating changes affect significantly the economic and financial system. The literature have focused primarily on the impact of a corporate rating change on the price of principal financial instruments (bonds, stocks, and CDS), showing that downgrades have a significant impact on the price of these instruments and on credit spreads (Hull et al., 2004; Kräussl, 2005; Micu et al., 2006; Norden and Weber, 2004). Corporate ratings also seem to influence

management' choices regarding capital structure, debt and equity financing, consequently, they affect also firms' performance (Kisgen, 2006, 2009; Kisgen and Strahan, 2010).

As showed in Chapter 1, also sovereign rating changes affect financial markets. Ferreira and Gama (2007) and Gande and Parsley (2005) show that sovereign downgrade announcements have significant spillover effects on financial markets. Sovereign rating is also a principal component of corporate ratings (Ferri et al., 2001). Numerous analyses show that sovereign risk affects firm's credit risk (Arteta and Hale, 2008; Augustin et al., 2014; Bedendo and Colla, 2015; Borensztein et al., 2013). The banking sector could be a main transmission channel of the sovereign risk. During the recent euro area sovereign debt crisis, in fact, the high exposure of the banking sector to riskier countries' debt affected negatively the lending supply to firms (Acharya et al., 2014b; Becker and Ivashina, 2014; Popov and Van Horen, 2015).

We assume that a sovereign rating change has a significant impact on the cost of bank loans to firms. Sovereign ratings could affect the cost of loans in different ways. We list below some of the reasons that may explain the relationship between the sovereign rating and the cost of bank loans, without pretending to provide an exhaustive list.

In general, the sovereign creditworthiness is deeply influenced by the performance of the country's economy as a whole. Indicating an increase in the likelihood of downgraded country's default, a sovereign downgrade could cause also an increase in the country risk component of the firm's systematic risk.

Moreover sovereign credit ratings issued by CRAs represent a rating ceiling for domestic firms' ratings (Borensztein et al., 2013). If a CRA announces a sovereign downgrade, domestic firms with a rating equal to or above their sovereign prior to the downgrade (bound firms) are significantly more likely to be downgraded than firms rated below their sovereign (non-bound firms). The rating ceiling policy causes additional negative financial effects for bound firms (Almeida et al., 2017); it affects also loan size and number of bank loans to firms (Adelino and Ferreira, 2016).

Finally, a sovereign downgrade could affect also directly firm's financial health. If, for example, the government is a main firm's shareholder, a sovereign negative rating change could affect negatively the stability of the firm's ownership structure. The government, in fact, might decide to sell off firm's shares for budgetary necessities. Otherwise, if the government is the principal firm's business customer, a downgrade could lead to a deterioration of receivables value. Similarly, the government could be forced to raise corporate taxes or to cut incentives in response to the increase in the sovereign credit risk. Firm's profitability, therefore, could be damaged by a restrictive fiscal policy.

The processes described above determine an increase in the credit risk of firms established in downgraded countries. An increase in the firm's credit risk should lead to greater loan spreads. We assume, therefore, that:

H1. *A sovereign rating downgrade leads to an increase in the cost of loans to domestic firms.*

If a rating change affects significantly loan spreads, we will verify whether this effect depends partially on the role of credit ratings in financial regulation

(*certification effect*). Kiff et al. (2012) indicate that the certification value attributed to credit ratings could be a main determinant of the impact of CRAs' judgments on financial markets. We test this hypothesis using the role of credit ratings in the minimum capital requirements calculation established by the Basel Committee. The Standardized Approach prescribes a list of risk weights based on external credit ratings that are applied to bank exposures to sovereigns (BIS, 2013): 0% from AAA to AA-; 20% from A+ to A-; 50% from BBB+ to BBB-; 100% from BB+ to B-; 150% below B-. Each risk weight identifies a regulation category. To test the presence of the *certification effect*, we verify whether a sovereign downgrade leading to a regulation category change (crossover) has a greater impact than a downgrade that does not cause a cross of regulation category boundaries (non-crossover).

The *certification effect* could be determined by numerous factors. After a crossover downgrade announcement, operational and regulatory constraints force institutional investors to sell off their investments. The behavior of these economic agents affects significantly the price of financial instruments; consequently, increased pressure on sales could lead to a reduction in the value of sovereign securities. The decrease in the price of sovereign securities affects also investors who are not subject to regulatory constraints, because the decrease in market prices leads to a devaluation of sovereign securities held by constrained and unconstrained investors. The overall effect is, therefore, an increase in the country risk that affects negatively numerous economic agents.

Furthermore, financial institutions could be forced to raise provisions commensurate with their exposure to downgraded countries. This process leads to

a reduction in available funds that banks could use for lending. We assume, therefore, that a crossover downgrade causes a decline in loan supply and, consequently, an increase in loan spreads.

Under current bank capital regulation national supervisors are allowed to exercise discretion and set risk weights lower than those prescribed in the Standardized Approach for exposures denominated and funded in the currency of the corresponding state. In order to avoid discriminatory treatment, bank supervisory authorities in other jurisdictions may also permit their own banks to apply the same risk weights to a given sovereign under certain conditions. EU authorities established a zero risk weight for all exposures denominated in euro and in any other Member State currency (BIS, 2013).

The particularly favorable treatment assigned to sovereign exposure has been criticized. Acharya and Steffen (2015), for example, demonstrate that the current financial regulation might have incentivized European banks to realize carry trades, financing with short-term debt investments in riskier countries' government bonds. Financial rules caused a regulatory arbitrage, a "zero risk contagion", which was a main determinant of European banking system fragility during the recent crisis.

Notwithstanding the favorable treatment assigned to sovereign exposures, we assume that crossover downgrades could have a greater impact on loan spreads than non-crossover downgrades. First, during the 2011 capital exercise European banks had to create a capital buffer commensurate with the exposure to sovereign debts (EBA, 2011). The coefficients used to estimate the capital buffer requirements are substantially equal to those prescribed in the Standardized

Approach. Moreover, approximately 40% of European banks subjects to the EBA's 2011 stress test had applied the IRB approach to their sovereign exposure before the capital exercise (Hannoun, 2011). Financial institutions, therefore, had already decided to measure sovereign risk. Hasan et al. (2015), in fact, show that, with the implementation of Basel II, foreign bank flows decline after sovereign downgrades leading to changes in risk weight categories. A negative rating change, consequently, reduces the firm's access to financial resources because of regulatory constraints.

Second, ECB relies on external credit ratings to determine acceptable collateral and margin requirements (ECB, 2013). Bolton and Jeanne (2011) highlight that, during the recent financial crisis, numerous investors were concerned of CRAs' decisions for regulatory reasons. A downgrade of a riskier country's rating could have a negative impact on government securities value, making more expensive the use of government securities as collateral and, consequently, causing a liquidity shock for the European banking system.

Finally, given the rating ceiling policy (Adelino and Ferreira, 2016; Almeida et al., 2017; Borensztein et al., 2013), a sovereign crossover downgrade could lead to a crossover downgrade of private issuer ratings. Almeida et al. (2016), in fact, underline that regulatory constraints could be a main determinant of the negative effects connected with the rating ceiling policy on firms' performance. Thus, our second hypothesis is:

H2. *A sovereign downgrade leading to changes in regulation categories has a greater impact on the spread of loans to domestic firms than a downgrade that does not cause a cross of regulation category boundaries.*

2.3. Data

Our sample consists of syndicated loans to non-financial[19] firms from EU Member States registered in Thomson Reuters Loan Pricing Corporation's Dealscan from January 2004 to February 2016. We consider the facilities in each deal as different loans. For each loan, we retrieve different information, such as the all-in-drawn spread, which is the amount the borrower pays in basis points over LIBOR for each loan dollar drawn down, including any annual or facility fees paid by the firm.

Table 2.1
Distribution of syndicated loans by country.

Country	No. of loans	Perc. of loans	Mean all-in spread *(bp)*	Mean loan amount *(millions of euro)*
Austria	77	1.07%	189.98	506.11
Belgium	212	2.95%	269.70	850.40
Bulgaria	1	0.01%	450.00	195.00
Cyprus	17	0.24%	236.47	338.69
Czech Republic	30	0.42%	236.82	247.31
Denmark	56	0.78%	275.94	745.11
Estonia	1	0.01%	170.00	43.10
Finland	73	1.02%	230.10	394.76
France	1,134	15.79%	238.15	417.77
Germany	881	12.26%	246.98	821.81
Greece	15	0.21%	253.50	324.55
Hungary	17	0.24%	228.41	329.65
Ireland	98	1.36%	273.36	712.59
Italy	488	6.79%	251.08	488.56
Luxembourg	93	1.29%	282.89	581.98
Malta	3	0.04%	300.00	66.48
Netherlands	494	6.88%	272.10	470.75
Poland	66	0.92%	233.22	347.50
Portugal	47	0.65%	213.21	807.45
Romania	21	0.29%	293.52	148.46
Slovakia	9	0.13%	164.94	170.35
Slovenia	2	0.03%	312.50	147.50
Spain	1,019	14.18%	258.10	369.62
Sweden	188	2.62%	342.44	386.20
United Kingdom	2,142	29.82%	314.69	385.67
Total	7,184	100.00%	261.52	411.89

[19] We exclude financial firms: SIC codes 6000-6999.

We obtain firm accounting data from Bureau Van Dijk's Orbis. We match firms in Dealscan to Orbis using company name, country of residence and other firms' information. After the matching, the sample consists of 7,184 loans granted to 1,723 firms.

In Table 2.1, we report the distribution of loans included in the sample by country. We indicate also the percentage distribution, the mean all-in spread and the mean amount. We observe that the firms included in our sample are established in 25 of 28 EU Members. We exclude loans to firms established in Croatia, Latvia, and Lithuania because of lack of some loan-level and firm-level information regarding these firms in Dealscan and Orbis.

We collect long term foreign currency sovereign ratings of EU Member States issued by Standard & Poor's from 2004 to 2016. We decided to use ratings issued by this CRA because previous studies found that Standard & Poor's updates its ratings more frequently, usually preceding other CRAs (Alsakka et al., 2014; Ismailescu and Kazemi, 2010).[20] In the analyzed period, Standard & Poor's announced 79 downgrades of European sovereign ratings. Table 2.2 reports the list of downgrades included in the sample. We observe that only six countries (Denmark, Czech Republic, Germany, Luxembourg, Sweden, and United Kingdom) have not been downgraded in this period. We notice also that approximately 44% of downgrades were announced between 2011 and 2012, when it was reached the peak of the sovereign debt crisis.

For the complete variables list, their relative sources and summary statistics see Table B.1 and Table B.2 in Appendix B. We check correlations among variables

[20] As robustness check, we replicated our analyses using downgrades announced by Moody's and Fitch. Our results hold also using these ratings.

before estimating each model. We confirm that none of the correlations is high enough to warrant concern in the following models.

Table 2.2
Downgrades included in the sample.

Country	Downgrade Year	No. of Downgrades
Austria	2012 (1)	1
Belgium	2011 (1)	1
Bulgaria	2008 (1), 2014 (2)	3
Croatia	2012 (1), 2014 (1)	2
Cyprus	2010 (1), 2011 (3), 2012 (4), 2013 (2)	10
Estonia	2009 (1)	1
Finland	2014 (1)	1
France	2012 (1), 2013 (1)	2
Greece	2004 (1), 2009 (2), 2010 (1), 2011 (4), 2012 (2), 2015 (4)	14
Hungary	2011 (1), 2012 (1)	2
Ireland	2009 (2), 2010 (2), 2011 (2)	6
Italy	2004 (1), 2006 (1), 2011 (1), 2012 (1), 2013 (1), 2014 (1)	6
Latvia	2007 (1), 2008 (2), 2009 (2)	5
Lithuania	2008 (2), 2009 (1)	3
Malta	2012 (1), 2013 (1)	2
Netherlands	2013 (1)	1
Poland	2016 (1)	1
Portugal	2005 (1), 2009 (1), 2010 (1), 2011 (2), 2012 (1)	6
Romania	2008 (1)	1
Slovakia	2012 (1)	1
Slovenia	2011 (1), 2012 (2), 2013 (1)	4
Spain	2009 (1), 2010 (1), 2011 (1), 2012 (3)	6
Total		79

2.4. Methodology

We verify if a sovereign rating downgrade has a significant impact on loan spreads (hypothesis *H1*) estimating the model described in Eq. (2.1):

$$LnSpread_{i,t} = \beta_0 + \beta_1 Downgrade_{i,t} + \beta_2 X_{i,t} + \beta_3 Y_{i,t} + \beta_4 Z_{i,t} + \varepsilon_{i,t} \quad (2.1)$$

The dependent variable is the logarithm of the all-in-drawn spread of loan granted to the *i-th* firm on day t.[21] The dummy variable *Downgrade* is our main interest variable. It is equal to 1 if the *i-th* firm is established in a country that has

[21] We use log transformed spread because of positive skewness of this variable. Firms, in fact, are unlikely to receive loans having spreads less than LIBOR (Goss and Roberts, 2011).

been downgraded in the six months before t[22] and 0 otherwise. If this variable is statistically significant and its coefficient is positive, we can confirm that a sovereign downgrade causes an increase in the cost of loans to domestic firms.

We also include three vectors of control variables. Vector *X* includes variables that describe loan characteristics (*Loan Variables*): *Reference Rate*, *Maturity*, *Secured*, *Covenant*, *Seniority*, *Loan Type,* and *Loan Purpose*.

Y comprehends firm-level variables (*Borrower Variables*). We control for the borrower's rating category (*InvGrade* and *SpecGrade*); firm's accounting data (*Size*, *Cash Flow*, *Leverage*, *Fixed Assets*), observed in the year preceding *t*; firm's industry (*Industry*); stock index returns of the country where the *i-th* firm is established over the thirty days prior to *t* (*SovStockIndex*), which we use as proxy of the current business climate. Finally, this vector includes also the initial sovereign rating, which is the rating assigned to the country where the *i-th* firm is established six months prior to *t* (*SovRating*).[23]

We include a dummy variable set, *Z*, to control for country (*Country FE*) and quarter (*Quarter FE*) fixed effects. In conclusion, ε represents the error term. The complete variables list is reported in Table B.1 in Appendix B.

In some cases, we observe that CRAs announce a downgrade of more than one notch, while, in other circumstances, they decide to reduce gradually the issuer rating with multiple changes. We investigate whether there is a relationship

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[22] We replicated the analysis using three months as time horizon. We considered a dummy variable equal to 1 if the *i-th* firm is established in a country that has been downgraded in the three months before *t*. Results obtained using this alternative definition of *Downgrade* are not statistically different from those presented.

[23] In an unreported model, we take into account also the rating warnings (outlooks and reviews) announced before the downgrade. We confirm that our results remain unchanged and rating warnings do not affect loan spreads. Since rating warnings are not involved in regulation, this finding confirms indirectly also the certification effect relevance.

among the rating change size and the impact of a downgrade on loan spreads. We verify this hypothesis substituting *Downgrade* with the variable *Shift*, which is the sum of negative rating changes in absolute value of the country where is established the *i-th* firm in the six months preceding t.

To verify the presence of the *certification effect* (hypothesis *H2*), we separate the impact of a crossover downgrade and the effect of a non-crossover downgrade. Therefore, we replace *Downgrade* with two dummy variables: *CDowngrade*, which is equal to 1 if the country where the *i-th* firm is established has been subject to a crossover downgrade, as defined in Section 2.2, in the six months before t and 0 otherwise; and *NCDowngrade*, which is equal to 1 if the country where the *i-th* firm is established has been subject to a non-crossover downgrade in the six months before t and 0 otherwise. The model is described by Eq. (2.2):

$$LnSpread_{i,t} = \beta_0 + \beta_1 CDowngrade_{i,t} + \beta_2 NCDowngrade_{i,t} + \beta_3 X_{i,t} + \beta_4 Y_{i,t} + \beta_5 Z_{i,t} + \varepsilon_{i,t} \quad (2.2)$$

2.5. The impact of a sovereign downgrade on loan spreads

Table 2.3 shows the results obtained from the estimation of Eq. (2.1). The model presented in column (1) is estimated considering all loans included in our sample. The variable *Downgrade* is significant at 1% level. The spread of loans to firms established in downgraded countries is, on average, 23% greater than the spread of other loans.

In columns (2), (3), and (4), we present models estimated excluding alternatively control variables. Results confirm the statistical significance of *Downgrade*.

Columns (5) and (6) allow us to observe the impact of a sovereign downgrade in two subsamples. In column (5), we estimate our model considering only firms established in the countries most affected by financial turmoil during the recent crisis, defined GIIPS (Greece, Ireland, Italy, Portugal, and Spain).

Table 2.3

The impact of a sovereign downgrade on loan spreads.

	(1) Full sample	*(2) Full sample*	*(3) Full sample*	*(4) Full sample*	*(5) GIIPS*	*(6) Non-GIIPS*	*(7) Shift*
Downgrade	0.233***	0.161***	0.150***	0.262***	0.174***	0.178***	-
	(0.000)	(0.005)	(0.004)	(0.000)	(0.004)	(0.000)	
Shift	-	-	-	-	-	-	0.140***
							(0.000)
Constant	6.877***	6.079***	4.697***	7.603***	3.885**	6.631***	6.819***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.031)	(0.000)	(0.000)
Loan Var.	*Yes*	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*
Borrower Var.	*Yes*	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*
Country FE	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Quarter FE	*Yes*	*No*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Observations	5,676	5,676	6,715	6,041	1,522	4,154	5,676
Adj R-squared	0.575	0.508	0.440	0.387	0.594	0.596	0.576

Notes: The table shows the results obtained from the estimation of Eq. (2.1). The dependent variable is *LnSpread*, logarithm of the all-in-drawn spread of loan granted to the *i-th* firm on day *t*. In column (1), we estimate the model considering all observations. In columns (2), (3), and (4), we report different model specifications. Models presented in columns (5) and (6) are estimated considering only firms established, respectively, in the GIIPS countries (Greece, Ireland, Italy, Portugal, and Spain) and in the Non-GIIPS countries. In column (7), we substitute *Downgrade* with the variable *Shift*. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

In column (6), instead, we estimate our model considering only firms established in the other countries of our sample excluding GIIPS. The impact of a sovereign downgrade on loan spreads is significant in all models; thus, this effect is not limited to the subsample of riskier countries. Furthermore, in an unreported model, we estimate the effect of a negative rating change on the spread of loans granted to firms established in European Monetary Union (EMU) Member States and we obtain qualitatively similar results.

In column (7), we include the variable *Shift* in place of *Downgrade*. Results highlight the significance of this variable: a one notch rating reduction leads to an average increase of 14% in loan spreads.

Finally, in an unreported model, we have also verified that the increase in loan spreads is greater when more CRAs downgrade the *i-th* firm's home country rating in the six months before the loan signing date.

These results confirm hypothesis *H1*. A sovereign rating downgrade leads to an increase in the domestic firms' borrowing cost.

2.5.1. The certification effect

The analysis proposed in the previous section demonstrates that a rating change has a significant impact on loan spreads.

As underlined formulating hypothesis *H2*, in Section 2.2, we can assume that part of this effect is due to the rating-based regulation.

We verify hypothesis *H2* estimating Eq. (2.2). *Panel A* (Table 2.4) shows results. We observe that both variables, *CDowngrade* and *NCDowngrade*, are statistically significant. The spread of loans to firms established in countries subject to a crossover downgrade are approximately 39% greater than other loan spreads; while the spread of loans to firms established in countries subject to a non-crossover downgrade are approximately 15% greater than other loan spreads. Our results demonstrate that both crossover and non-crossover sovereign downgrades affect loan spreads. However, we highlight that the impact of a downgrade leading to a regulation category change is greater. We assume that this difference is due to the *certification effect*.

Table 2.4

The *certification effect* of a sovereign downgrade.

Panel A – The impact of crossover and non-crossover downgrades on loan spreads.	*(1)*
CDowngrade	0.386***
	(0.000)
NCDowngrade	0.149***
	(0.000)
Constant	6.882***
	(0.000)
Loan Var.	*Yes*
Borrower Var.	*Yes*
Country FE	*Yes*
Quarter FE	*Yes*
Observations	5,676
Adj R-squared	0.577
Panel B – Difference between β_1 and β_2 assessed by the t-test.	
$H_0: \{\beta_1 = \beta_2$	
Diff.	0.236***
	(0.001)

Notes: *Panel A* shows the results obtained from the estimation of Eq. (2.2). The dependent variable is *LnSpread*, logarithm of the all-in-drawn spread of loan granted to the *i-th* firm on day *t*. In *Panel B*, we report the *t*-test results estimated to verify whether the *CDowngrade* coefficient is significantly different from the *NCDowngrade* coefficient. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

We assess whether *CDowngrade* coefficient is significantly different from *NCDowngrade* coefficient estimating a *t*-test. Our null hypothesis is that the two coefficients are not statistically different. Results, reported in *Panel B*, show that the *certification effect*, the difference between the impact of a crossover downgrade and a non-crossover downgrade, is statistically significant.

We can accept, therefore, hypothesis *H2*. The analysis shows, in fact, that a substantial part of the impact of a sovereign downgrade on loan spreads is due to regulatory constraints related to the role of ratings in financial regulation. This finding is particularly remarkable considering the European regulatory environment. Notwithstanding the favorable treatment of European sovereign exposure in current financial regulation, mentioned in Section 2.2, we

demonstrate that the *certification effect* of downgrades of EU countries' ratings is significant.

2.5.2. The impact of a sovereign downgrade across subsamples of firms

In this section we analyze the impact of a sovereign downgrade across subsamples of firms: (*a*) investment grade firms; (*b*) speculative grade firms; (*c*) unrated firms; (*d*) firms (rated and unrated) highly dependent on bank loans; and (*e*) government-owned firms.

a) Investment grade firms

First, we examine the impact on the spread of loans granted to investment grade firms.[24] These companies are the relatively most creditworthy issuers; therefore, they could shield themselves from the negative effects of a sovereign downgrade and, consequently, they may be less affected in terms of loan spreads.

Nevertheless, we may observe also an opposite result. The sovereign rating, in fact, is a main determinant of domestic firms' ratings and it also represents a rating ceiling (Borensztein et al., 2013). In general, CRAs do not assign to an issuer a rating above the sovereign. However, firms that demonstrate strong resilience and low default dependence from the sovereign can be rated up to two or four notches above the sovereign foreign currency rating (Almeida et al., 2017). After a sovereign downgrade, as anticipated in Section 2.2, bound firms, which are firms with a rating equal to or above their sovereign prior to the

[24] Investment grade category leads to numerous benefits, such as lower borrowing cost and higher liquidity of issued securities. Recently, the privileged status of investment grade firms was also recognized by the ECB (ECB, 2016). Investment grade euro-denominated bonds issued by non-bank corporations established in the euro area, in fact, are included in the list of assets that are eligible for regular purchases under Quantitative Easing. This directive assimilates de facto these securities to government bonds.

downgrade, are significantly more likely to be downgraded than non-bound firms, which are firms rated below their sovereign. Thus, as documented by Adelino and Ferreira (2016) and Almeida et al. (2016), the bound issuers, which are the relatively most creditworthy, may be the most affected by sovereign downgrades because of the rating ceiling policy. Similarly, if a country is subject to a crossover downgrade, also bound firms will be likely subject to a crossover downgrade.

However, we highlight that, in general, there are few firms directly affected by the sovereign rating ceiling policy.[25] Consequently, the significant impact documented in the previous sections cannot be only due to the presence of the rating ceiling. Given the rarity of bound firms, in fact, it could be argued that the sovereign ceiling policy has only a marginal effect. Instead, Borensztein et al. (2013) document significant effects of a policy defined as sovereign ceiling "lite", which implies that the sovereign ceiling policy is not an absolute constraint, but a limitation that tends to reduce corporate ratings when these ratings are close to their sovereign rating. The downward pressure due to a sovereign downgrade may affect a larger sample of firms. Consequently, the effects of this policy may not be limited to the actual bound firms, but they may be widespread across all firms that could be downgraded after a sovereign negative revision.

In sum, the presence of the sovereign rating ceiling policy, especially the "lite" version, and of *certification effect* could affect mostly investment grade firms. After a sovereign downgrade, investment grade firms, therefore, may be subject to a burden double than speculative grade firms: they may be affected, primarily, by

[25] Also in our sample there are only 114 loans granted to firms with a rating equal to or above their sovereign.

an increasing sovereign risk and, additionally, they may lose their rating category.[26] We highlight that investment grade firms might be negatively affected even without being really downgraded by a CRA. It is sufficient that the firm's downgrade due to the rating ceiling policy is perceived as a likely event by economic agents.

Thus, we verify if the relatively most creditworthy issuers, as investment grade firms, are able to shield themselves from the negative effects of a sovereign downgrade or if they are more affected than other firms because of the sovereign rating ceiling policy and the rating-based regulation. We estimate two models: first, we analyze if the impact of a sovereign rating change is greater for investment grade firms; second, we verify whether crossover downgrades affects mostly this category of firms. We construct interaction variables between our interest variables (*Downgrade*, *CDowngrade*, *NCDowngrade*) and the dummy variable *InvGrade*, until now included in the *Borrower Variables*. In the first model we include an interaction between *Downgrade* and *InvGrade*; in the second model we introduce two interactions between, respectively, *CDowngrade* and *InvGrade* and between *NCDowngrade* and *InvGrade*. The two models are expressed by Eqs. (2.3) and (2.4).[27]

$$LnSpread_{i,t} = \beta_0 + \beta_1 Downgrade_{i,t} + \beta_2 Downgrade * InvGrade_{i,t} + \beta_3 InvGrade_{i,t} + \beta_4 X_{i,t} + \beta_5 Y_{i,t} + \beta_6 Z_{i,t} + \varepsilon_{i,t} \quad (2.3)$$

[26] Finnerty et al. (2013) document that, if a firm crosses investment grade rating boundaries, the price of its securities and its credit risk will be affected negatively.

[27] To correctly interpret our results, we stress that our dependent variable is the logarithm of the loan spread. Therefore, our models estimate the impact of sovereign downgrades in relative terms.

$$LnSpread_{i,t} = \beta_0 + \beta_1 CDowngrade_{i,t} + \beta_2 CDowngrade * InvGrade_{i,t} + \beta_3 NCDowngrade_{i,t} + \beta_4 NCDowngrade * InvGrade_{i,t} + \beta_5 InvGrade_{i,t} + \beta_6 X_{i,t} + \beta_7 Y_{i,t} + \beta_8 Z_{i,t} + \varepsilon_{i,t} \quad (2.4)$$

Table 2.5

The impact of a sovereign downgrade on loan spreads distinguishing firm rating categories.

	(1) *Downgrade*	*(2)* *Certification Effect*
Downgrade	0.212*** (0.000)	-
Downgrade*InvGrade	0.190 (0.261)	-
CDowngrade	-	0.350*** (0.000)
CDowngrade*InvGrade	-	0.612*** (0.000)
NCDowngrade	-	0.135*** (0.001)
NCDowngrade*InvGrade	-	0.113 (0.554)
InvGrade	-0.650*** (0.000)	-0.649*** (0.000)
Constant	6.889*** (0.000)	6.888*** (0.000)
Loan Var.	*Yes*	*Yes*
Borrower Var.	*Yes*	*Yes*
Country FE	*Yes*	*Yes*
Quarter FE	*Yes*	*Yes*
Observations	5,676	5,676
Adj R-squared	0.576	0.578

Notes: In columns (1) and (2), we report results of models described by Eqs. (2.3) and (2.4). The dependent variable is *LnSpread*, logarithm of the all-in-drawn spread of loan granted to the *i-th* firm on day *t*. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Columns (1) and (2) of Table 2.5 present results, respectively, of Eqs. (2.3) and (2.4). We observe that investment grade firms have, on average, lower borrowing cost. Results reported in column (1) show that the interaction variables *Downgrade*InvGrade* is not significant at the considered levels. Therefore, we do not observe a statistically different impact of sovereign downgrades on the spread of loans granted to investment grade firms.

Instead, separating crossover and non-crossover downgrades, column (2), we highlight that the interaction variable *CDowngrade*InvGrade* is statistically significant. Crossover downgrades affect mainly investment grade firms. Thus, the *certification effect* has a greater impact on firms of this category. On the contrary, we observe that the variable *NCDowngrade*InvGrade* is not significant, implying that the firm's rating category does not affect the impact of a non-crossover downgrade on loan spreads.

b) Speculative grade firms

We estimated an additional model, not reported, introducing interaction variables between interest variables (*Downgrade*, *CDowngrade*, *NCDowngrade*) and the dummy variable *SpecGrade*. We observe that interaction variables (*Downgrade*SpecGrade*, *CDowngrade*SpecGrade*, *NCDowngrade*SpecGrade*) are not statistically significant. Thus, we do not find evidence of a statistically different impact of sovereign downgrades, also distinguishing crossover and non-crossover downgrades, on the spread of loans granted to speculative grade firms.

c) Unrated firms

We estimate Eqs. (2.1) and (2.2) considering only loans to unrated firms, not reported, and we confirm that a sovereign rating change affects significantly their borrowing cost. Thus, the impact of a sovereign downgrade is not limited to loans granted to rated firms. This result highlights the relevance of the impact of a sovereign rating change on the European syndicated loan market, which includes mostly unrated firms. In our sample, in fact, approximately 74% of loans are

granted to firms unrated by Standard & Poor's prior to the loan signing date.[28] The European financial system is traditionally considered bank-based (Demirgüç-Kunt and Levine, 1999); consequently, numerous firms do not issue traded financial securities and they do not solicit ratings by CRAs. A consequence of the European context is that numerous firms are financially dependent on bank credit supply. Despite the increase in loan spreads after a sovereign downgrade, the main sources of funding for these firms remain bank loans.

d) Firms highly dependent on bank loans

We also verify directly whether the financial dependence affects the impact of a sovereign downgrade. We estimate Eqs. (2.1) and (2.2) including *FinDep*, a measure of firm's financial dependence, which is calculated, following Augustin et al. (2014), as the ratio of total bank loans to total liabilities for each firm in the year preceding *t*. We report results in Table B.3 in Appendix B. We observe a sample size reduction due to an incomplete availability of total bank loans data in Orbis. The impact of a sovereign downgrade is greater on the spread of loans granted to the most financially dependent firms. Also in this case, crossover downgrades have a greater impact than non-crossover downgrades. We highlight that the unrated firms, which are approximately two-thirds of our subsample, show a greater ratio of financial dependence.[29] Thus, a sovereign downgrade affects particularly also the unrated firms that are financially dependent.

[28] In our sample, 1,722 loans are granted to firms rated by Standard & Poor's prior to the loan signing date.

[29] The unrated firms tend to be more financially dependent than the rated firms in our sample; in fact, *InvestGrade* and *SpecGrade* are negatively correlated to *FinDep*.

e) Government-owned firms

Finally, we verify also whether the impact on loan spreads could depend on the presence of government-owned firms in our sample. We identify this category of firms selecting those having a "Public authority, State, Government" entity as Global Ultimate Owner (GUO).[30] In our sample, only 154 loans are granted to government-owned firms. In an unreported model, we verify that the impact of a sovereign downgrade on the spread of loans to state-owned firms is not greater than others.

Overall, our results allow us to observe the impact of a sovereign downgrade across subsamples of domestic firms. The negative effects of a sovereign downgrade are widespread across all firms, also unrated, especially the most financially dependent.

In addition, we find that investment grade firms[31] are particularly affected by a crossover downgrade due to the rating-based regulation. Finally, the presence of government-owned firms does not affect the impact of a sovereign rating change. These results permit to expand the findings of Almeida et al. (2016). The sovereign rating ceiling policy, especially the "lite" version, is a determinant of the impact of a sovereign downgrade on firms' borrowing cost; but we underline that the impact of a sovereign downgrade is not limited to bound firms and that the *certification effect* is a main factor to explain the impact on loan spreads.

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[30] The GUO is "the independent shareholder with the highest direct or total % of ownership" identified in Orbis.

[31] We also check the validity of this result analyzing, in unreported models, the interaction between our interest variables and firms' balance sheet characteristics. We find that a sovereign downgrade affects particularly firms with greater size and cash flow ratio. These findings provide an additional confirm of our results, since investment grade firms have significantly greater size and cash flow ratio in our sample.

2.5.3. The impact on loan size

As showed in previous sections, a sovereign downgrade leads to an increase in loan spreads, but it could also affect loan size. Larger loans may generate more credit risk, but they may also allow for economies of scale in loan processing and monitoring for banks (Santos, 2011). To investigate whether a downgrade affects loan size, we estimate Eqs. (2.1) and (2.2) using as dependent variable *LnAmount*, which is the logarithm of the loan amount granted to the *i-th* firm on day *t*.

Results are reported in Table 2.6. We notice that a sovereign downgrade does not affect significantly loan size (column 1). Conversely, considering the *certification effect* (column 2), we observe that a crossover downgrade leads to a reduction in loan amounts. Our results show that a sovereign downgrade has a lower impact on loan size than on loan spread and that this impact is only restricted to crossover downgrades.

Table 2.6

The impact of a sovereign downgrade on loan size.

	(1) *Downgrade*	*(2)* *Certification Effect*
Downgrade	-0.165 (0.276)	-
CDowngrade	-	-0.238* (0.093)
NCDowngrade	-	-0.126 (0.462)
Constant	-1.724* (0.093)	-1.724* (0.089)
Loan Var.	*Yes*	*Yes*
Borrower Var.	*Yes*	*Yes*
Country FE	*Yes*	*Yes*
Quarter FE	*Yes*	*Yes*
Observations	5,541	5,541
Adj R-squared	0.509	0.509

Notes: In columns (1) and (2), we report results of models described by Eqs. (2.1) and (2.2) using as dependent variable *LnAmount*, which is the logarithm of the loan amount granted to the *i-th* firm on day *t*. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

2.6. Alternative hypotheses

The effect of a sovereign downgrade on borrowing cost could be determined by other dynamics not captured in previous models. We confirm the validity of our results testing alternative hypotheses.

2.6.1. Sovereign credit risk

The increase in loan spreads observed after a sovereign downgrade could be caused by an increase in the sovereign credit risk and only indirectly by a rating change. Consequently, the downgrade could reflect only an increase in the sovereign credit risk already perceived by market.

We verify this hypothesis including in Eq. (2.1) a measure of the credit risk of the country where the *i-th* firm is established. We introduce the variable *BondChange*, which indicates the change in the ten years government bond yield of the country where the *i-th* firm is established over the six months preceding *t*. Results are presented in column (1) of Table 2.7.[32]

We observe that the variable *BondChange* is significant. Government yield changes affect positively loan spreads. An increase in the sovereign credit risk leads to greater loan spreads. However, we highlight that the inclusion of this variable does not reduce the significance of *Downgrade*. A sovereign downgrade, therefore, is relevant also considering sovereign credit risk changes.

In column (2), we report an alternative model specification. We replace *BondChange* with the variable *SpreadChange*, which represents the change in the ten years government bond spread of the country where the *i-th* firm is established

[32] We observe a loss of 81 observations because of some missing in the sovereign bond time series database.

vis-à-vis German bund of comparable maturity over the six months preceding *t*. We estimate this model excluding loans granted to German firms. *SpreadChange* variable is significant, but we confirm that also this control variable does not reduce the significance of our interest variable.[33]

We highlight that the interpretation of our results could be twofold. On one side, our estimates could confirm that the rating changes are not mere recognitions ex post of an increase in the sovereign credit risk, but they introduce new information relevant for economic agents.

Table 2.7

The impact of a sovereign downgrade on loan spreads taking into account sovereign credit risk.

	(1)	*(2)*
Downgrade	0.231***	0.196***
	(0.000)	(0.000)
BondChange	0.060***	-
	(0.004)	
SpreadChange	-	0.081***
		(0.000)
Constant	7.433***	7.485***
	(0.000)	(0.000)
Loan Var.	*Yes*	*Yes*
Borrower Var.	*Yes*	*Yes*
Country FE	*Yes*	*Yes*
Quarter FE	*Yes*	*Yes*
Observations	5,595	4,907
Adj R-squared	0.537	0.536

Notes: In columns (1) and (2), we report results of models described by Eq. (2.1) adding, respectively, *BondChange* and *SpreadChange* variables. In column (2), we exclude loans granted to German firms. The dependent variable is *LnSpread*, logarithm of the all-in-drawn spread of loan granted to the *i-th* firm on day *t*. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

On the other side, this analysis could indirectly confirm that the impact of a sovereign downgrade is mostly due to the *certification effect*. As anticipated in the

[33] As a further robustness check, we estimate our model including CDS sovereign spread changes. We confirm that results of this analysis are not statistically different from those presented.

introduction, in fact, scientific literature has not yet proved whether CRAs have an information advantage assessing the developed countries' creditworthiness.[34] The market, therefore, could implicitly assign a "certification value" to credit ratings regardless CRAs' information advantage. We anticipate that in the next section we provide an additional confirm of the latter interpretation. However, we point out that our analysis focus on the impact of a sovereign rating change on loan spreads and on the measurement of the *certification effect*, while the assessment of CRAs' informational advantage is out of the scope of our study.

2.6.2. Crisis periods

The increase in loan spreads could not be caused by a sovereign rating change but it could reflect deterioration in macroeconomic fundamentals. Consequently, the increase of borrowing cost could be determined by business cycle downturns, reflecting a systemic effect, and not by downgrades.

We verify this alternative hypothesis introducing in Eq. (2.1) some variables that allow us to control whether the impact of a downgrade is only a signal of an economic and financial crisis. First, we include *Crisis*, which is a dummy variable equal to 1 in crisis periods of EU area identified by OECD (2016),[35] in the model described by Eq. (2.1). Results are presented in Table 2.8. In column (1), we observe that *Downgrade* is significant also taking into account recession periods. *Crisis*, instead, does not affect significantly loan spreads.

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[34] We highlight that recent works find some evidence that a sovereign rating announcement introduces "new" information relevant for investors (Kiff et al., 2012). However, it is underlined that a significant part of the observed effect is due to the role of the rating-based regulation.

[35] The variable *Crisis* takes value 1 in the two crisis periods identified by OECD: the global financial crisis from 02/2008 to 06/2009 and the euro area sovereign debt crisis from 05/2011 to 02/2013.

The variable *Crisis* indicates common recession periods of the whole EU area, not crisis of the specific analyzed country. Secondly, therefore, we estimate a further model replacing *SovStockIndex*, until now included in the *Borrower Variables*, with the variable *GDP*, which indicates the GDP percentage change of the country where the *i-th* firm is established in the quarter preceding *t*. Results are reported in column (2). Also in this model, the variable *Downgrade* remains statistically significant, while *GDP* does not affect loan spreads.

Third, in the model reported in column (3), we include also a measure representing financial crisis periods. We add, in fact, the variable *CDS*, which indicates the sovereign CDS spread level of the country where the *i-th* firm is established, observed on the day before *t*.[36] High sovereign CDS spread levels indicate a country's financial instability. The variable *CDS* is statistically significant: high CDS spread levels lead to an increase in loan spreads. However, the variable *Downgrade* remains significant.[37]

Finally, we estimate the model reported in column (3) separating crossover and non-crossover downgrades. Results are presented in column (4). We observe that the impact of a crossover downgrade is relevant, while non-crossover downgrades are less significant taking into account financial crisis periods. This result demonstrates the importance of the *certification effect*: by construction, in our model the news of the rating change was announced to the market prior to the loan signing. Thus, our findings suggest that the impact of a rating change on loan

[36] We observe a loss of observations because of some missing in the sovereign CDS time series database of some countries, especially at the beginning of the considered period. EU sovereign CDS transactions, in fact, increase since the beginning of the recent crisis.

[37] We estimate an additional model, not reported, including the VSTOXX index values, proxy of the market volatility observed on day *t*. Also taking into account financial volatility, *Downgrade* remains significant.

spreads is not due only to the disclosure of new information, which should be theoretically incorporated in the CDS spread observed on the day before the loan signing date, but it could be caused mainly by the rating-based regulation, regardless CRAs' information advantage.

Table 2.8

The impact of a sovereign downgrade on loan spreads taking into account sovereign economic and financial conditions.

	(1)	*(2)*	*(3)*	*(4)*
Downgrade	0.232***	0.230***	0.112**	-
	(0.000)	(0.000)	(0.029)	
CDowngrade	-	-	-	0.216**
				(0.033)
NCDowngrade	-	-	-	0.070
				(0.114)
Crisis	0.038	0.040	0.036	0.040
	(0.545)	(0.534)	(0.557)	(0.519)
GDP	-	0.053	0.257	0.246
		(0.853)	(0.375)	(0.407)
CDS	-	-	0.001***	0.001***
			(0.000)	(0.001)
Constant	6.883***	6.907***	4.105***	4.181***
	(0.000)	(0.000)	(0.000)	(0.000)
Loan Var.	*Yes*	*Yes*	*Yes*	*Yes*
Borrower Var.	*Yes*	*Yes*	*Yes*	*Yes*
Country FE	*Yes*	*Yes*	*Yes*	*Yes*
Quarter FE	*Yes*	*Yes*	*Yes*	*Yes*
Observations	5,676	5,676	5,074	5,074
Adj R-squared	0.575	0.575	0.584	0.584

Notes: In column (1), we report results of the model described by Eq. (2.1) including also the variable *Crisis*. In column (2), we replace *SovStockIndex* with the variable *GDP*. In column (3), we present results obtained including in the last model also the variable *CDS*. In column (4), we estimate the previous model separating crossover and non-crossover downgrades. The dependent variable is *LnSpread*, logarithm of the all-in-drawn spread of loan granted to the *i-th* firm on day *t*. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

We underline that the period analyzed in our work broadly overlaps the interval considered by Becker and Ivashina (2014). They focus on the effects of "financial repression", which refers to formal and informal pressures made by governments on the local financial sector to absorb new issues of government bonds. They find

that, during this period, with larger and riskier government debt, an increasing fraction of European firms issuing debt switched from loans to bonds, reflecting a higher relative cost of bank credit due to the financial repression.

Our analysis shows that financial repression is not the only factor that explains the increase in loan spreads. Also taking into account the increase in the sovereign risk, which Becker and Ivashina (2014) indicate as a relevant driver of financial repression, we still find a significant impact of crossover downgrades (Table 2.8).

Moreover, our analysis provides a more general assessment of the implications of increasing costs of bank credit. Becker and Ivashina (2014), sampling only firms that issue both loans and bonds, document that the financial repression indirectly leads to an increase in the cost of bank credit that forces firms to switch from loans to bonds. However, as underlined in Section 2.5.2, since our sample includes numerous private and unrated firms that have an impaired access to the bond market, we can analyze also the borrowing cost changes of firms that cannot easily switch from loans to bonds.

Overall, we confirm that a sovereign downgrade does not provide only a signal of an economic and financial crisis. It affects significantly the firm's cost of debt and this effect is mainly due to the *certification effect*. If we control for CDS spread levels, in fact, a downgrade that does not cause a cross of regulation category boundaries seems to have a negligible impact on loan spreads.

2.6.3. Banking Channel

A sovereign downgrade affects both loan contract counterparties. A sovereign downgrade could also cause a liquidity shock to domestic banks (BIS, 2011).

Adelino and Ferreira (2016) show that, after a sovereign downgrade, banks with ratings at the sovereign bound reduce their lending significantly more than otherwise similar banks whose ratings are not at the sovereign bound.

Furthermore, we highlight that, in one option prescribed by Basel rules regarding claims on banks, all banks incorporated in a given country receive a risk weight one category less favorable than that assigned to claims on the sovereign of that country (BCBS, 2006). Thus, a sovereign downgrade affects directly banks' ratings and, due to this regulation, it could increase the cost of banks' funding reducing the access to rating-sensitive sources of funding.

The observed effect on loan spreads, therefore, could be limited to loans made by banks established in a downgraded country. According to this hypothesis, the increase in the firms' borrowing cost could be caused by a reduction in lending supply attributed to an increase in the cost of funding for domestic banks following a sovereign downgrade.

Moreover, our results could be affected by an unobserved heterogeneity of lender banks. To verify these hypotheses, we estimate our models taking into account heterogeneity of lender banks and potential shocks to banking sector.

We point out that our sample comprehends only syndicated loans. Among syndicated members, a major role is attributed to arrangers. The arranger banks, in fact, usually hold the largest share of the syndicated loans, are also often administrative agents, coordinating other members (Adelino and Ferreira, 2016). Prior to signing the loan contract, arrangers assess the borrower quality and negotiate loan contract terms. After this process, they invite participant banks to acquire a loan share, remaining often responsible for the monitoring of the

borrower (Giannetti and Laeven, 2012). The arranger and the borrower are not always established in the same country. If the impact of a sovereign downgrade is caused only by a lender banks' liquidity shock, we assume to observe a significant impact of a sovereign rating change on loan spreads only when a CRA downgrades the country where the loan arranger is established. The impact observed estimating Eqs. (2.1) and (2.2) could be restricted to cases when both the arranger and the borrower firm are established in a downgraded country.

We verify this hypothesis including in Eq. (2.1): *i)* the dummy variable *Arranger*, which is equal to 1 if at least one arranger of the loan to the *i-th* firm is established in a country downgraded in the six months preceding *t*, 0 otherwise; *ii)* an interaction between *Arranger* and *Downgrade* to verify if the impact of a downgrade is greater when both the arranger and the borrower firm are established in a downgraded country; and *iii)* bank-firm fixed effects, to control for unobserved heterogeneity of lender banks.

Moreover, we include two variables to take into account syndicated structure: *Domestic*, which indicates the ratio of arrangers established in the same country of the *i-th* firm to number of arrangers; *Share*, which is the share of the loan to the *i-th* firm held by each arranger.

In the case of facilities with multiple arrangers, we consider each facility multiple times to capture differences across the arrangers (Adelino and Ferreira, 2016; Santos, 2011).

We report results in Table 2.9. Also including these variables and bank-firm fixed effects, we observe a significant increase in the loan spread after the downgrade of the country where the *i-th* firm is established.

Conversely, we do not find a significant impact of a downgrade of the country where the arranger is established. We do not observe an impact significantly different also when both the arranger and the borrower firm are established in a downgraded country, as highlighted by the low significance of *Downgrade*Arranger*.

Table 2.9

The impact of a sovereign downgrade on loan spreads taking into account lender bank characteristics.

	(1)
Downgrade	0.120***
	(0.000)
Arranger	0.015
	(0.621)
Downgrade*Arranger	0.054
	(0.245)
Domestic	0.129**
	(0.041)
Share	0.435***
	(0.000)
Constant	6.671***
	(0.000)
Loan Var.	*Yes*
Borrower Var.	*Yes*
Country FE	*Yes*
Quarter FE	*Yes*
Bank-firm fixed effects	*Yes*
Observations	28,445
Adj R-squared	0.542

Notes: The table reports results of the model described by Eq. (2.1) adding *Arranger*, *Downgrade*Arranger*, *Domestic*, *Share* and bank-firm fixed effects. The dependent variable is *LnSpread*, logarithm of the all-in-drawn spread of loan granted to the *i-th* firm on day *t*. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Furthermore, we observe that high ratio of arrangers established in the same country of the *i-th* firm leads to an increase in loan spreads. Probably, firms having a syndicate mostly formed by foreign creditors may select the banks that offer credit at the best conditions internationally. Conversely, firms with an

impaired access to the international credit market are more bound to terms and conditions of the local banking system.

We notice also that high share of loan held by a single arranger leads to an increase in loan spreads. As underlined by Bosch and Steffen (2011), if firms are opaque (privately held or unrated), syndicates are significantly smaller and arrangers have to retain a larger share of the loan to mitigate syndicate moral hazard.[38] We assume, therefore, that high concentration of loan share reflects high borrower risk that, consequently, leads to a greater spread.

In conclusion, we confirm that the impact of a sovereign downgrade on loan spreads is not due to unobserved heterogeneity of lender banks.

2.7. Robustness Checks

In the following sections, we estimate further tests to confirm the validity of our analysis.

2.7.1. The impact of a sovereign upgrade

Our first robustness check relies on comparison between negative and positive rating changes. The impact of a sovereign upgrade is not necessarily symmetric to the effect of a sovereign downgrade. On one side, a sovereign upgrade reflects an improvement of country's financial health and, consequently, it could stimulate lending supply to domestic firms.

[38] In syndicated loan, there is a particular form of moral hazard, defined syndicate moral hazard. The arranger, in fact, has an incentive to shirk on his monitoring effort because he only keeps a fraction of the loan (Bosch and Steffen, 2011). To mitigate this issue, the arranger holds a stake of the loan. In high information asymmetry environments, the arranger has to keep a particularly larger share.

On the other side, a sovereign downgrade affects directly domestic firms for the sovereign rating ceiling policy and for the other reasons mentioned in Section 2.2, while an upgrade does not lead automatically to an improvement of domestic firms' creditworthiness. After a sovereign downgrade, for example, CRAs probably downgrade bound firm for the rating ceiling policy, while there is not a comparable policy of opposite sign after an upgrade. Similarly, after a sovereign downgrade, banks could be forced to reduce their overall exposure to firms established in the downgraded country, while they could choose not to increase lending supply to the same firms after an upgrade. The negative effects of downgrades, therefore, seem more certain and immediate than positive effects of upgrades. For the same reasons, we assume that sovereign crossover upgrades could generate a limited *certification effect*.

We verify if sovereign upgrades affect loan spreads replacing in Eqs. (2.1) and (2.2) the variables *Downgrade*, *CDowngrade* e *NCDowngrade* with, respectively, *Upgrade*, *CUpgrade*, *NCUpgrade*. In the first model, *Upgrade* is a dummy variable equal to 1 if the *i-th* firm is established in a country that has been upgraded in the six months before *t* and 0 otherwise. In the second model, *CUpgrade* (*NCUpgrade*) takes value of 1 if the country where the *i-th* firm is established has been subject to a crossover (non-crossover) upgrade in the six months before *t* and 0 otherwise.

Table 2.10 reports estimates of the two models. In column (1), we observe that an upgrade does not affect significantly loan spreads. In column (2), we separate the impact of crossover and non-crossover upgrades. Also in this model, we highlight that *CUpgrade* and *NCUpgrade* are not statistically significant.

Thus, we confirm that upgrades do not affect significantly firms' borrowing cost. This result questions CRAs' information advantage hypothesis. If a rating change could introduce new information, we would expect to observe a significant impact after both a downgrade and an upgrade. Instead, the asymmetric impacts estimated in our analysis suggest that the sovereign rating ceiling policy and the *certification effect*, not associated with sovereign upgrades, are the most relevant factors of the increase in loan spreads observed after a downgrade.

Table 2.10

The impact of a sovereign upgrade on loan spreads.

	(1) *Upgrade*	*(2)* *Certification Effect*
Upgrade	-0.048	-
	(0.424)	
CUpgrade	-	0.035
		(0.794)
NCUpgrade	-	-0.055
		(0.434)
Constant	6.654***	6.653***
	(0.000)	(0.000)
Loan Var.	*Yes*	*Yes*
Borrower Var.	*Yes*	*Yes*
Country FE	*Yes*	*Yes*
Quarter FE	*Yes*	*Yes*
Observations	5,676	5,676
Adj R-squared	0.571	0.571

Notes: The table shows the impact of a sovereign upgrade on loan spreads. In column (1), we consider the impact of all upgrades, in column (2), we separate crossover and non-crossover upgrades. The dependent variable is *LnSpread*, logarithm of the all-in-drawn spread of loan granted to the *i-th* firm on day *t*. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

2.7.2. Endogeneity of loan contract terms

Our results could be biased by the endogeneity of maturity and loan spread. Dennis et al. (2000) show that, if this potential issue is not taken into account, the endogeneity could lead to improper inference. The relationship between spread and maturity could be twofold. Loans with longer maturities, generally, lead to

greater credit risk, but they are usually granted to less risky borrowers (Santos, 2011). To check the validity of our results, we reproduce the analysis described in Goss and Roberts (2011). We estimate a system of simultaneous equations using three stage least squares (3SLS):

$$LnSpread_{i,t} = \beta_0 + \beta_1 Maturity_{i,t} + \beta_2 Downgrade_{i,t} + \beta_3 X_{i,t} + \beta_4 Y_{i,t} + \beta_5 Z_{i,t} + \varepsilon_{i,t} \quad (2.5)$$

$$Maturity_{i,t} = \beta_0 + \beta_1 LnSpread_{i,t} + \beta_2 Downgrade_{i,t} + \beta_3 X_{i,t} + \beta_4 Y_{i,t} + \beta_5 Z_{i,t} + \varepsilon_{i,t} \quad (2.6)$$

In order to allow identification of the model, following Goss and Roberts (2011), we include in the spread equation, Eq. (2.5), all control variables considered in Eq. (2.1) except *Reference Rate*.

In the maturity equation, Eq. (2.6), we replace *CashFlow* and *Leverage* with *EBITDA*, the ratio of EBITDA to total assets of the *i-th* firm in the year preceding t, and *NetWorth*, the ratio of net worth to total assets of the *i-th* firm in the year preceding t. In addition, we control for the loan reference rate and we exclude quarter dummies.

Table 2.11 shows estimates of the system of equations. We observe that *LnSpread* and *Maturity* coefficients are negative. This result could seem counterintuitive observing the term structure. Goss and Roberts (2011) provide a plausible explanation assuming that low-quality firms are excluded from the long-term market. Short term loans, conversely, are granted to riskier firms that receive higher spreads.

As regards the impact of a downgrade, we observe that a sovereign rating change leads to an increase in loan spreads but it does not affect loan maturity.

Thus, we can confirm that results presented in previous sections are valid also taking into account the potential endogeneity of maturity and spread.

Table 2.11

Simultaneous equations of spread and maturity.

	(1) *LnSpread*	*(2)* *Maturity*
Maturity	-0.011* (0.067)	-
LnSpread	-	-18.43*** (0.000)
Downgrade	0.173*** (0.000)	-2.139 (0.261)
Constant	7.443*** (0.000)	190.6*** (0.000)
Loan Variables	*Yes*	*Yes*
Borrower Variables	*Yes*	*Yes*
Country dummies	*Yes*	*Yes*
Quarter dummies	*Yes*	*No*
Observations	5,507	5,507
Adj R-squared	0.404	0.269

Notes: The table shows results of a system of simultaneous equations estimated using three stage least squares (3SLS), described by Eqs. (2.5) and (2.6). Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

2.8. Conclusions

Our analysis shows that a sovereign downgrade affects significantly the spread of loans granted to domestic firms. Sovereign negative rating changes, in fact, lead to greater borrowing cost for firms. We confirm that the negative effects are widespread across all firms, also unrated, especially those most financially dependent on bank credit. We demonstrate that a relevant part of this effect depends on the reliance of financial regulation on credit ratings (*certification effect*). In addition, the *certification effect* leads to a reduction in loan size and to supplementary burdens for investment grade firms.

In the European syndicated loan market, almost three-quarters of loans are granted to unrated companies. Unrated companies have fewer chances to replace bank loans with other forms of funding (primarily corporate bonds). Consequently, the rating contingent regulation amplifies the effects of sovereign downgrades and can further worsen the economic situation in the country that has suffered the downgrade.

The impact of a sovereign downgrade on loan spreads is significant also taking into account an increase in the sovereign risk perceived by the market and measured by CDS or bond spreads, the effect of crisis periods, lender bank characteristics, and the potential endogeneity of loan contract terms. Furthermore, we demonstrate that only sovereign downgrades affects loan spreads, while sovereign upgrades do not have a significant impact.

In conclusion, we underline two elements. Our study shows that a sovereign rating change has not negligible real effects for firms. In the current financial context, characterized by an impaired access to credit for firms, government affects firms' performance not only directly, establishing tax and subsidies, but also indirectly. In fact, increasing or decreasing the likelihood of a downgrade, public policies could generate negative externalities affecting firms' borrowing cost.

Secondly, our analysis shows that the current financial system still relies heavily on credit ratings. The theoretical implications of rating-based regulation were already discussed in literature, but little empirical evidence has been presented until now. Financial regulators should be aware of the potential consequence of the certification role attributed to ratings issued by CRAs.

In terms of policy implications, our findings suggest that the role of credit ratings in the current regulation could lead to sizeable costs and to a greater financial instability. In the current debate regarding the reform of the prudential treatment of sovereign exposures, we think that the negative externalities connected with the rating-based regulation, especially in terms of greater firms' borrowing cost, should not be underestimated.

Appendix B

Table B.1

Variables description.

Variable	Description	Source
Dependent Variables		
LnSpread	Logarithm of the all-in-drawn spread of loan granted to the *i-th* firm on day *t*.	Dealscan
LnAmount	Logarithm of the loan amount granted to the *i-th* firm on day *t*.	Dealscan
Key Explanatory Variables		
Downgrade	Dummy variable equal to 1 if the *i-th* firm is established in a country that has been downgraded in the six months before *t* and 0 otherwise.	S&P
Shift	Sum of negative rating changes in absolute value of the country where is established the *i-th* firm in the six months preceding *t*.	S&P
CDowngrade	Dummy variable equal to 1 if the country where the *i-th* firm is established has been subject to a crossover downgrade in the six months before *t* and 0 otherwise.	S&P
NCDowngrade	Dummy variable equal to 1 if the country where the *i-th* firm is established has been subject to a non-crossover downgrade in the six months before *t* and 0 otherwise.	S&P
Upgrade	Dummy variables equal to 1 if the *i-th* firm is established in a country that has been upgraded in the six months before *t* and 0 otherwise.	S&P
CUpgrade	Dummy variable equal to 1 if the country where the *i-th* firm is established was subject to a crossover upgrade in the six months before *t* and 0 otherwise.	S&P
NCUpgrade	Dummy variable equal to 1 if the country where the *i-th* firm is established was subject to a non-crossover upgrade in the six months before *t* and 0 otherwise.	S&P
X: Loan Variables		
Reference Rate	Loan reference rate (Euribor or Libor) value observed in *t*.	Datastream
Maturity	Months to maturity on the loan.	Dealscan
Secured	Dummy variable equal to 1 if the loan is secured, 0 otherwise.	Dealscan
Covenant	Dummy variable equal to 1 if there are covenants in the loan contract, 0 otherwise.	Dealscan
Seniority	Indicator variables for seniority: *Senior, Mezzanine, Subordinated*. *Senior* is the omitted variable.	Dealscan
Loan Type	Indicator variables for loan typology: *Revolver/Line*, *Term loan*, *Bridge loan* and *Other*. *Revolver/line* is the omitted variable.	Dealscan
Loan Purpose	Indicator variables for loan purpose: *Merger & Acquisition*, *Capital expenditure*, *Leveraged Buyout*, *Restructuring*, *Working capital*, *Other*. *Merger & Acquisition* is the omitted variable.	Dealscan
Y: Borrower Variables		
InvGrade	Dummy variable equal to 1 if the *i-th* firm's long-term debt S&P rating on the loan signing date is higher than BB+. It is equal to 0 if borrower's rating is equal or lower than BB+ or if S&P does not assign a rating to the *i-th* firm.	Dealscan

SpecGrade	Dummy variable equal to 1 if the *i-th* firm's long-term debt S&P rating on the loan signing date is equal or lower than BB+. It is equal to 0 if borrower's rating is higher than BB+ or if S&P does not assign a rating to the *i-th* firm.	Dealscan
SovRating	S&P long-term foreign currency of the country where the *i-th* firm is established six months prior to *t*, mapped into 22 numerical categories (22 is assigned to AAA level and 1 to SD).	S&P
SovStockIndex	Stock index returns of the country where the *i-th* firm is established over the thirty days preceding *t*.	Datastream
Size	Logarithm of the *i-th* firm's total assets in the year preceding *t*.	Orbis
Cash Flow	Ratio of cash flow to total assets of the *i-th* firm in the year preceding *t*.	Orbis
Leverage	Ratio of total assets minus total equity to total assets of the *i-th* firm in the year preceding *t*: $\frac{Total\ Assets - Total\ Equity}{Total\ Assets}$	Orbis
Fixed Assets	Ratio of fixed assets to total assets of the *i-th* firm in the year preceding *t*.	Orbis
Industry	Indicator variables for the *i-th* firm's industry based on 2-digit SIC codes: *Agriculture* (01-09); *Mining* (10–14); *Construction* (15–19); *Manufacturing* (20–39) *Transportation, Commercial, Gas and Electricity* (40–49); *Wholesale* (50–51); *Retail* (52–59); *Financial* (60–69); *Services* (70–89); *Public Administrative* (90-99). *Mining* is the omitted variable.	Dealscan
Z: Country and Quarter dummies		
Country FE	Country fixed effects.	Dealscan
Quarter FE	Quarter fixed effects.	Dealscan
Other Variables (used to test alternative hypotheses and for robustness checks)		
BondChange	Change in the ten years government bond yield of the country where the *i-th* firm is established over the six months preceding *t*.	Datastream
SpreadChange	Change in the ten years government bond spread of the country where the *i-th* firm is established vis-à-vis German bund of comparable maturity over the six months preceding *t*.	Datastream
Crisis	Dummy variable equal to 1 in crisis periods of EU area identified by OECD (2016).	OECD
GDP	GDP quarterly percentage change of the country where the *i-th* firm is established in the quarter preceding *t*.	Datastream
CDS	Sovereign CDS spread level of the country where the *i-th* firm is established observed on the day before *t*.	Datastream
Arranger	Dummy variable equal to 1 if at least one arranger of the loan to the *i-th* firm is established in a country downgraded in the six months preceding *t*, 0 otherwise.	S&P
Domestic	Ratio of arrangers established in the same country of the *i-th* firm to number of arrangers.	Dealscan
Share	Share of the loan to the *i-th* firm held by each arranger.	Dealscan

Table B.2

Summary statistics.

Variable	Mean	Min	Median	Max	Std. Dev.	Obs.
Spread *(bp)*	272.44	6.50	250.00	2,000.00	182.92	7,184
Amount *(mln of euro)*	479.79	0.30	123.61	25,038.49	1,312.03	7,031
Downgrade	0.08	0.00	0.00	1.00	0.26	7,184
Shift	0.11	0.00	0.00	4.00	0.48	7,184
CDowngrade	0.03	0.00	0.00	1.00	0.17	7,184
NCDowngrade	0.05	0.00	0.00	1.00	0.21	7,184
Upgrade	0.02	0.00	0.00	1.00	0.13	7,184
CUpgrade	0.01	0.00	0.00	1.00	0.04	7,184
NCUpgrade	0.02	0.00	0.00	1.00	0.12	7,184
Reference Rate *(%)*	1.91	-0.13	1.28	5.38	1.77	7,184
Maturity (*months*)	71.06	1.00	60.00	432.00	40.89	6,715
Secured	0.60	0.00	1.00	1.00	0.49	7,184
Covenant	0.05	0.00	0.00	1.00	0.23	7,184
InvGrade	0.09	0.00	0.00	1.00	0.28	7,184
SpecGrade	0.07	0.00	0.00	1.00	0.26	7,184
SovRating	20.88	3.00	22.00	22.00	2.38	7,184
SovStockIndex *(%)*	0.14	-36.90	0.56	24.75	6.06	7,184
Size *(log)*	12.92	-6.91	13.11	19.68	3.03	7,184
Cash Flow	0.07	-0.27	0.07	0.72	0.11	6,081
Leverage	0.72	0.01	0.68	0.96	0.24	7,070
Fixed Assets	0.60	0.01	0.65	0.96	0.27	6,954
BondChange *(%)*	-0.03	-15.94	0.04	17.49	0.85	7,073
SpreadChange *(%)*	0.04	-15.62	0.03	18.57	0.75	6,192
Crisis	0.27	0.00	0.00	1.00	0.44	7,184
GDP *(%)*	0.80	-30.93	1.27	22.84	4.66	7,184
CDS *(bp)*	73.41	0.50	34.41	7,780.81	177.95	6,283
Arranger	0.10	0.00	0.00	1.00	0.30	34,334
Domestic	0.39	0.00	0.32	1.00	0.28	34,334
Share	0.13	0.01	0.08	1.00	0.13	33,597

Table B.3

The impact of a sovereign downgrade taking into account firm's financial dependence.

	(1) *Downgrade*	*(2)* *Certification effect*
Downgrade	0.169* (0.057)	-
Downgrade*FinDep	0.015*** (0.003)	-
CDowngrade	-	0.299** (0.015)
CDowngrade*FinDep	-	0.012** (0.020)
NCDowngrade	-	0.019 (0.726)
NCDowngrade*FinDep	-	0.176* (0.062)
FinDep	-0.002* (0.063)	-0.002* (0.069)
Constant	7.351*** (0.000)	7.339*** (0.000)
Loan Variables	*Yes*	*Yes*
Borrower Variables	*Yes*	*Yes*
Country dummies	*Yes*	*Yes*
Quarter dummies	*Yes*	*Yes*
Observations	1,428	1,428
Adj R-squared	0.691	0.692

Notes: In columns (1) and (2), we report results of models described by Eqs. (2.1) and (2.2) adding *FinDep* and the interaction between our interest variables (*Downgrade*, *CDowngrade*, and *NCDowngrade*) and *FinDep*. The dependent variable is *LnSpread*, logarithm of the all-in-drawn spread of loan granted to the *i-th* firm on day *t*. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

3. The Impact of Sovereign Rating Changes on the Activity of European Banks

3.1. Introduction

Credit ratings issued by credit rating agencies (CRAs) have acquired a prominent role in the current financial system. Numerous studies demonstrate that credit ratings affect the price of principal financial instruments, such as stocks, bond, and derivatives (Afonso et al., 2012; Hull et al., 2004; Ismailescu and Kazemi, 2010; Micu et al., 2006; Norden and Weber, 2004). CRAs' judgments also directly affect issuers' financial choices. Kisgen (2009) shows that firms are more likely to reduce debt and less likely to issue debt and reduce equity after a downgrade. Capital structure decisions seem more affected by whether a firm's credit rating was downgraded the previous year than by changes in leverage or profitability. Karam et al. (2014) demonstrate that a downgrade of a bank's rating represents a liquidity shock, which leads to a reduction in access to rating sensitive sources of funds and, subsequently, to a decline in domestic and foreign lending. Similarly, sovereign ratings affect economic growth (Chen et al., 2016) and sovereign fiscal discipline (Duygun et al., 2016).

The impact of a sovereign rating change is not negligible on the domestic banking system either (BIS, 2011). Until recently, the international financial system had paid little attention to sovereign risk commensurate with exposures to developed countries. However, the sovereign debt crisis has highlighted the strong connection between banks and sovereigns. The soundness of numerous banks was threatened by a remarkable increase in sovereign risk. They suffered significant

losses in their securities and lending portfolios, and, in some cases, had to rebuild capital buffers to meet the standard required by financial supervisors (De Bruyckere et al., 2013).

Our aim is to verify the impact of a sovereign rating change on the activity of European domestic banks, in terms of their regulatory capital ratio, profitability, liquidity, and lending supply. We also investigate the transmission channels of this impact.

In particular, we focus on the banking sector of EU Members. After the beginning of the sovereign debt crisis, the European financial system attracted increasing attention and became the proper context to analyze the connection between sovereign countries and domestic banks.

Our work contributes to the existing literature in several ways. First, our research expands studies on the impact of a sovereign rating change on the banking sector. Unlike other papers that analyze the effects of sovereign rating changes on banks' stocks and ratings, we focus on the real effects of sovereign rating revisions for the European banking sector. We find that a sovereign downgrade mainly affects capital ratios and the lending supply of domestic banks, while it has a lower impact on their profitability and liquidity, at least in the short-term. We also show that upgrades do not significantly affect the activity of European banks, indicating an asymmetric effect of sovereign rating changes.

Second, we contribute to the analysis of the potential transmission channels of sovereign risk to the banking sector. We find that the impact on the activity of domestic banks is partly explained by three channels: *assets channel*, *funding*

channel, and *rating channel*. Conversely, we do not confirm the presence of the *guarantee channel*.

Third, our work is related to the literature on the effects of the rating-based regulation. In fact, we underline the importance of a fifth transmission channel: the *certification channel*. We find strong evidence that the use of ratings in financial regulation has a direct impact on all variables used to measure the activity of banks, causing negative externalities for financial institutions. This result is particularly significant because the impact of the current rating-based regulation on the banking sector's activity is only partially investigated by previous works.

In addition, we confirm the validity of our results by estimating further robustness checks; taking into account sovereign risk changes, macroeconomic conditions, and potential endogeneity issues, estimating a GMM system and employing an instrumental variable approach.

The remainder of this chapter is organized as follows. In Section 3.2, we review the related literature and present research hypotheses. Section 3.3 describes the dataset. Section 3.4 presents the methodology. In Section 3.5, we verify the impact of a sovereign rating change on the activity of domestic banks. In Section 3.6, we analyze the potential transmission channels of the impact of a sovereign rating change. In Section 3.7, we present robustness checks. Section 3.8 concludes.

3.2. Review of related research and hypotheses

Several studies analyze contagion between sovereigns and banks, focusing mainly on the impact of an increase in sovereign risk on the price of financial instruments, as banks' stocks or CDS (Acharya et al., 2014a; Alter and Beyer, 2014; Alter and Schüler, 2012; Angeloni and Wolff, 2012; Bosma et al., 2012; Demirgüç-Kunt and Huizinga, 2013; Ejsing and Lemke, 2011; Vuillemey and Peltonen, 2013). For example, analyzing the European CDS market, De Bruyckere et al. (2013) find evidence of a risk spillover between banks and sovereigns. European sovereign and bank CDS markets seem positively correlated during the recent sovereign debt crisis.

Albertazzi et al. (2014) analyze the effects of sovereign debt tensions on the activity of Italian banks. They show that an increase in sovereign spreads leads to a rise in the interest rates on term deposits, newly issued bonds and, especially, on the lending rates to firms and households.

Acharya et al. (2014b), Becker and Ivashina (2014), and Popov and Van Horen (2015) show that the high exposure held by the banking sector to sovereign debt has a negative impact on the lending supply to firms during the sovereign debt crisis.

A more limited strain of literature analyses the direct impact of a sovereign rating change on the banking sector. Arezki et al. (2011) find that sovereign rating downgrades have significant spillover effects on European bank stock indices. Correa et al. (2014) and Caselli et al. (2016) study the reaction of bank stock prices to sovereign rating changes. They find that bank stock prices decrease after downgrades, while they are slightly sensitive to upgrades. Alsakka et al. (2014)

demonstrate that European sovereign rating downgrades and negative watch signals lead to bank rating downgrades. Williams et al. (2015) show that both positive and negative sovereign actions have an impact on bank share prices in emerging countries.

In view of described results, we can affirm that financial sector soundness is highly affected by changes in the sovereign rating. Consequently, we assume that the effects of a sovereign rating revision could also directly affect domestic banks' activity.

For example, a sovereign rating change could have an impact on banks' capital ratios. These ratios are broadly calculated by dividing regulatory capital by risk-weighted assets of a bank. A sovereign downgrade could lead to an increase in the riskiness of assets, decreasing the capital ratio. Similarly, it could represent a financial shock for banks' liquidity, reducing their access to rating-sensitive sources of funding (Adelino and Ferreira, 2016). The potential increase in the cost of financial resources could reduce their profitability and, at the same time, could force banks to reduce their lending supply. After an upgrade, we expect to observe the same process with an opposite sign. Therefore, our first hypothesis is:

H1. *A sovereign rating change has a significant impact on the activity of domestic banks in terms of their regulatory capital ratio, profitability, liquidity, and lending supply*.

If *H1* is true, we will focus on the transmission channels through which a sovereign rating change can affect the activity of domestic banks, in line with those identified by BIS (2011): *assets channel*, *funding channel*, *rating channel*, and *guarantee channel*.

First, we investigate whether a sovereign rating revision affects domestic banks through the *assets channel*. This channel primarily concerns banks' holdings of their home country debt. A downgrade could affect negatively the market value of government securities leading to a reduction in bank asset value. This effect could also be significant even if the losses are carried on the balance sheet only when the government securities are impaired, because investors could perceive that the downgrade threatens bank soundness already before the asset impairment. Therefore, the market sentiment could negatively affect bank value (BIS, 2011).

Angeloni and Wolff (2012), Correa et al. (2014), and De Bruyckere et al. (2013) find evidence of the *assets channel* by analyzing banks' stock prices and CDS spreads.

We assume that this channel is particularly relevant because of the great exposure of domestic banks to sovereign debts. European banks have sizeable exposure to sovereigns, and their sovereign portfolios present a strong home bias (BIS, 2011). In some countries, more than 70% of government debt is held by domestic banks (EBA, 2015).

Moreover, numerous studies demonstrate that a rating downgrade in one country has a significant spillover effect on the sovereign bond market of other countries (Afonso et al., 2012; Böninghausen and Zabel, 2015; Gande and Parsley, 2005). Thus, there is a double effect of a sovereign downgrade on domestic banks' assets: the first is the direct deterioration of asset value due to the reduction of downgraded sovereign security value; the second one concerns the reduction of other sovereign security value held in banks' portfolios, which are affected by the spillover effect. In addition, we highlight that the impact of

sovereign rating changes on the riskiness of banks' asset could be not limited to their sovereign debt exposures. For example, a sovereign downgrade may lead to an increase in the credit risk of borrower firms established in the downgraded country, causing an increase in the riskiness of exposure to these firms and, consequently, in the riskiness of banks' assets. Therefore, we verify the *assets channel* not by focusing solely on the direct exposure held by banks to the country subject to a rating change, but considering the whole riskiness of assets, assuming that:

H2. *A sovereign rating change significantly affects the risk-weighted assets of domestic banks.*

The *funding channel* regards the impact of a sovereign rating change on the access of banks to different sources of funding. Banks rely heavily on short-term wholesale funding (Adelino and Ferreira, 2016), but this makes them more vulnerable to financial shocks, such as sovereign downgrades. In fact, short-term sources of funding are more volatile and more rating-sensitive than retail deposits. Therefore, since a sovereign downgrade could lead to a decline in access to short-term funding, the *funding channel* could directly affect the activity of domestic banks.

This channel is also related to the *collateral channel*, which regards the use of sovereign securities as collateral for different transactions with central banks, such as interbank loans and repos. Deterioration in sovereigns' creditworthiness negatively affects the value of collateral, reducing liquidity and wholesale funding that banks could obtain from the central bank and the interbank market.

Some papers find evidence of the *funding channel* and of the *collateral channel*. Correa et al. (2014) find that European banks showed impaired access to dollar funding from U.S. money market funds during the recent crisis. De Bruyckere et al. (2013) show that bank CDS are more strongly related to sovereign CDS when the bank is more dependent on short-term funding. Conversely, analyzing emerging countries, Williams et al. (2015) find that the *collateral channel* plays a modest role and that it is limited to positive sovereign rating changes.

To verify the *funding channel*, we investigate whether the impact of a sovereign rating change depends on banks' reliance on short-term funding. We assume, therefore, that banks that are more dependent on short-term funding are more affected by sovereign rating changes through the *funding channel*. Thus, our next hypothesis is:

H3. *The funding channel leads to a greater impact of a sovereign rating change on the activity of domestic banks that are more dependent on short-term wholesale funding.*

The *rating channel* implies that sovereign rating changes could also have a direct impact on domestic bank ratings (Alsakka et al., 2014). In fact, the sovereign rating is a rating ceiling for ratings of domestic firms and financial institutions (Borensztein et al., 2013). Adelino and Ferreira (2016) find that, after a sovereign downgrade, domestic banks with a rating equal to or above their sovereign prior to the downgrade (bound banks) are significantly more likely to be downgraded than banks rated below their sovereign (non-bound banks). The rating ceiling policy also leads to a greater reduction in lending of bound banks.

The *rating channel* could have a direct effect on banks' activity. A bank rating downgrade reduces access to rating-sensitive sources of funding, and, subsequently, limits its activity. Therefore, if the *rating channel* is significant, we assume that the most affected banks will be bound banks, which are the financial institutions more likely to be downgraded after a sovereign rating change:

H4. *The rating channel leads to a greater impact of sovereign rating changes on the activity of domestic banks with a rating equal to or above their sovereign prior to the downgrade (bound banks).*

Another link between sovereigns and banks is the *guarantee channel*. The financial sector, especially large banks, traditionally had an implicit government guarantee. During the global financial crisis, several countries provided explicit and implicit guarantees to help domestic banks retain access to wholesale funding and to maintain financial stability. Larger banks, defined as "too-big-to-fail", have benefited from these guarantees due to their systemic importance. However, when the sovereign debt crisis weakened European countries' financial soundness, bank valuations were affected by the decrease in the implicit guarantee value, discounting the lower probability of future large bailouts with public funds. Bertay et al. (2013) demonstrate that market valuations of systemically large banks are lower in countries with large fiscal deficits because investors consider these banks too big to save.

Alter and Schüler (2012) find that sovereign CDS spreads become an important determinant of European bank CDS after government bailouts during the recent crisis. De Bruyckere et al. (2013) show that the bank-sovereign correlation is higher for large banks and that the contagion is greater for high debt-to-GDP

countries. Stângă (2014) showed that bailouts generate risk spillovers between the default risks of banks and sovereigns. Correa et al. (2014) find that sovereign credit rating downgrades have a negative impact on stock returns of banks that are expected to receive government support. In contrast, Williams et al. (2015) demonstrate that the size of banks in emerging countries does not affect the impact of a sovereign rating change on banks' share price.

We assume that banks' activity could be strongly affected by the *guarantee channel*, because this channel has a direct impact on banks' creditworthiness. Following the current literature, we assume that large banks are the most affected by a sovereign rating change through the *guarantee channel*. Large banks, in fact, are the most vulnerable to changes in the probability of support by their home country in the case of a financial distress situation. Therefore, we hypothesize that:

H5. *The guarantee channel leads to a greater effect of sovereign rating changes on the activity of larger banks*.

In addition to the above mentioned channels, we highlight that banks' balance sheets could also be affected by a sovereign change through another channel. Credit ratings play a major role in current financial regulation; in this sense, CRAs provide a "certification" service (Kiff et al., 2012). The Basel Committee prescribes the use of external ratings in the calculation of minimum capital requirements. In the Standardized Approach a list of risk weights based on external ratings is applied to bank exposures to sovereigns (BIS, 2013): 0% from AAA to AA-; 20% from A+ to A-; 50% from BBB+ to BBB-; 100% from BB+ to B-; 150% below B-. Each risk weight defines a regulation category. We can

divide sovereign rating changes into two groups: the rating revisions that lead to a regulation category change (crossover) and the rating actions that do not cause a cross of regulation category boundaries (non-crossover). After a sovereign crossover downgrade, in addition to the burden associated with a sovereign negative rating change, banks could experience a direct negative effect on their capital ratios. Due to the current regulation, we should observe an increase in their risk-weighted assets because they must apply higher risk weights to their exposures to the downgraded country. We define this additional effect as *certification effect*. In this context, the links between sovereigns and banks also became crucial from a regulatory point of view. Therefore, we verify whether a sovereign rating change affects the activity of domestic banks through the *certification channel*.

We highlight that the rules regarding sovereign exposures have been modified to allow national supervisors to set risk weights lower than those prescribed in the Standardized Approach for exposures denominated and funded in the currency of the corresponding state. To avoid discriminatory treatment, bank supervisory authorities in other jurisdictions may also permit their own banks to apply the same risk weights to a given sovereign under certain conditions. EU authorities established a zero risk weight for all exposures denominated in euro and in any other Member State currency (BIS, 2013).

Despite this exception, we assume that the distinction between crossover and non-crossover rating changes is still significant. During the 2011 capital exercise, EBA requires European banks to create a capital buffer commensurate with their exposure to sovereign debts by using substantially the same risk weights

described in the Standardized Approach (EBA, 2011). In addition, we highlight that several financial institutions had already decided to take into account the risk of their sovereign exposures and to create specific capital buffers, using the IRB approach, even before the capital exercise (Hannoun, 2011).

Furthermore, given the rating ceiling policy (Adelino and Ferreira, 2016), a sovereign crossover downgrade could lead to a crossover downgrade of bank ratings that represents an additional burden for financial institutions. Thus, our last hypothesis is:

H6. *A sovereign crossover rating revision has a greater impact on the activity of domestic banks than a non-crossover rating change.*

3.3. Data

Our sample includes all banks that are listed and traded at the end of the third quarter of 2016 and that are established in EU Member Countries. Therefore, our analysis regards only public banks. We have chosen to examine only listed banks, first, to ensure an appropriate availability of data about the activity of banks (Demirgüç-Kunt and Huizinga, 2013). Adopting a sample of public banks, in fact, we are able to employ quarterly accounting information, rarely disclosed by private banks, and, consequently, we can assess the immediate impact of sovereign rating changes on the activity of European banks.

Second, this choice allows us to adopt a sample that is directly comparable to those used in other related studies that analyze the impact of an increase in sovereign risk on the banking sector (Acharya et al., 2014a; Alter and Beyer, 2014; Alter and Schüler, 2012; De Bruyckere et al., 2013). However, an inevitable

drawback of this choice is that the inclusion of only public banks in our sample may represent a potential limitation to the generalization of our results.

We retrieve banks' accounting data from Thompson Reuters Datastream. We collect the quarterly balance sheet information from the first quarter of 2004 to the second quarter of 2016.

Table 3.1

Distribution of banks and rating changes by country.

Country	No. of banks	Sovereign Downgrades	Sovereign Upgrades
Austria	5	1	0
Belgium	2	1	0
Bulgaria	3	3	4
Croatia	4	2	0
Cyprus	2	10	6
Czech Republic	2	0	2
Denmark	5	0	0
Estonia	1	1	3
France	9	2	0
Germany	5	0	0
Greece	6	14	5
Hungary	1	2	1
Ireland	2	6	3
Italy	16	6	0
Lithuania	1	3	3
Luxembourg	1	0	0
Malta	4	2	0
Netherlands	4	1	1
Poland	11	1	1
Portugal	3	6	1
Romania	3	1	3
Slovakia	5	1	5
Spain	8	6	3
Sweden	4	0	1
United Kingdom	11	0	0
Total	118	69	42

The final sample consists of 118 banks. In Table 3.1, we report the distribution of considered banks by country. We observe that the financial institutions

included in our sample have been established in 25 of 28 EU Members.[39] They adopt heterogeneous business models (see the summary statics in Table C.2). Most of the financial institutions are commercial banks characterized by high deposit-to-asset and loan-to-asset ratios.[40] A small sample is more capital market-oriented, characterized by a low share of loans on the balance sheet and a low reliance on deposits.

We collect long-term foreign currency sovereign ratings of EU Member States issued by Standard & Poor's from 2004 to 2016. We decide to use ratings issued by this CRA because previous studies found that Standard & Poor's updates its ratings more frequently, usually preceding other CRAs (Alsakka et al., 2014; Ismailescu and Kazemi, 2010).[41]

Table 2.1 reports the list of sovereign rating changes included in the sample. We observe the impact on the activity of domestic banks of 69 downgrades and 42 upgrades announced by Standard & Poor's in the analyzed period. We highlight that only six countries (Denmark, Czech Republic, Germany, Luxembourg, Sweden, and the United Kingdom) have not been downgraded. As expected, the average level of sovereign creditworthiness decreases during the period considered in our analysis.

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[39] We include in our sample also Greek banks. Since this country was subject to numerous rating revisions, we have also verified whether our results are robust to the exclusion of banks headquartered in Greece. In unreported models, we have obtained qualitatively similar results also not considering Greek banks.

[40] Roengpitya et al. (2014) classify banks with a loan-to-asset ratio greater than 60% as commercial banks. In our sample, approximately 61% of banks present a ratio over this threshold and only 20% have a ratio lower than 50%.

[41] As a robustness check, we estimated our models also using rating changes announced by Moody's and Fitch. We have verified that our results broadly hold also using other CRAs' sovereign ratings. Not reported results are available from the authors.

In Table 3.2, we report the distribution of rating changes by year. We observe that approximately 46% of downgrades were announced at the peak of the sovereign debt crisis, between 2011 and 2012. In contrast, 45% of upgrades were announced after the peak of the crisis.

For the complete variables list, their relative sources and summary statistics see Tables C.1 and C.2 in the Appendix C. Estimating each model, we check correlations among variables and confirm that none of the correlations is high enough to warrant concern in the models presented in the following sections.

Table 3.2

Distribution of rating changes by year.

Country	Downgrade Year	# Down.	Upgrade Year	# Up.
Austria	2012	1	-	-
Belgium	2011	1	-	-
Bulgaria	2008, 2014 (2)	3	2003, 2004, 2005, 2006	4
Croatia	2012, 2014 (1)	2	-	-
Cyprus	2010, 2011 (3), 2012 (4), 2013 (2)	10	2008, 2013 (2), 2014 (2), 2015	6
Czech Rep.	-	-	2007, 2011	2
Estonia	2009	1	2004, 2010, 2011	3
France	2012, 2013	2	-	-
Greece	2004, 2009 (2), 2010, 2011 (4), 2012 (2), 2015 (4)	14	2012 (2), 2014, 2015, 2016	5
Hungary	2011, 2012	2	2015	1
Ireland	2009 (2), 2010 (2), 2011 (2)	6	2014 (2), 2015	3
Italy	2004, 2006, 2011, 2012, 2013, 2014	6	-	-
Lithuania	2008 (2), 2009	3	2004, 2005, 2014	3
Malta	2012, 2013	2	-	-
Netherlands	2013	1	2015	1
Poland	2016	1	2007	1
Portugal	2005, 2009, 2010, 2011 (2), 2012	6	2015	1
Romania	2008	1	2004, 2005, 2014	3
Slovakia	2012	1	2004 (2), 2005, 2008, 2015	5
Spain	2009, 2010, 2011, 2012 (3)	6	2004, 2014, 2015	3
Sweden	-	-	2004	1
Total		69		42

3.4. Methodology

We verify whether a sovereign rating change affects the activity of domestic banks estimating the model described in Eq. (3.1):

$$Y_{i,t} = \beta_0 + \beta_1 Downgrade_{i,t-j} + \beta_2 X_{i,t-k} + \beta_3 Z_{i,t} + \varepsilon_{i,t} \quad (3.1)$$

The dependent variable is the measure of the activity of domestic banks. Our measures of banks' activity, retrieved by financial institutions' quarterly reports, are: *CAR* (the logarithm of the capital adequacy ratio of the *i-th* bank in the quarter *t*); *ROE* (the logarithm of return on equity of the *i-th* bank in the quarter *t*); *Liquidity* (the logarithm of cash and securities to total deposits of the *i-th* bank in the quarter *t*); *Loans* (the logarithm of loans of the *i-th* bank in the quarter *t* to assets in the quarter *t-1*).

Downgrade is a dummy variable that is equal to 1 if the home country of the *i-th* bank has been downgraded in the two quarters before *t* and 0 otherwise. Therefore, for example, if we observe our dependent variable in the third quarter of 2015, we consider the third quarter of 2015 as *t*, *Downgrade* is equal to 1 if the home country of the *i-th* bank has been downgraded in the first and/or in the second quarter of 2015. In this way, if a downgrade took place in the third quarter of 2015, *Downgrade* takes value 1 when observing our dependent variables in the fourth quarter of 2015 and in the first quarter of 2016.

If *Downgrade* is statistically significant, we can confirm that a sovereign downgrade has an impact on the activity of domestic banks (*H1*).

Adopting this methodology, we verify the short-term impact of a sovereign rating change. However, we have replicated our analyses using a dummy variable that takes value 1 if the home country of the *i-th* bank has been downgraded in the

four quarters before t and 0 otherwise.[42] The results obtained replacing *Downgrade* with the described variable (not reported for space consideration) show that our results also hold in a longer term.

We include a vector of control variables, X, which takes into account balance sheet information of the *i-th* bank (*NPL*, *P/BV*, *Leverage*, *Size*, *Deposits*), retrieved in the last annual balance sheet preceding t, and its rating (*InvGrade* and *SpecGrade*). We add: *NPL* and *Leverage* to take into account banks' riskiness; *P/BV* to include signals about the franchise value, as well as potential hidden losses in accounting values (Calomiris and Nissim, 2014); retail deposits (*Deposits*) to consider the business model and the stability of funding of banks; *Size* to take into account numerous qualitative factors associated with the bank size (e.g. diversification, competitiveness, bargaining power, and market share); *InvGrade* and *SpecGrade* to consider banks' creditworthiness.[43] The complete variables list is reported in Table C.1 in the Appendix C.

We also include a dummy variable set, Z, to control for bank- and quarter-fixed effects. In conclusion, ε represents the error term.

We verify also whether a sovereign positive rating change affects the activity of domestic banks. Thus, we estimate the same model described in Eq. (3.1) replacing *Downgrade* with the variable *Upgrade*, which is equal to 1 if the home country of the *i-th* bank has been upgraded in the two quarters before t and 0 otherwise.

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[42] We have obtained qualitatively similar results also adopting one quarter as time interval. We have not considered wider time intervals than four quarters to prevent contamination by other events that could affect the activity of banks.

[43] Our results hold also including other control variables, such as the the ratio of securities to total assets and the ratio of wholesale funding to total funding.

3.5. The impact of a sovereign rating change on the activity of domestic banks

3.5.1. The impact of a sovereign downgrade

Table 3.3

The impact of a sovereign downgrade on the activity of domestic banks.

	(1) *CAR*	*(2)* *ROE*	*(3)* *Liquidity*	*(4)* *Loans*
Downgrade	-0.049***	-0.069	0.027	-0.022**
	(0.000)	(0.273)	(0.203)	(0.049)
NPL	-0.001	-0.002	0.003**	-0.001
	(0.681)	(0.691)	(0.033)	(0.830)
P/BV	-0.006	0.090	0.028***	0.001
	(0.615)	(0.127)	(0.000)	(0.931)
Leverage	-0.661***	0.629**	0.337***	-0.376***
	(0.000)	(0.039)	(0.006)	(0.000)
Size	-0.072***	-0.090	0.188***	-0.119***
	(0.000)	(0.347)	(0.000)	(0.004)
Deposits	-0.004	-0.517	-1.813***	-0.412*
	(0.960)	(0.129)	(0.000)	(0.087)
InvGrade	0.027	-0.023	0.040	0.005
	(0.406)	(0.802)	(0.459)	(0.849)
SpecGrade	-0.059	-0.546***	0.165**	-0.018
	(0.129)	(0.001)	(0.010)	(0.634)
Fixed Effects	Yes	Yes	Yes	Yes
Observations	2,023	2,121	2,432	2,168
Adj R-squared	0.702	0.508	0.861	0.744

Notes: The table shows the results obtained from the estimation of Eq. (3.1). In columns (1), (2), (3), and (4), we use as dependent variable, respectively, *CAR*, *ROE*, *Liquidity*, and *Loans*. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

In Table 3.3, we report the results of Eq. (3.1). In columns (1), (2), (3), and (4) we use as dependent variables, respectively, *CAR*, *ROE*, *Liquidity*, and *Loans*.[44]

We observe that a sovereign downgrade has a significant impact on capital ratios and loans of domestic banks. After a downgrade announcement, the European banks' capital ratio declines, on average, by 4.9%. Financial institutions

[44] We obtain qualitatively similar results estimating these and also the other models clustering standard errors at country- or at bank-level.

also reduce their loans by 2.2%. Conversely, sovereign downgrades do not affect significantly banks' ROE and liquidity ratio.

The results suggest that a sovereign negative rating change directly affects the capital ratio of domestic banks, reducing their stability. This effect also leads to a reduction in loans to customers, but it does not affect profitability and liquidity in the short term. Therefore, we confirm hypothesis *H1* for CAR and bank lending, while we reject the hypothesis with regard to *ROE* and *Liquidity*.

3.5.2. The impact of a sovereign upgrade

We also verify the impact of sovereign upgrades. As anticipated in Section 3.4, we replace the variable *Downgrade* with *Upgrade*.

Table 3.4 shows that sovereign upgrades do not affect the activity of domestic banks; in fact, they do not have a significant impact on any dependent variable used in our models.

Our analysis shows an asymmetric impact between negative and positive rating changes. Other studies also find evidence of this asymmetry in terms of impact on financial markets (Afonso et al., 2012), transmission of financial contagion (Gande and Parsley, 2005), bank ratings (Adelino and Ferreira, 2016), and bank stock returns (Correa et al., 2014). Sovereign downgrades seem to have a direct impact on the financial system, while domestic banks do not benefit from a sovereign upgrade announcement. These results question CRAs' information advantage in the assessment of sovereign creditworthiness. If a rating change could introduce new information, we would expect that both downgrades and

upgrades have a significant impact. For a more detailed discussion of this topic see, for example, the report of the (IMF, 2010).

We highlight that, as mentioned in Section 3.2, the sovereign rating is a main determinant of domestic issuers' ratings, representing a rating ceiling (Borensztein et al., 2013). In particular, Borensztein et al. (2013) underline that the sovereign rating ceiling does not only represent a constraint for domestic issuers' ratings, but it also provides a limitation that tends to reduce domestic issuers' ratings when they are close to their sovereign rating. Therefore, a sovereign downgrade leads to a downward pressure to domestic issuers' ratings. This policy determines an asymmetry in the effects of downgrades and upgrades. In fact, there is not a policy of opposite sign comparable to the sovereign ceiling associated with an upgrade. After a sovereign downgrade, domestic issuers' ratings are subject to a downward pressure; while, they are not necessarily subject to an upward pressure after an upgrade.

Therefore, the negative effects of downgrades seem more certain and immediate than the positive effects of upgrades. A downgrade may be perceived as a wake-up call (Ferreira and Gama, 2007), an alert concerning the country's financial stability that affects significantly all domestic issuers. In contrast, the effects of a positive rating revision seem to be more limited to the upgraded country's creditworthiness with less indirect effects on domestic issuers.

The asymmetric impact of negative and positive revisions could also depend on the different choices made by banks after a rating announcement. For example, after a sovereign downgrade, banks could be forced to reduce their overall exposure to a downgraded country for regulatory reasons or to decrease their

assets' riskiness, while they could choose not to increase their exposure to the same country after an upgrade.

These results lead us to reject hypothesis *H1* with regard to sovereign upgrades. Therefore, in the remaining parts of our study, we focus only on negative rating changes.

Table 3.4

The impact of a sovereign upgrade on the activity of domestic banks.

	(1) *CAR*	*(2)* *ROE*	*(3)* *Liquidity*	*(4)* *Loans*
Upgrade	0.001	0.027	-0.015	0.031
	(0.996)	(0.843)	(0.675)	(0.160)
NPL	-0.001	-0.002	0.003**	-0.001
	(0.746)	(0.737)	(0.038)	(0.761)
P/BV	-0.005	0.093	0.027***	0.002
	(0.692)	(0.112)	(0.000)	(0.773)
Leverage	-0.661***	0.629**	0.339***	-0.382***
	(0.000)	(0.038)	(0.006)	(0.000)
Size	-0.073***	-0.086	0.187***	-0.116***
	(0.000)	(0.365)	(0.000)	(0.004)
Deposits	0.015	-0.504	-1.824***	-0.401*
	(0.842)	(0.146)	(0.000)	(0.094)
InvGrade	0.028	-0.023	0.039	0.006
	(0.387)	(0.800)	(0.468)	(0.823)
SpecGrade	-0.060	-0.557***	0.168***	-0.021
	(0.126)	(0.001)	(0.009)	(0.559)
Fixed Effects	Yes	Yes	Yes	Yes
Observations	2,023	2,121	2,432	2,168
Adj R-squared	0.699	0.507	0.861	0.744

Notes: The table shows the results obtained from the estimation of Eq. (3.1) replacing the variable *Downgrade* with *Upgrade*. In columns (1), (2), (3), and (4), we use as dependent variable, respectively, *CAR*, *ROE*, *Liquidity*, and *Loans*. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

3.6. The transmission channels of the impact of a sovereign downgrade

In this section, we examine the channels through which a sovereign rating change affects the activity of domestic banks. Given the results reported in Section 3.5, we focus only on sovereign downgrades and we analyze mainly the impact on capital ratios and on bank lending.

3.6.1. Assets channel

We verify the *assets channel* (*H2*) by introducing *RWA*, the logarithm of the risk-weighted assets of the *i-th* bank in the quarter *t* to assets in the quarter *t-1*, as a dependent variable of Eq. (3.1). We assume that a sovereign downgrade leads to an increase in risk-weighted assets of domestic banks. Therefore, we expect that the coefficient of *Downgrade* is significant and has a positive sign.

Table 3.5

The impact of a sovereign downgrade on the risk-weighted assets of domestic banks.

	(1) *RWA*
Downgrade	0.071***
	(0.004)
NPL	-0.002
	(0.510)
P/BV	-0.063*
	(0.079)
Leverage	0.305**
	(0.023)
Size	-0.277***
	(0.000)
Deposits	0.285
	(0.153)
InvGrade	0.084**
	(0.046)
SpecGrade	0.039
	(0.607)
Fixed Effects	Yes
Observations	1,603
Adj R-squared	0.763

Notes: The table shows the results obtained from the estimation of Eq. (3.1) using *RWA* as dependent variable, the logarithm of the risk-weighted assets of the *i-th* bank in the quarter *t* to assets in the quarter *t-1*. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

Table 3.5 reports results of the Eq. (3.1) estimated using *RWA* as a dependent variable. We observe that a sovereign downgrade leads to a significant increase in risk-weighted assets of 7.1%. A sovereign negative rating change affects banks' balance sheet causing an increase in the riskiness of their assets. Moreover, we

highlight that an increasing size leads to lower risk-weighted assets and that banks with high leverage also have a high risk-weighted asset ratio.

This result confirms the *assets channel* (*H2*), indicating a direct impact on the capital ratio of domestic banks. Risk-weighted assets, in fact, are the denominator of CAR. Thus, the impact of a sovereign downgrade on the capital ratio of domestic banks, presented in Section 3.5.1, is at least partly explained by an increase in the riskiness of assets due to the *assets channel*.

3.6.2. Funding channel

To verify the *funding channel* (*H3*), we add in Eq. (3.1) the variable *ShortDebt*, which is the logarithm of short-term debt to assets of the *i-th* bank, observed in the quarter *t-1*, and the interaction between *Downgrade* and *ShortDebt*. As underlined in Section 3.2, we assume that this channel particularly affects banks that are heavily dependent on short-term funding. If the interaction *Downgrade*ShortDebt* is significant, we can confirm the presence of the *funding channel*.[45]

Table 3.6 shows the results. We highlight that the interaction variable is significant both in column (1), considering *CAR* as dependent variable, and in column (2), taking into account the impact on *Loans*. An increase in the bank's dependence on short-term funding amplifies the impact of a sovereign downgrade on capital ratios and on lending supply.

[45] Following Williams et al. (2015), we obtain qualitatively similar results verifying whether a sovereign downgrade has a stronger effect on banks established in countries with relatively low sovereign ratings.

Therefore, since the *funding channel* is relevant to explain the impact of sovereign rating changes on the activity of domestic banks, we confirm hypothesis *H3*.

Table 3.6

The *funding channel.*

	(1) *CAR*	*(2)* *Loans*
Downgrade*ShortDebt	-0.046**	-0.037**
	(0.011)	(0.016)
Downgrade	-0.136***	-0.098***
	(0.000)	(0.009)
ShortDebt	-0.009	0.008
	(0.266)	(0.395)
NPL	-0.001	-0.001
	(0.868)	(0.621)
P/BV	-0.004	0.002
	(0.742)	(0.761)
Leverage	-0.583***	-0.383***
	(0.000)	(0.000)
Size	-0.104***	-0.132***
	(0.000)	(0.001)
Deposits	0.035	-0.420*
	(0.689)	(0.076)
InvGrade	0.021	0.028
	(0.517)	(0.263)
SpecGrade	-0.069*	0.013
	(0.086)	(0.711)
Fixed Effects	Yes	Yes
Observations	1,747	2,111
Adj R-squared	0.719	0.753

Notes: The table shows the results obtained from the estimation of Eq. (3.1) introducing the variable *ShortDebt* and the interaction variable *Downgrade*ShortDebt*. In columns (1) and (2), we use as dependent variables, respectively, *CAR* and *Loans*. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

3.6.3. Rating channel

We analyze the *rating channel* (*H4*) by introducing in Eq. (3.1) the variable *Ceiling*, which takes the value 1 if the *i-th* bank's rating is equal to or above its sovereign prior to the downgrade and 0 otherwise, and an interaction between *Downgrade* and *Ceiling*. Therefore, *Ceiling* identifies bound banks, and the

interaction allows us to verify whether the impact of a sovereign change is greater on bound banks. If the interaction variable is significant, we will confirm the *rating channel*.

We report the results in Table 3.7. Bound banks have relatively lower capital ratios than other banks (column 1), while the variable *Ceiling* does not affect bank loans (column 2).

Table 3.7

The *rating channel*.

	(1) *CAR*	*(2)* *Loans*
Downgrade*Ceiling	-0.041**	0.021
	(0.038)	(0.235)
Downgrade	-0.030**	-0.039**
	(0.031)	(0.024)
Ceiling	-0.025*	-0.009
	(0.075)	(0.643)
NPL	-0.001	-0.001
	(0.418)	(0.956)
P/BV	-0.006	0.001
	(0.618)	(0.838)
Leverage	-0.656***	-0.379***
	(0.000)	(0.000)
Size	-0.074***	-0.104**
	(0.000)	(0.030)
Deposits	0.008	-0.285
	(0.918)	(0.250)
InvGrade	0.030	0.003
	(0.354)	(0.908)
SpecGrade	-0.055	-0.029
	(0.156)	(0.453)
Fixed Effects	Yes	Yes
Observations	1,978	2,095
Adj R-squared	0.701	0.755

Notes: The table shows the results obtained from the estimation of Eq. (3.1) introducing the variable *Ceiling* and the interaction variable *Downgrade*Ceiling*. In columns (1) and (2), we use as dependent variable, respectively, *CAR* and *Loans*. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

In addition, the interaction variable *Downgrade*Ceiling* is significant only in the model reported in the first column. The impact of a sovereign downgrade is

greater on the capital ratio of bound banks. Instead, our analysis suggests that bound banks do not reduce their lending supply after a sovereign downgrade more than other financial institutions.

Thus, we find evidence in support of hypothesis *H4* only analyzing the impact on capital ratio. Conversely, the impact on bank loans is not affected by the *rating channel*.

3.6.4. Guarantee channel

We examine the *guarantee channel* (*H5*) by replacing in Eq. (3.1) the variable *Size* with *Assets/GDP*, which is the ratio of total assets of the *i-th* bank to the GDP of its home country in the year preceding *t*, and the interaction between this variable and *Downgrade*. We assume that this channel plays a relevant role in explaining the impact of a sovereign rating change on larger banks, which are the financial institutions that have benefited most from the implicit guarantees of their home country. Therefore, we expect that the *Downgrade*Assets/GDP* interaction is significant, implying that a sovereign downgrade leads to a greater burden for larger banks.

Table 3.8 shows the results. We observe that the variable Assets/GDP has a positive impact on CAR, column (1), and a negative impact on *Loans*, column (2). Large banks have, on average, higher capital ratios but they offer fewer loans in proportion to their assets.

In contrast to our hypothesis, we find that large banks are not more affected by a sovereign downgrade than other banks. The impact of *Downgrade*Assets/GDP* on *CAR* is positive, but poorly significant, as indicated in column (1). In addition, the coefficient of this variable is significant and positive in the model reported in

column (2). This result implies that the impact of sovereign rating changes on lending supply slightly declines as the bank dimension increases. Therefore, the impact of a sovereign downgrade on capital ratios and on lending supply is not due to the *guarantee channel*. These results lead us to reject hypothesis *H5*.

Table 3.8

The *guarantee channel*.

	(1) *CAR*	*(2)* *Loans*
Downgrade*Assets/GDP	0.001	0.001***
	(0.109)	(0.009)
Downgrade	-0.049***	-0.024**
	(0.000)	(0.038)
Asset/GDP	0.001**	-0.002***
	(0.025)	(0.000)
NPL	-0.001	-0.001
	(0.794)	(0.724)
P/BV	-0.004	-0.001
	(0.712)	(0.943)
Leverage	-0.665***	-0.366***
	(0.000)	(0.000)
Deposits	0.069	-0.361
	(0.384)	(0.112)
InvGrade	0.017	-0.022
	(0.584)	(0.410)
SpecGrade	-0.070*	-0.050
	(0.064)	(0.152)
Fixed Effects	Yes	Yes
Observations	2,023	2,168
Adj R-squared	0.702	0.743

Notes: The table shows the results obtained from the estimation of Eq. (3.1) replacing the variable *Size* with *Assets/GDP* and adding the interaction variable *Downgrade*Assets/GDP*. In columns (1) and (2), we use as dependent variable, respectively, *CAR* and *Loans*. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

3.6.5. Certification channel

Finally, we analyze the *certification channel* (*H6*) by separating the impact of a crossover downgrade and the effect of a non-crossover downgrade. Therefore, in Eq. (3.1), we replace *Downgrade* with two dummy variables: *CDowngrade* (equal to 1 if the home country of the *i-th* bank has been subject to a crossover

downgrade in the two quarters before *t* and 0 otherwise) and *NCDowngrade* (equal to 1 if the home country of the *i-th* bank has been subject to a non-crossover downgrade in the two quarters before *t* and 0 otherwise).

The model is described by Eq. (3.2):

$$Y_{i,t} = \beta_0 + \beta_1 CDowngrade_{i,t-j} + \beta_2 NCDowngrade_{i,t-j} + \beta_3 X_{i,t-k} + \beta_4 Z_{i,t} + \varepsilon_{i,t} \quad (3.2)$$

Analyzing previous channels, we focus on the impact on capital ratios and on bank loans, because we do not detect a significant effect of sovereign downgrades on banks' ROE and liquidity ratios. Verifying the *certification channel* (*H6*), instead, we extend our analysis by also including ROE and liquidity ratio. The distinction between crossover and non-crossover downgrades, in fact, reveals that the current regulation has a relevant effect on all measures of the activity of European banks. Therefore, we analyze the effect of the *certification channel* on (*a*) capital ratio, (*b*) ROE and lending supply, and (*c*) liquidity. Finally, we also verify whether the certification channel has an incremental impact on the activity of domestic banks (*d*).

a) The impact on capital ratio

Table 3.9 reports estimates of Eq. (3.2) using *CAR* as a dependent variable. In column (1), we observe that a non-crossover downgrade has a significant impact on banks' capital ratios, while a crossover seems only slightly relevant, at least in the short-term.

This result is due to a different impact of the two downgrade typologies on the numerator and on the denominator of capital ratio. In fact, in columns (2) and (3), we analyze in detail the effect on the denominator (*RWA*) and on the numerator

(*Tier1*)[46] of ratio. We find evidence of a significant impact of both crossover and non-crossover downgrades on *RWA*. Both downgrades lead to an increase in the riskiness of banks' assets.

Table 3.9

The *certification channel*.

	(1) *CAR*	*(2)* *RWA*	*(3)* *Tier1*	*(4)* *ROE*	*(5)* *Loans*
CDowngrade	-0.030*	0.067**	0.057**	-0.251***	-0.041**
	(0.066)	(0.031)	(0.050)	(0.004)	(0.032)
NCDowngrade	-0.059***	0.074**	0.001	0.051	-0.011
	(0.000)	(0.010)	(0.995)	(0.527)	(0.322)
NPL	-0.001	-0.002	-0.004	-0.004	-0.001
	(0.763)	(0.507)	(0.275)	(0.475)	(0.781)
P/BV	-0.006	-0.063*	0.007	0.084	0.001
	(0.643)	(0.079)	(0.755)	(0.154)	(0.898)
Leverage	-0.657***	0.305**	-0.209**	0.602**	-0.384***
	(0.000)	(0.024)	(0.038)	(0.046)	(0.000)
Size	-0.073***	-0.277***	-0.557***	-0.081	-0.117***
	(0.000)	(0.000)	(0.000)	(0.389)	(0.004)
Deposits	-0.007	0.287	0.146	-0.518	-0.404*
	(0.929)	(0.150)	(0.439)	(0.125)	(0.094)
InvGrade	0.026	0.084**	0.025	-0.021	0.006
	(0.413)	(0.046)	(0.567)	(0.813)	(0.824)
SpecGrade	-0.063	0.040	-0.036	-0.499***	-0.014
	(0.107)	(0.601)	(0.538)	(0.003)	(0.703)
Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	2,023	1,603	1,569	2,121	2,168
Adj R-squared	0.703	0.763	0.845	0.510	0.744

Notes: The table shows the results obtained from the estimation of Eq. (3.2). In columns (1), (2), (3), (4), and (5), we use as dependent variables, respectively, *CAR*, *RWA*, *Tier1*, *ROE*, and *Loans*. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

However, crossover downgrades also positively affect *Tier1*, while non-crossover downgrades do not have a significant impact on this variable. Therefore, we observe that European banks react to sovereign crossover downgrades by increasing their capital quality. The positive increase in the

[46] The numerator of the capital adequacy ratio also includes Tier 2. We have verified that sovereign downgrades, also distinguishing crossovers and non-crossovers, do not significantly affect this capital measure.

numerator of the capital ratio almost counteracts the positive increase in the denominator.

The *certification channel* is significantly perceived by bank management: it forces them to raise bank capital to contrast the additional burden due to the rating-based regulation.

b) The impact on ROE and lending supply

In Table 3.9, we present also the impact of crossover and non-crossover downgrades on *ROE* (column 4) and *Loans* (column 5). We find that profitability of domestic banks declines only after a sovereign crossover rating change. Similarly, in column (5), we observe that the effect on banks' lending supply is entirely due to crossover downgrades.

c) The impact on liquidity

In Table 3.10, we report estimates of the impact of crossover and non-crossover downgrades on banks' liquidity. We observe that banks decide to raise their liquidity ratio to mitigate the negative effects of crossover sovereign downgrades.

To better understand the impact of a sovereign crossover downgrade on banks' liquidity, we disentangle the impact on bank's debt maturity and investment securities portfolio.

We estimate two models by introducing in Eq. (3.2) the following dependent variables: *S/LDebt*, the logarithm of short-term debt to long-term debt of the *i-th* bank in the quarter *t*, and *Securities*, the logarithm of total investments of the *i-th* bank in the quarter *t* to assets in the quarter *t-1*.

We present our estimates in columns (2) and (3) of Table 3.10, respectively. We observe that a sovereign crossover downgrade leads to an increase in the short-term debt compared to the long-term debt and to an increase in the securities portfolio value. After a sovereign crossover downgrade, European banks raise their liquidity ratio by purchasing more marketable securities and rely more on short-term funding.

This result may suggest that, since a sovereign crossover downgrade may reduce access to long-term funding sources, European banks purchase securities, primarily government bonds, and use them as collateral for operations with central banks to increase their short-term funding.

Table 3.10

The impact of the *certification channel* on banks' liquidity.

	(1) *Liquidity*	*(2)* *S/LDebt*	*(3)* *Securities*
CDowngrade	0.099***	0.276**	0.095***
	(0.003)	(0.048)	(0.003)
NCDowngrade	-0.013	0.033	-0.015
	(0.574)	(0.715)	(0.537)
NPL	0.003**	0.024***	0.004***
	(0.021)	(0.000)	(0.005)
P/BV	0.027***	0.081**	0.013**
	(0.000)	(0.020)	(0.044)
Leverage	0.363***	5.343***	0.532***
	(0.003)	(0.000)	(0.000)
Size	0.182***	-0.091	0.067
	(0.000)	(0.553)	(0.117)
Deposits	-1.832***	-0.760*	-0.160
	(0.000)	(0.087)	(0.268)
InvGrade	0.037	-0.606***	0.123**
	(0.490)	(0.001)	(0.011)
SpecGrade	0.151**	-0.006	0.258***
	(0.019)	(0.976)	(0.000)
Fixed Effects	Yes	Yes	Yes
Observations	2,432	2,350	2,231
Adj R-squared	0.862	0.543	0.788

Notes: The table shows the results obtained from the estimation of Eq. (3.2) using as dependent variables, respectively, *Liquidity* (column 1), *S/LDebt* (column 2) and *Securities* (column 3). Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

In addition, we highlight that these results may also be partly explained by "financial repression" theory, examined by Becker and Ivashina (2014). They find that the share of government debt held by the domestic banking sectors of Eurozone countries in 2013 was more than twice that held in 2007 and that the increased government bond holdings generated a crowding out of corporate lending. They show that these results are due to the financial repression, which refers to formal and informal pressures made by governments on the local financial sector to absorb new issues of government bonds. In fact, they find that during the recent financial crisis, with larger and riskier government debt, an increasing fraction of European firms issuing debt switched from loans to bonds, reflecting a higher relative cost of bank credit due to the financial repression.

Our results are consistent with their findings. In fact, since a sovereign crossover downgrade leads to an increase in the cost of government debt, especially in terms of bond yields and CDS spreads as underlined in Section 3.2, governments may resort to formal and informal pressures on domestic banks to absorb new issues of government bonds. Therefore, domestic financial institutions could decide to reduce lending supply also to raise additional funds to purchase government debt.

d) The incremental impact of the certification channel

We also verify whether the *certification channel* has an incremental impact on the activity of banks. In Eq. (3.1), we replace the variable *Downgrade* with *RiskShift*, which is the percentage change in the risk weight applied to the exposure to the home country of the *i-th* bank over the two quarters before *t*.

Each crossover downgrade leads to different regulatory capital absorption. For example, a crossover downgrade that changes the issuer rating from AAA to A+ causes a shift in the risk weight equal to 20 percentage points, because the Standardized Approach assigns to AAA level a risk weight of 0% and to A+ level a risk weight of 20%. Therefore, the variable *RiskShift* indicates whether the impact of a crossover downgrade is greater as the shift in the risk weight increases.

Table 3.11

The incremental impact of the *certification channel*.

	(1) *CAR*	*(2)* *RWA*	*(3)* *Tier1*	*(4)* *ROE*	*(5)* *Liquidity*	*(6)* *Loans*
RiskShift	-0.049	0.157*	0.149*	-1.122***	0.261***	-0.091**
	(0.336)	(0.080)	(0.093)	(0.000)	(0.002)	(0.033)
NPL	-0.001	-0.001	-0.004	-0.005	0.003**	-0.001
	(0.704)	(0.595)	(0.262)	(0.373)	(0.022)	(0.838)
P/BV	-0.005	-0.065*	0.007	0.077	0.027***	0.001
	(0.662)	(0.076)	(0.759)	(0.186)	(0.000)	(0.845)
Leverage	-0.665***	0.312**	-0.207**	0.571*	0.364***	-0.387***
	(0.000)	(0.020)	(0.040)	(0.056)	(0.003)	(0.000)
Size	-0.072***	-0.279***	-0.557***	-0.080	0.184***	-0.116***
	(0.000)	(0.000)	(0.000)	(0.391)	(0.000)	(0.004)
Deposits	0.015	0.254	0.146	-0.541	-1.829***	-0.398*
	(0.843)	(0.208)	(0.431)	(0.107)	(0.000)	(0.097)
InvGrade	0.028	0.080*	0.024	-0.021	0.038	0.006
	(0.386)	(0.058)	(0.573)	(0.816)	(0.482)	(0.816)
SpecGrade	-0.057	0.026	-0.038	-0.465***	0.150**	-0.013
	(0.150)	(0.729)	(0.514)	(0.005)	(0.020)	(0.728)
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,023	1,603	1,569	2,121	2,432	2,168
Adj R-squared	0.699	0.763	0.845	0.512	0.861	0.744

Notes: The table shows the results obtained from the estimation of Eq. (3.1) replacing *Downgrade* with the variable *RiskShift*. In columns (1), (2), (3), (4), (5) and (6), we use as dependent variables, respectively, *CAR*, *RWA*, *Tier1*, *ROE*, *Liquidity*, and *Loans*. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

The estimates are reported in Table 3.11. We find evidence of an incremental impact on *RWA*, *Tier1*, *ROE*, *Liquidity*, and *Loans*. In models that are not

reported, we obtain similar results also considering *S/LDebt* and *Securities* as dependent variables. Instead, the incremental impact is less significant for *CAR*.

These results strengthen our previous findings that show a direct link between the role of external ratings in the current financial regulation and the observed impact on the activity of European banks.

In sum, our estimates suggest that banks are significantly affected by rating-based regulation. After a sovereign crossover rating change, domestic financial institutions are affected through the above-mentioned channels, especially through the *certification channel*. Our analysis suggests that to counteract the increase in the risk-weighted assets, banks raise capital and liquid assets, relying more on short-term funding, and reduce their lending supply. This process mitigates the negative impact on the capital ratio but reduces banks' profitability.

These results confirm our hypothesis *H6*. The *certification channel* plays a major role and suggests that the current financial regulation significantly affects the activity of European banks.

3.7. Robustness checks

In the following sections, we present supplementary tests to confirm the validity of our analyses. First, we verify whether our results also hold when considering sovereign risk changes and worsening macroeconomic conditions.

We then take into account potential endogeneity and reverse causality problems. Lower capital ratios of domestic banks that imply a less stable banking system could negatively affect sovereign financial soundness and could lead to a sovereign downgrade. Due to space considerations, we present estimates

considering only banks' capital ratio as a dependent variable. However, we confirm that the same conclusions apply also to bank loans.

In addition, we have verified whether the bank's business model affects our estimates. We calculate the first quartile of banks' loan-to-asset ratio in a given year. We divide our sample of banks into two groups, distinguishing between commercial banks (financial institutions with a loan-to-asset ratio greater than the first quartile in *t*) and others (financial institutions with a loan-to-asset ratio lower than the first quartile in *t*).[47] In an unreported model, we find that the impact of a sovereign downgrade on the activity of commercial banks does not differ statistically from the effect on the activity of others banks.

3.7.1. Sovereign risk

In this section, we verify whether our results are driven by an increase in the sovereign risk or by a deterioration in macroeconomic fundamentals. In fact, the reduction of capital ratio and the other effects on the activity of domestic banks observed after a sovereign downgrade could be due to an increase in the sovereign credit risk of the home country and only indirectly to the rating change. In this case, the variable *Downgrade* should be less significant if we directly take into account measures of sovereign risk and of macroeconomic context.

To verify this hypothesis, we introduce three variables in Eq. (3.1): *CDS*, which represents the sovereign CDS spread level of the *i-th* bank's home country

[47] We use the first quartile as a threshold because the large majority of banks in our sample is composed by commercial banks, characterized by a high loan-to-asset ratio. In fact, the average of threshold values by year is a loan-to-asset ratio of 50%.

in the quarter before t[48]; *GDP*, the quarterly percentage change of the home country GDP of the *i-th* bank in the quarter before t; *ECB*, the ECB interest rate on the main refinancing operations observed in the quarter before t.[49]

Table 3.12

The impact of a sovereign downgrade taking into account sovereign economic and financial conditions.

	(1) *CAR*
Downgrade	-0.023**
	(0.027)
CDS	-0.001***
	(0.000)
GDP	0.086
	(0.260)
ECB	-0.242***
	(0.000)
NPL	-0.001
	(0.715)
P/BV	0.003
	(0.872)
Leverage	-0.663***
	(0.000)
Size	-0.085***
	(0.000)
Deposits	-0.065
	(0.418)
InvGrade	0.007
	(0.836)
SpecGrade	-0.010
	(0.806)
Fixed Effects	Yes
Observations	1,847
Adj R-squared	0.723

Notes: In column (1), we report the results obtained from the estimation of Eq. (3.1) introducing the variables *CDS*, *GDP*, and *ECB*. The dependent variable is *CAR*. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

[48] We obtain qualitatively similar results by estimating two alternative models replacing *CDS*, respectively, with the change in the 10-year government bond yield of the *i-th* bank's home country and with the change in the 10-year government bond spread of the *i-th* bank' home country vis-à-vis German bund of comparable maturity.

[49] Our results hold also including the ratio of NPL to gross loans of the banking system of the *i-th* bank's home country in the year preceding t as additional control variable of sovereign risk.

The estimates are reported in Table 3.12. We observe that high CDS spread and ECB rate levels lead to a decrease in banks' capital ratios. Conversely, a reduction in GDP does not significantly affect the activity of domestic banks. However, the variable *Downgrade* remains significant also after the introduction of *CDS*, *GDP*, and *ECB*. The impact of a sovereign downgrade is, therefore, also relevant considering sovereign credit risk and macroeconomic fundamentals.

Our results indicate that the impact of a sovereign downgrade on the activity of domestic banks is not a secondary effect that solely reflects an increase in the sovereign credit risk, already perceived by investors, or a deterioration of the macroeconomic context. Instead, we confirm that the impact observed in previous analyses depends directly on the role of credit ratings in the current financial system.

3.7.2. System GMM

We use a dynamic panel data approach, a system generalized method of moments (system GMM), to address potential bias in our previous estimates. Using this method we control for the potential endogeneity arising from the dynamic nature of the relation between dependent and independent variables.

In the model reported in Table 3.13, we include the lagged dependent variable and we treat the variable *Downgrade* as endogenous.[50] We use the Arellano and Bond (1991) test for residual autocorrelation and the Sargan test to verify over-identifying restrictions.

[50] We obtain qualitatively similar results also treating the other control variables as endogenous.

We find that the lag *CAR* is a significant determinant, but our main results remain unchanged. *Downgrade*, in fact, also remains significant using the GMM estimation procedure.[51] Moreover, the diagnostic statistics support our chosen specification.

Table 3.13

The impact of a sovereign downgrade estimated using the system GMM.

	(1)
	CAR
CAR_{t-1}	0.747***
	(0.000)
Downgrade	-0.019**
	(0.012)
NPL	-0.001
	(0.145)
P/BV	0.005
	(0.499)
Leverage	-0.008
	(0.892)
Size	0.016***
	(0.003)
Deposits	0.014
	(0.848)
InvGrade	-0.018
	(0.108)
SpecGrade	-0.028**
	(0.031)
Quarter dummies	Yes
AR(2)	0.447
Sargan test	0.115
Observations	1,570

Notes: The table shows the results of the dynamic panel regressions using system GMM. The dependent variable of the model is *CAR*. We include the lagged dependent variable and we treat *Downgrade* as endogenous. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

3.7.3. Instrumental variable

As further robustness check, we estimate Eq. (3.1) by employing an instrumental variable (IV) approach. We instrument *Downgrade* with *Election*,

[51] Our results hold also estimating the Han and Phillips (2010) regression.

which takes the value 1 if there was a legislative election in the home country of the *i-th* bank in the year preceding *t* and 0 otherwise.[52] We collect election years from the Database of Political Institutions 2015 (Cruz et al., 2016).

Table 3.14

Instrumental variable regression.

	(1) *CAR*
Downgrade	-0.328*
	(0.054)
NPL	-0.001
	(0.426)
P/BV	-0.013
	(0.289)
Leverage	-0.662***
	(0.000)
Size	-0.073***
	(0.002)
Deposits	-0.112
	(0.309)
InvGrade	0.011
	(0.760)
SpecGrade	-0.058
	(0.192)
Fixed Effects	Yes
Observations	1,997
Adj R-squared	0.602

Notes: The table shows the estimates from the second-stage IV regression. We instrument the variable *Downgrade* with *Election*. The dependent variable of the model is *CAR*. Robust *p*-values in parentheses. *** Significant at 1%, ** significant at 5%, * significant at 10%.

We assume that our instrument is strong because election years are highly correlated with sovereign downgrades. Block and Vaaler (2004), in fact, demonstrate that CRAs downgrade sovereign ratings more often in election years. According to political business cycle (PBC) theories, elected incumbent government officials have incentives to adopt economic policies to increase voter

[52] We obtain qualitatively similar results also including resignations and changes of prime ministers.

support in an election year, which could negatively affect their country's financial soundness. Consequently, CRAs anticipate these policies assigning relatively lower ratings to sovereign issuers in election years. The first-stage F-test confirms our instrument significance. The statistics is equal to 30.17, which is significantly above the "rule of thumb" threshold of 10.

We also assume that our instrument is valid because the variable *Election* should not affect the activity of domestic banks other than through its correlation with sovereign downgrades.

Table 3.14 reports the estimates from the second-stage IV regression. The results confirm that the instrumented variable *Downgrade* also has a significant negative impact on capital ratios of domestic banks. We conclude that endogeneity is not driving our results.

3.8. Conclusions

We analyze the effect of sovereign rating changes on the activity of European domestic banks in terms of their regulatory capital ratio, profitability, liquidity, and lending supply. We show that a sovereign downgrade has a significant impact on the domestic banking sector. Primarily, a sovereign negative rating change leads to a reduction in capital ratios and in lending supply of domestic banks.

The impact on the activity of domestic banks is partly explained by three channels: the *assets channel*, the *funding channel*, and the *rating channel*. Instead, we do not find evidence of the *guarantee channel*.

Moreover, we document that the use of credit ratings in financial regulation (*certification effect*) significantly affects all variables used to measure the activity

of European banks. Therefore, our results show that the rating-based regulation has a widespread effect on the activity of European banks.

In contrast, we do not find a significant impact of upgrades on the activity of European banks.

Our results also hold when taking into account sovereign risk, macroeconomic conditions, and potential endogeneity issues, estimating a GMM system and employing an instrumental variable approach.

Our results have significant implications. First, our analysis shows that CRAs' judgments directly affect banks' activity. Sovereign rating changes do not have an impact limited to financial markets, but they have significant real effects that are direct and immediate, already tangible over six months after the announcement of a downgrade.

Second, our empirical evidence provides significant insights regarding the transmission channels of sovereign risk to the banking sector and, consequently, to the whole economic system. In this regard, we underline the importance of the *certification channel*. Notwithstanding the intention to reduce reliance on ratings in regulation expressed by national and supranational authorities after the 2007 financial crisis (Financial Stability Board, 2010), rating-based regulation remains a main transmission channel of negative shocks to the economic system. In addition, we emphasize that the Basel Committee has recently proposed a new regulatory framework that aims to restrict the use of internal models in the calculation of regulatory capital requirements for credit risk (BCBS, 2016), also for exposures to financial institutions. However, this new proposal could make banks more dependent on external ratings. Adopting the standardized approach,

the capital absorption calculation of exposures to banks depends heavily on banks' home country ratings (BCBS, 2006). Therefore, a sovereign downgrade could lead to an automatic and immediate increase in the capital absorption of exposures to banks established in the downgraded country, strengthening the impact of sovereign rating revisions on the activity of banks.

Appendix C

Table C.1

Variables description.

Variable	Description	Source
Dependent Variables		
CAR	Logarithm of the capital adequacy ratio of the *i-th* bank in the quarter *t*.	Datastream
ROE	Logarithm of return on equity of the *i-th* bank in the quarter *t*.	Datastream
Liquidity	Logarithm of cash and securities to total deposits of the *i-th* bank in the quarter *t*.	Datastream
Loans	Logarithm of loans of the *i-th* bank in the quarter *t* to assets in the quarter *t-1*.	Datastream
RWA	Logarithm of the risk-weighted assets of the *i-th* bank in the quarter *t* to assets in the quarter *t-1*.	Datastream
Tier1	Logarithm of the Tier 1 capital of the *i-th* bank in the quarter *t* to assets in the quarter *t-1*.	Datastream
S/LDebt	Logarithm of short-term debt to long-term debt of the *i-th* bank in the quarter *t*.	Datastream
Securities	Logarithm of total investments of the *i-th* bank in the quarter *t* to assets in the quarter *t-1*.	Datastream
Key Explanatory Variables		
Downgrade	Dummy variable equal to 1 if the home country of the *i-th* bank has been downgraded in the two quarters before *t* and 0 otherwise.	S&P
Upgrade	Dummy variable equal to 1 if the home country of the *i-th* bank has been upgraded in the two quarters before *t* and 0 otherwise.	S&P
ShortDebt	Logarithm of short-term debt (mainly interbank debts and repurchase agreements) to asset of the *i-th* bank, observed in the quarter *t-1*.	Datastream
Ceiling	Dummy variable that takes the value 1 if the *i-th* bank's rating is equal to or above its sovereign prior to the downgrade and 0 otherwise.	S&P
Assets/GDP	Ratio of total assets of the *i-th* bank to the GDP of its home country in the year preceding *t*.	Datastream
CDowngrade	Dummy variable equal to 1 if the home country of the *i-th* bank has been subject to a crossover downgrade in the two quarters before *t* and 0 otherwise.	S&P
NCDowngrade	Dummy variable equal to 1 if the home country of the *i-th* bank has been subject to a non-crossover downgrade in the two quarters before *t* and 0 otherwise.	S&P
RiskShift	Percentage change in the risk weight applied to exposure to the home country of the *i-th* bank over the two quarters before *t*.	S&P
Control Variables		
NPL	Ratio of non-performing loans to total assets of the *i-th* bank in the year preceding *t*.	Datastream
P/BV	Ratio of price to book value per share of the *i-th* bank in the year preceding *t*.	Datastream
Leverage	Ratio of total assets minus total equity to total assets of the *i-th*	Datastream

	bank in the year preceding *t*.	
Size	Logarithm of the *i-th* bank's total assets in the year preceding *t*.	Datastream
Deposits	Ratio of deposit to total assets of the *i-th* bank in the year preceding *t*.	Datastream
InvGrade	Dummy variable equal to 1 if the *i-th* bank's long-term debt S&P rating in the quarter *t* is higher than BB+. It is equal to 0 if the bank's rating is equal or lower than BB+ or if S&P does not assign a rating to the *i-th* bank.	S&P
SpecGrade	Dummy variable equal to 1 if the *i-th* bank's long-term debt S&P rating in the quarter *t* is equal or lower than BB+. It is equal to 0 if the bank's rating is higher than BB+ or if S&P does not assign a rating to the *i-th* bank.	S&P
Other variables		
CDS	Sovereign CDS spread level of the *i-th* bank's home country in the quarter before *t*.	Datastream
GDP	GDP quarterly percentage change of the *i-th* bank's home country in the quarter before *t*.	Datastream
ECB	ECB interest rate on the main refinancing operations observed in the quarter before *t*.	Datastream
Election	Dummy variable equal to 1 if there was a legislative election in the *i-th* bank's home country in the year preceding *t* and 0 otherwise.	Cruz et al. (2016)

Table C.2

Summary statistics.

Variable	Mean	Median	Std. Dev.	Obs.
CAR	0.14	0.13	0.04	2,526
ROE	-0.14	0.09	0.18	3,616
Liquidity	0.79	0.47	1.52	3,508
Loans	0.60	0.63	0.16	2,770
RWA	0.54	0.55	0.21	1,936
Tier1	0.06	0.05	0.03	1,922
S/LDebt	9.77	1.07	8.24	3,268
Securities	0.26	0.22	0.17	3,124
Downgrade	0.10	0.00	0.30	6,018
Upgrade	0.05	0.00	0.22	6,018
ShortDebt	0.15	0.13	0.11	3,521
Ceiling	0.13	0.00	0.33	5,755
Assets/GDP	16.32	1.61	90.74	4,817
CDowngrade	0.04	0.00	0.18	6,018
NCDowngrade	0.07	0.00	0.25	6,018
RiskShift	0.01	0.00	0.07	6,018
NPL *(%)*	5.95	3.54	8.01	3,337
P/BV	1.35	1.16	1.05	4,344
Leverage	0.78	0.81	0.14	4,817
Size *(millions of euro)*	4,308.09	543.26	11,355.11	4,817
Deposits	0.53	0.52	0.20	4,663
InvGrade	0.32	0.00	0.47	6,018
SpecGrade	0.05	0.00	0.21	6,018
Bond *(%)*	-0.10	-0.07	1.60	5,472
CDS *(bp)*	137.63	57.47	435.68	5,040
ECB *(%)*	1.56	1.00	1.30	5,900
Election	0.25	0.00	0.43	6,018

4. Conclusions

In this dissertation, we verify whether sovereign rating changes significantly affect the European financial system. The main findings show that sovereign rating revisions have a significant impact on the CDS market, on the firms' borrowing cost, and on the activity of domestic banks.

We find evidence of an asymmetric impact between negative and positive rating changes. Upgrades affect the sovereign CDS spreads of upgraded issuers, but they do not cause a spillover effect. They do not have a significant impact on syndicated loan spreads and on the activity of domestic banks. In contrast, generally, downgrades have a significant impact on all measures analyzed. As showed in Chapters 2 and 3, a negative rating action does not reflect only an increase in the sovereign credit risk, but it significantly affects the behavior of economic agents.

The effects of downgrades are significantly transmitted through the banking sector. In the first chapter, we document that a high exposure to a downgraded country held by the bank sector of an EMU country enhances the transmission of the spillover effect. The estimates presented in Chapter 2 confirm that banks raise the spread of loans granted to firms established in downgraded countries. Finally, in Chapter 3, we demonstrate that banks are directly affected by a sovereign downgrade and that they transfer the negative shock to the economic system reducing their lending supply.

The results presented in previous chapters highlight that the impact of downgrades partly depends on the effect of the rating-based regulation, defined *certification effect*. The *certification effect* explains, in fact, a significant part of

the impact of downgrades on sovereign CDS markets; it also affects the cost and the size of syndicated loans. Furthermore, the *certification effect* has a substantial negative impact on the activity of banks. Despite normative changes, the European banking system still heavily relies on credit ratings. In fact, the *certification effect* almost entirely explains the impact of a downgrade on banks' lending supply, profitability, and liquidity.

The impact of a sovereign rating change is also related to the sovereign rating ceiling "lite" policy. As documented in Chapter 2, the combined impact of the *certification effect* and of this policy particularly affects investment grade firms. After a sovereign downgrade, in fact, in addition to the increase in the sovereign risk, these firms may also lose their rating category.

Moreover, the robustness checks reported in Chapter 2 suggest that these two phenomena could also explain, almost partially, the above mentioned asymmetry between sovereign downgrades and upgrades. After a sovereign downgrade, the rating ceiling policy leads CRAs to downgrade bound issuers, while there is not a comparable policy of opposite sign after an upgrade. Similarly, after a sovereign downgrade, banks could be forced by regulation to reduce their overall exposure to firms established in the downgraded country, while they could choose to not increase lending supply to the same firms after an upgrade. According to our results, the negative effects of sovereign downgrades on the financial system are more certain and immediate than positive effects of upgrades.

Overall, the presented analysis has significant implications. First, our results show that sovereign rating changes, mainly downgrades, affect numerous economic agents. They have a significant impact on the behavior and on the

decisions of investors, managers, and bankers. Downgrades do not affect only financial markets but they have significant real effects on the whole economic system. Moreover, the negative impact is not limited to the downgraded country, but it affects also the financial markets of other countries. Given the significant real effects of sovereign ratings, governments should take into account the impact of their policies on the likelihood of a rating change in their decision making process.

Second, this analysis also suggests that a greater European banking sector's financial soundness, obtained improving banks' capital adequacy but also with the achievement of a stable European banking union, could be useful to mitigate the transmission of negative effects caused by a sovereign downgrade to the global financial system.

Third, the documented negative externalities associated with the reliance of financial regulation on credit ratings imply that CRAs' decisions have a significant impact on the financial system regardless of their accuracy or of investors' beliefs. This effect could be seen as a result of an unmotivated market power granted to CRAs. The significant issues documented analyzing the *certification effect* could contribute to underline the limits of ratings in the current debate regarding the reform of the prudential treatment of sovereign exposures. Any regulatory change should not underestimate the externalities of rating-based regulation on public finances, economic activities, and financial stability.

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