UCLM UNIVERSIDAD DE CASTILLA-LA MANCHA

Facultad de Ciencias Sociales de Cuenca

Documento de trabajo

SEMINARIO PERMANENTE DE CIENCIAS SOCIALES

AN EMPIRICAL INVESTIGATION OF THE EFFECT OF CREDIT RATINGS ON SOVEREIGN CREDIT RISK

Laura Ballester
Ana González-Urteaga

SPCS Documento de trabajo 2015/2
http://www.uclm.es/CU/csociales/DocumentosTrabajo

Facultad de Ciencias Sociales de Cuenca | Avda. de los Alfares, 44 | 16.071–CUENCA
Teléfono (+34) 902 204 100 | Fax (+34) 902 204 130

Autores:
Laura Ballester
laura.ballester@uv.es
Ana González-Urteaga
ana.gonzalezu@unavarra.es

Edita:

Facultad de Ciencias Sociales de Cuenca
Seminario Permanente de Ciencias Sociales
Codirectora: Pilar Domínguez Martínez
Codirectora: Silvia Valmaña Ochaita
Secretaria: María Cordente Rodríguez
Secretaria: Nuria Legazpe Moraleja
Avda. de los Alfares, 44
16.071–CUENCA
Teléfono (+34) 902 204 100
Fax (+34) 902 204 130
http://www.uclm.es/cu/csociales/documentosTrabajo.asp

I.S.S.N.: 1887-3464 (ed. CD-ROM) 1988-1118 (ed. en línea)
D.L.: CU-532-2005

Impreso en España – Printed in Spain.

AN EMPIRICAL INVESTIGATION OF THE EFFECT OF CREDIT RATINGS ON SOVEREIGN CREDIT RISK

Laura Ballester [a] and Ana González-Urteaga [b,1]

[a] *University of Valencia, Avda. Los Naranjos s/n, 46022 Valencia, Spain*

[b] *Public University of Navarre, Arrosadia Campus, 31006 Pamplona, Spain*

ABSTRACT

We investigate the cross-border spillover effects of credit rating events for sovereign CDS Latin American emerging economies during 2004-2014. The article extends the previous literature measuring the effect in terms of change in contagion, which we quantify using the novel GVAR methodology. We find that CDS of boarding markets anticipate both positive and to a greater extent negative events that occurs in a given country. Alternatively, only upgrades display a significant spillover effect the days after the event. Therefore, CDS already reflect the information before the positive or negative rating announcement occurs. However, only upgrades contain new information that have a significant impact on the CDS markets of other sovereigns.

Keywords: CDS spreads, credit ratings, emerging markets, spillover effects, GVAR

JEL codes: F30, G15, G24, C50

---

[1] Corresponding author at: Public University of Navarre, Arrosadia Campus, 31006 Pamplona, Spain. Tel.: +34 948 16 6083. *E-mail address:* ana.gonzalezu@unavarra.es. The authors would like to express her gratitude for the grant received from the Fundación Ramón Areces. A. González-Urteaga acknowledges financial support from ECO2012-35946-C02-01 and ECO2012-34268.

Version March 2015

1. INTRODUCTION

One of the most significant financial events over the past decade has been the rapid growth experienced by the OTC credit derivatives market. From 2008, credit default swaps (hereafter, CDS)[2] were the most widely traded credit derivative instrument in order to transfer credit risk efficiently, representing opportunities for business diversification and hedging counterparty risk. According to the International Swaps and Derivatives Association (ISDA), the notional outstanding value for the CDS market increased from $8.4 trillion at the end of 2004 to $24.4 trillion at mid-year 2013, with a cleared transactions volume totaled $2.5 trillion. Nowadays, CDS are considered a good proxy of credit risk, the probability of default of the reference entity and therefore of the level of risk assumed by the counterparty. Also, CDS are the most liquid credit derivative products and account for about half of credit derivatives traded on that market.

Our empirical focus is on emerging market sovereign CDS. The expansion of emerging debt markets is a fact that may lead to the recent increase in the fraction of the CDS contracts written on high-yield debt instruments. Emerging sovereigns are among the largest high-yield borrowers in the world. However, countries in financial distress generally do not enter bankruptcy proceedings or ever liquidate their assets, so the nature of default risk is somewhat different. In practice, they go through debt restructuring mechanisms in which defaulted bond are exchanged for new longer maturity, lower yield debt instruments. Given the nature of sovereign default risk, it is important to analyze sovereign CDS reaction to credit rating announcements.

CDS are an interesting financial instrument to analyze the impact of credit rating changes because CDS are credit spreads themselves and both reflect the credit quality of a particular country/firm, yet oppositely. Theoretically a negative relation is expected between them, the higher the CDS spread, the worse the credit rating. However, several recent papers document informational advantages with CDS spreads being more timely and often predicting credit ratings (Hull et al., 2004, Flannery et al., 2010, Chava et al., 2012, Lee et al., 2014). As pointed in Chiang et al. (2007), the news that received substantial attention from policy makers and investors included the announcements of

[2] A CDS is essentially an insurance contract that provides protection against the risk of default by a specific reference entity. The CDS spread is the periodic rate that a protection buyer pays on the notional amount to the protection seller for transferring the risk of a credit event for some period.

changes in foreign sovereign credit ratings for a particular country in the region. The heavily growing CDS market is a particular example of credit risk sensitive derivatives markets that should react significantly if credit ratings reveal new information. In fact, given that the literature has demonstrated that a significant part of sovereign CDS spreads is explained by common factors such as investors' risk appetite and global economic fundamentals (Remolona et al., 2008, Longstaff et al., 2008, Eichengreen et al., 2012), any credit rating announcement containing new information should have spillover effects on the CDS spreads of other sovereigns. However, the literature has focused on analyzing the effect inside the own country, and little attention has been paid to cross-border effects. In this paper we address this issue.

More specifically, using the information content in emerging sovereign CDS contracts, we investigate the cross-border spillover effects, in terms of changes in contagion, of these credit rating events. In particular, we focus on measure the effect of rating announcements in a particular country (including changes in ratings and in outlooks, and distinguishing between positive and negative ones) have on sovereign CDS spreads of other countries in the same region, in terms of the impact on contagion. More specifically, we test if the contagion has changed due to a rating announcement. Theoretically, sovereign credit risk levels measured by CDS spreads and rating change announcements should reflect the same information content given that both are based on public and available information. If this is true, we expect that CDS spreads should not react to a positive or negative rating announcement, and thereby, the change in contagion should not be significant.

The contagion is measured in terms of return spillovers following a Generalized VAR (GVAR) approach (Diebold and Yilmaz, 2012). More specifically, we first use the *net-pairwise spillover* measure of the GVAR to compute the spillover effect between two countries' sovereign CDS. After that, we calculate the change in the pairwise contagion prior (post) the credit rating event, hereafter prior-effect (post-effect), from a range around 25 days prior (post) the event. Finally, we contrast whether these effects are statistically significant on average, distinguishing between positive and negative events. This enables us to analyze whether sovereign CDSs of other countries respond symmetrically, in terms of contagion, to positive and negative rating announcements in a given country.

To sum up, we use daily data of sovereign CDS spreads for Argentina, Brazil, Chile, Colombia, Mexico and Peru, covering the Latin America emerging market from 2004 to 2014. We seek to address the following questions: Is there a significant change in the spillover effect on the CDS spreads of other sovereign entities due to the credit rating events on a given country? Is there a significant change in the contagion prior or post the events? Are the reactions symmetric in response to positive and negative rating announcements)

Our findings corresponding to the effects in average through all the countries, generally show that both positive and negative rating announcements spill over significantly (leading to an increase in contagion) into other emerging CDS markets some days before the event. This indicates that CDS of boarding countries already reflect the information before the event occurs in a given country. The impact of the upgrades is in the short term, whereas the downgrades appear to be more intense, with an impact in the short and medium term, and with a higher magnitude. Alternatively, with an increase in contagion among countries, only upgrades display a significant spillover effect the days after the event. This means that only upgrades contain new information that have a significant impact on the CDS markets of other sovereigns.

At the country level substantial differences are found depending on the studied country. In short, Latin American emerging countries' sovereign CDS anticipate exclusively negative rating announcement produced both in Argentina and Brazil. In the case of Chile, only upgrades have a significant impact in terms of contagion on boarding sovereign CDS in the short-term, both prior and post the rating event. Finally, both positive and negative events occurred in Mexico have significant effects 3 days before and after the event. Alternatively, there are not observed significant effects in the cases of Colombia and Peru.

The remaining part of this paper is organized as follows. Section 2 reviews the related literature. Section 3 describes the data. Section 4 discussed the methodological approach. Section 5 presents the results while section 6 concludes.

2. LITERATURE REVIEW

Previous research has studied the impact of credit rating events on bond markets (Hite and Warga, 1997, Steiner and Heinke, 2001, Gande and Parsley, 2005, Jorion and Zhang, 2010), stock markets (Dichev and Pietroski, 2001, Vassalou and Xing, 2004, Behr and Güttler, 2008, Chung et al., 2012) or both (Hand et al., 1992). They all find evidence of market response to negative credit rating events, but no (or weak) significant reaction to positive ones. Finnerty et al. (2013) explain that this is due to the intensive credit monitoring by bond investors and credit analysts, triggering that downgrades are better anticipated than upgrades.

More recently, the literature has analyzed the relationship between rating announcements and the CDS market. Hull et al. (2004) examine the relationship between international CDS spreads and announcements by rating agencies from 1998 to 2002. They find that reviews for downgrade contain significant information, but downgrades and negative outlooks do not. There is anticipation of all three types of ratings announcements by the CDS market. Moreover, credit spread levels provide helpful information in estimating the probability of negative credit rating changes. Norden and Weber (2004) in an event study framework find that stock and CDS markets not only anticipate rating downgrades but also reviews for downgrade by all agencies. Moreover, a combined analysis of different rating events within and across agencies reveals that reviews for downgrade by Standard & Poor's and Moody's exhibit the largest impact on both markets. With an event study analysis similar to the previous authors, Galil and Soffer (2011) corroborate that the CDS market responds to bad rating news stronger than to good news during 2002-2006. Previously three cited studies use corporate and/or sovereign CDS spreads. In a recent paper, Finnerty et al. (2013) document the impact of credit rating events on international corporate CDS spreads during the period 2001-2009. As in previous studies they find that rating downgrades have a much greater impact on CDS than upgrades and that downgrades are better anticipated by the CDS market than upgrades[3].

[3] Related with general financial events, Dooley and Hutchison (2009) using Norden and Weber (2004)'s methodology show that 2007-2008 US financial and economic news had statistically and economic impact on 14 emerging countries' sovereign CDS spreads. Jorion and Zhang (2009) find that bankruptcy announcements cause negative abnormal equity returns and increases in corporate CDS spreads for creditors.

This paper is most closely related to Ismailescu and Kazemi (2010). From January 2001 to April 2009, they examine not only the effect of sovereign credit rating change announcements on the CDS spreads of the event countries, but also their spillover effects on other emerging economies. The latter is the aim of our paper, and as far as we know this is the only other paper that examines this issue. Their results suggest that positive events have a greater impact on CDS markets in the two-day period surrounding the event, and are more likely to spill over to other emerging countries[4].

In this paper we focus our attention in analyzing the spillover effects of a rating event that occurs in one emerging country on CDS spreads of other boarding economies, but following a distinct methodology. We estimate a GVAR model in order to obtain *net pairwise* measures of contagion between CDS series. This enables us to measure the actual change in contagion that is due to a credit rating announcement[5]. Besides, we are able to test if the contagion has significantly changed some days prior and post the event. Our paper also contributes to the related literature in that we focus exclusively in Latin America emerging market using an extensive sample period from 2004 to 2014 and analyzing the effect in terms of contagion of rating events not only for all the countries in the zone but also at the country level.

The other strand of literature our study relates to focuses on the definition and quantification of contagion. Although a very intuitive concept, contagion is difficult to define and measure empirically. Dornbusch et al. (2000), Kaminsky et al. (2003), Bae et al. (2003) and Longstaff (2010), among others, define contagion as an episode in which there is a significant increase in cross-market linkages when a shock occurs. Pericoli and Sbracia (2003) review different definitions and related measures of contagion that are frequently used in the literature, including changes in the probability of currency crises; volatility spillovers (commonly based on the estimation of multivariate GARCH models); Markov-switching models to test for jumps between multiple equilibria; correlation or

[4] Gande and Parsley (2005) analyzes also the effect of a sovereign credit rating change of one country on the sovereign credit spreads of other countries from 1991 to 2000, but they use sovereign bond spreads instead of CDS. They find evidence of significant spillover effects with negative rating events associated with an increase in spreads.

[5] Thus, we analyze the rating announcements' effect in one country on CDSs of other country in terms of changes in contagion between the CDS series of both countries. We focus on contagion because following Celik (2012) among others, the issue of contagion in financial markets is of fundamental importance. It has serious consequences for the global economy in relation to monetary policy, optimal asset allocation, risk measurement, capital adequacy and asset pricing.

co-movements in financial markets and changes in the transmission mechanism, that is when a country-specific shock becomes global. All methodologies have limitations and a number of caveats often apply. In this study, we define contagion as the change in the propagation mechanism when a shock occurs and we measure it in terms of return spillovers using GVAR methodology. This approach enables us to measure directional contagion between two particular series, not only the total spillovers among all the series. To our knowledge, we are the first to document the spillover effects in Latin American sovereign CDS markets due to credit rating announcements using the novel GVAR methodology.

3. DATA

The data set consists of daily data of sovereign CDS spreads for Latin American emerging countries collected from Datastream. We select US dollar denominated, senior tier and 5-year CDS quotes, since these contracts are generally considered the most liquid and constitute the majority of the entire CDS market (Jorion and Zhang, 2007 and Eichengreen et al., 2012). It covers the time period from April 22, 2004 to January 27, 2014, almost a decade, and six Latin American emerging markets, concretely Argentina, Brazil, Chile, Colombia, Mexico and Peru[6]. This results in 15,288 panel daily observations for 2,548 days.

Descriptive statistics on the CDS data for each country are reported in Table 1, while Figure 1 illustrates the daily time evolution of mean CDS spreads of an equally-weighted portfolio formed with all countries in our sample. The mean of CDS spreads varied significantly by country ranging from 69.17 bps for Chile to 1,016.35 bps for Argentina. Two sharp increases in CDS premiums are observed during the sample period. The first corresponds to the 2008 global credit crisis, which affected to all countries with a bigger impact in the Argentinian case. The second sharp rise corresponds to the end of the sample period, reflecting the Argentine credit risk troubles.

[6] Following FTSE country classification as at September 2014, we cover all the types of emerging countries: advanced emerging, with Brazil and Mexico, secondary emerging (with Chile, Colombia and Peru) and frontier emerging (with Argentina).

Finally, we collect rating announcement events from S&P's Sovereign Rating and Country Transfer and Convertibility Assessment Histories. Literature has shown that S&P rating changes occur more frequently, providing a larger data set, are less anticipated by markets, and precede those of other rating agencies (Gande and Parsley, 2005, Reisen and Von Maltzan, 1999). In this study rating announcement events consists of actual rating changes and reviews for rating changes. Positive (negative) events are upgrades (downgrades) of S&P's letter credit ratings or upward (downward) revisions in the sovereign's credit outlook[7].

Table 2 displays the distribution of credit rating events per country (Panel A) and per year (Panel B). We observe 48 credit rating changes for the six emerging markets in our sample, where positive rating events clearly dominate with 39 upwards in contrast with the 9 downwards. Chile, Colombia and Peru do not show negative events, while negative events outnumbered positive events in the case of Argentina. Twenty of the 39 positive events were reported in the first four years only, concretely until mid-2008. With the global financial crisis of 2008 four downgrades are reported in late 2008 and during 2009, in particular for Argentina and Mexico. After that, positive events dominate again with 16 upwards in total versus 4 downgrades, 3 of them of Argentina during 2012 and 2013, a period characterized by the decline of its credit quality.

4. METHODOLOGY

The methodology follows a two-stage empirical procedure. In the first stage we use CDS spreads, more precisely CDS log-returns, as an indicator of sovereign credit risk, and we measure the contagion effect among each pair of countries over time. We define contagion as the change in the propagation mechanism when a shock occurs and we measure it in terms of return spillovers.

More concretely, the return spillover effects are obtained following the Generalized Vector Autoregressive framework (GVAR) methodology developed by Diebold and Yilmaz (2009, 2012), which is a VAR-based spillover index particularly suited for the investigation of systems of highly interdependent variables. Spillovers are

[7] CreditWactches are not included because none of them occur during our simple period.

measured from a particular variance decomposition associated with an N-variable vector autoregression framework, which allow us to parse the forecast error variances of each variable into parts which are attributable to the various system shocks. The major advantage of this approach is that it eliminates the possible dependence of the results on ordering in contrast to the traditional Cholesky factorization[8]. In addition to that, it includes directional contagion indicator from/to a particular series, not only the total spillovers.

More specifically, this approach consists of two steps. First, we consider a covariance stationary N-variable VAR(p)

$$x_t = \sum_{i=1}^{p} \phi_i \, x_{t-i} + \varepsilon_t \tag{1}$$

where $\varepsilon \sim (0, \Sigma)$ is a vector of independently and identically distributed disturbances and x_t denotes a N-variable vector of CDS log-returns. To ease the analysis the model is written as the moving average representation $x_t = \sum_{i=0}^{\infty} A_i \varepsilon_{t-i}$, where the $N \times N$ coefficient matrices are estimated by $A_i = \phi_1 A_{i-1} + \phi_2 A_{i-2} + \cdots + \phi_p A_{i-p}$, with A_0 being the identity matrix and $A_i = 0$ for $i < 0$.

Next, we calculate the variance decompositions. The variance shares defined as the fractions of the H-step-ahead error variances in forecasting x_i that are due to shocks to x_j, for $H = 1,2,...$, are given by

$$\theta_{j \to i}^{G}(H) = \frac{\sigma_{jj}^{-1} \sum_{h=0}^{H-1} \left(e_i' A_h e_j\right)^2}{\sum_{h=0}^{H-1} \left(e_i' A_h \Sigma A_h' e_i\right)}, \text{ for } i, j = 1,2, \dots, N \tag{2}$$

where σ_{jj} is the standard deviation of the error term for the j^{th} equation, i.e. the squared root of the diagonal elements of the variance-covariance matrix Σ and e_i is the vector with one as the i^{th} element and zeros otherwise. As the shocks to each variable are not orthogonalized, the row sum of the variance decomposition is not equal to 1. Thus, each entry of the variance decomposition matrix can be normalized by the row sum as

$$\tilde{\theta}_{j \to i}^{G}(H) = \frac{\theta_{j \to i}^{G}(H)}{\sum_{j=1}^{N} \theta_{j \to i}^{G}(H)} \times 100, \text{ for } i, j = 1,2, \dots, N \tag{3}$$

---

[8] This problem is circumvented by exploiting the generalized VAR framework of Koop et al. (1996) and Pesaran and Shin (1998), among others.

where the multiplication by 100 is just to have it in percentage terms. Note that, by construction $\sum_{j=1}^{N}\tilde{\theta}_{j\to i}^{G}(H)=100$ and $\sum_{i,j=1}^{N}\tilde{\theta}_{j\to i}^{G}(H)=N\times 100$.

Note that return spillovers show the degree of variation in CDS log-returns of portfolio *i* which is not due to the historical information of the CDS log-returns of portfolios *i* and *j* but to shocks (innovations) in CDS log-returns of portfolio *j*. This indicator takes higher values as the intensity of the contagion effect, caused by the specific shocks of *j*'s CDS log-returns, increases. In the extreme case in which there are no spillovers from one series to the other, the indicator is equal to zero.

Using the above normalized variance contributions we can then construct some different spillover measures. Among them we will use the *total return spillover* index, which we use in order to select the forecast horizon *H*, and the *net pairwise return spillover* indices, which measure the actual contagion between each pair of return series.

More concretely, the *total return spillover* index measures the contribution of spillovers of return shocks across all N series to the total forecast error variance is given by:

$$TS^{G}(H)=\frac{\sum_{\substack{i,j=1\\ i\neq j}}^{N}\tilde{\theta}_{j\to i}^{G}(H)}{N} \tag{4}$$

It indicates on average the percentage of the forecast error variance in all the series that comes from spillovers (from contagion due to shocks).

By contrast, the *net pairwise return spillover* indices between series *i* and *j* are defined as

$$NPS_{i\to j}^{G}(H)=\tilde{\theta}_{i\to j}^{G}(H)-\tilde{\theta}_{j\to i}^{G}(H),\ \text{for } i,j=1,2,\dots,N \tag{5}$$

It is simply the difference between the gross return shocks transmitted from *i* to *j* and those transmitted from *j* to *i*. Hence, it is positive (negative) when the impact of *i*'s shocks is higher (lower) than vice versa, indicating that portfolio *i* is net transmitter (receiver) of return spillovers to (from) portfolio *j*.

We produce the *net pairwise return spillover* measure using a 200-day rolling samples and thus we lose the first 200 daily observations. At each rolling window, the lag

p of the GVAR model is determined using the likelihood ratio test, which confirms that p varies over time[9]. To choose the forecast horizon of ten days ($H = 10$) we compute at each window the *total return spillover* index for H varying from 1 to 16. The results show that the index is sensitive to the choice of the forecast horizon for low values of H, but in general it is stabilized for $H = 10$. This is the forecasting horizon commonly used in similar studies (see for example Diebold and Yilmaz, 2012 or Ballester et al., 2014).

The second stage of the empirical procedure consists of measure the impact of credit rating announcements that occurs in a given country on sovereign CDS of other emerging boarding countries, in terms of change in contagion which is measured by the *net pairwise return spillover* indices. In particular, we calculate the change in the pairwise contagion prior and post each credit rating event[10], what is named prior and post effect, and we do that for a range around 25 days prior and post the event:

$$Prior\text{-}effect = NPS^{G}_{i\to j}(H)_t - NPS^{G}_{i\to j}(H)_{t-x}, \qquad \text{for } x = 1,2,\dots,25$$

$$Post\text{-}effect = NPS^{G}_{i\to j}(H)_{t+x} - NPS^{G}_{i\to j}(H)_t, \qquad \text{for } x = 1,2,\dots,25$$

where t is the day of the credit rating event. The maximum value of 25 days is selected to avoid losing those events that are closed to the beginning and the end of the sample period.

After that, we test if prior and post effects are significantly different from zero in mean taking into account all the countries and events, and distinguishing between positive and negative events. We also perform the test at the country level. The use of positive and negative credit rating events allows us to analyze whether the reaction of sovereign CDS of other countries, in terms of contagion, is symmetric to positive and negative rating news responses in a given country.

If the prior-effect is statistically significant means that it exists a significant change in the contagion prior to the event between each pair of countries, suggesting that before the event occurs in a given country, the CDS spreads in the second country incorporate the rating information. On the other hand, a significant post-effect indicates

[9] The Akaike information criterion does lead in some cases to higher values, but this criterion tends to overestimate the number of lags.

[10] The rolling GVAR analysis leads to lose the first three credit rating events (the two reported in 2004 and the first one reported in 2005), all of them positive. That way, we finally work with 45 credit rating announcements in total, 36 upwards and 9 downwards.

a significant change in contagion between countries after the event, suggesting that rating news in a particular country contain new information that have a significant impact on the sovereign CDS of the other boarding country.

5. EMPIRICAL RESULTS

Table 3 displays the credit rating events' prior and post effect in average through all the countries and all the events, distinguishing also between positive and negative events.

Regarding the prior-effect, we observe that it always has a negative sign, indicating that cross-border contagion increases prior to the event. When considering all the events without distinguishing by sign, we note that the impact of the prior-effect is greater in the short term (from 3 to 8 days prior to the event), although it is significant both in the short and the medium term (for all periods analyzed). Looking at positive and negative events, the results show a more pronounced effect of negative ones. For downgrades the prior-effect is significant both in the short and medium term for all periods analyzed, while the upgrades have significant effect only in the short-term and with a smaller impact (in terms of the magnitude) in absolute value. These findings differ from those of Ismailescu and Kazemi (2010) who report that only positive events display some spillover effects, but they only analyze post-effects. Our results are more in line with those obtained by Norden and Weber (2004) and Hull et al. (2004). Since they find that CDS market anticipate rating downgrades for the event country, if any spillover effect exists prior the event, it is most likely to be observed for negative rating announcements.

By contrast, when analyzing the post-effects our results are in line with those of Ismailescu and Kazemi (2010), since positive events are the ones who display a significant impact after the event[11]. Their sign is positive, indicating that post-event contagion increases significantly due to positive credit rating announcements. This post-effect emerges three days after the event and it is more pronounced (in terms of magnitude) 20 days after the event.

[11] Gande and Parsley (2005) find the opposite result. However, they use sovereign bond spreads instead of CDSs and besides, they use a quite different sample (1991-2000) comparing to ours (2004-2014).

In short, the sovereign CDS of the six Latin American emerging countries considered anticipate positive and, with a greater impact, negative rating events in a given country, increasing the contagion between countries in the days before the event occurs. The impact of this prior-effect is a short-term impact in the case of the upgrades, while for the downgrades it is a short and medium-term impact. Nevertheless, only upgrades have a significant effect the days after the event (post-effect) with a rise of the contagion across countries. Therefore, CDS of boarding countries already reflect the information before the positive or negative rating announcement occurs in a given country. However, only upgrades in a given country contain new information that have a significant impact on the CDS markets of other sovereigns.

Next, we repeat the significance tests for the corresponding effects by each country with the rest of the countries. Table 4 displays the results. When the effects are significant, it is observed that their estimated sign is consistent with the sign previously obtained in average through all countries. The prior-effects are negative and post-effects are positive, indicating a rise in contagion, both before and after the event.

However, if we take a deeper look we observe differences depending on the studied country. In general, sovereign CDS of the considered emerging countries in Latin America anticipate exclusively negative credit rating events produce both in Argentina and Brazil. The spillover between these two countries and the rest of cross-border countries increases in the days prior to the downgrade. For Brazil, the impact is larger in the long-term. In the case of Chile it is observed that only upgrades have a significant impact in terms of contagion on boarding sovereign CDS in the short-term (around 3 and 5 days), both prior and post the credit event. Finally, for credit rating announcements produced in Mexico, both positive and negative events have significant effects 3 days before and after the event. In both cases, however, the impact (the magnitude in absolute value) in terms of contagion is quite low. Alternatively, there are not observed significant effects in the cases of Colombia and Peru.

6. CONCLUSIONS

This paper investigates the cross-border spillover effects, in terms of changes in contagion, of credit rating announcements for six sovereign CDS Latin American emerging economies during 2004-2014. More specifically, we focus on measure the effect of rating announcements (including changes in rating and in outlooks) in a particular country on sovereign CDS spreads of other countries located in the same region, in terms of impact on contagion. In particular, we test if the contagion has changed due to a rating announcement. The contagion is measured in terms of return spillovers using the novel GVAR approach of Diebold and Yilmaz, 2012. In particular, we calculate the change in the pairwise contagion prior and post each credit rating event from a range around 25 days prior and post the event, and finally we test if they are significant in mean. Additionally, we distinguish between positive and negative events in order to determine whether the reactions are symmetric in response to upgrades and downgrades.

Our results generally show that there is a significant change in the spillover effect on the CDS spreads of other sovereign entities due to the credit rating events on a given country. More specifically, we find that CDS markets anticipate both positive and to a greater impact negative events. Thus, the contagion prior the events significantly change (with an increase in contagion), indicating that CDSs of boarding countries already reflect the information before the positive or negative rating announcement occurs in a given country. Alternatively, only upgrades display a significant spillover effect the days after the event, suggesting that only upgrades contain new information that have a significant impact on the CDS markets of other sovereigns. Therefore, the reactions are not symmetric in response to positive and negative announcements.

At the country level differences are found depending on the country. Only negative events produced both in Argentina and Brazil spill over significantly to the rest of the boarding countries in the days prior to a downgrade. By contrast, only upgrades have a significant impact in terms of contagion on the rest of cross-border countries in the short-term both prior and post the credit event. In the case of Mexico, there is a symmetric in response to positive and negative events, with a significant prior and post effect to 3 days, although the impact in terms of contagion (the magnitude) is quite low. Alternatively, we do not observed significant effects in the cases of Colombia and Peru.

REFERENCES

BAE, K.H.; KAROLYI, G.A. & STULZ, R.M. (2003). "A new approach to measuring financial contagion", *Review of Financial studies*, 16(3), pp. 717-763.

BALLESTER, L.; CASU, B. & GONZALEZ-URTEAGA, A. (2014). "Bank Fragility and Contagion: Evidence from the CDS market", *Cass Business School. Working paper Series*, 33.

BEHR, P. & GÜTTLER, A. (2008). "The informational content of unsolicited ratings", *Journal of Banking & Finance*, 32(4), pp. 587-599.

CELIK, S. (2012). "The more contagion effect on emerging markets: The evidence of DCC-GARCH model", *Economic Modelling*, 29, pp. 1946-1959.

CHAVA, S.; GANDURI, R. & ORNTHANALAI, C. (2012). "Are credit ratings still relevant?", *Working Paper*, Georgia Institute of Technology and University of Toronto.

CHIANG, T.C.; JEON, B.N. & LI, H. (2007). "Dynamic correlation analysis of financial contagion: evidence from the Asian Markets", *Journal of International Money and Finance* 26, pp. 1206-1228.

CHUNG, K.H.; ANN FROST, C, & KIM, M. (2012). "Characteristics and information value of credit watches", *Financial Management*, 41(1), pp. 119-158.

DICHEV, I.D. & PIOTROSKI, J.D. (2001). "The long–run stock returns following bond ratings changes", *The Journal of Finance*, 56(1), pp. 173–203.

DIEBOLD, F.X., & YILMAZ, K. (2009). "Measuring Financial Asset Return and Volatility Spillovers, with Application to Global Equity Markets", *The Economic Journal*, 119(534), pp. 158-171.

DIEBOLD, F.X. & YILMAZ, K. (2012). "Better to give than to receive: Predictive directional measurement of volatility spillovers", *International Journal of Forecasting*, 28(1), pp. 57-66.

DOOLEY, M. & HUTCHISON, M. (2009). "Transmission of the US subprime crisis to emerging markets: Evidence on the decoupling–recoupling hypothesis", *Journal of International Money and Finance*, 28(8), pp. 1331-1349.

DORNBUSH, R.; PARK, Y.C. & CLAESSENS, S. (2000). “Contagion: understanding how it spreads”, *The World Bank Research Observer,* 15(2), pp. 177-197.

EICHENGREEN, B.; MODY, A.; NEDELJKOVIC, M. & SARNO, L. (2012). “How the subprime crisis went global: Evidence from bank credit default swap spreads”, *Journal of International Money and Finance,* 31(5), pp. 1299-1318.

FINNERTY, J.D.; MILLER, C.D. & CHEN, R.R. (2013). “The impact of credit rating announcements on credit default swap spreads”, *Journal of Banking & Finance,* 37, pp. 2011-2030.

FLANNERY, M.; HOUSTON, J. & PARTNOY, F. (2010). “Credit default swap spreads as viable substitutes for credit ratings”, *University of Pennsylvania Law Review* 158 (7), pp. 2085-2123.

GALIL, K. & SOFFER, G. (2011). “Good news, bad news and rating announcements: An empirical investigation”, *Journal of Banking & Finance*, 35(11), pp. 3101-3119.

GANDE, A. & PARSLEY, D.C. (2005). “News spillovers in the sovereign debt market”, *Journal of Financial Economics,* 75(3), pp. 691-734.

HAND, J.R.; HOLTHAUSEN, R.W. & LEFTWICH, R.W. (1992). “The effect of bond rating agency announcements on bond and stock prices”, *The Journal of Finance*, 47(2), pp. 733-752.

HITE, G. & WARGA, A. (1997). “The effect of bond-rating changes on bond price performance”, *Financial Analysts Journal*, pp. 35-51.

HULL, J.; PREDESCU, M. & WHITE, A. (2004). “The relationship between credit default swap spreads, bond yields, and credit rating announcements”, *Journal of Banking & Finance*, *28*(11), pp. 2789-2811.

ISMAILESCU, I. & KAZEMI, H. (2010). “The reaction of emerging market credit default swap spreads to sovereign credit rating changes”, *Journal of Banking & Finance,* 34(12), pp. 2861-2873.

JORION, P. & ZHANG, G. (2007). “Good and bad credit contagion: Evidence from credit default swaps, *Journal of Financial Economics*, 84(3), pp. 860-883.

JORION, P. & ZHANG, G. (2009). “Credit contagion from counterparty risk”, *Journal of Finance*, 64(5), pp. 2053-2087.

JORION, P. & ZHANG, G. (2010). “Information transfer effects of bond rating downgrades”, *Financial Review*, 45(3), pp. 683-706.

KAMISKY, G.L.; REINHART, C.M. & VÉGH, C.A. (2005). “When it rains, it pours: procyclical capital flows and macroeconomic policies”, In *NBER Macroeconomics Annual 2004*, 19, pp. 11-82. MIT Press.

KOOP, G.; PESARAN, M.H. & POTTER, S.M. (1996). “Impulse response analysis in nonlinear multivariate models”, *Journal of Econometrics*, 74(1), pp.119-147.

LEE, J.; NARANJO, A. & SIRMANS, S. (2014). “CDS momentum: slow moving credit ratings and cross-market spillovers”, *Available at SSRN 2423371*.

LONGSTAFF, F.A.; PAN, J.; PEDERSEN, L.H. & SINGLETON, K.J. (2008). “How sovereign is sovereign credit risk?”, Working paper, UCLA and Stanford.

LONGSTAFF, F.A. (2010). “The subprime credit crisis and contagion in financial markets, *Journal of Financial Economics*, 97(3), pp. 436-450.

NORDEN, L. & WEBER, M. (2004). “Informational efficiency of credit default swap and stock markets: The impact of credit rating announcements”, *Journal of Banking & Finance*, 28(11), pp. 2813-2843.

PERICOLI, M. & SBRACIA, M. (2003). “A primer on financial contagion”, *Journal of Economic Surveys*, 17(4), pp. 571-608.

PESARAN, M.H. & SHIN, Y. (1998). “An autoregressive distributed-lag modelling approach to cointegration analysis”, *Econometric Society Monographs*, 31, pp. 371-413.

REISEN, H. & VON MALTZAN, J. (1999). “Boom and bust and sovereign ratings”, *International Finance*, 2(2), pp. 273-293.

REMONOLA, E.M.; SCATIGNA, M. & WU, E. (2008). “A ratings-based approach to measuring sovereign risk”, *International Journal of Finance & Economics*, 13(1), pp. 26-39.

STEINER, M. & HEINKE, V.G. (2001). “Event study concerning international bond price effects of credit rating actions”, *International Journal of Finance & Economics*, 6(2), pp. 139-157.

VASSALOU, M. & XING, Y. (2004). “Default risk in equity returns”, *The Journal of Finance*, 59(2), pp. 831-868.

TABLE 1: Descriptive statistics of the daily CDS spreads

This table presents the mean and standard deviation for the daily 5-year CDS spreads in basis points from April 22, 2004 to January 27, 2014 for six Latin American emerging markets: Argentina, Brazil, Chile, Colombia, Mexico and Peru.

	Mean	**Std.Dev.**
Argentina	1,016.35	1,024.02
Brazil	193.83	136.58
Chile	69.17	51.87
Colombia	184.49	105.86
Mexico	119.17	72.59
Peru	167.00	91.60
Average	291.67	197.15

TABLE 2: The distribution of credit rating events

This table presents the distribution of credit rating events per country (Panel A) and per year (Panel B), from April 22, 2004 to January 27, 2014 for six Latin American emerging markets: Argentina, Brazil, Chile, Colombia, Mexico and Peru.

Panel A: The distribution of credit rating events per country

	Number of positive events	Number of negative events	Total
Argentina	5	6	11
Brazil	9	1	10
Chile	4	0	4
Colombia	6	0	6
Mexico	4	2	6
Peru	11	0	11
Total	39	9	48

Panel B: The distribution of credit rating events per year

	Number of positive events	Number of negative events	Total
2004	2	0	2
2005	5	0	5
2006	7	1	8
2007	6	0	6
2008	3	2	5
2009	0	2	2
2010	4	0	4
2011	5	0	5
2012	3	2	5
2013	4	2	6
2014	0	0	0
Total	39	9	48

TABLE 3: Credit rating events' prior and post effect for all the countries

This table presents the credit rating events' prior and post effect in average through all the countries and all the events, distinguishing also between positive and negative events. For any rating event in a given country occurring at time *t*, the effects are calculated for a range (*x*) around 25 days prior and post the event, that is for the period [t–*x*,*t*+*x*]. In particular, since the general conclusions hold regarding short, medium and large term, the table shows the results obtained for some selected values of *x*, that is *x* = 1, 3, 5, 8, 10, 15, 20, 25. Besides, the table only reports the cases that result significant at the 10% level (*), at the 5% level $^{(**)}$ or at the 1% level (***). The sample period is from April 22, 2004 to January 27, 2014 and the countries are the following for six Latin American emerging markets: Argentina, Brazil, Chile, Colombia, Mexico and Peru.

	Prior-effect			*Post-effect*		
All countries	All events	Positive events	Negative events	All events	Positive events	Negative events
x = 1	-0.06***		-0.20***			
x = 3	-0.28***	-0.21***	-0.49***	0.14**	0.19**	
x = 5	-0.31***	-0.17***	-0.74***	0.26**	0.27**	0.24**
x = 8	-0.26***	-0.18***	-0.58***	0.19***	0.22**	
x = 10	-0.13**		-0.59***			
x = 15	-0.16**		-0.74***	0.24**	0.26**	
x = 20	-0.18***		-0.77***	0.43***	0.57**	
x = 25	-0.14**		-0.66***	0.24**	0.34**	

TABLE 4: Credit rating events' prior and post effect by country

This table presents the credit rating events' prior and post effect in average by each country with the rest of the countries, for all the events and distinguishing also between positive and negative events. For any rating event in a given country occurring at time *t*, the effects are calculated for a range (*x*) around 25 days prior and post the event, that is for the period [t–*x*,*t*+*x*], that is for the period [t–*x*,*t*+*x*]. In particular, since the general conclusions hold regarding short, medium and large term, the table shows the results obtained for some selected values of *x*, that is *x* = 1, 3, 5, 8, 10, 15, 20, 25. Besides, the table only reports the cases that result significant at the 10% level (*), at the 5% level (**) or at the 1% level (***).The sample period is from April 22, 2004 to January 27, 2014 and the countries are the following for six Latin American emerging markets: Argentina, Brazil, Chile, Colombia, Mexico and Peru. For Argentina only the *prior-effect* is shown, because there are not obtained significant values for the *post-effect.* Chile displays only the effect for positive events, because there are not reported negative events for Chile during the sample period. And finally, the cases of Colombia and Peru are not shown because there are not obtained significant effects.

Panel A: Argentina

	Prior-effect		
Argentina	All events	Positive events	Negative events
$x = 1$	-0.10***		-0.18***
$x = 3$	-0.37***		-1.32***
$x = 5$	-0.70***		-1.32***
$x = 8$	-0.46***		-0.76***
$x = 10$	-0.46***		-0.81***
$x = 15$	-0.58***		-1.18***
$x = 20$	-0.45***		-0.86***
$x = 25$	-0.36**		-0.69***

Panel B: Brazil

	Prior-effect			*Post-effect*		
Brazil	All events	Positive events	Negative events	All events	Positive events	Negative events
$x = 1$	-0.08***		-0.43***			
$x = 3$	-0.12**		-0.77**	0.20**		
$x = 5$	-0.29***	-0.21**	-0.90**			
$x = 8$	-0.27**		-0.96**			
$x = 10$			-0.99**	0.29**		
$x = 15$			-1.19**	0.32**		
$x = 20$	-0.38**		-1.45**			
$x = 25$			-1.27**	0.34**		

Panel C: Chile

	Prior-effect	*Post-effect*
Chile	Positive events	Positive events
$x = 3$	-0.88**	0.42***
$x = 5$	-0.76**	0.95**

Panel D: Mexico

	Prior-effect			*Post-effect*		
Mexico	All events	Positive events	Negative events	All events	Positive events	Negative events
$x = 3$	-0.10***	-0.12***				0.09**

FIGURE 1: Emerging market Average CDS spreads