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News spillovers in the sovereign debt market ☆

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Abstract

We study the effect of a sovereign credit rating change of one country on the sovereign credit spreads of other countries from 1991 to 2000. We find evidence of spillover effects; that is, a ratings change in one country has a significant effect on sovereign credit spreads of other countries. This effect is asymmetric: positive ratings events abroad have no discernable impact on sovereign spreads, whereas negative ratings events are associated with an increase in spreads. On average, a one-notch downgrade of a sovereign bond is associated with a 12 basis point increase in spreads of sovereign bonds of other countries. The magnitude of the spillover effect following a negative ratings change is amplified by recent ratings changes in other countries. We distinguish between common information and differential components of spillovers. While common information spillovers imply that sovereign spreads move in tandem, differential spillovers are expected to result in opposite effects of ratings events across countries. Despite the predominance of common information spillovers, we also find evidence of differential spillovers among countries with highly negatively correlated capital flows or trade flows vis-á-vis the United States. That is, spreads in these countries generally fall in response to a downgrade of a country with highly negatively correlated capital or trade flows. Variables proxying for cultural or institutional linkages (e.g., common language, formal trade

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blocs, common law legal systems), physical proximity, and rule of law traditions across countries do not seem to affect estimated spillover effects.

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1. Introduction

During the 1990s a fundamental shift occurred in the nature of cross-country economic linkages. While the trend toward trade liberalization continued, many observers note that financial flows are now the dominant vehicle of interdependence. Capital flows have been central in the crises of the exchange rate mechanism (ERM) in 1992, the Tequila crisis in 1994–1995, and the Asian and the Ruble crises of the latter half of the 1990s. Moreover, at least during crisis periods, cross-country transmission contributes to financial market turmoil beyond individual country borders.

In part, because of readily available high frequency data from organized exchanges, studies of financial market spillovers frequently examine co-movements of stock market returns. In the context of contagion, these studies test whether stock market correlations increase during contagious episodes.[1] In contrast, this paper contributes to a more recent literature on bond market contagion and spillovers. Empirically, we focus on the transmission of news concerning sovereign credit ratings, to sovereign bonds issued by other countries. As these rating changes occur sporadically throughout our sample period, we can examine the nature of cross-border financial market linkages in both crisis and noncrisis periods.

The study of the sovereign bond market offers some obvious advantages. First, sovereign debt serves as the benchmark for all other interest rates in the local economy, e.g., the cost of corporate borrowings, thus developments in this market have wider implications for credit conditions in general. Second, sovereign spreads reflect the default risk of borrowing countries (in addition to other risks, such as liquidity risks). Thus, conceptually, sovereign debt affords a primary channel for the transmission of spillovers of ratings.

[1]A vast literature exists on stock market contagion. Examples of theoretical models include Allen and Gale (2000), Kodres and Pritsker (2002), and Kyle and Xiong (2001). In the empirical literature on stock market contagion, substantial debate is ongoing about the definition of contagion as well as its measurement. For example, in contrast to the typical tests of a post-event increase in correlations, Bae et al. (2003) propose a multinomial logistic regression approach to measure contagion. Forbes and Rigobon (2002) draw a conceptual distinction between contagion and interdependence and suggest a sharper empirical test methodology to test for contagion. Also, see Karolyi and Stulz (1996) for an analysis of stock return co-movements between the United States and Japan, and Mauro et al. (2002) for an analysis of the co-movement of emerging market yield spreads in the 1990s as compared with 1870–1913, a previous era of global capital market integration.

Our particular focus is on the cross-market spillovers of sovereign credit rating changes. We concentrate on the spillover of a change in the sovereign debt rating or the credit outlook of one country (labeled as the event country) to interest rate spreads (vis-á-vis the interest rate of a U.S. Treasury bond of comparable maturity) on sovereign debt for all other countries (labeled as home countries).

Using a daily data set consisting of all publicly traded U.S. dollar denominated sovereign debt, we ask several related questions about observed cross-border spillovers. First, how much do sovereign spreads react to announcements concerning other sovereigns? Second, are the announcement effects asymmetric? Do negative announcements have a quantitatively different impact than positive announcements? Third, do these spillovers have an economic basis? In particular, do historical financial and trade linkages increase or reduce the size of the spillovers? Are spillovers greater between similar countries? Fourth, we explicitly study the impact of cultural or institutional linkages (e.g., common language, formal trade blocs, common law legal systems), physical proximity (distance or adjacency), and rule of law traditions across countries. Finally, we examine whether a sequence of events in separate countries reinforce each other.

We make a conceptual distinction between differential versus common information spillovers.[2]In principle, spillovers between two countries could be either positive or negative. For example, a positive ratings event, such as an explicit upgrade of the credit rating or an improvement in the credit outlook of a country, could signal a widespread common trend, thus leading to a general lowering of interest rate spreads for all other countries. We refer to this as the common information effect. Alternatively, such good news could reveal that the event country has enhanced its attractiveness at the cost of all other countries, resulting in an increase in interest rate spreads in other countries.[3]We refer to this as the differential effect. Moreover, any given rating event could contain both common information and differential effects. In these cases, we refer to the net impact. Finally, a given ratings change could have differential effects only for a subset of countries. We explicitly test for these cross-sectional effects in our empirical analysis. More formally, we hypothesize that

[2]In their study of bankruptcy announcement spillovers, Lang and Stulz (1992) characterize spillovers as the result of either contagion or competitive effects. In their context, contagion effects are declines in share prices of other (i.e., those not making announcements) firms in the industry, while competitive effects convey information about how the announcement impacts the bankrupt firm's competitors. We adopt this conceptual characterization, though in a modified form, because contagion, in current usage, typically refers to a post-event increase in correlations. In addition, there are many examples of such contagion-competitive analysis, although not necessarily in the context of the Lang and Stulz (1992) framework. For example, Bittlingmayer and Hazlett (2000) examine industry spillovers resulting from government anti-trust actions against Microsoft, and Eckbo (1983) and Stillman (1983) examine the anticompetitive effects of horizontal mergers. In the banking literature, Slovin et al. (1999) examine contagion and competitive effects at commercial banks, and Saunders (1987) examines contagion effects in the interbank market. Also, see Hand et al. (1992) for an analysis of the effect of bond rating agency announcements on U.S. bond and stock prices, and Eichengreen et al. (1996) for an analysis of whether speculative attacks in one country raise the probability of an attack in another.

[3]This could occur, for example, as a result of a rebalancing of global portfolios toward the upgraded country and away from all other countries with similar risk weightings within the portfolio.

positive (negative) events decrease (increase) sovereign spreads abroad, if the common information effect dominates the differential effect and vice versa.

We reach five primary findings. First, we find evidence of spillover effects; that is, a ratings change in one country has a significant effect on sovereign credit spreads of other countries. Second, this effect is asymmetric: positive ratings events abroad have no discernable impact on sovereign spreads, whereas negative ratings events are associated with an increase in spreads. On average, a one-notch downgrade of a sovereign bond is associated with a 12 basis point increase in spreads of sovereign bonds of other countries, assuming a 6% yield on a U.S. Treasury of comparable maturity. Third, despite the predominance of common information spillovers, we find evidence of differential spillovers for countries with highly negatively correlated trade or capital flows (vis-á-vis the United States). Our evidence also suggests that the transmission channel for spillovers is stronger through capital than through trade flow linkages. Fourth, variables proxying for cultural or institutional linkages (e.g., common language, formal trade blocs, common law legal systems), physical proximity, and rule of law traditions across countries do not seem to systematically affect observed spillovers. Fifth, our results support the Kaminsky and Reinhart (2000) assertion that susceptibility to crises is highly nonlinear more generally. In particular, we find that negative spillovers are amplified by recent ratings change activity.

Several related lines of research are reviewed in Section 2. We describe our data set in Section 3. In Section 4 we discuss our framework for analyzing spillovers in terms of common versus differential information effects. Section 4 also outlines the testable hypotheses and presents our empirical results. Section 5 concludes.

2. Brief review of the literature

Early studies of ratings changes, e.g., Cantor and Packer (1996) and Reisen and von Maltzan (1999), focus on the impact of ratings changes on own country spreads. While the estimated own country effects are often substantial, they reveal little about spillovers. Moreover, to the extent spillovers are empirically relevant, one potential limitation of studying own country effects is that the event window could be contaminated by events in other countries, which can distort the estimated effect on spreads.[4]

One recent debate concerns whether credit rating agencies have been effective in predicting crises and whether their actions have contributed to crisis severity. The findings of Cantor and Packer (1996) and Reisen and von Maltzan (1999) suggest that sovereign ratings are effectively a sufficient statistic for explaining cross-sectional interest rate spreads; that is, once ratings are included in a cross-section regression, other macroeconomic variables lose their explanatory power. However, in an influential paper, Radelet and Sachs (1998) argue that the sovereign credit

[4]In our data more than two-thirds of the ratings events occur within 30 days of each other, which is the typical window length for studies that examine own country spreads.

rating agencies not only failed to predict the recent Asian financial crisis, but also exacerbated it by downgrading countries after the onset of the crisis. More recently, Reinhart (2002) shows a strong link between currency crises and default in emerging economies. She finds that sovereign credit ratings systematically fail to predict currency crises but do considerably better in predicting defaults.[5] Ultimately, whether ratings changes convey new information that is relevant across markets is an empirical issue that we examine in this study.

Another strand of research focuses on the transmission channels during specific crisis episodes or within regional groupings of countries. Eichengreen and Mody (2000) analyze data on developing country bonds issued in the years 1991–1996 and find that observed changes in fundamentals explain only a fraction of the spread compression in the period leading up to the crisis in emerging markets. Hernandez and Valdes (2001) examine the relative importance of alternative contagion channels during the Thai, Russian, and Brazilian crises. They find that, when crises are measured by changes in sovereign bond spreads, financial competition seems to explain almost all contagious episodes. When crises are measured by stock market returns, trade links and neighborhood effects are dominant during the Thai and Brazilian crises, while financial competition is the relevant channel during the Russian crisis. De Gregorio and Valdes (2001) examine similar issues during the 1982 debt crisis, the 1994 Mexican devaluation, and the 1997 Asian crisis. Using daily data during the Asian currency crisis, Ito and Hashimoto (2002) examine contagion effects among six Asian countries. They find that bilateral trade linkages are an important component of currency market participants' expectations of subsequent cross-country transmission of exchange rate shocks. Rigobon (2003) examines whether a shift occurs in the transmission of shocks during crises and develops a test for the stability of the transmission mechanisms among 36 stock markets during the last three major financial crises. Rigobon (2002) examines the impact of an upgrade of Mexico from noninvestment grade to investment grade in 2000 and shows a statistically significant change in the propagation of shocks around the time the upgrade was announced.

Other studies have attempted to identify the specific news events in one country that affect other countries. Kaminsky and Schmukler (1999) examine what type of news moved the stock markets of nine Asian countries during the Asian crisis. Baig and Goldfajn (1999) examine spillover effects in five Asian economies using daily data for one year during the Asian crisis by categorizing all news events as either Good News or Bad News. In contrast to these studies, our study estimates the impact to home country sovereign spreads of specific ratings change events abroad for 34 countries over a ten-year period that spans both crisis and noncrisis time periods.

A few recent studies specifically examine bond market interdependence around crises events. Kaminsky and Reinhart (2001) find that the degree of interdependence among interest rates of four Asian countries (Indonesia, Korea, Philippines, and

[5]Slightly less than half of the currency crises are linked to default, and 84 percent of defaults are associated with currency crises.

Thailand) was most intense during the period immediately following the Thai and Korean currency devaluations. Kaminsky and Reinhart (2002) examine daily co-movements of bond, equity, foreign exchange, and domestic money markets for 35 developed and emerging markets during the turbulent 1997–1999 period. They find important differences in the co-movement of returns across these four asset markets, with bond markets exhibiting the greatest degree of international synchronization.

Closer in spirit to the present paper, Kaminsky and Schmukler (2002) focus on 16 emerging markets and ask whether sovereign credit rating changes contribute to market instability. They find that ratings changes directly impact stock and bond markets of the countries being rated. They also find evidence of cross-country contagion, particularly during crisis times and among neighbor countries. Our study differs from theirs in several ways. First, we consider a larger set of 34 countries that includes both developed and emerging markets. Second, we characterize these spillovers economically, e.g., by including control variables for trade and capital flows, cultural and institutional linkages, physical proximity, and rule of law traditions. Ultimately, we provide several new results, including evidence of asymmetric spillovers, and a linkage between spillovers and trade and capital flows. We find these linkages are more pervasive than cultural, regional, or institutional arrangements. Finally, we present evidence that negative ratings are amplified by recent ratings change activity.

3. Data

The primary data set we examine consists of daily market-closing observations of the interest rate spread over the closest (maturity) matched U.S. government bond for all countries with (currently) publicly traded U.S. dollar denominated sovereign debt. The data cover the period from January 1, 1991 to December 31, 2000 and are compiled from Bloomberg. The only criterion for inclusion in our data set is the existence of publicly traded U.S. dollar denominated sovereign debt as of March 2001. The thirty-four countries meeting this criterion are Argentina, Austria, Belgium, Brazil, Canada, Chile, China, Columbia, Denmark, Finland, Greece, Hungary, Iceland, Indonesia, Ireland, Israel, Italy, Korea, Lebanon, Malaysia, Mexico, New Zealand, Panama, Philippines, Poland, South Africa, Spain, Sweden, Thailand, Tunisia, Turkey, United Kingdom, Uruguay, and Venezuela.

The time-series data on ratings changes for these countries are obtained from the Standard & Poor's (S&P) website (http://www2.standardandpoors.com). We focus on S&P ratings changes for several reasons. First, Standard and Poor's appears to be more active in making ratings changes, thereby providing a larger data set. For example, in our sample period, there are 36% more ratings changes by S&P than by Moody's. Second, other authors find that S&P ratings changes tend not to be anticipated by the market (Reisen and von Maltzan, 1999). Finally, in our own comparisons we find that S&P ratings changes precede Moody's roughly two-thirds of the time.

We also examine lower frequency economic data for these countries. We obtain data on bilateral gross capital flows between each country in our sample and the United States. The U.S. Treasury's website (http://www.treas.gov/tic/) posts bilateral monthly data on flows (purchases and sales) of private and public debt between the United States and other countries. We focus on the aggregate bilateral numbers, i.e., sales plus purchases of all short term public plus private debt. We examine data on bilateral trade flows between each country and the United States. Monthly data are available from the U.S. Census Bureau at http://www.census.gov/foreign-trade/balance/index.html#A.

We also utilize a host of time-invariant country-specific data characterizing various cultural, legal, and institutional features of the countries in the sample. Trade bloc definitions are taken from Frankel (1997). Based on his findings, we focus on membership in four primary trade blocs: the North American Free Trade Agreement (Nafta), the Mercado Comun del Sur (Mercosur), the European Union (EU), and the Association of South East Asian Nations (Asean). The legal tradition of each country in our sample is classified by its origin (common law or civil law) and the rule of law tradition. La Porta et al. (1997, 1998) compile and tabulate these variables. In the few instances in which our countries are not included in their studies we collect these data from the original sources (Reynolds and Flores (1989) and the International Country Risk Guide at http://www.prsgroup.com).

Classification of countries into emerging/developed is obtained from www.securities.com (a Euromoney website), the International Finance Corporation (IFC) Emerging Stock Markets Factbook (1996), and the S&P/IFC Emerging Stock Markets Factbook (2001). The S&P uses the additional classification "Frontier," which counts as emerging. A country is defined as emerging if it is listed as emerging in at least one of these three sources. We include bilateral dummy variables for sharing a common language and adjacency. The language dummy takes the value one if the country pair shares a common language (either official or primary business language), and zero otherwise. The data are taken from the *CIA World Factbook* (http://www.cia.gov/cia/publications/factbook/indexgeo.html). We also include an explicit measure of physical distance between countries, computed as the greater-circle distance between countries' capital cities. The latitude and longitude information is available at http://www.un.org/Depts/unsd/demog/392.htm. Finally, we explicitly control for crisis episodes. Our sample spans the Mexican, Asian, Russian, and Brazilian crises. Collectively, there were 53 ratings events during these crises out of a total of 155 ratings events we consider.

4. Empirical results

This section contains four sections. We begin by discussing rating events and their temporal distribution throughout our sample. We next describe our empirical specification and we present our benchmark spillover results. In Section 3 we ask whether rating agencies anticipate spillover effects and adjust ratings simultaneously. The final section presents some robustness results.

4.1. Preliminary analysis

The starting point for our analysis is the definition of a rating event (which is often referred to as a rating change). Focusing on implemented ratings changes could be too restrictive. Rating agencies typically issue secondary announcements about credit outlook that could qualify a country's stated grade. For example, Standard & Poor's frequently puts sovereigns on credit watch–negative a few months prior to a downgrade. Hence, focusing on the explicit ratings alone (represented by the letter grade D through AAA) could miss important information. A country with a particular credit rating (say, BBB) that receives a positive credit outlook and a few months later has its prior credit rating confirmed (no upgrade in the explicit credit rating of BBB) in our framework represents two events, namely upgrade in the credit outlook and confirmation of prior credit rating. Focusing on the explicit credit rating alone would erroneously omit these events. We thus incorporate the additional information in the credit outlook into a comprehensive credit rating (CCR). Consequently, we define ratings changes (events) more generally to include changes in either the credit rating or the credit outlook. In other words, events can be positive, such as an upgrade of the explicit credit rating (letter rating) or an upward revision in the credit outlook of the sovereign, or they can be negative, such as a downgrade of the explicit credit rating or a downward revision in the credit outlook of the sovereign.

We numerically code the letter ratings on a scale from 0 (lowest) to 16 (highest). Similarly, we code the credit outlook on a scale between -1 (negative) and $+1$ (positive). Thus each country's bonds have a comprehensive credit rating for each time period. Our interest is any nonzero change in the aggregate comprehensive credit rating of a sovereign. Appendix A tabulates the construction of our comprehensive credit rating.

Table 1 contains some data on individual rating change events. There were 155 events between January 1, 1991 and December 31, 2000. According to the table,

Table 1
Number of ratings events on a single day
The sample is separated into positive events and negative events based on Standard and Poor's ratings.

Number of events on a day	All events		Positive events		Negative events	
	Frequency	Density	Frequency	Density	Frequency	Density
1	128	85.3%	66	84.6%	70	90.9%
2	16	10.7	8	10.3	7	9.1
3	2	1.3				
4	4	2.7	4	5.1		
Total[a]	150		78		77	

[a]For the five days having both positive and negative events, the event direction (positive or negative) is determined by the net ratings change. Hence, $150 = 78 + 77 - 5$.

ratings changes are most commonly announced individually (for one country at a time), though multiple event days occur for 15% of the cases. Table 1 also splits the sample into positive and negative events. The number of positive (78) and negative events (77) is approximately equal. On only five days are positive and negative ratings announcements made on the same day. For these five days we focus on the net ratings change. This overlap reduces the number of ratings changes to 150 ($78 + 77 - 5$).

In addition to multiple event days, events could be clustered in time. One way to quantify this is the duration between rating changes. Fig. 1 depicts the time duration between rating change events. Many ratings announcements are preceded by other ratings announcements. For example, 49 events, or about one-third, came within two weeks (ten trading days) of another ratings announcement. Similarly, fully one-half of the events followed other events by three weeks or less.

This temporal association suggests that ratings changes could have different impacts, depending on other ratings change activity. Moreover, failing to account for such clustering could seriously bias the estimated effects of ratings changes, even in studies focusing on own country effects (e.g., Cantor and Packer, 1996; Reisen and von Maltzan, 1999), because the event-window could be contaminated by spillover effects of ratings changes in other countries. Alternatively, if ratings changes are regarded (by market participants) in the context of recent changes, or if the effects persist beyond a day, part of today's change in spreads will be influenced by prior ratings changes. The importance of considering events in other countries is also highlighted by Kaminsky and Reinhart (2000), among others. In our data more than two-thirds of the ratings events occur within 30 days of each other, the typical window length for studies that examine own country spreads. If spillovers exist, the measured own country effect will be a function of these other events within the window. Fig. 2 presents another view of this clustering for positive and negative events separately. Both calm and active spells are in the data. It is an empirical question whether this intensity matters for the reaction of sovereign spreads to these news events.

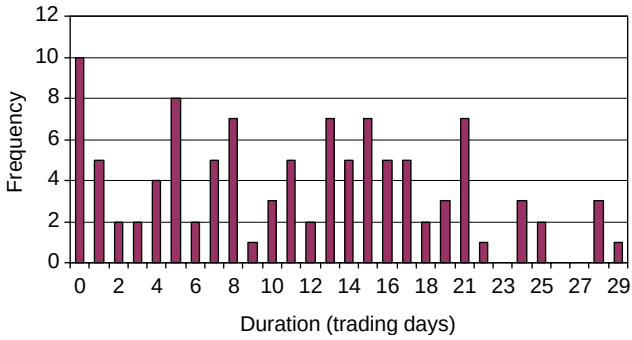

Fig. 1. Frequency and time duration between ratings event.

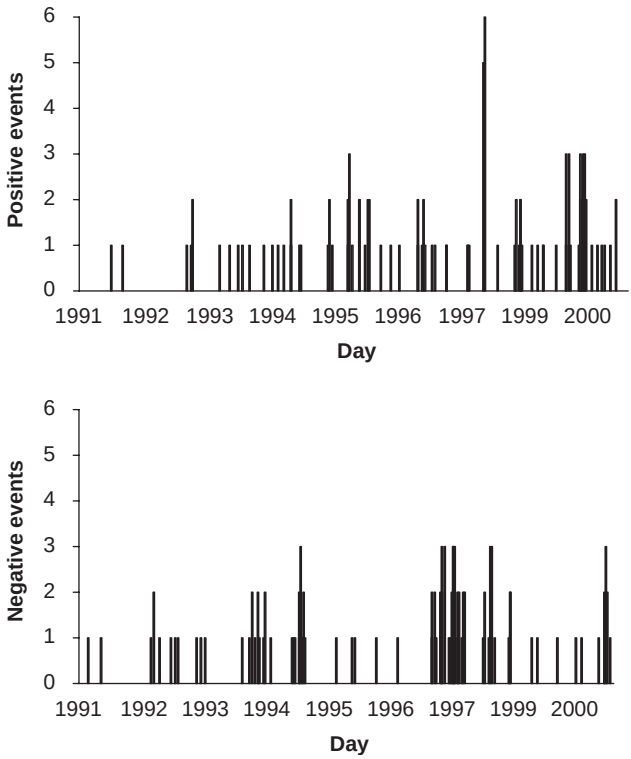

Fig. 2. Positive and negative events within a two-week window.

4.2. Empirical specification and benchmark results

The variable of interest in verifying the existence of spillovers is the interest rate response in country $j(\neq i)$ to an event (change in the CCR) in country $i(\neq j)$. This variable, referred to as the change in spreads (or as the interest rate response), is defined as the change in the percentage spread, i.e., the interest rate differential over a U.S. Treasury bond of comparable maturity, as a percentage of the relevant U.S. Treasury interest rate. For robustness, we examine the basis point spread, measured as the interest rate differential in basis points (1/100th of a percentage point) over a U.S. Treasury of comparable maturity. When we have multiple sovereign bonds issued by the same country, e.g., of different maturities, issued at different times, we choose one representative bond with the most time-series observations, to ensure greater consistency throughout the sample. We refer to the interest rate response generically as the (change in) spread. We use a standard two-day window [0,1] to incorporate the effects of time-zone differences between the location of the exchange where the

sovereign bonds are traded (London or Luxembourg) and the countries in our sample.[6]

For estimation, we pool the data for all countries (j) excluding the event country (i), at each event time (t) into two subsamples, one for positive events and another for negative events. For ease of interpretation, we force the sign of $Event_{i,t}$ to be the same for both negative and positive regressions. $Event_{i,t}$ is defined as the absolute value of the aggregate change in comprehensive credit ratings across all countries, i.[7] Overall, our data set has a panel structure: 150 events and 34 countries. Thus, we have a maximum (positive + negative) of $33 \times 150 = 4,950$ data points. However, given that not all countries had data for all 150 events in the sample, the total number of observations in our sample is 2,122 (1,114 for positive events and 1,008 for negative events).[8] Specifically, we estimate the following regression for both negative and positive events separately.

$$\Delta\ Spread_{j,t} = \alpha + \beta_1\ \mathrm{Event}_{i,t} + \sum_k \beta_k X_k + \varepsilon_{ij,t}, \quad \forall j \neq i. \tag{1}$$

Initially, the matrix X contains controls for the maturity of the bond and full sets of year and country dummies. We also include the level of the home and event country comprehensive credit ratings, to allow the effects of ratings changes to vary with the credit rating of both countries under consideration. The spillover effect for a sovereign rated B might differ from that for another rated AA. Subsequently, we consider additional explanatory variables X_k, as well as different definitions of the dependent variable.

Our research design avoids the event window contamination problem (the potential impact of temporal clustering of events in other countries). First, we measure the dependent variable as the change in the interest rate spread over a short window (two-days), instead of over a benchmark estimated using a longer historical time period, such as 30 days. Second, we control for the intensity of past events as a separate independent variable (an element of the matrix X).

Results from estimating Eq. (1) are summarized in Table 2. Immediately apparent in the table is the contrast between the results for positive events and those for negative events. For negative ratings events, the estimated sign of β_1 is consistent with the presence of common information effects. That is, negative news for one country translates into increased spreads for all dollar denominated sovereign debt. However, positive events do not appear to induce statistically significant spillover effects.

[6]While spillovers due to an event (day 0) in the later part of the day in a Western country of our sample, such as Venezuela, will be recorded on day 1 in London or Luxembourg, spillovers due to an event (day 0) in the earlier part of the day in an Eastern country in our sample, such as New Zealand, will be recorded the same day in London or Luxembourg.

[7]This does not affect our interpretation of the coefficients because we run the positive and negative analysis separately.

[8]For example, a few of the sovereign bonds in our sample were issued as late as 1998, making it impossible for us to measure the spillover effects on these bonds of events prior to their issuance.

Table 2
Asymmetric spillover effects
This table presents the coefficient estimates from the equation

$$\Delta Spread_{j,t} = \alpha + \beta_1 Event_{i,t} + \beta_2 Prior\ event_{i,t} + \sum_k \beta_k X_k + \varepsilon_{ij,t}, \quad \forall j \neq i.$$

In the first specification, we include only the $Event_{i,t,}$. In the second specification, we include a measure of recent ratings change activity ($Prior\ event_{i,t}$). The dependent variable is the cumulative two-day [0,1] change in the percentage spread. Percentage spreads are calculated as the interest rate differential over a U.S. Treasury bond of comparable maturity, as a percentage of the relevant U.S. Treasury interest rate. Event is defined as the change in the comprehensive credit rating. Prior event is defined as the cumulative change in the comprehensive credit ratings of nonevent country bonds during the two weeks preceding the event.

	Positive rating events				Negative rating events			
	(1)		(2)		(3)		(4)	
Variable	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic
Constant	24.092	4.777[a]	24.470	4.852[a]	13.469	0.804	9.427	0.560
Maturity	−0.895	−4.990[a]	−0.909	−5.067[a]	−0.510	−0.894	−0.380	−0.665
Event	0.025	0.135	0.068	0.382	1.960	3.260[a]	2.286	3.512[a]
Prior event			−0.179	−1.634			0.527	3.000[a]
Comprehensive credit rating (event country)	0.058	1.125	0.094	1.740	0.777	2.873[a]	0.880	3.118[a]
Comprehensive credit rating (nonevent country)	−0.026	−0.125	−0.022	−0.107	−0.046	−0.100	−0.022	−0.047
Year dummies	Yes		Yes		Yes		Yes	
Event country dummies	Yes		Yes		Yes		Yes	
Home country dummies	Yes		Yes		Yes		Yes	
Adjusted R^2	0.134		0.135		0.095		0.098	
Observations	1,114		1,114		1,008		1,008	

[a]The superscript a indicates statistical significance at the 1% level using robust standard errors in a two-tailed test.

One possible explanation for such a direction-specific impact is that positive events are anticipated (e.g., a local government could have an incentive to leak or preannounce the likelihood of a positive ratings change soon after any favorable discussions with a rating agency), whereas negative events tend to have a larger surprise component because of the absence of similar incentives. Another possible explanation could be a tendency of the rating agencies to maintain the ratings at a higher level and, consequently a reluctance to lower the sovereign credit rating or the credit outlook. This could arise from fears of losing continued access to critical information, such as the level of foreign currency reserves, which could be privately observed by the foreign governments.[9]

Overall, the results in Table 2 indicate that negative rating changes are more informative than positive events. In particular, the estimated coefficient on β_1 (for negative announcements) indicates that a one-notch cumulative drop in the comprehensive credit rating during a two-week period is associated with a 12 basis point increase in yields of other country bonds, assuming a 6% yield on a U.S. Treasury bond of comparable maturity.[10]

Nonlinearity, in the sense used by Kaminsky and Reinhart (2000), implies that events in other countries can cumulate. Hence, an announcement in isolation will have a different impact than one announced in the context of other ratings changes. Empirically, we wish to allow for the cumulative impact of a sequence of time-clustered events and for the possibility of multiple or offsetting events. We examine this by introducing an additional term into the above specification. This variable measures the net rating change (excluding those in the event country) during the preceding two weeks.[11] For robustness, we also consider one- and three-week windows.

The estimates confirm the nonlinear nature of the relationship. In particular, in the negative events regression, we reject (at the 1% level) the null hypothesis that recent ratings activity does not matter. Moreover, once we control for the context of the ratings change, the estimate of spillovers increases. According to this specification, a negative rating announcement abroad increases spreads by an average of 14 basis points in nonevent countries. However, adding these recent ratings events to the positive events regression has no impact on the evidence that positive events are not associated with any spillovers.

To summarize, most sovereign ratings changes are announced singly. However, most sovereign ratings changes are not announced in isolation. One-third of all announcements occur within two weeks of another announcement. Moreover, this announcement intensity varies through time. We confirm the importance of this

[9]Such a bias has been well documented in the literature on equity analysts. For example, Womack (1996) concludes that "new buy recommendations occur seven times more often than sell recommendations, suggesting that brokers are reluctant to issue sell recommendations."

[10]With unchanged U.S. interest rates (e.g., 6%), 12 basis points $\approx 6\%^{*}$ the change in percentage spreads ($1.96 = \hat{\beta}_1$ in Table 2).

[11]For a particular country, ratings changes are not typically revised in quick succession. However, three events were revised within the two-week window. Given that our focus is on spillovers, we exclude own country events within the window.

intensity for negative ratings changes. Both the announcement and recent prior announcements have explanatory power for the response of sovereign spreads to downgrades. Our results also support the hypothesis that an asymmetry exists between the information conveyed by positive events and negative events. In particular, negative events, such as downgrades and downward revisions in credit outlook, appear to be highly informative, while positive events, such as upgrades and upward revisions in credit outlook, have no discernable impact on spreads. Finally, the evidence suggests that negative news concerning one country is interpreted broadly as negative news in general, i.e., as common information.

4.3. Transmission mechanisms and their economic basis

There are a number of transmission channels for these ratings events. One possibility is the potential impact of a ratings change in country i on the rating of country j. Do rating agencies anticipate spillover effects, and thus adjust ratings simultaneously?[12] As a result of the temporal clustering shown in Fig. 2, ratings changes in other countries could have a lagged effect. We can be more precise by modeling the probability of a rating change event directly as a function of events in other countries using a probit specification.

In constructing the sample for the probit estimation, we take all of the events and select a matched sample of nonevent days as a control group. The structure of the control sample will be the same as the event sample (if country A has three events, three nonevent days are selected for the control sample). Even though we sample the control group randomly, we perform a Monte Carlo experiment by repeating the exercise 10,000 times to ensure that our control group is representative. In subsequent analysis we are concerned with possible differences in the information content of positive and negative announcements, hence we model the probability of ratings changes separately for positive and negative events samples. That is, observed ratings changes in country j are modeled as a function of contemporary and lagged ratings changes in all other countries. Specifically, we estimate

$$\Delta rating_{j,t} = \alpha + \beta_1 \Delta rating_{\forall i \neq j,t} + \beta_2 \Delta rating_{\forall i \neq j,t-10,t-1} + \sum_k \beta_k X_k + \varepsilon_{j,t}, \qquad (2)$$

where $\Delta rating_{j,t}$ is a dummy variable taking the value one on days of a change in the comprehensive credit rating of the jth country at time t and $\Delta\ rating_{\forall i \neq j,t}$ is the sum of the ratings changes of all other countries at time t. $\Delta\ rating_{\forall i \neq j,t-10,t-1}$ is the sum of the ratings changes of all other countries between time $t-10$ (days) and $t-1$. For ease of interpretation, we use the absolute values of the sums for both negative and positive regressions. The matrix X contains year dummies as additional controls. In Table 3, we report the average (across the 10,000 estimations) marginal effects and their t-statistics.[13] According to the estimates, some evidence emerges for rating

[12]We thank a referee for drawing our attention to this issue.

[13]The marginal effects and their standard errors are calculated according to Greene (2003, pp. 667–675).

Table 3
Ratings events spillovers (probit estimations)
This table summarizes the results of tests of the hypothesis that the probability of a ratings change in a given country increases with (similarly signed) ratings events in other countries. For both positive and negative ratings change samples we report two specifications, one without year dummies and one with year dummies. Specifically, we estimate

$$\Delta rating_{j,t} = \alpha + \beta_1 \Delta rating_{\forall i \neq j,t} + \beta_2 \Delta rating_{\forall i \neq j,t-10,t-1} + \sum_k \beta_k X_k + \varepsilon_{j,t},$$

where $\Delta rating_{j,t}$ is a dummy variable taking the value one on days of a change in the comprehensive credit rating of the jth country at time t and $\Delta rating_{\forall i \neq j,t}$ is the sum of the ratings changes of all other countries at time t. $\Delta rating_{\forall i \neq j,t-10,t-1}$ is the sum of the ratings changes of all other countries between time $t-10$ (days) and $t-1$. For each simulation, an equal number of nonevent days is sampled from the raw data as a control sample and paired with the event sample. We repeat this 10,000 times for both the positive and negative ratings events. Information saved from each estimation includes the coefficients and standard errors, the implied marginal effects and standard errors, and the pseudo R^2. The table reports the averages across all 10,000 estimations.

	Positive rating events				Negative rating events			
	(1)		(2)		(3)		(4)	
Variable	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic
Constant	−0.050	−0.945	−0.117	−0.660	−0.047	−0.947	−0.079	−0.570
Ratings change other countries (same day)	0.494	1.756	0.495	1.759	0.456	1.070	0.413	0.729
Ratings change other countries (previous two weeks)	0.076	0.946	0.064	0.764	0.094	1.537	0.065	0.944
Year dummies	No		Yes		No		Yes	
Pseudo R^2	0.047		0.089		0.035		0.076	
Observations	152		152		148		148	
Number of estimations	10,000		10,000		10,000		10,000	

spillovers for ratings upgrades, though the results are significant at only the 10% level. For ratings downgrades, where we previously reported evidence of ratings spillovers to spreads (Table 2), there is no evidence linking ratings downgrades abroad to the probability of a downgrade at home.

Another way to address this question is to ask whether ratings changes in a particular country are Granger-caused by ratings changes in other countries. As in the probit estimations we pool the data across countries and we conduct a similar Monte Carlo experiment. After each sample is drawn, we regress observed ratings changes in country j on contemporary and previous ratings changes in all other countries. Specifically, we estimate (by ordinary least squares)

$$\Delta rating_{j,t} = \alpha + \sum_{m=1}^{10} \beta_m \Delta rating_{j,t-m} + \sum_{n=1}^{10} \beta_n \Delta rating_{\forall i \neq j,t-n} + \sum_{k} \beta_k X_k + \varepsilon_{j,t}, \tag{3}$$

where $\Delta rating_{j,t}$ is the change in the comprehensive credit rating of the jth country at time t. The matrix X contains year dummies as additional controls. The independent variables include ten lags of ratings changes in country j and ten lags of (the sum of) ratings changes in all other countries. The test for Granger-causality is an exclusion restriction on the (ten) β_n coefficients, i.e., that they are all equal to zero. In Table 4, we summarize results for four specifications: for upgrades and downgrades, we report specifications with and without year dummies. For each specification we report the average F-statistic and significance levels across the 10,000 regressions. According to the table, there is no evidence of Granger-causality in the data. We are unable to reject the joint hypothesis that the coefficients on lagged ratings changes of other countries are zero. These results, combined with those in Table 3, suggest that ratings changes are not themselves being transmitted across countries.

Despite the prevalence of common information spillovers presented in Table 2, some cases could arise in which the interest rate response is opposite in sign (e.g., bad news abroad could lower domestic spreads) perhaps because of a rebalancing of global portfolios. Alternatively, a negative announcement could raise spreads in some countries relative to other countries. We attempt to isolate these differential effects by explicitly accounting for linkages among capital and trade flows.[14] We hypothesize that the spillover impact of a ratings change should be heightened for two countries with highly correlated trade or capital flows (either positively or negatively). More formally, we expect common information spillovers to dominate for countries with highly positively correlated capital (trade) flows and differential effects to exist between countries with highly negatively correlated capital (trade) flows.

[14]Note that trade and capital flows do not sum to zero (as in a country's balance of payments) because we consider only bilateral flows (vis-á-vis the United States), the trade flows do not include services, and official transactions are excluded.

Table 4
Ratings events spillovers (Granger-causality regressions)
This table summarizes the results of tests of the hypothesis that ratings events in a given country are Granger-caused by previous ratings events in other countries. For both positive, and negative ratings change samples we report two specifications, one including, and one excluding year dummies. Both specifications regress observed ratings changes in country j on contemporary and previous ratings changes in all other countries. Specifically, we estimate

$$\Delta rating_{j,t} = \alpha + \sum_{m=1}^{10} \beta_m \Delta rating_{j,t-m} + \sum_{n=1}^{10} \beta_n \Delta rating_{\forall i \neq j, t-n} + \sum_k \beta_k X_k + \varepsilon_{j,t},$$

where $\Delta rating_{j,t}$ is the change in the comprehensive credit rating of the jth country at time t. The independent variables include ten lags of ratings changes in country j and ten lags of (the sum of) ratings changes in all other countries. The test for Granger-causality is an exclusion restriction on the β_n coefficients. The F-statistic and significance level is reported for each of the four specifications. For each simulation, an equal number of nonevent days is sampled from the raw data as a control sample and paired with the event sample. We repeat this 10,000 times for both the positive and negative ratings events. The table reports the averages across all 10,000 estimations.

	Positive rating events		Negative rating events	
Description	(1)	(2)	(3)	(4)
$H_0 : \beta_n = 0, \forall n$	1.529	1.473	1.467	1.115
Significance level	0.200	0.226	0.222	0.408
Year dummies	No	Yes	No	Yes
Adjusted R^2	0.032	0.035	0.118	0.141
Observations	152	152	148	148
Number of estimations	10,000	10,000	10,000	10,000

We empirically implement this idea by considering time-series correlations of gross capital (and trade) flows (inflows plus outflows) of each country in our sample vis-á-vis the United States. Thus, we treat the United States as a proxy for the rest of the world from each country's perspective. This choice is dictated by a desire to employ a database with consistent collection and assimilation methods across countries. To allow for changing economic fundamentals in, and perceptions of, each foreign country, these correlations are recomputed at every event date using a moving window of capital (and separately, trade) flow data. Given results from other studies of herd and trend-chasing behavior in financial portfolio data, we conjecture that more recent capital flows history will be more relevant. However, given that the data are reported only monthly, calculating extremely short-term correlations is infeasible. Hence we compromise and focus on only the most recent six months to compute the correlation of capital (and trade) flows. For completeness, we also report results using correlations computed from longer (12 months) time spans.

Thus, for each event date we use the most recent six or 12 months of data and compute the vector of correlation coefficients. We identify those country pairs with high positive correlation and those with high negative correlation. For those countries with highly correlated capital flows (the top quartile of the empirical distribution), we assign a value of one to a dummy variable; all other observations

are assigned a zero value. We contrast these country pairs with those having high negative correlation (the bottom quartile of the empirical distribution). Both dummies are included in the regression. Subsequently, we use the entire vector of correlation coefficients instead of dummy variables as an additional robustness check. Both methods produce similar results.

The results from incorporating these new variables are presented in Table 5. We present results considering capital and trade flows individually, and then all four dummy variables simultaneously. We find that, as hypothesized, home country spreads decrease (relative to the average) in response to a negative event abroad when capital flows are negatively correlated. The coefficient estimate of −2.55 is statistically significant at the 1% level. That is, compared with a typical country experiencing a ratings downgrade, we find a decrease of approximately 15 basis points in the sovereign spreads of similarly downgraded countries having highly negatively correlated capital or trade flows with the United States.[15] However, we find no such effect for positive events, which is not surprising because we find no evidence of spillovers for positive events in Table 2.

Moreover, home country spreads decrease (relative to the average) in response to a negative event abroad for countries with highly negatively correlated trade flows. The coefficient estimate of −2.12 is statistically significant at the 5% level and implies a 13 basis point decrease in home country spreads in response to a one-notch downgrade in the event country.[16] As with capital flows, we find no such effects for positive events.

In Table 6, we add controls for emerging/developed country status, membership in a trade bloc, common law legal system, rule of law, adjacency, physical distance between countries, existence of a common language, and crisis periods.[17] A trade bloc, signifying a formal agreement between countries, serves as a long-term commitment among its members to reduce trade barriers and formally commits its members to a path of increased economic integration within the bloc. An alternative explanation for the formation of trade blocs is that highly integrated countries are more likely to form a bloc. To the extent that member economies are more closely linked, common information spillovers are likely to predominate. Consequently, one would expect a decrease (increase) in spreads to be higher for positive (negative) events associated with countries from the same trade bloc relative to other countries. The sign of the coefficient on our trade bloc variable supports this interpretation, though the coefficient is never statistically different from zero.

[15]With unchanged U.S. interest rates (e.g., 6%), 15 basis points ≈ 6%* the change in percentage spreads (−2.55).

[16]Again, 13 basis points ≈ 6%* the change in percentage spreads (−2.12).

[17]The dummy variables for emerging or developed country status, common law legal system, membership in a trade bloc, and common language take the value one when both countries are a member of the category, and zero otherwise. Adjacency is a variable that takes the value one when the countries share a land border and zero otherwise. Distance is measured from each country's capital cities, using the great circle formula as in Parsley and Wei (2001). Rule of law is a variable that takes the average of the rule of law scores of the two countries. The crisis dummy variable takes the value one during crisis periods and zero otherwise.

Table 5
Differential and common information spillovers, capital and trade flows
This table presents the coefficient estimates from the equation

$$\Delta Spread_{j,t} = \alpha + \beta_1 Event_{i,t} + \beta_2 Prior\ event_{i,t} + \sum_k \beta_k X_k + \varepsilon_{ij,t}, \quad \forall j \neq i.$$

We sequentially add variables for highly correlated capital flows and for trade flows. The dependent variable is the cumulative two-day [0,1] change in the percentage spread. Percentage spreads are calculated as the interest rate differential over a U.S. Treasury bond of comparable maturity, as a percentage of the relevant U.S. Treasury interest rate. Event is defined as the change in the comprehensive credit rating. Prior event is defined as the cumulative change in the comprehensive credit ratings of nonevent country bonds during the two weeks preceding the event.

	Positive rating events				Negative rating events			
	(1)		(2)		(3)		(4)	
Variable	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic
Constant	24.821	4.866[a]	23.706	4.871[a]	4.172	0.236	12.318	0.802
Maturity	−0.916	−5.080[a]	−0.880	−5.079[a]	−0.160	−0.263	−0.490	−0.947
Event	0.071	0.395	0.058	0.319	2.220	3.472[a]	2.402	3.663[a]
Prior event	−0.180	−1.639	−0.176	−1.628	0.470	2.656[a]	0.496	2.854[a]
Capital flows—positive	0.257	0.957			−1.150	−1.694		
Capital flows—negative	−0.133	−0.562			−2.551	−2.591[a]		
Trade flows—positive			−0.324	−1.183			0.287	0.427
Trade flows—negative			−0.340	−1.434			−2.120	−2.136[c]
Comprehensive credit rating (event country)	0.092	1.681	0.084	1.571	0.784	3.055[a]	0.889	3.124[a]
Comprehensivecredit rating (nonevent country)	−0.025	−0.123	−0.030	−0.149	0.087	−0.186	−0.020	−0.042
Year dummies	Yes		Yes		Yes		Yes	
Event country dummies	Yes		Yes		Yes		Yes	
Home country dummies	Yes		Yes		Yes		Yes	
Adjusted R^2	0.135		0.136		0.105		0.103	
Observations	1,114		1,114		1,008		1,008	

[a]The superscripts a and c indicate statistical significance at the 1% and 5% level using robust standard errors in a two-tailed test.

Table 6
Differential and common information spillovers, cultural, legal, institutional linkages, and crisis controls
This table presents the coefficient estimates from Eq. (1). We simultaneously add variables for highly correlated trade and capital flows, membership in a trade bloc, home and event country status as emerging/developed, contiguity, distance, common language, origin of legal system, and rule of law. We estimate

$$\Delta\ Spread_{j,t} = \alpha + \beta_1\ Event_{i,t} + \beta_2\ Prior\ event_{i,t} + \sum_k \beta_k X_k + \varepsilon_{ij,t}, \quad \forall j \neq i.$$

The dependent variable is the cumulative two-day [0,1] change in the percentage spread. Percentage spreads are calculated as the interest rate differential over a U.S. Treasury bond of comparable maturity, as a percentage of the relevant U.S. Treasury interest rate. Event is defined as the change in the comprehensive credit rating. Prior event is defined as the cumulative change in the comprehensive credit ratings of nonevent country bonds during the two weeks preceding the event.

	Positive rating events				Negative rating events			
	(1)		(2)		(3)		(4)	
Variable	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic
Constant	21.735	4.171[a]	20.697	3.989[a]	11.681	0.661	9.955	0.545
Maturity	−0.859	−5.004[a]	−0.806	−4.691[a]	−0.275	−0.497	−0.153	−0.251
Event	0.058	0.325	0.188	1.133	2.317	3.573[a]	2.207	3.376[a]
Prior event	−0.149	−1.409	−0.085	−0.768	0.447	2.571[b]	0.485	2.824[a]
Emerging	1.073	1.134	0.510	0.515	−1.709	−0.251	−3.506	−0.504
Developed	−0.587	−0.636	−0.040	−0.040	−10.235	−2.272[b]	−8.477	−1.789
Capital flows—positive	0.311	1.188	0.287	1.094	−1.042	−1.596	−1.083	−1.641
Capital flows—negative	−0.117	−0.493	−0.101	−0.428	−2.617	−2.630[a]	−2.583	−2.653[a]
Trade flows—positive	−0.307	−1.128	−0.282	−1.023	0.154	0.222	0.188	0.267
Trade flows—negative	−0.368	−1.585	−0.380	−1.628	−2.056	−2.195[c]	−1.983	−2.181[c]
Adjacent	0.215	0.307	0.208	0.296	−3.208	−1.440	−3.099	−1.387

Distance	0.000	1.057	0.000	1.069	−0.000	−0.538	−0.000	−0.469
Language	−0.235	−0.977	−0.227	−0.946	0.789	0.940	0.767	0.904
Bloc	−0.526	−1.465	−0.521	−1.452	3.387	1.337	3.419	1.340
Common law	0.393	1.538	0.385	1.514	0.660	0.567	0.714	0.603
Rule of law	0.078	0.237	0.082	0.247	−0.472	−0.422	−0.424	−0.387
Crisis			0.749	1.563			−3.121	−1.514
Comprehensivecredit rating (event country)	0.077	1.426	0.046	0.784	0.768	2.950[a]	0.715	2.775[a]
Comprehensive credit rating (nonevent country)	−0.050	−0.246	−0.054	−0.263	−0.063	−0.137	−0.060	−0.129
Year dummies		Yes		Yes		Yes		Yes
Event country dummies		Yes		Yes		Yes		Yes
Home country dummies		Yes		Yes		Yes		Yes
Adjusted R^2		0.137		0.138		0.127		0.129
Observations		1,114		1,114		1,008		1,008

The superscripts a, b, and c indicate statistical significance at the 1%, 2.5%, and 5% level, respectively, using robust standard errors in a two-tailed test.

Table 7
Differential and common information spillovers (capital and trade flow correlations) individually
This table presents the coefficient estimates from Eq. (1). We simultaneously add variables for highly correlated trade and capital flows, membership in a trade bloc, home and event country status as emerging/developed, contiguity, distance, common language, origin of legal system, and rule of law. We estimate

$$\Delta\ Spread_{j,t} = \alpha + \beta_1\ Event_{i,t} + \beta_2 Prior\ event_{i,t} + \sum_k \beta_k X_k + \varepsilon_{ij,t}, \quad \forall j \neq i.$$

The dependent variable is the cumulative two-day [0,1] change in the percentage spread. Percentage spreads are calculated as the interest rate differential over a U.S. Treasury bond of comparable maturity, as a percentage of the relevant U.S. Treasury interest rate. Event is defined as the change in the comprehensive credit rating. Prior event is defined as the cumulative change in the comprehensive credit ratings of nonevent country bonds during the two weeks preceding the event. In this table capital and trade flow correlations are used in place of the previous dummy variable approach.

	Positive rating events				Negative rating events			
	(1)		(2)		(3)		(4)	
Variable	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic
Constant	21.707	4.107[a]	20.669	3.942[a]	16.998	0.975	15.040	0.835
Maturity	−0.854	−4.912[a]	−0.801	−4.620[a]	−0.449	−0.848	−0.318	−0.544
Event	0.081	0.457	0.212	1.271	2.244	3.453[a]	2.134	3.241[a]
Prior event	−0.159	−1.479	−0.096	−0.854	0.487	2.806[a]	0.525	3.037[a]
Emerging	1.818	3.039[a]	1.435	2.327[b]	−2.360	−0.343	−4.198	−0.596
Developed	−1.370	−2.358[b]	−1.004	−1.591	−9.836	−2.176[c]	−8.027	−1.694
Capital flows—positive	0.307	0.981	0.267	0.850	−1.251	−1.296	−1.272	−1.315
Capital flows—negative	−0.102	−0.635	−0.101	−0.631	−3.170	−2.467[b]	−3.094	−2.471[b]
Trade flows—positive	−0.348	−0.979	−0.315	−0.874	0.530	0.551	0.557	0.574
Tradeflows—negative	−0.082	−1.426	−0.083	−1.452	−0.361	−1.828	−0.343	−1.761
Adjacent	0.244	0.347	0.237	0.336	−3.288	−1.467	−3.173	−1.411

Distance	0.000	1.077	0.000	1.087	−0.000	−0.642	−0.000	−0.569
Language	−0.210	−0.873	−0.201	−0.838	0.899	1.072	0.875	1.033
Bloc	−0.529	−1.472	−0.525	−1.462	3.178	1.264	3.216	1.269
Common law	0.365	1.424	0.354	1.393	0.786	0.656	0.836	0.687
Rule of law	0.034	0.104	0.037	0.112	−0.460	−0.407	−0.404	−0.366
Crisis			0.052	0.897			0.727	2.772[a]
Comprehensive credit rating (event country)	0.083	1.559	−0.048	−0.233	0.782	2.932[a]	−0.056	−0.119
Comprehensive credit rating (nonevent country)	−0.045	−0.217	0.747	1.570	−0.061	−0.131	−3.268	−1.513
Year dummies		Yes		Yes		Yes		Yes
Event country dummies		Yes		Yes		Yes		Yes
Home country dummies		Yes		Yes		Yes		Yes
Adjusted R^2		0.136		0.137		0.120		0.121
Observations		1,114		1,114		1,008		1,008

The superscripts a, b, and c indicate statistical significance at the 1%, 2.5%, and 5% level, respectively, using robust standard errors in a two-tailed test.

This latter conclusion also applies to the additional controls for common language, common law legal systems, physical proximity (distance or adjacency), and rule of law traditions. None of the coefficients is statistically different from zero for these variables. In general terms we introduce these additional variables to control for historical and time-invariant factors that could affect our conclusions about both the extent of spillovers and their economic basis. In related studies, the importance of these variables is shown in studies of goods market integration (e.g., Rose, 2000; Rose and van Wincoop, 2001; Parsley and Wei, 2001) and in financial market integration (e.g., La Porta et al., 1998; van Rijckeghem and Weder, 1999). These additional variables leave our previous conclusions unchanged. The adjusted R^2 rises in both the positive and negative regressions. However none of the additional variables is statistically significant.

Finally, we introduce a control for crisis periods. Because our data span five crisis periods, and fully one-third of our events occur during these periods, we are concerned that the results are driven by a subsample of events. The crisis dummy identifies the EMS crisis, the Mexican peso crisis, the Asian financial crisis, the Russian crisis, and the Brazilian crisis. Again, adding this control to our regression equations (positive and negative) leaves our previous results unchanged. In particular, statistically significant spillovers exist only for negative rating events.

4.4. Robustness and extensions

Several robustness checks are made to our basic results.[18] First, we consider several variations of our measures of trade and capital flow correlations. Next, we consider different measures of the dependent variable in our regressions. We extend the definition of *Prior event* to three weeks (instead of two), and we consider a subset of (larger) countries only. Finally, we conduct a test of whether the correlation structure itself changes between event and nonevent days. The basic findings presented in Table 6 continue to hold using these new variable definitions and tests.

In Table 7, we use the actual correlations in place of our dummy variable approach in Table 6. Instead of identifying the highly correlated countries with a dummy variable, we substitute the correlation coefficients directly. The results are similar, albeit marginally less significant (statistically) for trade flows as compared capital flows (10% as compared with 5%). A concern with these correlation measures is the horizon over which they are computed. We explore this issue in three steps, reported in Appendices B–D. We compute correlations over a longer (12-month) time horizon and enter both the six-month and 12-month correlations simultaneously in the regressions. These results are presented in Appendix B. Two primary conclusions emerge. (1) The six-month capital flows correlations seem to dominate the 12-month correlations. However, both are statistically significant. (2) When the 12-month trade flows correlations are introduced simultaneously with the six-month trade flows correlations, only the common information effect (trade flows—positive) coefficient becomes significant for the correlations computed over

[18]To conserve space, we present robustness results only for the specifications presented in Table 6.

the longer horizon. Thus the previously significant (trade flows—negative) coefficient drops out. This suggests that the transmission channel is stronger through capital than through trade flow linkages and that the capital account is more important in the short run, while trade correlations are more important in the longer run. These conclusions are supported in Appendix C, where the six-month and 12-month results are presented side by side, and in Appendix D, where trade and capital flow correlations are compared separately. Given that our main results do not appear sensitive to this aspect of the specification, our subsequent robustness results are based on the dummy variable approach used in Table 6.

In the next robustness exercise, we address the concern that our results are sensitive to the manner in which spreads are measured. Thus in Appendix E, we measure the dependent variable using the basis points spread. The results are again qualitatively unchanged.

In Appendix F we perform the analysis on a reduced set of countries. In principle, we expect announcements in smaller countries to have less of a spillover impact. Thus, by focusing on larger countries we expect more economically significant spillovers. We drop the ten smallest countries (those with 1997 purchasing power parity adjusted gross domestic product below $100 million).[19] As expected, average spillovers are larger for the remaining countries, and trade and capital flow correlations are important for the size of these spillover effects. A negative event in one of these larger economies raises spreads by 17 basis points as compared with only 13 basis points in the similar regression in Table 6.

In Appendix G we consider recent ratings changes using a longer (three-week) window. Again, our results are essentially unaffected. In particular, the coefficient estimate for spillovers is virtually unchanged, and the estimate for recent ratings is only slightly smaller than that reported in Table 6.

Finally, the spillovers simply could be a manifestation of the existing correlation structure, i.e., our events could merely demonstrate existing cross-country correlation. A rigorous test of this hypothesis is whether the cross-country returns correlation matrices between event and nonevent days are equal. If these matrices are different, then the observed spillovers are not entirely the result of the existing correlation structure. We test this hypothesis using the asymptotic χ^2 test proposed by Jennrich (1970). This test does not require an assumption that the event and nonevent samples (whose correlation matrices are being tested for equality) have equal standard deviations or means. This is important because, as shown by Ronn (1995), Boyer et al. (1999), Loretan and English (2000), and Forbes and Rigobon (2002), typical tests for differences in the pair-wise correlations between two time periods (contagion and noncontagion) are biased because of differences in volatilities between the two periods.[20] Jennrich's test is applicable even when the means and

[19]The source for this data is the World Bank publication World Development Report, 1998−1999. The dropped countries are Finland, Hungary, Iceland, Ireland, Israel, Lebanon, New Zealand, Panama, Tunisia, and Uruguay.

[20]Ronn (1995) presents a theoretical result (the insight for which he attributes to Stambaugh's discussion of the Karolyi and Stulz (1996) paper at the May 1995 National Bureau Economic Research Conference on Financial Risk Assessment and Management) that correlations, conditional on the magnitude of asset

variances in the two samples are different. The specific details of the test statistic for our case are presented in Appendix H.

We conduct Jennrich's test for our sample of negative rating events, because these are where we find evidence of spillovers. To conserve space, we report results only for the percentage spreads sample. We implement the test by randomly sampling percentage spreads from nonevent periods (with replacement) and comparing these with the percentage spreads on event days. Ultimately, we repeat the test 10,000 times and report summary statistics from these tests. For each test, both the event and nonevent samples contain an equal number of observations from which the correlation matrices are constructed.[21] In addition, we impose the sampling restriction that, at each event date, our randomly selected nonevent date is chosen from among the nonevent days preceding the event date. The corresponding nonevent date is taken from (the nonevent dates) within the window $[-60, -21]$.

The results from these tests can be easily summarized. The median test statistic from the simulations is 2,036.7, and the 5% critical value for the test is 617.2 (for $n(n-1)/2$ degrees of freedom, where n is the number of countries, which in our case is 34). Thus, the null hypothesis that the correlation matrices between the event period and nonevent periods are equal is easily rejected. Across all 10,000 tests, we reject the equality null 75% of the time at the 5% level. Thus we are reasonably assured that our results are not simply a reflection of the existing correlation structure. In the majority of cases the correlation structure itself changes on event days.

An additional issue is whether the correlations are higher or lower during the events sample relative to nonevent periods. For example, Chakrabarti and Roll (2002) examine whether regional stock market correlations increase around the Asian financial crisis. For this we examine each of the 10,000 nonevent day correlation matrices, and make an element-by-element comparison with the correlation coefficients in the event-days correlation matrix. We compute the proportion of cross-correlations that were net increases (percentage of increases minus decreases of element-by-element comparisons of correlations) in the event period as compared with the nonevent periods. Surprisingly, we find some evidence

(*footnote continued*)
price changes, differ from unconditional correlations. Boyer et al. (1999) argue that testing for changes in correlations between two periods (e.g., by splitting the sample) is misleading as a direct consequence of selection bias. Loretan and English (2000) explore this linkage between correlation and volatility of equity, bond, and foreign exchange returns from two representative countries and conclude that correlation breakdowns could reflect time-varying volatility of financial markets instead of a change in relationships between asset returns. Forbes and Rigobon (2002) focus on tests for contagion based on cross-market correlation coefficients and show that these are biased and inaccurate because of heteroskedasticity. They also show how to correct for this bias under certain conditions.

[21]On two of the negative events days there was also a positive announcement. Consequently, these two days were excluded from the events sample. Hence, the number of returns in the event and the nonevent samples is 75.

of decreased correlations during the negative ratings events period. The proportion of net decreases is 2.5 percent higher than in the nonevent samples. This difference is statistically significant at the 1% level. Thus, while we can easily reject the hypothesis that the correlation structure was the same on event and nonevent days, not all correlations increase during event days.

5. Conclusions

This paper examines the extent of cross-border financial market linkages by focusing on the transmission of news events (specifically sovereign credit rating changes) concerning one country to sovereign bond spreads in other countries. We show the existence of asymmetric spillovers: positive ratings events abroad have no discernable impact on the sovereign spreads, whereas negative ratings events are associated with an economically meaningful and statistically significant increase in spreads. We present a framework characterizing these spillovers in terms of common information and differential information effects associated with a ratings change.

While common information events imply that sovereign spreads move in tandem, differential spillovers are expected to result in opposite effects of ratings events across countries. We find that differential spillovers exist among countries with highly negatively correlated capital flows or trade flows (vis-á-vis the United States). Interest rate spreads in these countries generally fall (relative to other countries) in response to a downgrade of a country with highly negatively correlated capital or trade flows. Our evidence also suggests that the transmission channel for spillovers is stronger through capital than through trade flow linkages.

We also confirm the importance of cumulative events, as posited by Kaminsky and Reinhart (2000). In other words, ratings changes should not be viewed as isolated events, and it is appropriate to ask the context in which the change was announced: have there been other similar ratings changes in the past few days? Finally, we explicitly test whether our results stem from time-invariant historical, economic, institutional, cultural, or location-specific factors, or from time-dependent crisis-specific factors. Our conclusions with regard to spillovers remain unaffected.

Our paper has numerous implications for future research. For example, the existence of asymmetric spillovers is consistent with a view that rating agencies could be biased in evaluating sovereigns, e.g., through their reluctance to issue low credit ratings (at initiation) or to lower a credit rating in a timely manner. To explore this issue further, one must examine the incentives of the rating agencies in divulging ratings changes in a timely manner. In addition to the extent that large spillovers can be viewed as a precursor to a financial contagion, one can characterize (and possibly forecast) the vulnerability of an economic system to a financial contagion in terms of the aggregate spillovers.

Appendix A

Table A.1 tabulates the construction of the comprehensive credit rating.

Appendix B

Six-month versus 12-month horizons for correlation measures is shown in Table B.1.

Appendix C

Side-by-side comparison of six-month and 12-month correlations is shown in Table C.1.

Appendix D

Capital and trade flows correlations are shown in Table D.1.

Appendix E

In Table E.1, the dependent variable is measured using basis points spread.

Appendix F

The analysis on a reduced set of countries in performed in Table F.1.

Appendix G

The recent ratings changes using a longer (three-week) windows is considered in Table G.1.

Appendix H

Jennrich's test statistic for the equality of two correlation matrices is shown in Table H.1.

Table A.1
The construction of the comprehensive credit rating measure
We code each country's credit rating from 1 to 16 to obtain the explicit credit rating (ECR). Information on the credit outlook then is added to obtain the comprehensive credit rating (CCR). For example, if a country is rated BB+ with no further information on its credit outlook, the ECR and CCR is 6. If Standard & Poor's now places the country on watch for a possible upgrade, the ECR is still 6. However, its CCR is 6.50. We code countries with ECR below B- as zero.

Sovereign rating	ECR
Explicit credit rating	
AAA	16
AA+	15
AA	14
AA−	13
A+	12
A	11
A−	10
BBB+	9
BBB	8
BBB−	7
BB+	6
BB	5
BB−	4
B+	3
B	2
B−	1
Credit outlook	
	Add to ECR
Positive	1
Credit watch—developing	0.5
Stable	0
Credit watch—negative	−0.5
Negative	−1

Table B.1
Differential and common information spillovers, six-month versus 12-month horizons for correlations measures
This table presents the coefficient estimates from Eq. (1). We simultaneously add variables for highly correlated trade and capital flows, membership in a trade bloc, home and event country status as emerging/developed, contiguity, distance, common language, origin of legal system, and rule of law. We estimate

$$\Delta\ Spread_{j,t} = \alpha + \beta_1\ Event_{i,t} + \beta_2\ Prior\ event_{i,t} + \sum_k \beta_k X_k + \varepsilon_{ij,t}, \quad \forall j \neq i.$$

The dependent variable is the cumulative two-day [0,1] change in the percentage spread. Percentage spreads are calculated as the interest rate differential over a U.S. Treasury bond of comparable maturity, as a percentage of the relevant U.S. Treasury interest rate. In this table capital and trade flow correlations are used in place of the previous dummy variable approach. Event is defined as the change in the comprehensive credit rating. Prior event is defined as the cumulative change in the comprehensive credit ratings of nonevent country bonds during the two weeks preceding the event.

	Positive rating events				Negative rating events			
	(1)		(2)		(3)		(4)	
Variable	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic
Constant	21.778	4.158[a]	20.793	4.007[a]	13.508	0.794	11.696	0.666
Maturity	−0.851	−4.918[a]	−0.800	−4.645[a]	−0.377	−0.711	−0.249	−0.425
Event	0.073	0.413	0.197	1.189	2.269	3.527[a]	2.159	3.313[a]
Prior event	−0.151	−1.386	−0.092	−0.804	0.466	2.728[a]	0.505	2.976[a]
Emerging	1.708	2.880[a]	1.351	2.180[c]	−1.242	−0.188	−3.120	−0.461
Developed	−1.268	−2.180[c]	−0.927	−1.452	−11.609	−2.578[a]	−9.751	−2.075[c]
Capital flows—positive (six months)	0.227	0.708	0.196	0.611	−1.517	−1.564	−1.526	−1.569
Capital flows—negative (six months)	−0.100	−0.599	−0.099	−0.595	−3.172	−2.460[b]	−3.092	−2.463[b]
Trade flows—positive (six months)	−0.431	−1.070	−0.399	−0.985	−0.604	−0.578	−0.578	−0.551

Trade flows—negative (six months)	−0.077	−1.365	−0.078	−1.394	−0.349	−1.674	−0.329	−1.583
Capital flows—positive (12 months)	0.314	0.934	0.291	0.866	0.063	0.064	−0.035	−0.036
Capital flows—negative (12 months)	0.072	0.149	0.066	0.136	−2.484	−1.880	−2.563	−1.964[c]
Trade flows—positive (12 months)	0.079	0.230	0.083	0.242	4.256	3.077[a]	4.242	3.073[a]
Trade flows—negative (12 months)	−0.583	−1.324	−0.555	−1.281	0.182	0.128	0.107	0.076
Adjacent	0.227	0.321	0.221	0.312	−3.317	−1.503	−3.209	−1.449
Distance	0.000	1.208	0.000	1.212	−0.000	−0.431	−0.000	−0.359
Language	−0.224	−0.942	−0.215	−0.907	1.092	1.294	1.070	1.256
Bloc	−0.541	−1.516	−0.537	−1.507	3.047	1.238	3.088	1.246
Common law	0.381	1.489	0.371	1.461	0.653	0.551	0.705	0.586
Rule of law	0.039	0.118	0.042	0.126	−0.333	−0.305	−0.282	−0.264
Crisis			0.706	1.500			−3.296	−1.535
Comprehensive credit rating (event country)	0.073	1.340	0.043	0.736	0.770	2.908[a]	0.716	2.746[a]
Comprehensive credit rating (nonevent country)	−0.050	−0.243	−0.053	−0.257	−0.154	−0.323	−0.152	−0.318
Year dummies		Yes		Yes		Yes		Yes
Event country dummies		Yes		Yes		Yes		Yes
Home country dummies		Yes		Yes		Yes		Yes
Adjusted R^2		0.135		0.135		0.128		0.130
Observations		1,114		1,114		1,008		1,008

The superscripts a, b, and c indicate statistical significance at the 1%, 2.5%, and 5% level, respectively, using robust standard errors in a two-tailed test.

Table C.1
Differential and common information spillovers, side-by-side comparison of six-month and 12-month correlations
This table presents the coefficient estimates from Eq. (1). We simultaneously add variables for highly correlated trade and capital flows, membership in a trade bloc, home and event country status as emerging/developed, contiguity, distance, common language, origin of legal system, and rule of law. We estimate

$$\Delta\ Spread_{j,t} = \alpha + \beta_1\ Event_{i,t} + \beta_2\ Prior\ event_{i,t} + \sum_k \beta_k X_k + \varepsilon_{ij,t}, \quad \forall j \neq i.$$

The dependent variable is the cumulative two-day [0,1] change in the percentage spread. Percentage spreads are calculated as the interest rate differential over a U.S. Treasury bond of comparable maturity, as a percentage of the relevant U.S. Treasury interest rate. In this table capital and trade flow correlations are used in place of the previous dummy variable approach. Event is defined as the change in the comprehensive credit rating. Prior event is defined as the cumulative change in the comprehensive credit ratings of nonevent country bonds during the two weeks preceding the event. In this table capital and trade flow correlations are computed using the previous twelve months data.

	Positive rating events				Negative rating events			
	(1)		(2)		(3)		(4)	
Variable	Six-month Coefficient	*t*-statistic	12-month Coefficient	*t*-statistic	Six-month Coefficient	*t*-statistic	12-month Coefficient	*t*-statistic
Constant	20.669	3.942[a]	21.067	4.032[a]	15.040	0.835	10.239	0.529
Maturity	−0.801	−4.620[a]	−0.820	−4.661[a]	−0.318	−0.544	−0.328	−0.520
Event	0.212	1.271	0.198	1.194	2.134	3.241[a]	2.173	3.304[a]
Prior event	−0.096	−0.854	−0.082	−0.720	0.525	3.037[a]	0.546	3.174[a]
Emerging	1.435	2.327[b]	1.430	2.382[b]	−4.198	−0.596	−2.132	−0.309
Developed	−1.004	−1.591	−1.011	−1.627	−8.027	−1.694	−10.600	−2.188[c]
Capital flows—positive	0.267	0.850	0.391	1.186	−1.272	−1.315	−0.401	−0.387

Capital flows—negative	−0.101	−0.631	0.130	0.271	−3.094	−2.471[b]	−2.918	−2.308[b]
Tradeflows—positive	−0.315	−0.874	−0.064	−0.210	0.557	0.574	3.897	3.044[a]
Trade flows—negative	−0.083	−1.452	−0.530	−1.236	−0.343	−1.761	0.280	0.206
Adjacent	0.237	0.336	0.227	0.319	−3.173	−1.411	−2.946	−1.298
Distance	0.000	1.087	0.000	1.171	−0.000	−0.569	−0.000	−0.258
Language	−0.201	−0.838	−0.227	−0.958	0.875	1.033	1.018	1.180
Bloc	−0.525	−1.462	−0.548	−1.546	3.216	1.269	3.015	1.221
Common law	0.354	1.393	0.406	1.611	0.836	0.687	0.635	0.550
Rule of law	0.037	0.112	0.081	0.244	−0.404	−0.366	0.261	0.261
Crisis	0.747	1.570	0.754	1.638	−3.268	−1.513	−3.559	−1.606
Comprehensive credit rating (event country)	0.052	0.897	0.045	0.766	0.727	2.772[a]	0.777	2.833[a]
Comprehensive credit rating (nonevent country)	−0.048	−0.233	−0.046	−0.221	−0.056	−0.119	−0.067	−0.144
Year dummies		Yes		Yes		Yes		Yes
Event country dummies		Yes		Yes		Yes		Yes
Home country dummies		Yes		Yes		Yes		Yes
Adjusted R^2		0.137		0.136		0.121		0.125
Observations		1,114		1,114		1,008		1,008

The superscripts a, b, and c indicate statistical significance at the 1%, 2.5%, and 5% level, respectively, using robust standard errors in a two-tailed test.

Table D.1
Differential and common information spillovers, capital and trade flows correlations individually
This table presents the coefficient estimates from Eq. (1). We simultaneously add variables for highly correlated trade and capital flows, membership in a trade bloc, home and event country status as emerging/developed, contiguity, distance, common language, origin of legal system, and rule of law. We estimate

$$\Delta\ Spread_{j,t} = \alpha + \beta_1\ Event_{i,t} + \beta_2\ Prior\ event_{i,t} + \sum_k \beta_k X_k + \varepsilon_{ij,t}, \quad \forall j \neq i.$$

The dependent variable is the cumulative two-day [0,1] change in the percentage spread. Percentage spreads are calculated as the interest rate differential over a U.S. Treasury bond of comparable maturity, as a percentage of the relevant U.S. Treasury interest rate. In this table capital and trade flow correlations are used in place of the previous dummy variable approach. Event is defined as the change in the comprehensive credit rating. Prior event is defined as the cumulative change in the comprehensive credit ratings of nonevent country bonds during the two weeks preceding the event.

	Positive rating events				Negative rating events			
	(1)		(2)		(3)		(4)	
Variable	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic
Constant	21.268	3.978[a]	20.226	3.931[a]	11.669	0.609	13.039	0.711
Maturity	−0.831	−4.647[a]	−0.788	−4.602[a]	−0.218	−0.343	−0.365	−0.629
Event	0.210	1.257	0.213	1.275	2.124	3.236[a]	2.167	3.261[a]
Prior event	−0.091	−0.814	−0.092	−0.818	0.532	3.036[a]	0.569	3.270[a]
Emerging	1.457	2.350[b]	1.478	2.493[b]	−3.995	−0.570	−3.124	−0.435
Developed	−1.028	−1.614	−1.054	−1.737	−8.193	−1.740	−9.190	−1.879
Capital flows—positive	0.261	0.832			−1.234	−1.276		
Capital flows—negative	−0.102	−0.630			−3.105	−2.490[b]		
Trade flows—positive			−0.308	−0.854			0.493	0.510

Trade flows—negative			−0.083	−1.458			−0.357	−1.789
Adjacent	0.233	0.329	0.246	0.348	−3.091	−1.379	−2.968	−1.292
Distance	0.000	1.011	0.000	1.107	−0.000	−0.557	−0.000	−0.437
Language	−0.216	−0.903	−0.199	−0.826	0.923	1.104	0.826	0.947
Bloc	−0.550	−1.528	−0.522	−1.458	3.179	1.254	3.202	1.267
Common law	0.393	1.540	0.353	1.395	0.856	0.699	0.777	0.667
Rule of law	0.082	0.249	0.039	0.117	−0.283	−0.264	0.029	0.027
Crisis	0.776	1.677	0.783	1.656	−3.307	−1.534	−3.445	−1.544
Comprehensive credit rating (event country)	0.052	0.897	0.051	0.894	0.732	2.798[a]	0.796	2.885[a]
Comprehensive credit rating (nonevent country)	−0.044	−0.213	−0.045	−0.218	−0.060	−0.130	0.006	0.014
Year dummies		Yes		Yes		Yes		Yes
Event country dummies		Yes		Yes		Yes		Yes
Home country dummies		Yes		Yes				
Adjusted R^2		0.138		0.138		0.129		0.124
Observations		1,114		1,114		1,008		1,008

The superscripts a and b indicate statistical significance at the 1% and 2.5%, respectively, using robust standard errors in a two-tailed test.

Table E.1
Differential and common information spillovers, dependent variable measured in basis points
This table presents the coefficient estimates from Eq. (1). We simultaneously add variables for highly correlated trade and capital flows, membership in a trade bloc, home and event country status as emerging/developed, contiguity, distance, common language, origin of legal system, and rule of law. We estimate

$$\Delta Spread_{j,t} = \alpha + \beta_1 Event_{i,t} + \beta_2 Prior\,event_{i,t} + \sum_k \beta_k X_k + \varepsilon_{ij,t}, \quad \forall j \neq i.$$

The dependent variable is the cumulative two-day [0,1] change in the spread measured in basis points. Spreads are calculated as the interest rate differential over a U.S. Treasury bond of comparable maturity. Event is defined as the change in the comprehensive credit rating. Prior event is defined as the cumulative change in the comprehensive credit ratings of nonevent country bonds during the two weeks preceding the event.

	Positive rating events				Negative rating events			
	(1)		(2)		(3)		(4)	
Variable	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic
Constant	76.921	2.925[a]	70.412	2.681[a]	28.532	0.327	19.898	0.221
Maturity	−3.340	−3.840[a]	−3.008	−3.447[a]	−0.964	−0.363	−0.355	−0.121
Event	0.509	0.612	1.326	1.673	12.585	3.520[a]	12.038	3.344[a]
Prior event	−0.660	−1.255	−0.260	−0.474	2.082	2.270[b]	2.271	2.502[b]
Emerging	5.576	1.122	2.039	0.398	1.279	0.038	−7.705	−0.223
Developed	−3.798	−0.796	−0.367	−0.072	−56.237	−2.392[b]	−47.441	−1.925
Capital flows—positive	1.962	1.349	1.812	1.245	−5.519	−1.669	−5.722	−1.714
Capital flows—negative	0.072	0.061	0.171	0.143	−12.570	−2.551[b]	−12.402	−2.569[a]
Trade flows—positive	−0.473	−0.323	−0.314	−0.212	1.164	0.342	1.333	0.387

Trade flows—negative	−1.631	−1.338	−1.707	−1.393	−9.032	−1.947	−8.666	−1.922
Adjacent	0.285	0.098	0.239	0.081	−16.641	−1.502	−16.094	−1.450
Distance	0.000	1.910	0.000	1.924	−0.000	−0.316	−0.000	−0.247
Language	−1.049	−0.842	−0.997	−0.803	4.261	1.014	4.148	0.977
Bloc	−0.847	−0.534	−0.813	−0.513	17.681	1.420	17.839	1.423
Common law	1.635	1.185	0.385	1.514	2.167	0.375	2.438	0.415
Rule of law	1.073	0.651	1.094	0.662	−1.898	−0.340	−1.659	−0.303
Crisis			4.701	1.822			−15.611	−1.554
Comprehensive credit rating (event country)	0.370	1.346	0.172	0.584	4.033	2.835[a]	3.767	2.661[a]
Comprehensive credit rating (nonevent country)	0.104	0.087	0.082	0.069	−0.204	−0.087	−0.185	−0.079
Year dummies		Yes		Yes		Yes		Yes
Event country dummies		Yes		Yes		Yes		Yes
Home country dummies		Yes		Yes		Yes		Yes
Adjusted R^2		0.091		0.093		0.105		0.106
Observations		1,114		1,114		1,008		1,008

The superscripts a and b indicate statistical significance at the 1% and 2.5% level, respectively, using robust standard errors in a two-tailed test.

Table F.1
Differential and common information spillovers, larger countries
This table presents the coefficient estimates from Eq. (1) for a reduced set of countries (those with 1997 purchasing power parity adjusted gross domestic product greater than or equal to $100 million). We simultaneously add variables for highly correlated trade and capital flows, membership in a trade bloc, home and event country status as emerging/developed, contiguity, distance, common language, origin of legal system, and rule of law. We estimate

$$\Delta\ Spread_{j,t} = \alpha + \beta_1\, Event_{i,t} + \beta_2\, Prior\, event_{i,t} + \sum_k \beta_k X_k + \varepsilon_{ij,t}, \quad \forall j \neq i.$$

The dependent variable is the cumulative two-day [0,1] change in the percentage spread. Percentage spreads are calculated as the interest rate differential over a U.S. Treasury bond of comparable maturity, as a percentage of the relevant U.S. Treasury interest rate. Event is defined as the change in the comprehensive credit rating. Prior event is defined as the cumulative change in the comprehensive credit ratings of nonevent country bonds during the two weeks preceding the event.

	Positive rating events				Negative rating events			
	(1)		(2)		(3)		(4)	
Variable	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic
Constant	14.497	1.871	14.497	1.856	−29.396	−1.574	−31.271	−1.630
Maturity	−0.667	−2.454[b]	−0.666	−2.390[b]	0.426	0.656	0.574	0.800
Event	0.306	0.887	0.306	0.888	3.162	3.336[a]	2.986	3.083[a]
Prior event	0.218	1.365	0.218	1.325	0.769	3.132[a]	0.815	3.347[a]
Emerging	2.223	1.420	2.222	1.385	17.037	2.756[a]	14.484	2.136[c]
Developed	−2.021	−1.288	−2.021	−1.246	−13.740	−2.200[c]	−10.952	−1.589
Capital flows—positive	0.199	0.522	0.199	0.509	−1.637	−1.850	−1.588	−1.793
Capital flows—negative	0.087	0.262	0.087	0.261	−3.409	−2.654[a]	−3.300	−2.688[a]

Trade flows—positive	−0.388	−0.922	−0.388	−0.907	0.254	0.315	0.322	0.390
Trade flows—negative	−0.310	−0.875	−0.310	−0.866	−3.080	−2.183[c]	−2.968	−2.179[c]
Adjacent	−0.213	−0.192	−0.213	−0.192	−1.803	−0.775	−1.635	−0.698
Distance	0.000	0.492	0.000	0.492	0.000	1.484	0.000	1.599
Language	−0.313	−0.875	−0.313	−0.881	2.450	2.279[b]	2.497	2.255[b]
Bloc	−0.796	−1.268	−0.796	−1.268	4.444	1.267	4.469	1.262
Common law	0.442	0.899	0.442	0.896	0.821	0.534	0.926	0.582
Rule of law	0.493	0.778	0.494	0.779	−0.841	−0.522	−0.756	−0.483
Crisis			0.002	0.004			−4.051	−1.412
Comprehensive credit rating (event country)	0.127	1.497	0.127	1.446	1.070	2.980[a]	0.991	2.732[a]
Comprehensive credit rating (nonevent country)	−0.267	−0.744	−0.267	−0.744	−0.009	−0.017	0.030	0.053
Year dummies		Yes		Yes		Yes		Yes
Event country dummies		Yes		Yes		Yes		Yes
Home country dummies		Yes		Yes		Yes		Yes
Adjusted R^2		0.281		0.280		0.109		0.111
Observations		544		544		650		650

The superscripts a, b, and c indicate statistical significance at the 1%, 2.5%, and 5% level, respectively, using robust standard errors in a two-tailed test.

Table G.1
Differential and common information spillovers, prior events during the previous three-weeks
This table presents the coefficient estimates from Eq. (1). We simultaneously add variables for highly correlated trade and capital flows, membership in a trade bloc, home and event country status as emerging/developed, adjacency, distance, common language, origin of legal system, and rule of law. We estimate

$$\Delta Spread_{j,t} = \alpha + \beta_1 Event_{i,t} + \beta_2 Prior\ event_{i,t} + \sum_k \beta_k X_k + \varepsilon_{ij,t}, \quad \forall j \neq i.$$

The dependent variable is the cumulative two-day [0,1] change in the percentage spread. Percentage spreads are calculated as the interest rate differential over a U.S. Treasury bond of comparable maturity, as a percentage of the relevant U.S. Treasury interest rate. Event is defined as the change in the comprehensive credit rating. Prior event is defined as the cumulative change in the comprehensive credit ratings of nonevent country bonds during the three weeks preceding the event.

	Positive rating events				Negative rating events			
	(1)		(2)		(3)		(4)	
Variable	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic	Coefficient	*t*-statistic
Constant	19.810	3.871[a]	19.451	3.784[a]	17.093	0.975	15.874	0.885
Maturity	−0.759	−4.494[a]	−0.743	−4.357[a]	−0.450	−0.818	−0.345	−0.573
Event	−0.063	−0.320	0.054	0.309	2.104	3.520[a]	1.978	3.279[a]
Prior event	−0.304	−2.079[c]	−0.245	−1.785	0.349	1.829	0.398	1.940
Emerging	1.721	3.031[a]	1.515	2.690[a]	−1.271	−0.188	−3.008	−0.437
Developed	−1.193	−2.170[c]	−1.011	−1.790	−10.681	−2.378[b]	−8.983	−1.926
Capital flows—positive	0.306	1.171	0.290	1.104	−0.984	−1.511	−1.021	−1.549
Capital flows—negative	−0.133	−0.560	−0.120	−0.505	−2.767	−2.781[a]	−2.747	−2.805[a]
Tradeflows—positive	−0.326	−1.207	−0.305	−1.121	0.043	0.064	0.059	0.088

Trade flows—negative	−0.369	−1.587	−0.376	−1.610	−2.021	−2.184[c]	−1.940	−2.166[c]
Adjacent	0.211	0.301	0.206	0.295	−3.223	−1.439	−3.113	−1.386
Distance	0.000	0.999	0.000	1.016	−0.000	−0.542	−0.000	−0.474
Language	−0.235	−0.978	−0.229	−0.954	0.814	0.968	0.795	0.935
Bloc	−0.560	−1.550	−0.548	−1.517	3.242	1.283	3.257	1.280
Common law	0.393	1.550	0.386	1.528	0.636	0.545	0.690	0.582
Rule of law	0.084	0.254	0.085	0.258	−0.469	−0.421	−0.419	−0.386
Crisis			0.521	1.291			−3.187	−1.469
Comprehensive credit rating (event country)	0.060	1.168	0.044	0.842	0.684	2.723[a]	0.623	2.516[b]
Comprehensive credit rating (nonevent country)	−0.053	−0.259	−0.054	−0.266	−0.083	−0.177	−0.080	−0.172
Year dummies	Yes		Yes		Yes		Yes	
Event country dummies	Yes		Yes		Yes		Yes	
Home country dummies	Yes		Yes		Yes		Yes	
Adjusted R^2	0.140		0.140		0.127		0.128	
Observations	1,114		1,114		1,008		1,008	

The superscripts a, b, and c indicate statistical significance at the 1%, 2.5%, and 5% level, respectively, using robust standard errors in a two-tailed test.

Table H.1
Jennrich's test statistic for the equality of two correlation matrices
See Jennrich (1970) for additional details of the test statistic. For any two p-variate sample correlation matrices R_1 and R_2 of sizes n_1 and n_2, the Jennrich's test statistic given below is distributed as a χ^2 with $p(p-1)/2$ degrees of freedom. The expressions tr and dg refer to the trace and diagonal of a matrix, respectively. In the context of this paper, the sample correlation matrices are of percentage spreads during an event period (negative ratings events) and during a nonevent period, selected randomly with replacement from the available data. We repeated this test 10,000 times. See Section 4.4 for additional discussion.

$$\chi^2 = \frac{1}{2} tr(Z^2) - \mathrm{d}g'(Z) S^{-1} \mathrm{d}g(Z)$$

where

$Z = c^{1/2} \overline{R}^{-1} (R_1 - R_2)$

$c = n_1 n_2 / (n_1 + n_2)$

$\overline{R} = (n_1 R_1 + n_2 R_2)/(n_1 + n_2)$

$S = (\delta_{ij} + \bar{r}_{ij} \bar{r}^{ij})$

δ_{ij} = Kronecker delta

$\bar{r}_{ij}$ = element of $\bar{R}$ and

$\bar{r}^{ij}$ = element of $\bar{R}^{-1}$

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