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New Evidence on Sovereign to Corporate Credit Rating Spill-overs

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Abstract

We explore what happens to domestic firm-level ratings around the time of a sovereign-rating action on a day-by-day and country-by-country basis. Our granular approach provides banks and investors with a fuller picture of their sovereign credit risk exposure and, as such, our analysis might feed into banks' internal modelling of their credit risk exposure for the purpose of determining regulatory capital, introduced under Basel II. We also provide a novel analysis of any bias in spill-over and we show that, *inter alia*, the tendency for greater spill-over of negative sovereign-rating actions can largely be accounted for by firm- and sovereign-level factors. However, even after allowing for these factors, some countries suffer from negative bias. The implied higher correlation between sovereign and firm-level ratings in times when countries are in crisis versus when they are in recovery may contribute to quicker and/or deeper crises versus slower and/or longer recoveries.

JEL classification: G15, G24

Keywords: Credit risk, sovereign ratings, firm ratings, rating spill-over effects.

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1. Introduction

In this paper, we provide new findings on the spill-over of Standard and Poor's (S&P) sovereign credit ratings into the credit ratings of domestic firms, employing a sample of 34 countries. Credit ratings are important in determining access to debt markets (e.g. Williams, Alsakka & Ap Gwilym, 2013). Where sovereign ratings spill over into the ratings of domestic corporations, this will have an immediate and direct impact on the cost of firm-level borrowing (Hand, Holthausen & Leftwich, 1992; Augustin, Boustanifar, Breckenfelder & Schnitzler, 2016).

Our analysis offers two key contributions. First, we explore what happens to domestic firm-level ratings for each country in our sample around the time of a sovereign-rating action on a day-by-day basis. Our more granular approach is particularly useful for those wanting information on the extent and timing of spill-over of the sovereign rating into firm-level ratings on a country-by-country basis. Second, we add to the literature by providing a novel analysis of any possible bias in the spill-over of sovereign ratings to domestic firms.

Our results are useful to banks in determining their exposure to sovereign credit risk. If a bank has lent heavily to companies within a particular sovereign, our results provide a country-specific picture of the likelihood of transmission of sovereign credit risk to company credit ratings, allowing the bank a fuller picture of its sovereign credit risk exposure. As such, our analysis might feed into banks' internal modelling of their credit risk exposure for the purpose of determining regulatory capital, introduced under Basel II. Our analysis is equally useful to investors to enable them to determine the likely spill-over of sovereign credit risk into their investments in different countries.

Our analysis of bias is directed at regulatory bodies and government finance ministers. They should understand and appreciate the extent to which there is evidence that the impact of positive and negative sovereign-rating actions on domestic companies has been unequal and may therefore continue to be so, both before and after accounting for factors which we expect to determine the extent of spill-over. The implied higher correlation between sovereign and firm-level ratings in times when countries are in crisis versus when they are in recovery could contribute to quicker and/or deeper crises versus slower and/or longer recoveries.

We show that firm-level rating changes in the days and hours up to the sovereign change are few across all countries in our sample but this picture changes within an hour of the sovereign change. Our focus on the short term contrasts with prior studies¹ and improves our ability to claim causality running from the sovereign-rating action to the ratings of domestic firms. In addition, our examination of sovereign spill-over on a day-by-day basis provides additional information about the *timing* of sovereign spill-over.

A large literature exists on the spill-over of sovereign ratings across multiple dimensions, and in Section 2 we explain how our study fits into this wider literature. Most closely related to our paper are the studies which examine sovereign-corporate rating inter-dependence (Ferri, Liu & Majnoni, 2001; Williams et al. 2013; Borensztein, Cowan & Valenzuela, 2013; Almeida, Cunha, Ferreira & Restrepo, 2017).

Before allowing for firm and sovereign characteristics we find that negative spill-over tends to be higher than positive spill-over, a result reported by Ferri et al. (2001). However, our country-by-country results show that this is not the case for all countries. For example, in the month following a positive sovereign action, 74.1% of Argentinean (South African) rated firms also undergo a positive rating action, against 59.0% (33.3%) of firms undergoing a negative action in the month following a negative sovereign action. We also find that, in aggregate, unconditional spill-over to firms domiciled in NHICs tends to be higher than to firms domiciled in higher income countries (HICs) (as reported by Ferri et al. 2001). However, our country-by-country focus demonstrates that there is considerable heterogeneity in sovereign spill-over within both HIC and NHIC status countries. Thus, for example, the (unconditional) probability of negative sovereign spill-over within one month of the sovereign action is 81.5% for Brazil, an NHIC with average GDP per capita across our sample period of 4,943 USD; and contrasts with 36.5% for Indonesia, an NHIC with an average GDP per capita across our sample period of 1,249 USD and with 38.8% for France, an HIC with an average GDP per capita across our sample period of 34,323 USD. As stated above, this country-by-country analysis is useful for those wanting to know their exposure to the spill-over of sovereign credit risk for a particular country.

¹ Prior studies examine the link between corporate and sovereign changes on a yearly (e.g. Ferri et al. 2001; Borensztein et al. 2013), quarterly (e.g. Williams et al. 2013) or monthly (e.g. Almeida et al. 2016) basis.

We examine bias in spill-over after allowing for firm characteristics and sovereign conditions, which we term ‘conditional bias’. We find that, *ceteris paribus*, total conditional spill-over (i.e. both positive and negative) is higher for NHICs, a finding which supports the earlier concerns of Ferri et al. (2001) that the reliance on external ratings for the calculation of banks’ capital asset requirements is likely to be detrimental to banks in NHICs.

Ex ante, we suggest that *negative* bias might arise where S&P allocates more resources to discovering deteriorations in credit quality to protect its reputation (Ederington & Goh (1998)) or for countries which face a realistic prospect of default, when unfavourable government actions would have consequences for domestic firms (Borensztein et al. 2013). However, we find no evidence that conditional negative bias is universal or higher in lower-rated countries. For most countries, any negative-positive bias is captured by the variables which represent firm characteristics and changes in the sovereign environment. These findings contrast with prior literature. Williams et al. (2013) examine the impact of changes in emerging market sovereign ratings on the ratings of banks domiciled within these markets and find that positive sovereign actions have a greater impact than negative actions. Borensztein et al. (2013) find that, in aggregate, negative sovereign actions have a greater impact on domestic firms than positive sovereign actions. We suggest that our findings differ from these studies as a result of differences in sample and/or methodological approach. Thus, we extend the analysis of Williams et al. (2013) to additionally incorporate developed markets and all of the industrial sectors of S&P-rated firms. The analysis of Borensztein et al. (2013) examines the impact of changes in the sovereign rating on domestic firm ratings on an annual basis with no evident reference to the relative timing of sovereign- and firm-level actions.² We ensure that sovereign actions precede firm-level actions in all cases. We also adopt a shorter-term focus than in either paper, for the reasons we set out above.

Again, our country-by-country analysis of bias provides novel results. We find evidence of persistent negative spill-over bias for Spain, Hong Kong, Indonesia, Colombia and Brazil. We find some evidence of persistent positive spill-over bias for Argentina. The findings of positive or

² It is problematic, for example, to suggest that a firm action at the beginning of the year is related to a sovereign action at the end of the same calendar year

negative bias are anomalous in that our theoretical justifications for such bias are not borne out by the empirical analysis. We suggest that the governments and regulatory authorities of the countries concerned may want to seek an explanation for the cause of such bias from S&P.

Our focus is the country specific. However, we also add to the literature by identifying the common determinants of sovereign spill-over across countries. We find that the pre-existing stock-market volatility and the current credit rating of the firm relative to the sovereign determine the probability of sovereign spill-over to a domestic firm. We separate firms which are rated at parity with the sovereign rating from those rated above the sovereign rating, which have been considered equally ‘bound’ by the sovereign rating in prior studies (Borensztein et al. 2013; Almeida et al. 2017). We find that firms rated above the sovereign are relatively more immune from domestic sovereign credit risk than those rated at parity with the sovereign. We also find that the odds of spill-over to a firm rated at parity with the sovereign are higher for investment-grade sovereigns than for sub-investment grade sovereigns, which suggests that the coupling of firm and sovereign ratings for firms at parity with the sovereign rating occurs when the sovereign rating is still some way from default. This leads us to query the suggestion of Borensztein et al. (2013), that the primary reason for the continued operation of a de facto sovereign ceiling (by which the rating of a firm cannot exceed the credit rating of the sovereign in which the firm is domiciled) is the likely implementation of capital controls in the event of a sovereign moving close to default.

Finally, we stress that our analysis does not in any way address the validity of sovereign ratings, it is simply an assessment of the relationship between sovereign-rating actions and subsequent changes to the ratings of firms located within that country. We acknowledge that a number of papers challenge the reliability of the sovereign ratings produced by the credit rating agencies (see, e.g., Ferri et al. 2001; Guegan, Hassani & Zhao, 2013; and the many press articles of Paul Krugman³). This does not prevent our analysis from providing a useful input into banks’

³ For example, see the blog of Paul Krugman at http://krugman.blogs.nytimes.com/2012/04/02/ratings-disaster/?_r=1. In this article Krugman also cites Jonathan Portes ‘when it comes to assessing sovereign debt ‘credit risk’ [the credit rating agencies] ... do not know what they are talking about.’

internal ratings based systems to determine the likely exposure of firms domiciled within a country to that country's sovereign-rating actions.

The remainder of our paper is organized as follows. In Section 2, we develop our hypotheses. Section 3 describes the data and methods we employ. Section 4 contains the results of the link between sovereign and corporate rating changes on a country-by-country basis. Section 5 concludes.

2. Literature and Hypotheses

A large literature exists on the spill-over of sovereign ratings across multiple dimensions and we explain in this section how our study fits into this wider literature. For an alternative discussion of the spill-over of sovereign credit risk along a number of dimensions see Tran, Alsakka and Ap Gwilym (2014).

A number of papers examine the spill-over of sovereign-rating actions undertaken by the rating agencies into returns on assets in the stock, bond and credit default swap (CDS) markets. Brooks, Faff, Hillier and Hillier (2004), Ismailescu and Kazemi (2010) and Hill and Faff (2010) examine the spill-over of sovereign-rating changes into the returns on *domestic* assets, while other papers focus on contagion across markets by examining the spill-over of sovereign-rating changes in one country into the returns on assets in *foreign* markets (Gande & Parsley, 2005; Ferreira & Gama, 2007; Ismailescu & Kazemi, 2010; Arezki, Candelon & Sy, 2011; Afonso, Furceri & Gomes, 2012; Böninghausen & Zabel, 2015). Whether examining spill-over into domestic or foreign asset returns, these analyses focus on the spill-over of sovereign rating agency actions into asset returns at the aggregate level.

Closer to our analysis are papers which examine the spill-over of sovereign credit risk into individual firms. Augustin et al. (2016) examine the relationship between sovereign and corporate CDS spreads in the wake of the first Greek bailout on 11 April 2010 via a sample of 226 firms across 15 European countries. They provide evidence of increased interdependence of sovereign and corporate CDS spreads in the period following the bailout. Other recent papers also report a link between sovereign and corporate CDS spreads (Bai and Wei, 2012; Bedendo and Colla,

2013). Acharya , Drechsler and Schnabl (2014) explore the impact of sovereign credit risk on a sample of European firms via their exposure to GIIPS banks (i.e. those incorporated in Greece, Ireland, Italy, Portugal and Spain), which are assumed to be more severely impacted by the credit crisis. They find that firms with higher exposure to GIIPS banks are credit constrained and have lower levels of investment, sales and employment growth relative to firms with lower exposure. Most closely related to our work are the studies which examine sovereign-corporate rating interdependence (Ferri et al. 2001; Williams et al. 2013; Borensztein et al. 2013; Almeida et al. 2017), and the marginal contributions of our paper to this literature are discussed in the Introduction.

The unique contributions of our analyses stem in part from our access to the entire history (1923 et seq.) of sovereign and corporate ratings produced by S&P. We track all rated firms across our sample period, including those which have not undergone any changes to their rating since the initial rating. Access to full rating histories for all rated firms allows us to build a more complete picture of the impact of sovereign credit rating actions on the credit ratings of domestic firms.⁴ The timings of rating actions (available since 1996) allow us to confirm the relative timing of changes to the sovereign- and firm-level ratings when they occur on the same day, and we therefore ensure that sovereign actions precede firm-level actions in all cases.

A S&P publication dated 7 December 2011 clearly indicates the link between their sovereign- and firm-level ratings:

today [7 December 2011] ... [S&P] has placed its ratings on some of the largest rated banking groups in the Eurozone on CreditWatch with negative implications ... This follows the placement of the sovereign credit ratings ... on CreditWatch with negative implications on Dec. 5, 2011 ... We intend to resolve the CreditWatch placement on these banks soon after the resolution of the CreditWatch placement on the related sovereign.⁵

We formulate four hypotheses in relation to our analysis, described in the following paragraphs.

Evidence that sovereign-rating actions impact firm-level rating actions is strengthened where a limited number firm-level actions occur in the pre-sovereign-rating action window, and a

⁴ Databases used in most prior research cover only rating changes, so firms which are rated but do not have a rating change during the period of analysis are omitted.

⁵ ‘Standard and Poor’s Places Several Large Bank Groups Across The Eurozone on CreditWatch Negative’, 7 December 2011, S&P.

much larger number of actions occur in the post-sovereign-rating action window. Our first hypothesis is:

H1: Since sovereign-rating actions have a direct impact on firm-level rating actions there is a large increase in the number of domestic firm rating actions from the pre to the post sovereign-rating action period.

To address H1, we provide a detailed examination of *unconditional* sovereign spill-over for each of our sample countries, where we employ the term ‘unconditional’ to describe sovereign spill-over prior to allowing for firm and sovereign characteristics which determine spill-over.

Our remaining hypotheses address bias in spill-overs. Where negative sovereign-rating actions have a stronger impact than positive rating actions (i.e. negative bias exists), this may contribute to quicker and/or deeper crises versus slower and/or longer recoveries. We determine, on a country-by-country basis, the impact of positive and negative sovereign-rating changes both before and after controlling for sovereign- and firm-level factors which determine spill-over. We term any bias after controlling for sovereign- and firm-level determinants of spill-over ‘conditional’ bias. Where conditional negative bias exists, it may indicate inequity in firm re-ratings as a result of a sovereign re-rating.

Conditional negative bias across all countries might arise since rating agency reputation relies on the timely identification of credit problems associated with *negative* changes to the rating, with more resources allocated by the rating agencies to discovering deteriorations in credit quality (Ederington & Goh, 1998). If this is the case then rating agencies are likely to expend more effort investigating firm-level credit ratings in the wake of *negative* sovereign-rating actions, which would affect the relative impact of positive and negative sovereign actions. Equally, if the damage to rating agency reputations applies primarily to firms awarded ratings which turn out to be too high, ‘blanket’ firm-level rating changes are more likely for negative sovereign actions, particularly in times associated with a large degree of uncertainty. This leads to our second hypothesis:

H2: Rating agency reputation relies on the timely identification of credit problems associated with negative changes to ratings, and this is reflected in conditional negative spill-over bias across all countries.

Negative bias might apply particularly to countries with a realistic prospects of default; as sovereigns approach default, so the likelihood increases that the country will implement policies which in turn will impact the ability of firms domiciled within the country to repay their foreign currency debts (see, e.g., Durbin & Ng, 2005). A negative bias arises from the increased probability of government action which would adversely impact the corporate sector. This leads to our third hypothesis:

H3: The extent of sovereign spill-over is affected by adverse government actions when countries face default. Negative bias is greater for the sub-set of countries with a realistic prospect of default.

We argue that the theoretical arguments for conditional negative bias outweigh those for conditional positive bias and, therefore, we anticipate conditional negative rather than conditional positive bias. However, conditional positive bias in sovereign spill-over might arise from the relative timings of sovereign upgrades and downgrades. Kim and Nabar (2007) show that the rating agencies wait longer to implement upgrades and, therefore, when a positive sovereign change does occur the rating agencies are confident that a recovery is under way and may therefore be willing to upgrade a greater proportion of firms.

Borensztein et al. (2013) argue that the primary reason for the operation of a sovereign ceiling is the likely implementation of capital controls in the event of a sovereign moving close to default. This is related to H3 above. However, we separately examine the operation of the sovereign ceiling via a fourth hypothesis.

H4: Spill-over to firms rated at or above the sovereign ceiling is particularly acute for the negative actions of sovereigns which are closer to default.

We do not formulate a hypothesis to address the relative total (i.e. positive *and* negative) spill-over of sovereign rating actions to NHICs versus HICs. However, we undertake this analysis

after allowing for firm and sovereign characteristics to allow for comparison with the ‘unconditional’ results of Ferri et al. (2001).

3. Data and Methodology

3.1 Sample

Our sample consists of the universe of S&P-rated firms across 34 countries for the period June 1996 through to the close of May 2012. Full rating histories for all rated firms are required to reliably assess the impact of sovereign credit rating spill-over to the credit ratings of domestic firms.⁶ The precise timings of rating actions are also required to allow us to analyse the relative timing of changes to the sovereign- and firm-level ratings. These data are available from S&P’s Ratings Xpress, which provides a full rating history from 1923 and the precise timing of rating actions from 1996.

Rating agencies supply sovereign issuer ratings with respect to both *foreign* currency denominated and *local* currency denominated debt. Given that the local currency rating is more likely to act as a proxy for inflation risk rather than sovereign default risk, we focus our analysis on long-term foreign currency ratings. World Bank/IMF data show that for each country in our sample both firms and sovereigns issue foreign-currency denominated debt.⁷

S&P’s Ratings Xpress provides ratings for the following sub-sectors: Asset-Backed Securities, Commercial Mortgage-Backed Securities, Corporations, Financial Institutions, International Public Finance, Insurance, Real Estate Companies, Residential Mortgage-Backed Securities, Servicer Evaluations, Sovereigns, Utilities. We define all firm-level ratings as those belonging to the following sub-sectors: Corporations, Financial Institutions, Insurance, Utilities. All Real Estate Companies (RECs) are also classified as Corporations and we therefore include RECs under ‘Corporations’. Owing to S&P’s specific use of the word ‘Corporations’, we label all non-sovereign issuers in our sample as ‘firm-level’ issuers.

⁶ As stated in the Introduction, databases used in most prior research cover only rating changes and, thus, firms which are rated but do not have a rating change during the period of analysis are omitted.

⁷ We provide a table showing the data, which is available online (Supplementary Table S1).

To qualify for our analysis there must be an adequate number of firm-level ratings, which we define as a minimum of 20 firms with issuer ratings domiciled in a given country at one point during our sample period. We exclude all countries where S&P did not amend the sovereign issuer foreign currency credit rating or outlook at least once during our sample period.⁸ This filtering process leaves us with 34 ‘countries’: Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Colombia, Denmark, Germany, France, Greece, Hong Kong, India, Indonesia, Ireland, Italy, Japan, Republic of Korea, Luxembourg, Malaysia, Mexico, Netherlands, New Zealand, Portugal, South Africa, Spain, Sweden, Taiwan, Thailand, Turkey, the UK and the USA.

We obtain details of the rating value and outlook (including credit watch status) for all firms and sovereigns rated at the beginning of our sample period, 31 May 1996, and thereafter we track all changes in long-term issuer ratings and outlooks. Thus, for example, for Germany we start by tracking the 21 firms rated at 31 May 1996 and add each newly rated firm until by the close of our sample period we are tracking 1,291 rated firms. All actions are classified into negative and positive actions. When tracking actions we assume that only actions which follow the direction of the sovereign action are related to the sovereign change.⁹ Throughout our analyses the data are dynamic, in the sense that we track what happens to firm ratings across our sample on a day-by-day basis and in particular what happens to domestic firm ratings in the wake of a sovereign-rating action (we employ second by second data on the sovereign action day to identify which firm-level actions precede and which follow the sovereign action).

In Table 1 we present basic statistics for sovereign- and firm-level ratings across our sample countries. Columns 2 and 3 indicate the dates at which firms and sovereigns were first rated, and Columns 4 through 6 provide firm and sovereign-rating details at the end of our sample period (May 2012). Column 4 shows the number of firms rated, and Columns 5 and 6 the average

⁸ S&P did not amend the sovereign issuer foreign currency credit rating or outlook at least once during our sample period in the case of Norway, Singapore and Switzerland. S&P do not issue a sovereign rating for the Cayman Islands. We lack sovereign-level data for Bermuda.

⁹ The following rating actions are excluded from our analysis: the first rating, withdrawn ratings, the first rating following a withdrawn rating, the first rating following a default, rating changes between categories of default, outlook changes to and from developing status. As would be expected, firm-level changes tend to be in the same direction as the sovereign change. Any changes to the outlook status which occur at the same time as a rating change are assumed to be dominated by the rating change.

firm and sovereign rating at 31 May 2012. All of these data are static in the sense that they relate to a point in time.

In Columns 7 through 12 the data are dynamic in the sense that they relate to actions across our sample period. Column 7 details the total number of sovereign actions (total = 313) and Column 8 details the number of positive (vs negative) actions across our sample period. Positive actions are rating upgrades or positive credit watch or outlook changes, and negative actions are rating downgrades or negative credit watch or outlook changes. Over the sample period the following countries had only positive (negative) sovereign actions: Australia, Canada, Chile, Denmark, Sweden (Austria, France, the USA). Thus 31 (29) countries undergo positive (negative) sovereign actions. Turkey experienced the most sovereign actions at 29, 52% of which were positive, followed by Indonesia (25, 44% positive) and Argentina (20, 30% positive).

The sample firms underwent a total of 51,709 changes to their rating in the sample period (Column 9). For our subsequent analyses we employ data for all firms rated at the time of each of the sovereign-rating actions. Across the eligible sample of 34 countries, 20,407 domestic firms (Column 11) hold a rating at the start of each of the 313 days (Column 7) when the sovereign rating is changed in the period June 1996 through to the close of May 2012. 6,574 firms contribute the 20,407 firm ratings (Column 12).

Insert Table 1 about here

The analysis requires that both sovereign- and firm-level ratings exist for a particular country. As such, any firm-level actions which occur when the sovereign is in default are excluded from the analysis (sovereign-rating withdrawals do not affect our sample sovereigns). There are five sovereign defaults in our sample which affect Argentina, Greece and Indonesia. We find that, unlike other negative rating actions for these countries, there are no immediate firm-level rating changes in response to defaults. This is not surprising given that the rating agencies have control over the timing of their rating actions but they have no control over the timing of defaults; as such we find that revisions to firm-level ratings tend to *precede* sovereign defaults and

are in response to previous rating revisions. We undertake a separate analysis of firm-level actions around sovereign defaults in Section 5.2.

Data availability for Taiwan and Luxembourg reduces the sample for the regression analysis of spill-over to 20,132 firms across 32 countries. For the analysis of bias, we require that both sovereigns and firms undergo both positive and negative rating actions. This further reduces the number of sovereigns and firm ratings available; we undertake analyses of spill-over across both the (0,3) window and the (0, 21) window, and the samples are 9,152 firm ratings across 18 countries for the (0, 3) window and 10,608 firm ratings across 22 countries for the (0, 21) window.¹⁰

3.2 Method and Variables

To investigate sovereign spill-over we employ logit models, and our dependent variable, *Firm-action*, takes a value of 1 if the firm experiences a rating change in the same direction as the sovereign change within three days of the sovereign-rating change, (0, +3), and 0 otherwise. We also report results for the (0, +21) window, which we employ to determine timing differences and persistent disparities between positive and negative actions.

The scope of our sample is determined by the reach of S&P, and thus the data are not a random sample of all sovereigns but rather an enumeration of all countries with adequate firm-level rating coverage. We employ a model with sovereign fixed effects since we do not intend to extrapolate the results beyond our sample of sovereigns. Since the data are nested, we produce standard error estimates by clustering at the sovereign level – that is, the highest level of aggregation at which the data might be correlated (see, e.g., Thompson, 2011). Since each firm can contribute more than one firm-rating observation to each sovereign, we employ robustness checks employing two-way clustering at both the firm and sovereign level, and we

¹⁰ In Supplementary Table S2, available online, we provide a brief summary of the samples employed in the different tables and we set out details of differences in samples due to the availability of data and/or due to a lack of sovereign and/or firm rating actions.

confirm that standard errors are only minimally affected by clustering at both the firm and sovereign level. In all cases we apply a finite sample adjustment to the standard errors.¹¹

The sovereign fixed effect accounts for all time invariant sovereign characteristics and we are unable to also employ time invariant sovereign variables. However, we do include sovereign variables which vary across time. These ‘within country’ effects are important controls given that sovereign actions occur at different points in time.

Where it is useful to us to examine both the cross-sectional and time-varying effects of sovereign-level variables we support our fixed effects analysis with a random effects model, with firms nested within sovereign actions nested within sovereigns. We are aware of the criticisms of such an approach, where the number of groups (countries in our case) is limited (e.g. Bryan and Jenkins, 2013). However, we do not employ any cross-level interactions, which therefore reduces any bias (see Stegmüller, 2013).

To identify the determinants of sovereign spill-over we employ firm and (time-varying) sovereign characteristics likely to impact sovereign spill-over.

We follow both Borensztein et al. (2013) and Williams et al. (2012) by including the macroeconomic variables which drive sovereign ratings as set out by Cantor and Packer (1996) – that is, (the natural log of) per capita GDP, GDP growth, GDP growth volatility, the annual consumer price index (CPI) rate and the current account relative to GDP. We find that many countries with high current account deficits have a low level of sovereign spill-over (the USA, the UK, New Zealand); further, the annual CPI rate and GDP growth volatility fail to be significant in all preliminary analyses. We therefore select (the natural log of) per capita GDP and GDP growth from among these variables. Borensztein et al. (2013) argue that capital account restrictions drive the rating agencies’ sovereign ceiling policy, and to capture this we employ the capital account openness index of Chinn and Ito (2008) (*KAOpen*).

¹¹ We control for any effects which would induce correlation between observations drawn from the same time point. Sovereign actions can occur at any time and clustering by time amounts to clustering by sovereign action. Sovereign actions are nested within sovereigns and again the standard errors are only be minimally affected by clustering at the sovereign action in addition to the sovereign level.

The extent of the spill-over of sovereign credit ratings into domestic firm credit ratings is also likely to depend on the sovereign environment – that is, the credibility of the government to take action which favours the corporate sector, the extent of creditor protection within each market and the quality of the regulatory authorities. Faced with greater uncertainty or a lack of confidence in a particular market, we argue that the rating agencies are more likely to implement changes to firm-level ratings in response to a sovereign-rating change. The World Bank provides appropriate variables to capture most of these effects (*Government effectiveness, Regulatory quality, Corruption, Rule of law*).¹²

We find that *GDP per capita, KAOpen, Corruption, Government effectiveness, Regulatory quality* and *Rule of Law* are highly correlated with cross-correlations exceeding 80%. To deal with the multicollinearity we first create a variable, ‘*Environment*’, by summing the World Bank indices, given that they are all measured on a scale of -2.5 to $+2.5$. We then undertake a principal components analysis and via one factor, which we term the ‘*Wealth/Risk factor*’, we capture 83% of the variance of these variables. The *Wealth/Risk factor* has similar weights on each component variable and a correlation with each of the component variables exceeding 90%. Where better suited to the question in hand, we employ the component variables (specifically, *KAOpen* is employed in our sovereign ceiling analysis).

We add more immediate measures of macroeconomic circumstances – that is, stock market returns (*Return*) and volatility (*StDev*) – where returns represent the direction in which economic conditions are changing and volatility measures the degree of uncertainty associated with a particular market. Volatility is higher during financial crises (e.g. Schwert 2011 and 1990), and therefore captures crisis conditions in which the rating agencies might be expected to hedge

¹² *Government effectiveness* measures ‘the quality of policy formulation and implementation, and the credibility of the government’s commitment to such policies’. *Regulatory quality* is a measure of ‘the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.’ *Corruption* measures ‘the extent to which public power is exercised for private gain’. *Rule of law* measures ‘the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence’. All measures run from -2.5 to $+2.5$. Incidentally, high levels of state ownership might also be expected to increase the dependency of firm default risk on sovereign default risk. However, a preliminary analysis at the aggregate level suggests a number of anomalies; for example, the state owned enterprise share of the market is low in Hong Kong and Mexico, relative to France and Belgium (see Kowalski, Buge, Sztajerowska and Egerland, 2013) and yet spill-over is higher for the former two. Firm-level state ownership data are not available across our sample.

their risk by applying blanket firm-level rating adjustments in response to deteriorations in sovereign ratings. Negative stock market returns, stock market volatility and credit rating changes are associated with crises, and Ferri et al. (1999), *inter alia*, demonstrate that while sovereign-rating changes further exacerbate crises, higher volatility emerges before any rating changes. We measure returns and volatility in the three months *prior to* the sovereign-rating change to capture conditions in the lead up to the sovereign change. These two variables have no cross-correlations with a magnitude exceeding 50%.

We now turn to firm-level variables. If a company in our sample has been listed, observable owing to the assignment of a ticker symbol, we assume that information quality is greater owing to greater scrutiny. However Behr, Kisgen and Taillard (2014) argue that rating agencies are more likely to inflate the ratings of small firms rather than large firms, since large firms are more visible and the rating agencies will be conscious of any impact on their reputation of inaccuracies in the ratings of large firms. The same effect might operate for listed firms, with the rating agencies more likely to revise the ratings of more visible firms to protect their reputation, particularly in the wake of a sovereign downgrade.

The propensity of firms to be affected by the sovereign rating might be affected by the firm's own credit risk, as given by the firm credit rating. Our sample includes many unlisted entities with little or no available accounting or market data. However, a firm's credit rating incorporates data on, *inter alia*, leverage and profitability (see, e.g., Blume, Lim & MacKinlay, 1998). We expect that firms with higher ratings are more likely to have access to resources (e.g. capital) which would allow them to better withstand a deterioration in sovereign conditions. However, firms with higher ratings are also more likely to have access to capital denominated in foreign currency and when the sovereign foreign currency credit rating is downgraded, firms with higher levels of foreign currency borrowing are more likely to be affected. The firm-rating variable also controls for any re-rating owing to the credit risk of the firm as distinct from the firm rating being at or above the sovereign rating (see below).

Independent from the impact of the firm's own credit rating on spill-over, a firm's likelihood of undergoing a rating change in the wake of a sovereign re-rating is also related to whether the

firm is rated below, at or above the sovereign rating. If a sovereign ceiling is in operation, firms rated at and above the sovereign rating will be more likely to have their ratings revised in response to the sovereign-rating revision. *Equal Sov.* takes a value of 1 for firms with ratings which equal the home sovereign rating just prior to the sovereign action, and 0 otherwise. The variable denoted '*> Sov*' takes a value of 1 for a firm with a rating that exceeds the sovereign rating just prior to the sovereign action, and 0 otherwise. Where a firm has a rating of 'AAA/Stable', the firm rating cannot be amended upwards in response to a positive sovereign-rating change and these cases at the limit are excluded from the variables *Equal Sov* (1 case) and '*> Sov*' (16 cases) for positive actions. The correlation between the firm rating and the dummy variables indicating a rating above or at parity with the sovereign rating is very low (< 3% in both cases).

Our preliminary analysis suggests that financial firms in the Eurozone countries are particularly impacted by sovereign-rating changes, and Williams et al. (2013) provide evidence that bank rating changes in developing countries are significantly affected by sovereign-rating changes.¹³ Further, it is important that we control for the industrial breakdown of our sample of rated firms since this is likely to differ from that of all firms in the economies of the constituent sovereigns, given that financial firms are often rated first (Ferri et al. 2001). Some 34.1% of rated firms are defined by S&P as 'Financial', a sector which comprises primarily banks. As such we include sector dummies. *Financial (Utilities) [Insurance]* takes a value of 1 if the firm belongs to the Financial (Utilities) [Insurance] sector, and 0 otherwise. The sector 'Corporations' is the baseline.¹⁴

In addition to the selected sovereign- and firm-level characteristics we include the following sovereign action-level control variables: *Sovrch* takes a value of 1 for sovereign-rating changes and a value of 0 for outlook or credit watch changes. Williams et al. (2013) report that sovereign-rating changes have a more significant impact on the ratings of banks in developing

¹³ Explanations for this correlation in ratings include the fact that domestic banks tend to hold large amounts of domestic sovereign debt and that in times of crisis governments offer support to banks (see Correa, Lee, Sapriza & Suarez, 2013).

¹⁴ Supplementary Table S3, available online, sets out the mean values of key variables for each sovereign and in the final column the World Bank income status.

countries. However, a number of studies demonstrate that outlook and credit watch changes reveal significant information about credit quality, and may be more timely than rating changes (see Alsakka and Ap Gwilym (2012) for a review of literature related to sovereign outlook and credit watch changes). *Days* is the natural log of the number of days since the last sovereign action in the same direction. Sovereign actions which are far apart might contain more information giving rise to a review of firm-level ratings. Alternatively, where sovereign actions are close together this is indicative of rapidly changing sovereign conditions which may lead to more firm-level changes. *Multiple* takes a value of 1 where the rating action was a multiple notch upgrade or downgrade.

4. Empirical Results

4.1 Country-level spill-over statistics

In this section, we investigate our first hypothesis, as stated in Section 2:

H1: Since sovereign-rating actions have a direct impact on firm-level rating actions there is a large increase in the number of domestic firm rating actions from the pre to the post sovereign-rating action period.

The date of the sovereign (country) action is Day 0, and we split Day 0 into firm-level changes which occur before and after the sovereign action. Day 1 is the 24 hour period for the day after the sovereign change, and so on.

Insert Table 2 about here

Very little firm-level activity occurs in the days prior to sovereign-rating actions with a sharp increase on Day 0 for many countries (Table 2); we find that 34% of Day 0 actions occur within 1 hour of the sovereign-rating action (not tabulated). As such, Table 2 provides support for our first hypothesis that sovereign-rating actions lead to firm-level rating actions.¹⁵

¹⁵ To support Table 2, in Supplementary Table S4 (available online) we explain how we deal with firm-level rating changes which occur in the windows of more than one sovereign change, and in Supplementary Table S5 (available online) we report the daily average number of firm-level changes across the same windows shown in Table 2 to provide an alternative picture based on the same data.

In Table 3 we report the *proportion* of firms which undergo a rating change in the wake of a sovereign action in the period (0, +3) days after the sovereign change¹⁶ and within one trading month – that is, the period (0, +21) days. We also calculate the proportion of firms that we *expect* to change their rating in the days immediately after the sovereign action, which is shown in Table 3 under ‘[Exp. (0, 3)]’. This is based on a daily distribution of firm rating actions in proportion to the number of firms rated each day. Expectations of a domestic firm rating action in the (0, +3) window are between 0% and 1%, other than for Turkey (1.22%), and tend to lie closer to 0% than 1%.

Insert Table 3 about here

The analysis presented in Table 3 provides further support for H1 since for 33 out of 34 countries in our sample¹⁷ the proportion of firms which undergo a rating action in the same direction as the sovereign-rating action in the days immediately following a sovereign action is higher than would be expected based on an equal daily distribution.

However, we find evidence of considerable heterogeneity across countries in the propensity of firms to undergo a rating action in response to a sovereign-rating action. For *positive* actions, Argentina, India and Turkey have the highest probability of sovereign spill-over, and for *negative* actions, Brazil, India and Turkey. Thus, for example, 63.7% (74.1%) of Argentinean firms undergo a positive rating action within 4 (22) days of a positive sovereign-rating action and 79.2% (81.5%) of Brazilian firms undergo a negative rating action within 4 (22) days of a negative sovereign-rating action. By comparison, the figures for positive sovereign spill-over are less than 1% ((0, +3) window) and 5% ((0, +21) window) for Canada, Germany, Portugal, Spain, Denmark, the UK and New Zealand. The figures for negative sovereign spill-over are less than or equal to 1% ((0, +3) window) and 5% ((0, +21) window) for Germany, the UK and the USA (the USA has no positive sovereign-rating changes in the sample period).

¹⁶ For most countries there is a considerable reduction in firm-level actions two days after the sovereign action (i.e. most firm-level actions occur in the (0, +1) window). However, for most Eurozone countries, firm-level actions occur in the (0, +3) window. Further analysis of the Eurozone countries reveals that the propensity for firm-level ratings to change following a sovereign rating change is dominated by the change to the ratings of financial institutions (banks) during the credit crisis, and this reaction usually follows the sovereign change with a delay of two to three days.

¹⁷ Denmark is the exception and in this case no firm level actions occur following a positive sovereign action (Denmark had no negative sovereign actions across our sample period). In the case of Portugal and New Zealand this is only true for negative sovereign rating actions (again for positive sovereign actions there were no firm-level actions for these countries).

The results in Table 3 also indicate, on a country-by-country basis, where the impact of positive and negative sovereign-rating changes on domestic companies has been unequal and may therefore continue to be so. Thus, for example, over the (0, 21) window the probability of spill-over for negative sovereign-rating changes for Brazil (Portugal) is 81.5% (48.7%), which compares with 39.9% (0.0%) for positive sovereign changes. Firm-level rating actions impact the cost of firm-level borrowing. As stated in the Introduction, the implied higher correlation between sovereign and firm-level ratings in times when countries are in crisis, versus when they are in recovery, may contribute to quicker and/or deeper crises versus slower and/or longer recoveries. Table 3 indicates that negative spill-over tends to be greater than positive spill-over, confirming the result of Borensztein et al. (2013) and contrary to the findings of Williams et al. (2013). However, our country-by-country results show that this is not the case for all countries, as illustrated by examples in the Introduction. Table 3 also indicates that spill-over tends to be greater for NHICs, confirming the result of Ferri et al. (2001). However, we demonstrate that there is considerable heterogeneity in sovereign spill-over within both HIC and NHIC status countries, again as illustrated by examples in the Introduction.

4.2 Determinants of Sovereign Spill-over

In this section we empirically examine the sovereign- and firm-level factors discussed in Section 3.2 which would theoretically be expected to impact the extent of spill-over.

To determine which factors explain the spill-over of positive and negative sovereign-rating changes we undertake separate regressions for positive and negative actions. We do not consider reverse causality to be an issue since even at the height of the credit crisis any causality from the corporate sector to the sovereign did not occur quickly (see, e.g., Ejsing & Lemke (2011)) and the data in Table 2 further demonstrate that there are very few firm-level actions prior to sovereign-rating actions but a large increase in firm actions from the date of the sovereign action.¹⁸

¹⁸ Michaelides, Milidonis, Nishiotis and Papakyriakou (2015) report that information leakage prior to a sovereign re-rating impacts the domestic stock market in the period prior to the sovereign re-rating, particularly in countries of lower institutional quality. However, this does not impact the relationship between sovereign and firm re-ratings, and Table 3 provides evidence that in terms of ratings, reverse causality is not an issue.

The results of the preliminary regression analyses are shown in Table 4 for positive sovereign actions (n = 6,445) and negative sovereign actions (n = 13,687).

Insert Table 4 about here

As anticipated given stock market volatility is a measure of uncertainty, we find that a higher level of recent stock market *volatility* is associated with increased (reduced) spill-over of negative (positive) sovereign credit rating changes into domestic firm credit ratings. Stock market *returns* are not significant in the negative actions model but for positive actions a more positive recent stock index performance increases the spill-over of sovereign credit rating changes into domestic corporate credit ratings across the (0, 3) window.

Within country variations in the Wealth/Risk factor do not impact sovereign spill-over in the (0, 3) window. The results for the sovereign Wealth/Risk factor over the (0, 21) period suggest that, *ceteris paribus*, negative spill-over is *higher* when a country is in a wealthy low credit risk state whereas positive spill-over is *lower* when a country is in a wealthy low risk state. The former result is not as expected, since the findings of Ferri et al. (2001) suggest that sovereign spill-over decreases as wealth increases. However, our variable only captures time series (within country) elements of the Wealth/Risk factor.

Firms with better credit quality (a higher credit rating) are more affected by negative changes to the sovereign rating over the (0, 3) window, but not over the (0, 21) window. We argue that the former result would be expected where higher credit quality firms have greater access to *foreign currency* debt. This is counterbalanced by the greater access to resources which would allow them to better withstand a deterioration in sovereign conditions, which would explain the result over the (0, 21) window.

Listed firms are more vulnerable than non-listed firms to sovereign-rating changes for *positive* actions only – that is, the rating agencies are more likely to revise upwards (but not downwards) the ratings of listed firms. We argue that listed status would signal both greater visibility and better information quality. The higher *positive* spill-over for listed firms suggests that the rating agencies are more inclined to couple sovereign and firm risk because they have more confidence in the information provided by listed firms. We find no support for the theory

that the rating agencies are more conservative with the ratings of more visible firms, which would affect negative spill-over.

Holding the firm rating level constant, firms rated at parity with the sovereign have odds of undergoing a credit rating change in response to a sovereign-rating change of between 10.3 and 32.7 times that of a firm rated below the sovereign rating. Firms rated above the sovereign rating have odds of undergoing a change of between 1.4 and 5.5 times that of a firm rated below the sovereign rating. The studies of Almeida et al. (2017) and Borensztein et al. (2013) do not make a distinction between firms rated at parity with the sovereign and firms rated above the sovereign rating, but the odds of spill-over are significantly higher for the former group, suggesting that the latter group are relatively more immune from sovereign spill-over.

Finally, firms in the Financial (primarily banks) and Utilities sectors are more affected than ‘Corporations’ across both positive and negative actions. The regression analysis which supports our analysis of bias in Section 4.3 confirms that positive sovereign actions do not differ in their impact on Financial firms from negative sovereign actions (see Appendix 1). This contrasts with the finding of Williams et al. (2013) that positive sovereign actions have a greater impact on the banks domiciled within emerging market sovereigns than negative sovereign actions. We show that the concerns of Williams et al. (2013) about the impact of sovereign-rating actions on bank ratings in emerging markets apply equally to a sample of financial firms which includes developed markets.

We undertake robustness checks of the results in Table 4 by employing different sub-samples of our data. Specifically, we ensure that results are not driven by one or two economic areas by excluding (i) EU countries and (ii) the USA and EU countries. We also report standard errors clustered by both firm and sovereign. We confirm that our results are robust to this change in the standard error calculation and the employment of these sub-samples.¹⁹ Sub-samples of investment and non-investment grade sovereigns are employed in Section 4.4

¹⁹ These results are available online in Supplementary Tables S6 and S7.

4.3 Conditional Negative-Positive Bias

In this section, we examine the relative impact of positive and negative sovereign-rating changes after controlling for firm and sovereign characteristics, which enables us to address our second and third hypotheses.

As stated in the Introduction, where firms are more responsive to negative sovereign changes than positive sovereign changes, *ceteris paribus*, this may have unequal effects on the speed and depth of crises versus recoveries. Conditional negative bias (i.e. that which remains after allowing for firm-level and sovereign factors which determine the extent of spill-over) may be of particular interest to government finance ministers since it may indicate inequity in the re-rating of firms due to a change in the sovereign rating.

To investigate negative or positive conditional bias we employ the sample of countries which underwent *both* negative and positive changes to their sovereign rating. We therefore omit the eight countries having neither one nor the other.²⁰ We also remove countries with no firm-level actions in a particular window,²¹ and this gives us different sample countries for the two windows. Our samples are therefore 9,152 firms across 18 countries for the (0, 3) window and 10,608 firms across 22 countries for the (0, 21) model. As in Section 4.2, we begin our analysis of bias via a logistic regression analysis with *Firm-action* as the dependent variable. We create a positive sovereign action dummy variable (*SovPos*). We include appropriate control variables suggested by the results of the positive and negative regression analyses at 4.2 above – that is, *StDev*, *Wealth/Risk factor*, *Firm Rating*, *Eq. Sov.*, *> Sov.*, *Listed*, *Financial*, *Utilities*. We interact the positive sovereign action dummy variable with each sovereign country dummy and each control variable. In addition to country dummy variables, we include year dummy variables. Results for the logistic regression are shown in Appendix 1.

To determine bias we require a reference country. The choice of a reference country does not affect any estimates of bias, nor the ranking of countries by bias, but the choice does impact

²⁰ Chile, Canada, the USA, Austria, France, Denmark, Sweden, Australia. See online Table S2.

²¹ The following countries had no firm level actions in the (0,3) [(0, 21)] window: (Belgium, Portugal, Spain, the UK, New Zealand) [Portugal, New Zealand]. Italy is also excluded from the (0, 3) analysis. See online Table S2.

whether we find that bias is significant.²² As such, we employ two alternative reference countries, Korea and Greece, since preliminary analyses show that for both countries no bias is evident across either window ((0, 3) or (0, 21)), and in addition the positive sovereign dummy variable (*SovPos*) takes a different sign for each country. We suggest that conclusive evidence of positive or negative bias requires significance relative to both reference countries.²³

In Table 5 we report our findings in respect of negative-positive conditional bias on a country-by-country basis. Bias is indicated in the column ‘Ratio’, which is the odds of negative sovereign spill-over for a particular country divided by the odds of positive spill-over. These odds are determined from the underlying regression coefficients in Appendix 1. Countries with ratios which exceed 1 have negative bias, and countries with ratios which are less than 1 have positive bias. A full description and example of the calculations accompany Table 5. Significant bias relative to Korea and Greece are indicated in the columns ‘KOR’ and ‘GRC’, respectively. Bias at the longer-term (0, 21) window reflects persistent bias, whereas bias at the (0, 3) window not accompanied by bias at the (0, 21) window reflects the relative speed with which negative and positive adjustments are made.

Insert Table 5 about here

First we note that for most countries, after allowing for firm and sovereign factors which determine spill-over, no significant negative or positive bias exists. This indicates that the unconditional negative bias we noted in relation to Table 5 can largely be explained by firm- and time-varying sovereign characteristics. However, conditional bias does exist for some countries.

The results presented in Table 5 allow us to investigate our second hypothesis, as stated in Section 2:

²² Significance is measured relative to the reference case.

²³ We employ Argentina against the reference case Korea to explain further. In our logistic regression analysis (Appendix C), across the (0, 3) window we omit a dummy variable for Korea, but include dummies for all other countries (e.g. *ARG* for Argentina) plus an interaction term for each country with *SovPos* (*ARG* x *SovPos*). The coefficient on *SovPos* represents the reference case, Korea, and this coefficient takes value of 0.232 (see Appendix C) and is far from significant ($p = 0.847$). We can then assess the significance of the coefficient on *ARG* x *SovPos* relative to the base case. We find in fact that the odds of positive spill-over are significantly greater for Argentina than Korea (again, see Appendix C). Since this significance is relative to Korea, which has a positive, albeit insignificant coefficient, we employ a robustness check with Greece in place of Korea. With Greece as the reference case *SovPos* has a highly insignificant but negative coefficient of -0.385 , and again the odds of positive spill-over are significantly greater for Argentina.

H2: Rating agency reputation relies on the timely identification of credit problems associated with negative changes to ratings, and this is reflected in conditional negative spill-over bias across all countries.

Via H2 we expect conditional negative bias to occur for all countries under the assumption that the rating agencies seek to protect their reputation by being more proactive during negative actions. We find some support for H2 in that conditional negative bias occurs for more countries than positive bias. However, conditional negative bias is by no means universal.

Specifically, Table 5 indicates conditional negative bias across the (0, 3) window for Ireland, the Netherlands, Germany and Hong Kong. This bias decreases considerably across the (0, 21) window, which therefore indicates that for these countries S&P is quicker to adjust firm ratings downwards following negative sovereign actions than to adjust them upwards following positive sovereign actions. These conclusions can be compared with those for, say, Colombia, where across the (0, 3) window there is no conditional bias but there is conditional negative bias across the (0, 21) window. Persistent conditional bias is likely to be of greater concern. Relative to other countries, after allowing for sovereign and firm characteristics, Spain has the largest persistent conditional negative spill-over bias, followed by Hong Kong, Indonesia, Colombia and Brazil. We find consistent evidence of persistent conditional negative bias for each of these countries, and some evidence of persistent conditional negative bias for the UK, Belgium and Ireland.

Significant short-term (0, 3) positive conditional bias is indicated for Argentina and Thailand (coefficients are significant relative to both reference countries). However, over the (0, 21) window the conditional bias disappears for Thailand, which indicates that S&P is quicker to adjust firm ratings upwards after positive actions than downwards after negative actions, but no persistent bias is evident. The coefficient for the (0, 21) window for Argentina just fails to be significantly more positive than Greece at a 10% level (p -value = 12.8%), but as Greece has a small positive coefficient it is likely that persistent conditional positive bias does indeed exist for Argentina.

Kim and Nabar (2007) show that the rating agencies wait longer to implement upgrades, and we suggest therefore that when a positive sovereign change does occur the rating agencies are confident that a recovery is under way and may therefore be willing to upgrade a greater proportion of firms. If this argument holds true then we might expect conditional positive bias to be particularly associated with Argentina's recovery from default. However, the higher conditional positive (relative to negative) sovereign spill-over for Argentina occurs both before and after the Argentine default.

Via H3 we expect conditional negative bias to be related to the likelihood of adverse government actions as a sovereign approaches default. Specifically, we argue:

H3: The extent of sovereign spill-over is affected by adverse government actions when countries face default. Negative bias is greater for the sub-set of countries with a realistic prospect of default.

Table 5 does not indicate that this is the case since conditional negative bias is by no means exclusive to countries with a realistic probability of default.

Given our fixed effects country-by-country results fail to find support for H3, we employ additional analyses to provide further evidence. We classify all countries with a sub-investment grade rating as having a realistic prospect of default. We compare unconditional spill-over for investment versus sub-investment grade sovereigns. Since the rating of the firm relative to the sovereign is a key determinant of spill-over, we separately document spill-over for firms with ratings < Sovereign, = Sovereign, > Sovereign. We also show the spill-over separately for positive and negative sovereign actions.

Insert Panel A of Table 6 about here

Panel A of Table 6 suggests that spill-over *is* higher for sub-investment grade sovereigns, across *both* positive and negative actions, and is higher for negative actions, as anticipated by H3.

We now undertake a regression analysis. The expectation via H3 is that after controlling for firm-level characteristics and sovereign conditions, negative spill-over is greater for sub-investment grade sovereigns.

We employ a random effects model for this analysis given our desire to measure both within- and between-country effects. The sub-investment grade status (*Sub-IG*) of the sovereign enters the model and we do not also include the Wealth/Risk factor since this variable is highly (negatively) correlated with sub-investment grade status. We undertake the analysis across both the full sample employed in Table 4 ($n = 20,132$) and the sample with both positive and negative sovereign actions employed in the (0, 3) window in Table 5 ($n = 9,152$). The models are three level random effects models and 20,132 (9,152) firm ratings are nested in 304 (236) sovereign actions are nested in 32 (18) sovereigns.

The key variable is the interaction between the sub-investment grade status of the sovereign and the direction of the sovereign-rating change. We do not employ cross-level interactions, which circumvents the bias inherent in such models (see Stegmueller, 2013). We employ *SovNeg* rather than *SovPos* to indicate the direction of the sovereign action in this model (the magnitude of the interaction term is entirely unaffected by this, but the interpretation of the coefficient is more intuitive), and thus the key variable is *Sub-IG x SovNeg*.

Insert Panel B of Table 6 about here

The coefficients on the interaction between *Sub-IG* and *SovNeg* fail to be significant in any regression, which further supports our fixed effects country-by-country analysis of H3. We fail to find evidence that conditional negative spill-over is greater for sub-investment grade sovereigns.

However, we do find that the coefficient on *Sub-IG* tends to be significantly positive, which suggests that, *ceteris paribus*, spill-over (both negative *and* positive) to sub-investment grade sovereigns is greater.

4.4 Sovereign Ceiling Analysis

Borensztein et al. (2013) and Almeida et al. (2017) classify firms rated above and at par with the sovereign rating as ‘bound’ firms, and argue that, via the sovereign ceiling principle,

bound firms are significantly more likely to be affected by sovereign downgrades. Borensztein et al. (2013) argue that the primary reason for the operation of a sovereign ceiling is the likely implementation of capital controls in the event of a sovereign moving close to default. Via the arguments of Borensztein et al. (2013), firms with ratings at or above that of the sovereign (bound firms) are subject to greater spill-over, particularly following a negative sovereign action to a sovereign with a high prospect of default. We formulate our fourth hypothesis as follows:

H4: Spill-over to firms rated at or above the sovereign ceiling is particularly acute for the negative actions of sovereigns which are closer to default.

We add an additional dimension to the sovereign ceiling analysis of Borensztein et al. (2013) and Almeida et al. (2017) by distinguishing between those firms rated at parity with the sovereign (*Eq. Sov.*) and those firms rated above the sovereign rating (*> Sov.*). We compare the spill-over of sovereign-rating changes to domestic firms rated at and above the sovereign across the two groups of sovereigns (sub-investment/investment grade) and across events types (positive versus negative). The expectation is that the coefficients on the variables *Eq. Sov.* and *> Sov.* will be more positive (indicating greater sovereign spill-over) for negative sovereign-rating changes to sub-investment grade sovereigns.

As an additional test we assess the impact of capital account openness (*KAOpen*) on the spill-over of sovereign-rating actions. The expectation is that *KAOpen* has a negative coefficient, with more openness reducing sovereign credit risk spill-over to domestic firms, particularly where a lack of openness is coupled with a negative sovereign-rating action and a sub-investment grade sovereign rating (i.e. where capital controls are a more realistic prospect).

We employ a fixed effects model in which we undertake separate analyses on sub-samples of sub-investment-grade-rated (n = 982 for positive actions, n = 1,329 for negative actions) and investment-grade-rated sovereigns (n = 5,116 for positive actions, n = 12,705 for negative actions). The fixed effects model allows us to measure the impact of sovereign specific time variations in *KAOpen* for investment and sub-investment grade sovereigns and to examine the operation of the sovereign ceiling in sub-investment and investment grade sovereigns.

Our regressions include all of the variables employed in Table 4 other than the Wealth/Risk factor, which is replaced by one of its constituents, *KAOpen*. For the sake of clarity we only report coefficients for the variables representing capital account openness and the sovereign ceiling variables – that is, the firm rating being at or above the sovereign rating. As in earlier regressions, the firm rating is included to control for any re-rating owing to the credit risk of the firm as distinct from the firm rating being at or above the sovereign rating.

Insert Table 7 about here

After allowing for firm and sovereign characteristics, firms at parity with the sovereign rating are the most impacted by sovereign-rating changes across both investment and sub-investment grade sovereigns. The odds of sovereign spill-over to a firm rated at parity with the sovereign is higher for the negative actions of investment-grade sovereigns than for sub-investment grade sovereigns, once the impact of other firm and sovereign characteristics on sovereign spill-over have been accounted for. This suggests that the coupling of firm and sovereign ratings for firms at parity with the sovereign rating is related to the threat of adverse government action when the sovereign is still some way from default. Firms with ratings above the sovereign are relatively immune from sovereign spill-over.

We find that reduced capital account openness leads to greater spill-over among sub-investment grade sovereigns, which is as predicted by the prior literature. The result for investment grade sovereigns is of less importance to our analysis, since capital account openness is of less consequence when sovereigns are not approaching default. However, we find the opposite effect to that expected, with (time series) increases in capital account openness increasing spill-over.

5. Further Tests

5.1 Spill-over to Non-Higher Income Countries Relative to Higher Income Countries

Ferri et al. (2001) comment on the proposals put forward in 1999 by the newly formed Basel Committee on Banking Supervision, for the employment of external ratings in the calculation of bank capital asset requirements. They find that, in aggregate, companies in non-high income countries (NHIC) are more affected by sovereign rating changes than those in high

income countries (HIC) and they argue that a sovereign-rating downgrade would necessitate large increases in NHIC banks' capital asset requirements at a time when capital is set to become scarce. Similarly, Borenzstein *et al.* (2013) report higher spill-over for developing economies relative to developed economies.

However, Ferri *et al.* fail to control for firm and sovereign characteristics, and Borenzstein *et al.* take no evident account of the relative timing of sovereign- and firm-level actions by assuming that sovereign and firm-level actions at any time within the same calendar year are related. In this section we therefore re-examine aggregate spill-over to firms domiciled in NHICs relative to firms domiciled in HICs, after allowing for firm characteristics and the sovereign environment, and for the relative timing of firm and sovereign events.

Again, we employ a random effects model for this analysis, given our desire to measure both within- and between-country effects. The HIC status (*HIC*) of the sovereign enters the model and we do not also include the Wealth/Risk factor, again since this variable is highly correlated with HIC status. We employ the interaction between *SovPos* and *StDev* given the opposite effect of stock market volatility for positive and negative events. Otherwise our variables are those included in Table 4.

We undertake the analysis across the full sample employed in Table 4 ($n = 20,132$). The models are three level random effects models and 20,132 firm ratings are nested in 304 sovereign actions are nested in 32 sovereigns. The results are in Table 8.

Insert Table 8 about here

The key variable in our regression is HIC, and since this is significantly negative in both models (see Panel A of Table 8) it indicates that spill-over to HICs, both positive and negative, is lower than to NHICs, *ceteris paribus*. This result confirms the arguments of Ferri *et al.*, since the spill-over bias in relation to NHICs holds after allowing for firm characteristics and sovereign conditions.

The results in Section 4.3 suggest that NHICs are not more affected by *negative* spill-over bias, a result which we confirm by adding an interaction term between *SovPos* and *HIC* (see Panel B of Table 8). The coefficient on this interaction term fails to be significant.

5.2 Default Correlation Bias

We examine a source of potential bias not previously examined – that is, whether the strength of the link between sovereign- and firm-level S&P credit ratings is underpinned by the strength of the relationship between firm and sovereign defaults. If S&P is unbiased in its linking of sovereign and corporate credit ratings, then such linkage should be determined by the link between sovereign and corporate defaults, given that credit ratings reflect default risk. Sovereign and firm default actions are not rating agency determined. Data through to May 2013 are employed to investigate the incidence of firm-level defaults following a sovereign default.

Across the entire history of S&P's sovereign ratings there are only seventeen default ratings assigned to sovereigns, only five of which relate to our sample countries (all within our sample period); one each to Argentina and Greece and three to Indonesia. This low incidence of sovereign defaults reflects the date at which our sample of countries first obtained a S&P foreign currency sovereign rating which tends to be the late 1980s/early 1990s for those countries with a high level of spill-over of sovereign credit risk, thereby missing the debt crises of the 1980s. At the height of the South East Asian crisis, (impacting particularly Indonesia, Thailand and South Korea), Thailand and South Korea had minimum sovereign ratings of BBB– and B+, respectively. Thus our potential sample for this investigation is small. Nonetheless, we provide what evidence we can of the relationship between sovereign-rating spill-over and sovereign default spill-over.

In Table 9 we provide details of negative firm-level actions around the time of each sovereign default. We find little evidence of firm-level re-ratings in response to sovereign defaults, but then given sovereign defaults are not rating agency determined, the contemporaneous determination of sovereign and firm-level ratings does not apply. We find that the one year default rate for firms rated at the time of the sovereign default is 80% for Argentina, but varies from 0% to 62% across the three sovereign defaults by Indonesia and is 10% for Greece. There is a decline in the rating agencies' tendency to re-rate firms from Argentina to Indonesia to Greece (see Table 3) and thus Table 9 suggests that the relative firm-level default rates contingent upon sovereign default, reflect the relative spill-over of sovereign re-ratings into firm-level re-ratings. Our

analysis, albeit very limited in scope, shows no evidence of rating agency bias in relation to firm-sovereign default correlations.

Insert Table 9 about here

6. Conclusions

Our analysis provides a novel picture of the relationship between sovereign-level rating actions and firm-level rating actions on a day-by-day and country-by-country basis, highlighting both the extent and timing of sovereign spill-over. This granular approach is particularly useful to banks and investors with loans and investments in different countries, to determine the extent of their exposure to sovereign credit risk channelled via the sovereign credit rating.

We show that while in aggregate there is a considerable increase in the number of firm-level actions in the days immediately following the sovereign-rating change, there is considerable variation in the extent of sovereign spill-over between countries. We undertake analyses of spill-over both before and after allowing for firm and sovereign characteristics.

Prior to allowing for firm characteristics and sovereign conditions, most countries suffer from a negative bias in sovereign spill-over, but not all (e.g. South Africa, Argentina). We then show that for most countries any bias between the impact of negative and positive sovereign-rating actions can be accounted for by firm and sovereign characteristics. However, after accounting for firm and sovereign characteristics, persistent negative bias remains for some countries (Spain, Hong Kong, Indonesia, Colombia and Brazil).

References

- Acharya, V., Drechsler, I., & Schnabl, P. (2014). A Pyrrhic victory? Bank bailouts and sovereign credit risk. *Journal of Finance*, 69, 2689–2739
- Afonso, A., Furceri, D., & Gomes, P., (2012). Sovereign credit ratings and financial markets linkages: Application to European data. *Journal of International Money and Finance*, 31, 606–638.
- Almeida, H., Cunha, H., Ferreira, M.A., & Restrepo, F. (2017). The real effects of credit ratings: The sovereign ceiling channel. *Journal of Finance*, 72, 249–290.
- Alsakka, R., & Ap Gwilym, O. (2012). Credit rating agencies' signals: An analysis of sovereign watch and outlook. *International Review of Financial Analysis*, 21, 45–55.

- Arezki, R., Candelon, B., & Sy, A. (2011). Sovereign rating news and financial markets spillovers: Evidence from the European debt crisis. *IMF working paper* 11/68
- Augustin, P., Boustanifar, H., Breckenfelder, J., & Schnitzler, J. (2016). Sovereign credit risk and corporate borrowing costs. *European Central Bank working paper No. 1878*.
- Bai, J. & Wei, S.J. (2012). When is there a strong transfer risk from the sovereigns to the corporates? Property rights gaps and CDS spreads. *Federal Reserve Bank of New York, Staff Report no. 579*.
- Behr, P., Kisgen, D., & Taillard, J.P. (2016). Did government regulations lead to inflated credit ratings? *Management Science*, <http://dx.doi.org/10.1287/mnsc.2016.2615>.
- Bedendo, M., & Colla, P. (2013). Sovereign and corporate credit risk: Spillover effects in the eurozone, SSRN working paper 2212089.
- Blume, M., F. Lim, & MacKinlay, A. (1998). The declining credit quality of US corporate debt: Myth or reality? *Journal of Finance*, 54, 1389–1413.
- Böninghausen, B., & Zabel, M. (2015). Credit ratings and cross-border bond market spillovers *European Central Bank working paper No. 1831*.
- Borensztein, E., Cowan, K., & Valenzuela, P. (2013). Sovereign ceilings ‘lite’? The impact of sovereign ratings on corporate ratings. *Journal of Banking and Finance*, 37, 4014–24.
- Brooks, R., Faff, R., Hillier, D., & Hillier, J. (2004). The national market impact of sovereign rating changes. *Journal of Banking and Finance*, 28, 233–50.
- Bryan, M., & Jenkins, S. (2013). Regression analysis of country effects using multilevel data: A cautionary tale. *IZA Discussion Paper No. 7583*
- Cantor, R., & Packer, F. 1996, Determinants and impact of sovereign credit ratings, FRBNY Economic Policy Review, 37–54
- Chinn, M.D., & Ito, H. (2008). A new measure of financial openness. *Journal of Comparative Policy Analysis*, 10, 309–22.
- Correa, R., Lee, K-H., Sapriza, H., Suarez, G. (2014). Sovereign Credit Risk, Banks’ Government Support, and Bank Stock Returns around the World. *Journal of Money Credit and Banking*, 46, 93–121
- Durbin, E., & Ng, D. (2005). The sovereign ceiling and emerging market corporate bond spreads. *Journal of International Money and Finance*, 24, 631–49.
- Ederington, L. H., & Goh. J.C., (1998). Bond rating agencies and stock analysts: Who knows what when? *Journal of Financial and Quantitative Analysis*, 33, 569–85.
- Ferreira, M., & Gama, P., 2007. Does sovereign ratings news spill over to international stock markets? *Journal of Banking and Finance*, 31, 3162–3182.
- Ferri, G., Liu, L-G, & Majnoni, G., (2001). The role of rating agency assessments in less developed countries: Impact of the proposed Basel guidelines. *Journal of Banking and Finance*, 25, 115–148.
- Gande, A., & Parsley, D. (2005). News spill-overs in the sovereign debt market. *Journal of Financial Economics*, 75, 691–734.
- Gow, I., Ormazabal, G., & Taylor, D. (2010). Correcting for cross-sectional and time-series dependence in accounting research. *The Accounting Review*, 85, 483–512.
- Guegan, D., Hassani, B., & Zhao, X. (2013). Emerging Countries Sovereign Rating Adjustment using Market Information: Impact on Financial Institutions Investment Decisions. *CES working paper* 2013.34
- Hand, J., Holthausen, R. & Leftwich, R. (1992). The effect of bond rating agency announcements of stock and bond prices. *Journal of Finance*, 47, 733–52.
- Ismailescu, I., & Kazemi, H. (2010). The reaction of emerging market credit default swap spreads to sovereign credit rating changes. *Journal of Banking and Finance*, 34, 2861–2873.
- Kim, Y. & Nabar, S. (2007). Bankruptcy Probability Changes and the Differential Informativeness of Bond Upgrades and Downgrades, *Journal of Banking and Finance*, 31 3843–61.
- Kowalski, P., Buge, M., Sztajerowska, M. & Egerland, M. (2013). State-owned Enterprises: Trade Effects and Policy Implications. *OECD Trade Policy Papers No. 147*.

- Michaelides, A., Milidonis, A., Nishiotis, G.P., Papakyriakou, P. (2015). The adverse effects of systematic leakage ahead of official sovereign debt rating announcements. *Journal of Financial Economics*, 116, 526–547.
- Schwert, G. (1990). Stock volatility and the crash of '87. *Review of Financial Studies*, 3, 77–102.
- Schwert, G. (2011). Stock Volatility During the Recent Financial Crisis, *European Financial Management*, 17, 789–805
- Stegmueller, D. (2013). How many countries for multilevel modeling? A comparison of Frequentist and Bayesian approaches. *American Journal of Political Science*, 57, 748–761
- Thompson, S. (2011). Simple formulas for standard errors that cluster by both firm and time, *Journal of Financial Economics*, 99, 1– 10.
- Tran, V., Alsakka, R., & Ap Gwilym, O., (2014). Sovereign rating actions and the implied volatility of stock index options. *International Review of Financial Analysis*, 34, 101–113
- Williams, G., Alsakka, R., & Ap Gwilym, O., (2013). The impact of sovereign rating actions on bank ratings in emerging markets. *Journal of Banking and Finance* 37, 563–577.

Table 1: Sovereign and Firm Ratings Data

Table 1 shows the dates of the first sovereign and domestic firm foreign currency ratings (Columns 2 and 3), the number of firms rated and the mean firm and sovereign rating at the end of the sample period (Columns 4–6). The mean firm rating is calculated employing the numerical values set out in the text (AAA = 21) which is then reconverted to the nearest rating. Issuers with a long-term rating ‘NR’ (no rating), ‘R’ (under regulatory supervision) ‘SD’ and ‘D’ (in default) ratings are excluded from the number of firms and calculation of the mean rating. However, the number of firms with a default rating is shown in parentheses. Where the mean firm rating value is exactly between two ratings both ratings are shown. Columns 7 – 10 summarize the percentage of positive and negative rating actions (both sovereign and firm) over our sample period for each country. Columns 1, 7, 11 and 12 hold the primary data for subsequent analyses. Across the eligible sample of 34 countries (Column 1), 20,407 domestic firms (Column 11) hold a rating at the start of each day on each of the 313 days (Column 7) when the sovereign rating is changed in the period June 1996 through to the close of May 2012. 6,574 firms contribute the 20,407 firm ratings (Column 12).

Sovereign defaults are shown in parentheses in Column 7 as follows (Argentina = 1; Greece = 1; Indonesia = 3). Firm-level actions which occurred during periods when the sovereign was in default are excluded. The following rating actions are also excluded: the first rating, withdrawn ratings, the first rating following a withdrawn rating, the first rating following a default, rating changes between categories of default, outlook changes to and from developing status.

1	2	3	4	5	6	7	8	9	10	11	12
Sovereign	Date 1 st sovereign rating	Date of first firm rating(s)	No. firms rated (default) 29/05/12	Mean firm rating 29/05/12	Sovereign rating 29/05/12	N. Sov. Rating Actions 2002–12	% Pos 2002–12	N. Firm Rating Actions 2002–12	% Pos 2002–12	Firm ratings	No. firms
Latin America											
Argentina	25/08/93	14/01/94	20 (1)	B	B	19 (1)	32%	520	33%	555	55
Brazil	30/11/94	31/05/96	100 (2)	BB+	BBB	18	78%	769	67%	831	128
Chile	17/08/92	08/11/93	30	BBB	A+	5	100%	211	45%	136	40
Colombia	21/06/93	17/12/93	12	BBB-	BBB-	10	50%	75	47%	74	16
Mexico	29/07/92	22/10/92	57	BB+	BBB	11	73%	583	52%	482	91
North America											
Canada	24/08/49	07/04/54	254	BBB-/BBB	AAA	2	100%	2,061	40%	346	264
USA	01/01/41	18/05/23	2,641 (9)	BB+	AA+	3	0%	31,055	41%	7,762	2,665
Eurozone											
Austria	09/07/75	18/09/76	18	A-	AA+	2	0%	119	29%	36	18
Belgium	26/10/88	19/01/94	24	BBB/BBB+	AA	4	25%	135	33%	91	23
France	25/06/75	24/11/59	163 (1)	BBB+	AA+	2	0%	1,576	37%	317	159
Germany	17/08/83	17/08/83	1,291	AA-	AAA	2	50%	2,727	73%	2,672	1,336
Greece	09/09/88	28/01/97	10	B-	CCC	18 (1)	33%	189	25%	212	23
Ireland	01/10/88	24/11/88	45 (3)	BBB	BBB+	12	33%	436	37%	437	56
Italy	23/11/88	28/07/89	68 (1)	BBB-	BBB+	9	11%	701	30%	542	114
Luxembourg	28/04/94	21/07/87	46	BB+	AAA	2	50%	385	41%	95	48
Netherlands	01/10/88	01/03/83	94	BBB	AAA	2	50%	886	38%	183	92
Portugal	01/10/88	09/11/93	15	BB-	BB	13	15%	215	29%	166	20
Spain	01/08/88	23/05/91	39	BB+	BBB+	12	33%	404	31%	373	56
Other Europe											
Denmark	01/03/81	15/10/81	16	BBB+	AAA	2	100%	94	46%	7	5
Sweden	27/10/77	22/07/80	48	BBB+	AAA	3	100%	394	45%	109	57
UK	05/05/58	05/05/58	251	BBB	AAA	2	50%	2,386	35%	450	242
Asia Emerging											
China	20/02/92	17/10/94	72	BBB-	AA-	10	80%	349	46%	255	65
Hong Kong	23/10/88	20/09/88	50	BBB+/A-	AAA	12	83%	367	49%	422	69
India	13/09/90	20/09/95	25	BB+/BBB-	BBB-	15	53%	183	49%	188	31
Indonesia	20/07/92	29/09/93	25 (1)	BB-	BB+	22 (3)	50%	271	37%	367	57
Korea	01/10/88	13/09/90	54	BBB+/A-	A	12	58%	398	61%	224	47
Malaysia	08/03/89	11/06/93	15	BBB+	A-	15	47%	139	53%	118	19
Taiwan	20/04/89	24/10/95	39	BBB+	AA-	7	29%	170	46%	180	47
Thailand	14/06/89	07/06/94	17	BBB	BBB+	12	50%	179	48%	166	25
Turkey	04/05/92	22/12/93	15	BB-/BB	BB	29	52%	231	54%	279	21
Pacific											
Australia	27/02/57	01/08/85	148	BBB+	AAA	3	100%	1,502	43%	399	207
New Zealand	29/09/61	16/01/89	47 (1)	BBB/BBB+	AA	6	33%	362	37%	246	75
Other											
Japan	22/01/59	14/04/61	134	A	AA-	10	30%	1,539	53%	1,602	381
South Africa	03/10/94	07/07/95	19	BB/BB+	BBB+	7	71%	98	46%	85	22

Table 2: Relative Timing of Sovereign and Firm-level Rating Actions

We document the number of firm rating actions in the same direction as the sovereign-rating action for periods around the sovereign action. We also document the number of firm-level actions in the *opposite* direction to the sovereign for the period (-22, +21) relative to the sovereign actions. Finally, we document the number of firm-level actions in any direction for all periods outside the period (-22, +21) relative to the sovereign actions, denoted 'Any Direction, Rest of Year'. We confirm that there are no sovereign foreign currency rating actions to our sample countries in May 1996 and thus no firm actions in our sample period are related to sovereign actions just prior to our sample period. Each firm action is assigned to only one sovereign action (see Supplementary Table S4, available online). Where multiple actions occur for each firm, each one is included. An alternative presentation of these data, employing daily averages, is shown in Supplementary Table S5, available online

Column No.	Same Direction as Sovereign										Opposite Direction 12 (-22, +21)	Any Direction 13 Rest of Year
	2 N actions	3 (-22, -3)	4 (-2)	5 (-1)	6 0 before	7 0 after	8 (+1)	9 (+2)	10 (+3)	11 (+4, +21)		
Latin America												
Argentina	520	26	0	0	0	162	122	27	17	63	33	70
Brazil	769	29	1	0	0	220	114	1	2	57	22	323
Chile	211	2	0	0	0	10	7	0	1	3	2	186
Colombia	75	1	0	0	3	23	3	8	0	5	2	30
Mexico	583	16	3	4	2	118	13	4	0	8	19	396
North America												
Canada	2,061	7	0	0	0	2	0	0	0	30	0	2,022
USA	31,055	78	1	1	7	1	44	18	1	120	374	30,410
Eurozone												
Austria	119	0	0	0	0	0	0	3	6	0	7	103
Belgium	135	0	0	0	2	0	1	5	2	4	1	120
France	1,576	5	0	0	0	0	0	62	4	57	10	1,438
Germany	2,727	5	0	1	0	0	0	8	7	16	1184*	1,506
Greece	189	3	0	0	0	10	13	16	3	10	15	119
Ireland	436	30	0	1	0	6	4	10	16	16	19	334
Italy	701	17	3	0	4	7	1	67	6	64	17	515
Luxembourg	385	7	0	0	1	0	0	5	3	5	6	358
Netherlands	886	4	0	0	0	0	1	6	8	8	8	851
Portugal	215	4	0	0	0	16	5	24	15	20	6	125
Spain	404	15	14	0	0	1	0	17	17	45	12	283
Other Europe												
Denmark	94	0	0	0	0	0	0	0	0	0	1	93
Sweden	394	1	0	1	1	2	0	0	0	0	2	387
UK	2,386	16	0	1	0	0	1	0	0	11	18	2,339
Asia Emerging												
China	349	13	2	0	2	38	10	2	0	5	7	270
Hong Kong	367	6	3	0	2	48	28	1	2	7	17	253
India	183	6	0	1	2	97	13	12	0	2	3	47
Indonesia	271	6	0	0	17	39	21	25	6	19	10	128
Korea	398	24	4	0	7	60	13	7	1	21	6	255
Malaysia	139	3	1	1	4	31	8	0	4	11	2	74
Taiwan	170	4	0	1	0	2	8	0	0	12	6	137
Thailand	179	1	0	0	9	31	18	0	0	13	6	101
Turkey	231	2	0	0	7	81	50	16	17	31	14	13
Pacific												
Australia	1,502	2	1	0	1	10	11	1	0	16	19	1,441
New Zealand	362	1	2	0	0	2	2	0	0	8	17	330
Other												
Japan	1,539	54	10	14	13	44	17	1	2	67	36	1,281
South Africa	98	2	0	1	0	9	18	3	0	4	0	61
Total	51,709	390	45	27	84	1,070	546	349	140	758	1,901*	46,399

*As would be expected, firm-level actions tend to be in the same direction as the sovereign action and, with the exception of one case, the number of firm-actions in the same direction as the sovereign action significantly outweigh those in the opposite direction. The one exception relates to Germany; on 5 December 2011 the German sovereign rating was put on credit watch negative and on the same day 1,177 out of 1,336 rated German firms underwent a positive rating action. We do not consider these actions to be sovereign related since the direction of the firm-level actions differs from that of the sovereign action. S&P issued a press release on 5 December 2011 explaining that it had applied new rating criteria to the German Cooperative Banking Sector on this date (in turn these criteria were published on 9 November 2011) and this accounts for the large number of positive firm-level rating actions for Germany on 5 December 2011.

Table 3: Unconditional Impact of Sovereign Rating on Firm Ratings

This table presents the percentage of domestic firms which undergo rating actions in the same direction as the sovereign-rating action within the time frames (0, 3) days and (0, 21) days of the sovereign-rating action. For Day 0, only firm-level actions which occur *after* the sovereign action are included. The figures are illustrated in respect of positive actions for Argentina, as follows: 135 Argentinean firms held a rating at the start of the day across all days on which Argentinean positive sovereign-rating actions occurred. 86 domestic firms underwent at least one positive rating action within 3 days of a positive sovereign action. On average, 63.7% (86/135) of domestic firms underwent positive actions when the sovereign underwent a positive action. We also calculate the proportion of firms *expected* to undergo a rating action in a 4-day period, [Exp. (0, 3)]. The calculation of this last figure is shown in the note below the table.

	Positive Actions					Negative Actions			
	HIC	Firms Rated	% change (0,3)	% change (0, 21)	Exp. (0, 3) [#]	Firms Rated	% change (0,3)	% change (0, 21)	Exp. (0,3)
Latin America									
Argentina	No	135	63.7%	74.1%	0.93%	420	57.6%	59.0%	1.84%
Brazil	No	701	33.4%	39.9%	1.00%	130	79.2%	81.5%	0.48%
Chile	Yes	136	13.2%	15.4%	0.35%	No negative sov action			
Colombia	No	30	43.3%	46.7%	0.48%	44	47.7%	54.5%	0.55%
Mexico	No	337	29.1%	30.6%	0.63%	145	25.5%	26.9%	0.59%
North America									
Canada	Yes	346	0.6%	9.0%	0.39%	No negative sov action			
USA	Yes	No positive sov action				7,762	0.8%	2.4%	0.68%
Eurozone									
Austria	Yes	No positive sov action				36	25.0%	25.0%	0.62%
Belgium	Yes	23	0.0%	8.7%	0.30%	68	11.8%	14.7%	0.60%
France	Yes	No positive sov action				317	20.8%	38.8%	0.66%
Germany	Yes	1,336	0.1%	1.0%	0.37%	1,336	1.0%	1.3%	0.13%
Greece	Yes	57	17.5%	24.6%	0.42%	155	20.6%	24.5%	1.24%
Ireland	Yes	101	3.0%	12.9%	0.54%	336	9.8%	11.6%	0.92%
Italy	Yes	20	5.0%	5.0%	0.40%	522	15.3%	27.4%	0.93%
Luxembourg	Yes	47	0.0%	10.6%	0.58%	48	16.7%	16.7%	0.85%
Netherlands	Yes	92	4.3%	12.0%	0.45%	91	12.1%	12.1%	0.72%
Portugal	Yes	12	0.0%	0.0%	0.52%	154	39.0%	48.7%	1.24%
Spain	Yes	95	0.0%	1.1%	0.44%	278	12.6%	24.1%	0.97%
Other Europe									
Denmark	Yes	7	0.0%	0.0%	0.43%	No negative sov action			
Sweden	Yes	109	1.8%	1.8%	0.41%	No negative sov action			
UK	Yes	229	0.0%	2.2%	0.39%	221	0.5%	3.2%	0.72%
Asia Emerging									
China	No	226	18.1%	19.9%	0.58%	29	31.0%	31.0%	0.67%
Hong Kong	na	374	16.3%	16.8%	0.48%	48	37.5%	47.9%	0.51%
India	No	99	60.6%	61.6%	0.62%	89	69.7%	70.8%	0.64%
Indonesia	No	186	15.1%	19.4%	0.56%	181	34.8%	36.5%	0.95%
Korea	Yes	145	25.5%	37.2%	0.70%	79	55.7%	60.8%	0.44%
Malaysia	No	61	31.1%	44.3%	0.60%	57	42.1%	43.9%	0.54%
Taiwan	Yes	66	1.5%	3.0%	0.33%	114	7.9%	17.5%	0.39%
Thailand	No	83	32.5%	34.9%	0.58%	83	26.5%	39.8%	0.62%
Turkey	No	148	50.0%	64.9%	1.22%	131	68.7%	69.5%	1.02%
Pacific									
Australia	Yes	399	5.5%	9.5%	0.43%	No negative sov action			
New Zealand	Yes	70	0.0%	0.0%	0.36%	176	2.3%	6.3%	0.61%
Other									
Japan	Yes	839	2.6%	6.9%	0.50%	763	5.5%	9.6%	0.44%
South Africa	Yes	49	38.8%	44.9%	0.42%	36	30.6%	33.3%	0.50%

The number of firms rated at the start of each working day summed over our sample period for Argentina is 75,043 (this excludes periods when the sovereign is in default). 135 firms are rated on sovereign-rating action days and there are a total of 174 positive firm actions (see Table 1, Columns 9 & 10: $174/520 = 0.334$). There should be $135/75,043 \times 174$ positive firm actions = 0.313 positive firm rating actions on the sovereign-rating action days and $4 \times 0.313 = 1.252$ positive firm actions across all the (0, +3) periods around the sovereign actions. As a proportion of firms rated on sovereign-rating action days this is $1.252 / 135 = 0.93\%$. This expectation assumes that positive and negative actions are not mutually exclusive and one action per firm in the (0, +3) window (multiple changes to the same firm in the wake of the sovereign action are rare over the (0, 3) window).

Table 4
Determinants of the Likelihood of Firm-level Actions

We estimate the impact of firm characteristics and the sovereign environment on sovereign credit risk spill-over to domestic firms. We employ logit models and our dependent variable, *Firm-action*, takes a value of 1 if the firm experiences a rating action in the same direction as the sovereign action within (i) (0, 3) days or (ii) (0, 21) days of the sovereign action, and 0 otherwise. We estimate separate models for positive and negative actions. Since the data are nested we produce standard error estimates by clustering at the sovereign level – that is, the highest level of aggregation at which the data might be correlated (see, e.g., Thompson, 2011). Robustness checks employing two-way clustering at both the firm and sovereign level produce very similar standard errors estimates. A more detailed discussion of methodological issues can be found in Section 3.2. The *Wealth/Risk Factor* is derived from a principal components analysis of correlated sovereign variables (the sovereign rating; World Bank indices for government effectiveness, regulatory quality, corruption and the rule of law; GDP per capita and the capital account openness index of Chinn and Ito (2008)). *Return* and *StDev* are the returns and volatility on the sovereign stock market index in the 3 months prior to the sovereign-rating action. *GDP Growth* is geometric average annual growth in GDP employing 3 years' data, *Firm Rating* is the numerical value of the rating of the firm (AAA = 21), *EqSov* indicates a firm has a credit rating equal to the sovereign and *>Sov* indicates a firm has a rating greater than the sovereign credit rating. *Listed* indicates that a firm has been listed. *Financial (Utilities)* [*Insurance*] are dummy variables indicating that a firm belongs to the Financial (Utilities) [Insurance] sector. The sector 'Corporations' is the baseline. *Days*, *Sov Rch* and *MultiNotch* are control variables relating to the nature of the sovereign credit rating action.

Variable	Positive Actions				Negative Actions			
	Coefficient	z-stat.	Coefficient	z-stat.	Coefficient	z-stat.	Coefficient	z-stat.
Dependent	(0, 3)		(0, 21)		(0, 3)		(0, 21)	
Intercept	-4.8127	-2.54**	-0.7060	-0.70	-10.3505	-6.94***	-4.1723	-5.93***
Wealth/Risk Factor	-0.4252	-0.99	-0.8619	-2.81***	-0.2181	-0.45	0.7909	2.02**
StDev	-5.7473	-6.69***	-3.7002	-3.54***	4.8265	3.23***	5.1344	4.59***
Return	1.3976	1.68*	0.3647	0.54	0.5959	0.54	0.3401	0.75
GDP Growth	-0.6977	-0.69	-1.8896	-2.31**	-0.1422	-0.18	-0.1609	-0.21
Firm Rating	0.0656	0.67	-0.0209	-0.38	0.2688	4.28***	0.0588	1.08
Eq. Sov.	3.4887	7.34***	2.7244	13.72***	2.3307	6.85***	2.5986	6.13***
> Sov.	1.7083	2.50**	1.0987	3.47***	0.3184	0.79	0.8567	1.97**
Listed	0.4950	3.56***	0.6312	4.45***	0.3289	1.59	0.0829	0.46
Financial	0.8817	2.23**	0.9543	3.40***	1.2548	4.64***	1.0775	3.82***
Insurance	-0.3561	-0.25	0.6028	1.00	-0.6212	-1.41	-0.1837	-0.35
Utilities	0.5576	1.83*	0.3509	1.57	0.8229	2.40**	0.6791	2.33**
Days	-0.0446	-0.31	-0.1597	-1.46	-0.1234	-1.13	-0.1217	-1.98**
Sov. Rch.	-0.1247	-0.55	0.0138	0.06	-0.5556	-1.59	-0.2946	-1.93*
MultiNotch	0.5793	1.03	0.8835	1.21	0.5626	0.73	0.6624	1.27
Country Dummies#	Yes		Yes		Yes		Yes	
Year Dummies	Yes		Yes		Yes		Yes	
Max rescaled R Sqr.	0.6526		0.5678		0.6769		0.5680	
Obs.	6,445		6,445		13,687		13,687	

To allow valid model estimates we exclude country dummies where no firm-level actions occur. This only affects positive sovereign actions.

Table 5
Country-level Negative or Positive Bias in Sovereign Spill-over

We investigate the negative or positive bias for each country across both the (0, 3) and (0, 21) windows. The bias is given by the column 'Ratio' which shows the relative odds of negative to positive spill-over. The ratio is calculated before rounding and hence does not result from the 'Odds Neg.' and 'Odds Pos.' columns which are the rounded odds of negative and positive spill-over. Countries with ratios which exceed 1 have negative bias and countries with ratios which are less than 1 have positive bias. This bias is only significant if this is indicated in the 'KOR REF' and 'GRC REF' columns, which refer to significance relative to the reference countries Korea and Greece.

We derive the country level bias from a logistic regression analysis where our dependent variable, *Firm-action*, takes a value of 1 if the firm experiences a rating action in the same direction as the sovereign action and 0 otherwise. This regression analysis is shown in Appendix 1 (with Korea as a reference country). We examine both positive and negative actions in one regression employing a positive sovereign action dummy variable, *SovPos*. Country codes are as shown in Appendix 2. We illustrate the bias calculations via Appendix 1 as follows: With Korea as a reference country for the (0, 3) window, the key coefficients are as follows: Intercept = -3.3154, the dummy variable for Argentina (ARG) = -0.7137, the variable *SovPos* = 0.2323, *ARG x SovPos* = 1.8688. This last is significant at a 5% level. Thus the odds of negative spill-over for an Argentinean firm over the (0, 3) window is given by $\exp(-3.3154 - 0.7137)$ and the odds of positive spill-over for an Argentinean firm over the (0, 3) window is given by $\exp(-3.3154 - 0.7137 + 0.2323 + 1.8688)$. Without rounding this leads to a ratio of 0.122. The odds of positive spill-over for an Argentinean firm, relative to a Korean firm, are positive and significant at a 5% level (**). The coefficients using Greece as a base country lead to identical calculations of the odds but different levels of significance. Thus with Greece as a reference country the coefficient on the interaction (*SovPos x ARG*) is significant at a 10% level (*). The coefficient values for *SovPos* representing Korea and Greece are shown in Table 5; they lie either side of zero and neither is significant. Countries which do not have both positive and negative actions cannot be included in this analysis. We estimate our model (again see Appendix 1) across both the (0, 3) and (0, 21) windows. The samples are 9,152 firm ratings across 18 countries for the (0, 3) window and 10,608 firm ratings across 22 countries for the (0, 21) window (see Table S2, available online, for full sample details).

(0, 3) Window						(0, 21) Window					
Variable/ Country Code	Odds Neg.	Odds Pos.	Ratio	KOR REF.	GRC REF.	Variable/ Country Code	Odds Neg.	Odds Pos.	Ratio	KOR REF.	GRC REF.
<i>SovPos</i>				0.232	-0.385	<i>SovPos</i>				-0.093	0.0218
ARG	0.018	0.145	0.122	**	*	ARG	0.046	0.200	0.230	**	
CHN	0.005	0.026	0.173			TUR	0.023	0.068	0.342	*	
THA	0.014	0.065	0.214	*		CHN	0.008	0.021	0.395		
TUR	0.013	0.052	0.239			JPN	0.051	0.109	0.466		
ZAF	0.012	0.030	0.408			MYS	0.043	0.069	0.624		
IND	0.015	0.034	0.434			ITA	0.131	0.201	0.654		
MYS	0.016	0.027	0.586			DEU	0.006	0.009	0.663		
COL	0.013	0.017	0.768			ZAF	0.029	0.038	0.775		
KOR	0.036	0.046	0.793	N/A		GRC	0.136	0.139	0.978		N/A
MEX	0.039	0.049	0.804			KOR	0.097	0.089	1.098	N/A	
GRC	0.087	0.060	1.469		N/A	THA	0.059	0.049	1.222		
JPN	0.014	0.009	1.500			MEX	0.072	0.051	1.417		
BRA	0.059	0.039	1.522			IND	0.040	0.021	1.971		
IDN	0.031	0.010	3.003			NLD	0.220	0.106	2.066		
HKG	0.453	0.065	6.985	*	***	IRL	0.134	0.047	2.837		**
DEU	0.007	0.001	9.323	*	***	BEL	0.173	0.056	3.070		*
NLD	0.336	0.019	17.898	*	***	GBR	0.140	0.034	4.090		**
IRL	0.096	0.003	28.352	***	***	BRA	0.162	0.035	4.686	**	*
						COL	0.078	0.013	5.958	***	**
						IDN	0.050	0.008	6.268	**	
						HKG	1.242	0.179	6.948	**	***
						ESP	0.151	0.017	8.799	**	***

Table 6:
Spill-over in Investment and Sub-investment Grade Sovereigns

In Panel A we present the probability that a firm undergoes a rating action in the wake of a sovereign action across both the (0, 3) and (0, 21) windows in Investment and Sub-investment grade sovereigns. We control for the firm rating relative to the sovereign, which is a key determinant of spill-over (see Table 4). The total number of firm-level observations includes Luxembourg and Taiwan (275 observations), omitted from the regression analyses due to a lack of data. We indicate separately 17 firm-level observations rated at AAA Stable in the case of positive sovereign actions since they cannot undergo positive actions in response to a sovereign action. In Panel B we run random effects logistic regression analyses where our dependent variable, *Firm-action*, takes a value of 1 if the firm experiences a rating action in the same direction as the sovereign action within (i) (0, 3) days or (ii) (0, 21) days of the sovereign action, and 0 otherwise. The variables we employ are as defined for Table 4. However, in place of the *Wealth/Risk Factor* we employ *Sub-IG*, a dummy indicating sub-investment grade status. We pool positive and negative actions and we employ the interactions of sub-investment grade status with the direction of the sovereign action (*Sub-IG x SovPos*). This is the key variable. Across all sovereigns, 20,132 firm ratings are nested in 304 sovereign actions are nested in 32 sovereigns. Across sovereigns with both positive and negative actions, 9,152 firm ratings are nested in 236 sovereign actions are nested in 18 sovereigns. Coefficients on other variables reported in Table 4 are not reported for the sake of clarity (also not shown is the interaction of the volatility of the stock market with the direction of the sovereign action).

Panel A: Spill-over for Investment and Sub-investment Grade Sovereigns Conditioned on Firm Rating Relative to Sovereign.

Dependent	< Sovereign	= Sovereign	> Sovereign	All ratings available to change	AAA Stable
Investment grade sovereigns: Positive actions					
N	4,545	574	93	5,212	17
Firm Action (0, 3)	1.19%	48.78%	5.38%	6.50%	0%
Firm Action (0, 21)	3.87%	52.79%	10.75%	9.38%	0%
Investment grade sovereigns: Negative actions					
N	12,255	498	114	12,867	n.a.
Firm Action (0, 3)	2.56%	64.46%	19.30%	5.11%	
Firm Action (0, 21)	5.40%	69.48%	24.56%	8.05%	
Sub-investment grade sovereigns: Positive actions					
N	395	699	235	1,329	0
Firm Action (0, 3)	4.81%	65.24%	29.79%	41.01%	
Firm Action (0, 21)	12.15%	70.96%	35.74%	47.25%	
Sub-investment grade sovereigns: Negative actions					
N	248	453	281	982	n.a.
Firm Action (0, 3)	22.58%	76.16%	58.01%	57.43%	
Firm Action (0, 21)	27.82%	77.70%	58.72%	59.67%	

Panel B: Extract from Random Effects Model of Spill-over for Investment and Sub-investment Grade Sovereigns Conditioned on Multiple Factors.

Variable	All Sovereigns				Sovereigns with Both Positive and Negative Events			
	Coefficient	z-stat.	Coefficient	z-stat.	Coefficient	z-stat.	Coefficient	z-stat.
Dependent	(0, 3)		(0, 21)		(0, 3)		(0, 21)	
Sub_IG	1.4343	3.45***	0.7576	2.48**	0.8207	2.09**	0.4975	1.58
SovNeg	-0.5041	-0.99	-0.6510	-1.69*	-0.8000	-1.50	-0.9515	-2.18**
Sub_IG x SovNeg	-0.0542	-0.12	-0.3398	-0.99	0.0336	0.08	-0.0355	-0.10
Obs.		20,132		20,132		9,152		9,152

Table 7
Sovereign Ceiling Analysis:

Fixed Effect Regression Analyses on Sub-samples of Investment and Non-investment Grade Sovereigns

In Table 7 we assess the impact of spill-over on the variables representing the firm rating relative to the sovereign (*EqSov*, *>Sov*) via sub-samples of sub-investment grade and investment grade sovereigns. We run fixed effects logistic regression analyses where our dependent variable, *Firm-action*, takes a value of 1 if the firm experiences a rating action in the same direction as the sovereign action within (i) (0, 3) days or (ii) (0, 21) days of the sovereign action, and 0 otherwise. The variables we employ are as defined for Table 4. In place of the *Wealth/Risk Factor* we employ *KAOpen*, the capital account openness index of Chinn and Ito (2008). We also assess the impact of within country changes in capital account openness (*KaOpen*).

	Positive Actions Sov. Investment Grade		Positive Actions Sov. Sub-investment Grade		Negative Actions Sov. Investment Grade		Negative Actions Sov. Sub-investment Grade	
	Estimate	z-stat	Estimate	z-stat	Estimate	z-stat	Estimate	z-stat
(0, 3) window								
KA-Open	1.1756	4.51***	-0.3236	-2.38**	1.7415	1.68*	-0.1394	-1.98**
Eq. Sov.	3.5429	8.74***	3.5918	4.24***	2.6572	6.98***	1.9951	3.82***
> Sov.	0.3198	0.40	2.5128	2.43**	-0.1856	-0.30	0.4973	1.00
N	5,116		1,329		12,705		982	
(0, 21) window								
KA-Open	-0.1402	-0.48	-0.4668	-5.47***	1.0286	1.65*	-0.1339	-1.67*
Eq. Sov.	2.7435	8.76***	3.0255	11.16***	2.8735	6.32***	1.6448	3.96***
> Sov.	0.1340	0.33	2.0714	3.83***	0.4459	0.87	-0.1003	-0.23
N	5,116		1,329		12,705		982	

Table 8
Random Effects Model of Spill-over to HIC versus NHIC Sovereigns

In Table 8 we investigate relative spill-over to HICs versus NHICs. We run random effects logistic regression analyses where our dependent variable, *Firm-action*, takes a value of 1 if the firm experiences a rating action in the same direction as the sovereign action within (i) (0, 3) days or (ii) (0, 21) days of the sovereign action, and 0 otherwise. The variables we employ are as defined for Table 4. However, in place of the *Wealth/Risk Factor* we employ *HIC*, a dummy indicating higher income status of a sovereign. We pool positive and negative actions and given the opposite impact of stock market volatility on spill-over for positive and negative actions we employ the interaction of the volatility of the stock market with the direction of the sovereign action (*StDev* x *SovPos*).

In Panel B we add an interaction between HIC status and positive sovereign actions (*HIC* x *SovPos*); this analysis is for confirmation purposes only since results in Table 5 and Panel B of Table 6 suggest that this variable will not be significant. Across all sovereigns, 20,132 firm ratings are nested in 304 sovereign actions are nested in 32 sovereigns.

Panel A: Relative Spill-over to HICs Controlling for Firm and Sovereign Factors

Variable	All Sovereigns			
	Coefficient	z-stat.	Coefficient	z-stat.
Dependent	(0, 3)		(0, 21)	
Intercept	-3.7634	-4.69***	-1.5987	-2.66**
HIC	-2.4075	-6.34***	-1.2503	-4.77***
SovPos	0.0655	0.13	0.4163	1.10
St.Dev.	2.5528	2.50**	2.1982	2.73***
StDev x SovPos	-2.8756	-1.78*	-2.5207	-2.00**
Return	0.7621	1.16	0.4458	0.88
GDP Growth	-0.0624	-0.08	-0.8968	-1.60
Firm Rating	0.1730	7.85***	0.0238	1.82*
Eq. Sov.	3.1515	25.75***	2.7543	29.41***
> Sov.	1.1094	6.08***	1.1141	7.73***
Listed	0.4172	4.68***	0.3148	4.52***
Financial	1.1642	13.11***	1.0903	15.33***
Insurance	-0.6468	-0.98	0.1607	0.45
Utilities	0.7331	6.03***	0.5430	5.26***
Days	-0.2560	-2.70***	-0.2544	-3.55***
Sov. Rch.	-0.1731	-0.74	-0.1248	-0.70
MultiNotch	0.9555	2.18**	1.1753	3.58***
Obs.	20,132		20,132	

Panel B: Extract From Model with Interaction Term.

Variable	All Sovereigns			
	Coefficient	z-stat.	Coefficient	z-stat.
Dependent	(0, 3)		(0, 21)	
HIC	-2.1948	-4.88***	-1.0688	-3.38***
SovPos	0.2609	0.49	0.5934	1.44
HIC x SovPos	-0.4620	-0.97	-0.3750	-1.07
Obs.	20,132		20,132	

Table 9: Firm Defaults Following Sovereign Defaults

Panel A indicates the incidence of negative domestic firm *credit rating* actions, including the assignment of a default rating (shown in parentheses in Panel A), around sovereign defaults, for all firms rated at the time of the sovereign default. Panel B indicates the incidence of firm defaults in the wake of sovereign defaults. Panel C compares the incidence of firm defaults following sovereign defaults (as shown in Panel B) with the incidence of S&P firm rating actions following sovereign-rating actions (as shown in Table 3). The ratings dependency is measured over the shorter term given S&P jointly determine contemporaneous firm and sovereign ratings but default dependency is also measured over the longer term given this is not within S&P's control.

Panel A: All Firm Negative Rating Actions Before and After Sovereign Defaults (Firm defaults included in negative actions are shown in parentheses).

Country	Date Sovereign Default	Sov. action b4 default	Firms rated at sov. def.	Number of negative firm-level rating actions for firms rated at time of sovereign default				
				(-252, -22)	(-21,-1)	(0, 3)	(4, 21)	(22, 252)
Argentina	6 Nov. 2001	Downgrade to CC (t = -5)	35	129	54	0	27 (5)	43 (23)
Greece	27 Feb 2012	Downgrade to CC (t = -153)	10	21 (1)	0	0	0	3 (1)
Indonesia	29 Mar. 1999	Neg CW to Neg (t = -188)	14	0	0	0	0	1 (1)
Indonesia	17 Apr. 2000	Stable to CW Neg (t = -155)	13	1	0	0	0	16 (8)
Indonesia	22 Apr. 2002	Downgrade to CCC (t = -121)	6	2	0	0	0	0

Panel B: Numbers of Firm Defaults in the Days Following a Sovereign Default

Country	Date Sovereign Default	Rated at Sov. Def.	(0, 3) window	(4, 21) window	(22, 252) window
Argentina	6 Nov 2001	35	0	5	23
Greece	27 Feb 2012	10	0	0	1
Indonesia	29 Mar 1999	14	0	0	1
Indonesia	17 Apr 2000	13	0	0	8
Indonesia	22 Apr 2002	6	0	0	0

Panel C: Default Dependency Rates

Country	Date Sovereign Default	Firm default rate after sovereign defaults (see Panel B but note below are cumulative from Day 0)			Firm rating action after sovereign-rating action (see Table 3)	
		(0, 3)	(0, 21) (cumulative)	(0, 252) (cumulative)	Firm-level % change (0,3)	Firm-level % change (0, 21)
Argentina	6 Nov 2001	0%	14%	80%	57.6%	59.0%
Greece	27 Feb 2012	0%	0%	10%	20.6%	24.5%
Indonesia	29 Mar 1999	0%	0%	7%		
Indonesia	17 Apr 2000	0%	0%	62%	34.8%	36.5%
Indonesia	22 Apr 2002	0%	0%	0%		

Appendix 1: Regression Analysis to Support Table 5: Korea as Base Case

Appendix 1 supports Table 5. We run logistic regression analyses where our dependent variable, *Firm-action*, takes a value of 1 if the firm experiences a rating action in the same direction as the sovereign action within (i) (0, 3) days or (ii) (0, 21) days of the sovereign action, and 0 otherwise. The variables we employ are defined in Section 3.2. However, we grand mean center some variables (indicated by *GMC*) to ease interpretation. The intercept represents Korea. All country dummy variables and control variables are interacted with the positive action dummy (*SovPos*) and the interaction coefficients are shown to the right of the non-interaction coefficients to allow for ready comparison. Where there are no entries in the (0,3) window this indicates that a country has no firm-level actions in that window.

(0, 3) window				(0, 21) window			
<i>Non-interaction terms</i>	<i>Estimate</i>	<i>SovPos interaction terms</i>	<i>Estimate</i>	<i>Non-interaction terms</i>	<i>Estimate</i>	<i>SovPos interaction terms</i>	<i>Estimate</i>
Intercept	-3.3154***	SovPos	0.2323	Intercept	-2.3295***	SovPos	-0.0933
ARG	-0.7137	SovPos x ARG	1.8688**	ARG	-0.749**	SovPos x ARG	1.5641**
BRA	0.4834	SovPos x BRA	-0.6525	BRA	0.5124	SovPos x BRA	-1.4513**
				BEL	0.5743	SovPos x BEL	-1.0284
CHN	-2.0814***	SovPos x CHN	1.5218	CHN	-2.4513***	SovPos x CHN	1.0226
COL	-1.0046	SovPos x COL	0.0317	COL	-0.2256	SovPos x COL	-1.6914***
DEU	-1.5847*	SovPos x DEU	-2.4648*	DEU	-2.8474***	SovPos x DEU	0.5036
				ESP	0.4358	SovPos x ESP	-2.0813**
				GBR	0.3649	SovPos x GBR	-1.3153
GRC	0.8788	SovPos x GRC	-0.6172	GRC	0.3377	SovPos x GRC	0.1151
HKG	2.5226***	SovPos x HKG	-2.1761*	HKG	2.5460***	SovPos x HKG	-1.8451**
IDN	-0.1660	SovPos x IDN	-1.3319	IDN	-0.6608	SovPos x IDN	-1.7421**
IND	-0.8911	SovPos x IND	0.6023	IND	-0.8780*	SovPos x IND	-0.5853
IRL	0.9710	SovPos*IRL	-3.5770***	IRL	0.3165	SovPos x IRL	-0.9495
				ITA	0.2999	SovPos x ITA	0.5178
JPN	-0.9613	SovPos x JPN	-0.6379	JPN	-0.6523	SovPos x JPN	0.8578
MEX	0.0719	SovPos x MEX	-0.0144	MEX	-0.3019	SovPos x MEX	-0.2551
MYS	-0.8286**	SovPos x MYS	0.3024	MYS	-0.8224***	SovPos x MYS	0.5646
NLD	2.2234**	SovPos x NLD	-3.1170*	NLD	0.8149	SovPos x NLD	-0.6325
THA	-0.9651***	SovPos x THA	1.3085*	THA	-0.4952**	SovPos x THA	-0.1068
TUR	-1.0613	SovPos x TUR	1.1971	TUR	-1.4349**	SovPos x TUR	1.1664*
ZAF	-1.1016**	SovPos x ZAF	0.6639	ZAF	-1.1984**	SovPos x ZAF	0.3486
Controls				Controls			
Wealth/Risk Factor	-1.3032***	SovPos x WR Factor	0.9279	Wealth/Risk Factor	-1.1300***	SovPos x WR Factor	0.2660
StDev (GMC)	4.4603***	SovPos x SD (GMC)	-8.4709***	StDev (GMC)	5.6078***	SovPos x SD (GMC)	-8.3442***
Firm Ratg (GMC)	0.1785**	SovPos x Firm R (GMC)	-0.1767*	Firm Ratg (GMC)	0.1196**	SovPos x Firm R (GMC)	-0.1865***
Eq. Sov.	2.5400***	SovPos x Eq. Sov.	1.0605*	Eq. Sov.	2.2825***	SovPos x Eq. Sov.	0.6077
> Sov.	0.7556**	SovPos x > Sov.	1.2304**	> Sov.	0.5751	SovPos x > Sov.	0.7871**
Listed	0.4102	SovPos x Listed	-0.0659	Listed	0.2696	SovPos x Listed	0.3133
Financial	1.1173***	SovPos x Financial	-0.1837	Financial	1.1572***	SovPos x Financial	-0.1380
Utilities	1.0788**	SovPos x Utilities	-0.4597	Utilities	0.8056***	SovPos x Utilities	-0.4343
Year Dummies	Yes			Year Dummies	Yes		
N	9,152			N	10,608		

Appendix 2 Country Codes

Country	Code
Argentina	ARG
Australia	AUS
Austria	AUT
Belgium	BEL
Brazil	BRA
Canada	CAN
Chile	CHL
China	CHN
Colombia	COL
Germany	DEU
Denmark	DNK
Spain	ESP
France	FRA
UK	GBR
Greece	GRC
Hong Kong	HKG
Indonesia	IDN
India	IND
Ireland	IRL
Italy	ITA
Japan	JPN
Korea	KOR
Mexico	MEX
Malaysia	MYS
Netherlands	NLD
N. Zealand	NZL
Portugal	PRT
Sweden	SWE
Thailand	THA
Turkey	TUR
USA	USA
South Africa	ZAF

Supplementary tables to be made available online.

Supplementary Table S1
Total External Debt by Country: 2012 Q2

This table presents external debt statistics of the IMF/World Bank. External debt is defined as debt owed to non-residents repayable in foreign currency, goods, or services. The data are in USD. The data are for total external debt (long and short term) classified by borrower type and are available for 32 out of 35 of our sample of countries. The borrower classifications 'Government' and 'Monetary Authorities' are assumed to proxy for 'Sovereign' debt and other borrower types for 'Corporate' debt. The data for China are not available. However, IMF/World Bank data are available for 'public'/'publicly guaranteed' and 'private nonguaranteed' *long-term* external debt at the close of 2010. China has 45% public to 55% private external long-term debt at the close of 2010.

	Total USD millions	Govn.	Monetary Auth.	Bank	Other Sectors	Direct Inv.	Sovereign	Corporate
Latin America								
Argentina	143,806	47.8%	2.1%	2.6%	28.8%	18.6%	49.9%	50.1%
Brazil	417,665	14.2%	1.0%	33.4%	23.9%	27.5%	15.2%	84.8%
Chile	101,875	4.7%	1.6%	23.0%	58.8%	11.8%	6.3%	93.7%
Colombia	76,255	43.1%	1.5%	10.9%	43.6%	0.8%	44.6%	55.4%
Mexico	313,975	48.5%	1.5%	6.0%	44.0%	0.0%	50.0%	50.0%
North America								
Canada	1,201,239	28.6%	0.0%	25.9%	35.1%	10.4%	28.6%	71.4%
USA	15,415,265	32.9%	3.1%	19.6%	36.3%	8.2%	36.0%	64.0%
Eurozone								
Austria	779,904	30.8%	6.3%	43.5%	12.7%	6.8%	37.1%	62.9%
Belgium	1,372,357	18.9%	3.1%	40.4%	9.7%	27.9%	22.0%	78.0%
France	4,853,872	29.7%	3.9%	43.8%	13.4%	9.2%	33.6%	66.4%
Germany	5,617,751	29.8%	1.9%	42.7%	14.0%	11.6%	31.7%	68.3%
Greece	526,152	50.2%	25.4%	19.8%	2.9%	1.8%	75.6%	24.4%
Ireland	2,123,300	6.8%	5.9%	20.3%	50.2%	16.8%	12.7%	87.3%
Italy	2,352,649	35.9%	14.8%	28.0%	13.9%	7.4%	50.6%	49.4%
Luxembourg	2,315,127	0.2%	0.2%	26.1%	42.7%	30.8%	0.4%	99.6%
Netherlands	2,417,874	11.9%	0.2%	59.9%	16.9%	11.1%	12.1%	87.9%
Portugal	485,816	30.1%	19.3%	30.2%	14.4%	6.0%	49.3%	50.7%
Spain	2,260,332	13.3%	22.8%	32.9%	21.3%	9.8%	36.1%	63.9%
Other Europe								
Denmark	584,531	11.1%	0.1%	64.7%	15.3%	8.8%	11.2%	88.8%
Sweden	1,016,812	8.8%	0.3%	57.0%	10.4%	23.4%	9.1%	90.9%
UK	9,920,888	6.7%	0.4%	56.6%	29.8%	6.6%	7.1%	92.9%
Asia Emerging								
China	No data							
Hong Kong	1,029,927	0.1%	0.0%	69.3%	11.7%	18.8%	0.2%	99.8%
India	348,763	23.0%	0.0%	18.7%	58.2%	0.0%	23.0%	77.0%
Indonesia	238,917	47.2%	2.2%	9.0%	41.5%	0.0%	49.5%	50.5%
Korea	415,770	12.3%	9.0%	49.2%	27.4%	2.0%	21.4%	78.6%
Malaysia	96,982	5.7%	0.0%	51.9%	42.4%	0.0%	5.7%	94.3%
Taiwan	No data							
Thailand	120,073	11.5%	6.7%	23.3%	50.1%	8.4%	18.2%	81.8%
Turkey	322,058	26.3%	2.7%	31.5%	37.7%	1.8%	29.0%	71.0%
Pacific								
Australia	1,335,980	16.2%	0.0%	49.0%	22.3%	12.5%	16.2%	83.8%
New Zealand	235,523	19.7%	0.5%	47.4%	9.2%	23.3%	20.1%	79.9%
Other								
Japan	2,925,234	38.3%	0.3%	43.0%	17.6%	0.9%	38.6%	61.4%
South Africa	121,650	38.6%	0.6%	18.6%	22.9%	19.5%	39.1%	60.9%

Supplementary Table S2

In this table we set out the sample upon which each table in the paper is based, explaining and reconciling any differences.

Unconditional Ratings Analyses Sample: 20,407 firm ratings in 34 countries	
Table Number	Explanation
Tables 1, 2, 3 & Panel A of Table 6	<p>Domestic firms hold 20,407 ratings at the start of each day (Column 11 of Table 1) across the 34 countries (Column 1 of Table 1) on each of the 313 days (Column 7 of Table 1) when the sovereign rating is changed in the period June 1996 through to the close of May 2012. 6,574 firms (Column 12 of Table 1) contribute the 20,407 ratings.</p> <p>31 (29) countries undergo positive (negative) sovereign actions (Column 8 of Table 1, Table 3)</p>
Fixed Effect Regression Analysis of Factors which Affect Spill-over. Sample: 20,132 firm ratings in 32 countries	
Tables S3, 4, 7	<p>Inadequate data are available for Luxembourg and Taiwan to be included in the regression analyses. From 32 countries with <i>either</i> positive or negative sovereign actions, regressions are based on 29 (27) countries which undergo positive (negative) sovereign actions.</p> <p>Domestic firms hold 20,132 ratings at the start of each day across the 32 countries on each of the 304 days (Column 7 of Table 1, excl. Luxembourg and Taiwan entries) when the sovereign rating is changed in the period June 1996 through to the close of May 2012. 13,687 firms are rated at the time of negative sovereign actions and 6,445 at the time of positive actions (Table 4). 13,687 (6,445) firm ratings are from 5,393 (3,409) firms for negative (positive) sovereign actions.</p> <p>In Table 7 we sub-divide firm ratings as follows: Negative sovereign actions: 12,705 firm ratings in investment grade sovereigns and 982 in non-investment grade = 13,687 total Positive sovereign actions: 5,116 firm ratings in investment grade sovereigns and 1,329 in non-investment grade = 6,445 total.</p>
Fixed Effect Regression Analysis of Bias. Sample: (0, 3) window = 9,152 firm ratings in 18 countries and (0, 21) window = 10,608 firm ratings in 22 countries	
Table 5, Appendix 1	<p>To determine bias countries and firms must undergo <i>both</i> positive and negative rating actions (see Table 5).</p> <p>The following two countries had inadequate data: Luxembourg, Taiwan (Eligible sample reduction to 32 from sample of 34 countries)</p> <p>The following eight countries did not have positive <u>and</u> negative sovereign actions: Chile, Canada, the USA, Austria, France, Denmark, Sweden, Australia (eligible sample reduction to 24).</p> <p>The following two countries had no firm-level positive actions in the (0, 21) and (0, 3) windows: Portugal, New Zealand (Further sample reduction to 22 for (0, 21) window)</p> <p>The following three countries had no firm-level positive actions in the (0, 3) window: Belgium, Spain, UK (Further sample reduction to 19).</p> <p>The following country had one firm-level positive actions in the (0, 3) window leading to ML estimation problems: Italy (Further sample reduction to 18 for (0, 3) window).</p>
Random Effect Regression Analysis of Bias Sample: 20,132 firm ratings in 32 countries and 9,152 firm ratings in 18 countries	
Panel B of Table 6, Table 8.	<p>The random effects models are employed to determine:</p> <p>(i) The extent to which negative spill-over bias disproportionately impacts sub-investment grade sovereigns relative to investment grade sovereigns. The samples are 20,132 firm ratings nested in 304 sovereign actions nested in 32 sovereigns <i>and</i> 9,152 firm ratings nested in 236 sovereign actions nested in 18 sovereigns.</p> <p>(ii) The extent to which all spill-over, both positive and negative, impacts NHCs relative to HICs. The sample is 20,132 firm ratings are nested in 304 sovereign actions nested in 32 sovereigns.</p>
Default Analysis Sample: 78 firm ratings across 5 sovereign defaults	
Table 9	Sovereign defaults are excluded from our spill-over analyses and as such Table 9 stands alone from the other analyses. We examine what happens to 78 firms which are rated at the time of the 5 sovereign defaults which occur to our sample countries within our sample time period.

Supplementary Table S3 Key Variables by Sovereign (Averages)

Our regression analyses employ data for 20,132 firms across a sample of 32 countries (see Table A2). In Table A3 we present mean data for our key variables by country. The *Wealth/Risk Factor* is derived from a principal components analysis of the following (highly correlated) sovereign variables: The sovereign rating, the World Bank indices for (i) government effectiveness, (ii) regulatory quality, (iii) corruption and (iv) the rule of law, GDP per capita and the capital account openness index (*KAOpen*) of Chinn and Ito (2008). Data for *KAOpen* are also presented separately since this variable is employed in some of our analyses. *Return* and *StDev* are the returns and volatility on the sovereign stock market index in the 3 months prior to the sovereign-rating action. *GDP Growth* is geometric average annual growth employing 3 years' data (following Cantor and Packer, 1996), *Firm Rating* is the numerical value of a firm's credit rating (AAA = 21), *EqSov* indicates a firm has a credit rating equal to the sovereign and *>Sov* indicates a firm has a rating greater than the sovereign credit rating. *Listed* indicates that a firm has been listed. *Fin (Util) [Ins]* indicates that a firm belongs to the Financial (Utilities) [Insurance] sector. The sector 'Corporations' is the baseline. *WB status* is the World Bank income status of the sovereign.

Country	Code	N	Wealth/Risk Factor	KA- Open	StDev	Return	GDP Growth	Firm Rating	Eqsov	> Sov	Listed	FIN	UTIL	INS	WB status
Argentina	ARG	555	-2.24	-0.29	0.35	-0.09	0.02	8.9	30.5%	52.1%	33.5%	16.0%	33.9%	0.0%	Upp/Mid
Australia	AUS	399	0.21	1.52	0.11	0.01	0.08	15.4	10.8%	0.5%	43.1%	35.1%	9.3%	1.0%	High
Austria	AUT	36	0.57	2.44	0.37	-0.08	0.03	14.7	5.6%	0.0%	83.3%	44.4%	27.8%	0.0%	High
Belgium	BEL	91	0.40	2.44	0.27	-0.04	0.03	14.0	2.2%	2.2%	73.6%	39.6%	4.4%	4.4%	High
Brazil	BRA	831	-2.04	-0.18	0.24	0.05	0.11	9.1	49.8%	12.0%	71.4%	27.9%	16.7%	1.0%	Upp/Mid
Canada	CAN	346	0.54	2.44	0.17	-0.10	0.03	13.0	2.0%	0.6%	52.9%	14.2%	11.3%	3.2%	High
Chile	CHL	136	-0.41	2.06	0.13	0.02	0.18	13.2	21.3%	0.0%	62.5%	22.8%	26.5%	0.0%	High
China	CHN	255	-2.30	-1.17	0.27	0.07	0.20	11.9	25.1%	0.0%	64.3%	33.3%	5.1%	0.0%	Upp/Mid
Colombia	COL	74	-2.30	-0.80	0.21	0.04	0.08	10.0	63.5%	2.7%	55.4%	27.0%	35.1%	0.0%	Upp/Mid
Germany	DEU	2,672	0.58	2.44	0.34	0.06	0.02	17.1	0.2%	0.0%	36.2%	93.9%	0.4%	0.4%	High
Denmark	DNK	7	0.72	2.44	0.18	0.03	0.01	17.4	14.3%	0.0%	71.4%	42.9%	28.6%	0.0%	High
Spain	ESP	373	0.14	2.44	0.30	-0.02	0.01	14.6	4.6%	1.3%	68.6%	48.8%	19.0%	0.0%	High
France	FRA	317	0.44	2.44	0.35	0.02	0.02	14.9	0.6%	0.0%	75.7%	51.4%	3.2%	1.9%	High
UK	GBR	450	0.58	2.44	0.22	0.10	-0.07	14.1	0.7%	0.0%	84.0%	22.7%	29.8%	3.3%	High
Greece	GRC	212	-0.61	2.23	0.33	-0.06	0.00	10.8	15.6%	13.7%	72.6%	36.3%	8.5%	0.0%	High
Hong Kong	HKG	422	0.29	2.44	0.19	0.01	0.05	14.1	21.8%	0.0%	66.6%	25.8%	11.4%	1.7%	na
Indonesia	IDN	367	-2.44	1.09	0.33	-0.03	-0.06	7.4	30.5%	19.1%	40.9%	19.6%	3.3%	0.0%	Low/Mid
India	IND	188	-2.77	-1.17	0.23	0.05	0.12	10.9	77.1%	9.6%	77.7%	40.4%	18.6%	0.0%	Low/Mid
Ireland	IRL	437	0.40	2.44	0.26	0.07	-0.02	13.5	7.6%	14.4%	72.8%	46.2%	3.9%	7.3%	High
Italy	ITA	542	-0.18	2.44	0.26	-0.01	0.07	13.9	11.6%	2.0%	66.8%	62.5%	10.1%	0.0%	High
Japan	JPN	1,602	0.26	2.44	0.20	0.01	0.01	15.0	10.3%	2.4%	56.6%	35.5%	5.1%	0.7%	High
Korea	KOR	224	-1.37	-0.80	0.42	0.03	0.05	12.3	48.7%	0.0%	73.2%	46.9%	9.4%	0.0%	High
Mexico	MEX	482	-1.51	1.02	0.26	0.06	0.05	10.2	39.8%	9.1%	58.5%	22.0%	2.3%	0.0%	Upp/Mid
Malaysia	MYS	118	-1.36	0.28	0.27	-0.06	0.05	13.0	49.2%	0.0%	90.7%	46.6%	12.7%	0.0%	Upp/Mid
Netherlands	NLD	183	0.71	2.44	0.27	0.06	0.00	13.2	3.3%	0.0%	71.6%	20.8%	14.2%	4.4%	High
N. Zealand	NZL	246	0.57	2.44	0.16	0.00	0.03	14.4	1.2%	2.0%	63.4%	43.1%	22.4%	1.2%	High
Portugal	PRT	166	-0.20	2.44	0.21	-0.02	-0.01	14.1	27.1%	4.8%	80.1%	54.2%	12.0%	0.0%	High
Sweden	SWE	109	0.63	2.44	0.19	0.07	0.04	15.1	4.6%	0.0%	66.1%	33.9%	10.1%	4.6%	High
Thailand	THA	166	-1.92	-0.23	0.29	-0.02	0.05	11.9	23.5%	2.4%	69.3%	53.0%	5.4%	0.0%	Upp/Mid
Turkey	TUR	279	-2.18	-0.78	0.43	0.01	0.05	7.7	73.1%	8.6%	74.2%	59.1%	0.0%	0.0%	Upp/Mid
USA	USA	7,762	0.56	2.44	0.15	-0.03	0.04	10.9	0.9%	0.0%	79.1%	11.8%	1.7%	0.9%	High
South Africa	ZAF	85	-1.87	-1.17	0.21	0.00	0.06	10.8	45.9%	3.5%	74.1%	16.5%	16.5%	0.0%	High
All		20,132	0.00	1.95	0.22	0.00	0.04	12.5	11.0%	3.6%	65.9%	33.9%	6.5%	1.0%	High

Supplementary Table S4

Overlapping sovereign actions (see Table 2)

For situations in which sovereign actions occur in close succession to each other, firm-level actions might be temporally straddled by related sovereign actions. In such cases we assign the firm-level action to only one sovereign action to avoid double counting. Most of these actions are relatively easy to assign as they tend to occur either on the same day or the day after a sovereign action. The order of assignment to different periods is selected to represent the most likely scenario on the basis of other firm-level actions and is (0, +3), (+4, +21), (-22, -1).

The following sovereign-level actions in the same direction (all but one pair are negative), are affected by overlapping periods:

- Argentina (22 Sep & 14 Nov 2000; 19 & 26 Mar 2001; 9 & 30 Oct & 6 Nov 2001)
- Austria, France, Italy (5 Dec 2011 & 13 Jan 2012)
- Belgium (25 Nov & 5 Dec 2011)
- Colombia (10 Apr & 24 May 2000)
- Greece (9 & 14 Jan 2009; 7 & 16 Dec 2009; 29 Mar, 9 May, 13 Jun & 27 Jul 2011)
- Indonesia (31 Dec 1997, 9 Jan, 27 Jan, 11 Mar & 15 May 1998)
- Ireland (2 Feb & 1 Apr 2011; 5 Dec 2011 & 13 Jan 2012)
- Korea (24 Oct, 25 Nov & 11 & 22 Dec 1997)
- Malaysia (18 Aug & 25 Sep 1997; 24 Jul & 15 Sep 1998)
- Portugal (13 & 21 Jan 2009; 24 & 29 Mar 2011; 5 Dec 2011 & 13 Jan 2012)
- Spain (12 & 19 Jan 2009; 13 Oct & 5 Dec 2011; 5 Dec 2011 & 13 Jan 2012)
- Thailand (1 Aug, 3 Sep & 24 Oct 1997)
- Turkey (21 & 23 Feb, 17 Apr 2001; 30 Nov 2001 & 29 Jan 2002 (positive); 26 Jun & 9 Jul 2002)
- USA (14 Jul & 5 Aug 2011)

In the case of three of the above pairs of sovereign actions, firm-level actions occur in the two days before one sovereign action and the three days after another sovereign action, as follows:

- Spain: On Monday 12 January 2009, Spain underwent a negative outlook change, and on Monday 19 January 2009, a negative rating change. On Thursday 15 January 2009, one firm underwent a negative outlook change which is on Day (+3) for the change on 12 January and Day (-2) for the change on 19 January. The change is allocated to Day (+3) alone.
- Turkey: On Wednesday 21 February 2001, Turkey underwent a negative outlook change and on Friday 23 February 2001 a negative rating change. One firm-level rating downgrade and 8 firm-level negative changes in outlook accompanied the first action on 21 February and 9 firm-level rating downgrades accompanied the second action on 23 February. The firms involved are the same on both days and the actions closely track the sovereign actions. We assume that each firm-level action belongs only to the sovereign action on the same day.
- Portugal: On Thursday 24 March 2011, Portugal underwent a rating downgrade and on Tuesday 29 March 2011 a further downgrade. On Monday 28 March 2011, 9 firms underwent a rating downgrade. These downgrades occurred on Day (+2) for the change on 24 March and Day (-1) for the change on 29 March. The changes are allocated to Day (+2) alone.

Some EU sovereigns underwent a negative action on 5 December 2011 and a positive action on 23 January 2012 (Germany, Belgium, Luxembourg, Netherlands). The overlap period is 15 December 2011 through 3 January 2012 which is the period (+4, +22) for the first action and (-22, -2) for the second action. Indonesia underwent a negative sovereign action on 15 May 1998 and a positive sovereign action on 8 July 1998. Korea underwent a negative sovereign action on 22 December 1997 and a positive sovereign action on 18 February 1998. In these cases any firm-level actions which occur in the overlap period are assigned to the sovereign action in the same direction.

Supplementary Table S5
Average Actions Per Day

We present the *average* number of actions per day for each period by dividing the number of actions shown in Table 2 by the total number of days represented by each period. When calculating the number of days for each period we account for any periods of overlap between sovereign actions. We take no account of the variation in the number of rated firms. See the note to Table 2 in relation to actions in the opposite direction in the (-22, +21) window for Germany.

Country	N sov actions	Same Direction Sovereign Action								Opposite	All
		(-22, -3)	(- 2)	(-1)	(0)	(+1)	(+2)	(+3)	(+4, +21)	(-22, +21)	Other
<i>Latin America</i>											
Argentina	19	0.07	0.00	0.00	8.53	6.42	1.42	0.89	0.18	0.04	0.02
Brazil	18	0.08	0.06	0.00	12.22	6.33	0.06	0.11	0.18	0.03	0.10
Chile	5	0.02	0.00	0.00	2.00	1.40	0.00	0.20	0.03	0.01	0.05
Colombia	10	0.01	0.00	0.00	2.60	0.30	0.80	0.00	0.03	0.00	0.01
Mexico	11	0.07	0.27	0.36	10.91	1.18	0.36	0.00	0.04	0.04	0.11
<i>North America</i>											
Canada	2	0.18	0.00	0.00	1.00	0.00	0.00	0.00	0.83	0.00	0.51
USA	3	1.30	0.33	0.33	2.67	14.67	6.00	0.33	2.15	2.83	7.72
<i>Eurozone</i>											
Austria	2	0.00	0.00	0.00	0.00	0.00	1.50	3.00	0.00	0.08	0.03
Belgium	4	0.00	0.00	0.00	0.50	0.25	1.25	0.50	0.06	0.01	0.03
France	2	0.13	0.00	0.00	0.00	0.00	31.00	2.00	1.58	0.11	0.36
Germany	2	0.13	0.00	0.50	0.00	0.00	4.00	3.50	0.44	13.45	0.38
Greece	18	0.01	0.00	0.00	0.56	0.72	0.89	0.17	0.03	0.02	0.03
Ireland	12	0.13	0.00	0.08	0.50	0.33	0.83	1.33	0.07	0.04	0.10
Italy	9	0.09	0.33	0.00	1.22	0.11	7.44	0.67	0.40	0.04	0.14
Luxembourg	2	0.18	0.00	0.00	0.50	0.00	2.50	1.50	0.14	0.07	0.09
Netherlands	2	0.10	0.00	0.00	0.00	0.50	3.00	4.00	0.22	0.09	0.21
Portugal	13	0.02	0.00	0.00	1.23	0.38	1.85	1.15	0.09	0.01	0.03
Spain	12	0.06	1.17	0.00	0.08	0.00	1.42	1.42	0.21	0.02	0.08
<i>Other Europe</i>											
Denmark	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02
Sweden	3	0.02	0.00	0.33	1.00	0.00	0.00	0.00	0.00	0.02	0.10
UK	2	0.40	0.00	0.50	0.00	0.50	0.00	0.00	0.31	0.20	0.59
<i>Asia Emerging</i>											
China	10	0.07	0.20	0.00	4.00	1.00	0.20	0.00	0.03	0.02	0.08
Hong Kong	12	0.03	0.25	0.00	4.17	2.33	0.08	0.17	0.03	0.03	0.07
India	15	0.02	0.00	0.07	6.60	0.87	0.80	0.00	0.01	0.00	0.01
Indonesia	22	0.01	0.00	0.00	2.55	1.14	1.14	0.27	0.05	0.01	0.04
Korea	12	0.10	0.33	0.00	5.58	1.33	0.58	0.08	0.08	0.01	0.07
Malaysia	15	0.01	0.07	0.07	2.33	0.53	0.00	0.27	0.04	0.00	0.02
Taiwan	7	0.03	0.00	0.14	0.29	1.14	0.00	0.00	0.10	0.02	0.04
Thailand	12	0.00	0.00	0.00	3.33	1.50	0.00	0.00	0.06	0.01	0.03
Turkey	29	0.00	0.00	0.00	3.03	1.76	0.86	0.59	0.06	0.01	0.00
<i>Pacific</i>											
Australia	3	0.03	0.33	0.00	3.67	3.67	0.33	0.00	0.30	0.14	0.37
New Zealand	6	0.01	0.33	0.00	0.33	0.33	0.00	0.00	0.07	0.06	0.09
<i>Other</i>											
Japan	10	0.27	1.00	1.40	5.80	1.70	0.10	0.40	0.37	0.08	0.36
South Africa	7	0.01	0.00	0.14	1.29	2.57	0.43	0.00	0.03	0.00	0.02

Supplementary Table S6

Determinants of the Likelihood of Firm-level Changes: Two Way Clustering of Standard Errors

We re-estimate the results in Table 4 employing double clustering of standard errors at both the firm and sovereign level. 13,687 firms are rated at the time of negative sovereign actions and 6,445 at the time of positive actions (Table 4). 13,687 (6,445) firm actions are from 5,393 (3,409) firms for negative (positive) sovereign actions. The results in Panel A below are produced in SAS employing the code provided by Daniel Taylor in relation to the article of Gow et al. (2010) and the results in Panel B below are produced in STATA. A finite sample adjustment is made to the standard errors in all cases. As expected, standard error estimates are very similar to those produced via clustering at solely the sovereign level – that is, the highest level of aggregation at which the data might be correlated (see, e.g., Thompson, 2011). We confirm that the standard error on the variable *Return* in the Panel B regression with the variable (0, 3) as the dependent variable now fails to be significant (in fact the standard error only changes by 0.03 and the variable moves from marginally significant to marginally insignificant).

As in Table 4, we employ logit models and our dependent variable, *Firm-event*, takes a value of 1 if the firm experiences a rating change in the same direction as the sovereign change within (i) (0, 3) days or (ii) (0, 21) days of the sovereign event, and 0 otherwise. The independent variables are as set out in the text which accompanies Table 4.

Variable	Positive Events				Negative Events			
	Coefficient	z-stat.	Coefficient	z-stat.	Coefficient	z-stat.	Coefficient	z-stat.
Dependent	(0, 3)		(0, 21)		(0, 3)		(0, 21)	
Panel A: Estimation Via SAS								
Intercept	-4.8127	-2.49**	-0.7060	-0.69	-10.3505	6.80***	-4.1723	5.81***
Wealth/Risk Factor	-0.4252	-0.97	-0.8619	-2.75***	-0.2181	-0.44	0.7909	1.98**
St.Dev.	-5.7473	-6.55***	-3.7002	-3.47***	4.8265	3.16***	5.1344	4.50***
Return	1.3976	1.65	0.3647	0.53	0.5959	0.53	0.3401	0.74
GDP Growth	-0.6977	-0.68	-1.8896	-2.26**	-0.1422	-0.17	-0.1609	-0.21
Firm Rating	0.0656	0.65	-0.0209	-0.37	0.2688	4.19***	0.0588	1.06
Eq. Sov.	3.4887	7.18***	2.7244	13.43***	2.3307	6.71***	2.5986	6.01***
> Sov.	1.7083	2.45**	1.0987	3.39***	0.3184	0.78	0.8567	1.93**
Listed	0.4950	3.49***	0.6312	4.35***	0.3289	1.55	0.0829	0.45
Financial	0.8817	2.19**	0.9543	3.33***	1.2548	4.54***	1.0775	3.74***
Insurance	-0.3561	-0.25	0.6028	0.98	-0.6212	-1.38	-0.1837	-0.34
Utilities	0.5576	1.79*	0.3509	1.53	0.8229	2.35**	0.6791	2.28**
Days	-0.0446	-0.30	-0.1597	-1.43	-0.1234	-1.11	-0.1217	-1.94*
Sov. Rch.	-0.1247	-0.54	0.0138	0.06	-0.5556	-1.56	-0.2946	-1.89*
MultiNotch	0.5793	1.01	0.8835	1.18	0.5626	0.72	0.6624	1.24
Country Dummies#	Yes		Yes		Yes		Yes	
Year Dummies	Yes		Yes		Yes		Yes	
Max rescaled R Sqr.	0.6526		0.5678		0.6769		0.5680	
Obs.	6,445		6,445		13,687		13,687	
Panel B: Estimation Via STATA								
Intercept	-4.8127	-2.50**	-0.7060	-0.69	-10.3505	-6.81	-4.1723	5.81***
Wealth/Risk Factor	-0.4252	-0.97	-0.8619	-2.76***	-0.2181	-0.44	0.7909	1.98**
St.Dev.	-5.7473	-6.58***	-3.7002	-3.48***	4.8265	3.17***	5.1344	4.50***
Return	1.3976	1.65	0.3647	0.53	0.5959	0.53	0.3401	0.74
GDP Growth	-0.6977	-0.68	-1.8896	-2.27**	-0.1422	-0.17	-0.1609	-0.21
Firm Rating	0.0656	0.66	-0.0209	-0.37	0.2688	4.20***	0.0588	1.06
Eq. Sov.	3.4887	7.21***	2.7244	13.48***	2.3307	6.72***	2.5986	6.02***
> Sov.	1.7083	2.46**	1.0987	3.41***	0.3184	0.78	0.8567	1.93**
Listed	0.4950	3.50***	0.6312	4.37***	0.3289	1.56	0.0829	0.45
Financial	0.8817	2.19**	0.9543	3.34***	1.2548	4.55***	1.0775	3.75***
Insurance	-0.3561	-0.25	0.6028	0.99	-0.6212	-1.38	-0.1837	-0.34
Utilities	0.5576	1.80*	0.3509	1.54	0.8229	2.36**	0.6791	2.29**
Days	-0.0446	-0.30	-0.1597	-1.44	-0.1234	-1.11	-0.1217	-1.94*
Sov. Rch.	-0.1247	-0.55	0.0138	0.06	-0.5556	-1.56	-0.2946	-1.89*
MultiNotch	0.5793	1.01	0.8835	1.19	0.5626	0.72	0.6624	1.24
Country Dummies#	Yes		Yes		Yes		Yes	
Year Dummies	Yes		Yes		Yes		Yes	
Pseudo R Sqr.	0.5568		0.4543		0.608		0.4802	
Obs.	6,445		6,445		13,687		13,687	

To allow valid model estimates we exclude country dummies where no firm-level actions occur. This only affects positive sovereign actions.

Supplementary Table S7

Determinants of the Likelihood of Firm-level Changes Based on Sub-samples of Data.

We re-estimate the results in Table 4 employing sub-samples of the data, excluding Eurozone countries (Panel A) and excluding Eurozone countries plus the USA (Panel B). In Panel A (B) 10,394 (2,632) firms are rated at the time of negative sovereign changes and 4,709 at the time of positive changes. Standard error estimates take account of clustering at both the firm and the sovereign level employing the code provided by Daniel Taylor in relation to the article of Gow et al. (2010). The SAS procedure in this code provides a finite sample adjustment to the standard errors. As in Table 4, we employ logit models and our dependent variable, *Firm-event*, takes a value of 1 if the firm experiences a rating change in the same direction as the sovereign change within (i) (0, 3) days or (ii) (0, 21) days of the sovereign event, and 0 otherwise. The independent variables are as set out in the text which accompanies Table 4.

Variable	Positive Events				Negative Events			
	Coefficient	z-stat.	Coefficient	z-stat.	Coefficient	z-stat.	Coefficient	z-stat.
Dependent	(0, 3)		(0, 21)		(0, 3)		(0, 21)	
Panel A: Excluding Eurozone Firms								
Intercept	-7.5095	-3.34***	-3.4409	-3.31***	-9.9071	-8.27***	-3.9046	-5.56***
Wealth/Risk Factor	-1.0499	-2.88***	-1.1229	-7.10***	-0.1072	-0.28	0.8905	2.33**
St.Dev.	-6.0370	-5.95***	-2.9993	-2.53**	5.7234	3.15***	5.4062	3.56***
Return	1.2444	1.36	0.1348	0.20	0.7021	1.01	0.2656	0.62
GDP Growth	-0.0499	-0.04	-1.9842	-1.97*	0.2652	0.26	-0.9292	-1.17
Firm Rating	0.0535	0.47	-0.0368	-0.60	0.2681	3.16***	0.0117	0.31
Eq. Sov.	3.5759	6.67***	2.7727	14.45***	2.8816	5.99***	3.2052	6.69***
> Sov.	1.8675	2.49**	1.2697	4.31***	0.8474	3.18***	1.4555	4.43***
Listed	0.4715	3.19***	0.5496	3.61***	-0.0186	-0.09	-0.1908	-1.51
Financial	0.9631	2.36**	0.9842	3.29***	0.9470	2.68**	0.5247	2.18**
Insurance	-0.1113	-0.07	0.8545	1.59	-12.1166	-15.04***	-0.7029	-0.54
Utilities	0.5131	1.58	0.3116	1.32	1.0337	2.31**	0.7513	2.14**
Days	0.0664	0.50	-0.0954	-0.86	0.0064	0.07	-0.064	-1.01
Sov. Rch.	-0.0365	-0.17	0.0510	0.23	0.1534	0.61	-0.1377	-1.00
MultiNotch	12.9972	7.01***	0.8126	0.64	0.6676	0.41	0.1978	0.14
Country Dummies#	Yes		Yes		Yes		Yes	
Year Dummies	Yes		Yes		Yes		Yes	
Max rescaled R Sqr.	0.6341		0.5513		0.7440		0.5914	
Obs.	4,709		4,709		10,394		10,394	
Panel B: Excluding Eurozone and US Firms								
Intercept					-9.6115	-4.19***	-3.9814	-2.45**
Wealth/Risk Factor					-0.2073	-0.30	0.5384	0.94
St.Dev.					5.4525	3.17***	4.9298	3.83***
Return					0.5488	0.79	-0.0215	-0.05
GDP Growth					0.6648	0.58	-0.1201	-0.14
Firm Rating					0.3086	1.94*	0.1227	1.26
Eq. Sov.					2.6997	4.79***	2.6833	5.72***
> Sov.					0.6299	1.52	0.8742	3.60***
Listed					-0.1138	-0.50	-0.2773	-1.34
Financial		No positive sovereign actions for the USA			0.9979	2.36**	0.7594	2.65**
Insurance					-10.5517	-13.71***	0.7527	0.45
Utilities					1.1005	2.24**	0.9478	2.46**
Days					-0.0769	-0.58	-0.2107	-2.29**
Sov. Rch.					0.2312	0.80	-0.0358	-0.20
MultiNotch					0.6075	0.38	0.1055	0.08
Country Dummies#					Yes		Yes	
Year Dummies					Yes		Yes	
Max rescaled R Sqr.					0.6979		0.6227	
Obs.					2,632		2,632	

To allow valid model estimates we exclude country dummies where no firm-level actions occur. This only affects positive sovereign actions.