INVESTMENT-GRADE OR "JUNK" STATUS: DO SOVEREIGN CREDIT RATINGS REALLY MATTER?

Adriaan Slabbert, Gavin Keeton & Niki Cattaneo

RHODES UNIVERSITY

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ABSTRACT

Credit ratings play a well-established part in modern financial markets, reducing asymmetric information between investors and borrowers. In particular, sovereign credit ratings allow the world's lesser-known economies to access a wider pool of international capital, while simultaneously allowing international investors to access a more diverse set of investment opportunities. The importance of sovereign credit ratings in terms of the cost of government debt in developing nations was observed. The relationship between sovereign credit ratings and average bond spreads over the time period spanning 2006 – 2017 was examined in 25 emerging economies. Regression analysis in the form of fixed-effects and random-effects models was used to determine the impact of changes in sovereign credit ratings on the cost of sovereign debt, controlling for certain macroeconomic factors. It was concluded that sovereign credit ratings are relevant in helping to determine the cost of sovereign debt for developing economies, but that they are not the only factor considered by global markets. The thesis therefore recommended further research into the factors affecting the cost of sovereign debt as well as further refinements to the methodologies that ratings agencies use to assign ratings.

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1. Research background

Sovereign credit ratings may be defined as a "condensed assessment by credit rating agencies of a government's ability and willingness to repay its public debt both in principal and in interest on time" (de Vries and de Haan, 2014). Their purpose is to provide investors with a signal that alerts them to the risks associated with sovereign debt funded with bonds. The value of this role is linked to the phenomenon of asymmetric information, a situation that occurs when one party in a transaction (the sovereign seeking to issue debt) has more information than the other (the potential investor) (Akerlof, 1970). White (2002) notes the effect that asymmetric information has on lenders, given the necessity to ascertain the continued creditworthiness of borrowers after a loan has been granted. White (2002) observes that while specialist lenders, such as large banks or pension funds, may be able to gather the necessary information to judge the feasibility of the investment themselves, non-specialist lenders are unlikely to be able to do so. Requiring every investor to perform their own risk assessments and assess the creditworthiness of each debt-issuing sovereign would be a costly and ultimately futile exercise. This would be especially problematic for smaller, lesser-known nations. As a result, investors would be likely to focus on safer, larger and more familiar investment opportunities, i.e. the debt of developed nations. Access to funds for emerging markets would be greatly reduced and the costs of funding debt would increase as a consequence. The primary function of credit ratings agencies revolves around eliminating asymmetric information between the parties in a lending relationship (Ligeti and Szőrfi, 2016).

Hence, the role of credit ratings agencies is to specialize in the collection and analysis of large amounts of public and private information and to condense it into a single, universally understood and easily obtainable signal in the form of either a corporate or sovereign credit rating (Pennartz and Snoeij, 2012). White (2002:5) states that, in this way, credit ratings allow lenders to "pierce the fog of asymmetric information that surrounds lending relationships". Furthermore, White (2002:4) refers specifically to bonds as instruments where the "public good" nature of information means that information-gathering efforts are not duplicated, which would be inefficient. This outcome also benefits borrowers because it exposes them to a wider variety of potential lenders, thus allowing them a greater opportunity to attract funds by means of

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issuing debt. This should result in lower interest rates and potentially greater borrowings in a larger, more liquid market.

The concept of assigning a rating to sovereign debt is a relatively new idea, with Moody's rating only three (Canada, USA, Australia) and Standard and Poor's (S&P) two (Canada, USA) nations respectively as recently as 1975 (Bhatia, 2002). In 1993 only 12 emerging markets carried sovereign ratings (Kräussl, 2003). However, sovereign credit ratings have grown rapidly since the turn of the century. As of 2018, 149 nations carry a rating from at least one of the three leading ratings agencies, which are Moody's, S&P and Fitch Ratings (Trading Economics, 2018).

Cantor and Packer (1996) point out that the demand for sovereign credit ratings has increased dramatically since their introduction because more and more nations with relatively unfavourable risk profiles wished to borrow in the international bond markets, while many investors, particularly those from the USA, preferred to invest only in rated securities rather than unrated ones, regardless of whether or not they in fact have similar credit risks.

Furthermore, Cantor and Packer (1996) note that credit rating agencies rarely assign a higher rating to businesses or municipalities within a country than to the sovereign itself. This observation is based on the idea that no business or municipality can be considered to have a higher creditworthiness than the government of its nation of origin. In other words, sovereign credit ratings affect not only the ability of a sovereign to borrow, but also affect other borrowers of the same nationality. Thus, it may be inferred that sovereign ratings are no longer merely a useful tool to help a sovereign secure credit, but rather a non-negotiable pre-requisite for any sovereign and corporate wishing to secure international funds.

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Table 1: Ratings by Agency, Interpretation and Numerical Scale.

Fitch	S&P	Moody's	Ratings grade description (Moody's)	
AAA	AAA	Aaa	Investment Grade	Minimal credit risk
AA+	AA+	Aa1		Very low credit risk
AA	AA	Aa2		
AA-	AA-	Aa3		
A+	A+	A1		Low credit risk
A	A	A2		
A-	A-	A3		
BBB+	BBB+	Baa1		Moderate credit risk
BBB	BBB	Baa2		
BBB-	BBB-	Baa3		
BB+	BB+	Ba1	Speculative Grade	Substantial credit risk
BB	BB	Ba2		
BB-	BB-	Ba3		
B+	B+	B1		High credit risk
B	B	B2		
B-	B-	B3		
CCC+	CCC+	Caa1		Very high credit risk
CCC	CCC	Caa2		
CCC-	CCC-	Caa3		
CC	CC	Ca		In or near default, possibility of recovery
C	C			
DDD	SD	C		In default, little chance of recovery
DD	D			
D				

Source: CNB (2016).

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A number of studies (for example, Cantor and Packer, 1996, Elliason, 2002 and González-Rozada and Levy-Yeyati, 2010) have examined the question of whether or not differences in assigned credit ratings, in particular between investment-grade and speculative-grade, have any bearing on the market for government bonds, and in particular bond yields. Given that higher government bond yields imply higher debt service costs for governments, a significant inverse relationship between ratings and bond yields would indicate that countries with poor credit ratings should struggle to fund their debt given the higher financing costs involved.

Existing literature shows that there is disagreement concerning the significance of sovereign credit ratings and whether or not they significantly affect financial markets. Cantor and Packer (1996) find that differences in credit ratings have strong explanatory power with regards to differing bond yields across different panels of nations. A more recent study by Jaramillo and Tejada (2011) likewise finds that crossing the "threshold" between investment-grade and speculative-grade ratings categories has a significant effect on bond spreads.[1] In contrast, González-Rozada and Levy-Yeyati (2010) do not agree that credit ratings are significant in determining spreads for emerging markets. They suggest instead that ratings changes actually lag changes in bond spreads. Their findings support those of Mora (2006), and Eliasson (2002) who had already questioned the claimed long-term, forward-looking properties of credit ratings, concluding instead that sovereign credit ratings appear to be pro-cyclical, rather than bringing concerns hidden in macroeconomic fundamentals to the attention of investors. However, in a more recent study on the peripheral countries of the Eurozone, de Vries and de Haan (2014) find that sovereign credit ratings do have a significant ability to predict bond spreads. However, they note that the predictive relationship is present only since the European debt crisis of 2012.

2. Goals of the research

In light of the above-mentioned uncertainty and the relative shortage of information on how emerging market bond spreads are affected by sovereign credit ratings, it is clear that there is scope for more research on the importance of sovereign credit ratings for this group of countries. This research examines the effect of sovereign credit ratings on bond spreads for a group of mainly emerging market economies, to examine the question of whether differences in sovereign credit ratings have an effect on the cost of sovereign debt over and above the effects of macroeconomic factors. The research draws on the work of Jaramillo and Tejada (2011), which covers the period spanning 1997 – 2010. However, given that their (Jaramillo and Tejada, 2011) work ends shortly after the occurrence of the global financial crisis, the research will be relevant

[1] In this context, bond spreads are the difference in between a given country's US dollar bond yields and the yields on bonds of a similar maturity issued by the US government.

for examining the relationship between spreads and sovereign ratings in a post-crisis world and how this relationship may have changed in the current decade.

Against this backdrop, the paper analyzes the impact of changes in sovereign credit ratings on the cost of sovereign debt, in particular for emerging markets. The focus is on whether the cost of sovereign debt changes when a nation's credit rating crosses the investment-grade/speculative-grade threshold. In pursuit of this goal, the research aims to answer the following key questions:

- Do changes in sovereign credit ratings correlate significantly with changes in the cost of sovereign debt?
- Does crossing the investment-grade/speculative-grade threshold affect the cost of sovereign debt in a more substantial way than a one-notch ratings movement within the same ratings range?

3. Data, methods and techniques

The sample of countries is restricted to include only emerging market nations that have usually held ratings by Moody's and S&P near (i.e. slightly above or slightly below) the threshold over the period 2003 – 2017. This period is chosen so that potential changes in the relationship pre- and post- the global financial crisis can be examined.

Following the method of Jaramillo and Tejada (2011), bond yields on foreign currency (US dollar), long-term debt of the selected nations is compared to the yields on US Treasury Bills, which are used as a proxy for the risk-free rate. The size of the spreads (i.e. the difference in yields) are determined using the J.P. Morgan Emerging Market Bonds Index (EMBI) spread values. This is done for different periods before and after the financial crisis to examine structural changes in bond spreads over the period.

The method of Jaramillo and Tejada (2011), which takes the form of a fixed effects model, is used to assess whether sovereign ratings changes have a significant impact on bond spreads over and above certain key macroeconomic variables. Variables identified from the literature include a real GDP growth, public debt as a percentage of GDP and external debt as a percentage of GDP.

In addition, the CBOE Volatility Index (VIX) is used as a proxy for investor risk appetite, as in Jaramillo and Tejada (2011). The required macroeconomic data and bond spreads were obtained from Thompson-Reuters Datastream and J.P. Morgan, respectively. Credit ratings were obtained from Moody's and S&P.

3.1 Mean spread vs average ratings analysis

The overarching aim of this research is to analyse the influence of sovereign credit ratings on the relative cost of sovereign debt and whether there is any noteworthy difference in yield spreads when the threshold between investment-grade and "junk" status is crossed. In other words, is the impact on debt yields of a one-notch movement between the two asset classes (investment-grade and "junk") different to a one-notch movement within the individual asset classes? Given the conclusions of de Vries and de Haan (2014) the research also investigates changes in the relationship between sovereign credit ratings and bond yields over time, in particular in the aftermath of the global financial crisis of 2007/2008 and the Eurozone debt crisis of 2012. This is important as the impact of ratings changes and crossing the "threshold" is likely to be different in periods where the appetite for risk is high, compared with periods when it is low.

To investigate these questions, the relationship between sovereign ratings and bond spreads is examined over time. In order to achieve this, a sample of 39 largely emerging-market economies was selected.[2] The nations in question were selected on the basis of their sovereign rating history. The selected sovereigns all (i) displayed a ratings history that included substantial changes in their rating over time; and (ii) held ratings that generally fluctuated a few notches above, or a few notches below, the investment grade/junk status threshold.

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[2] The full, initial list of selected sovereigns was as follows: Argentina, Bahrain, Barbados, Belize, Bolivia, Brazil, Bulgaria, Chile, China, Colombia, Croatia, Cyprus, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Hungary, Iceland, Indonesia, Kazakhstan, Lebanon, Lithuania, Malaysia, Mexico, Morocco, Panama, Peru, Philippines, Portugal, Romania, Russia, Slovakia, South Africa, Spain, Thailand, Turkey, Uruguay. As noted above, one of the criteria for selecting sovereigns was a history of substantial ratings changes over the time period considered. For this reason, certain emerging markets, such as India, for example, were excluded. While Portugal and Spain are developed economies, they fell with the ratings range examined and were therefore included.

For each nation, the history of its sovereign ratings (specifically for long-term, foreign currency-denominated debt) was obtained from both S&P and Moody's for the period 2000-2017. Each ratings category is assigned a numerical value, with the highest ratings class, AAA, assigned a value of 1. Each subsequent one-notch movement down the rating scale sees the numerical value increase by 1. The lowest investment-grade rating, BBB-, carries a value of 10, while at the bottom of the scale, all ratings lower than C are assigned a value of 22.

Each sovereign's average monthly rating from both S&P and Moody's was recorded for each month of the period under consideration. The average across the two ratings agencies was calculated for every month, after which the values were averaged for each year in order to obtain average ratings levels for each year. In the interest of simplicity, in the months during which ratings adjustments took place, the numerical value assigned for that month was chosen based on which rating the sovereign held for the majority of the month. Hence, if the ratings change was made in the second half of the month, the selected average rating was the "old" rating. If, by contrast, the change took place in the opening half of the month, the selected average rating was the updated rating.

The average annual ratings for each nation in the sample was then plotted against that nation's corresponding Emerging Markets Bond Index (EMBI) spread, in order to provide a visual comparison of the relationship between ratings and spreads, as well as how the relationship has changed over time.[3] The EMBI spreads in question were obtained from J.P. Morgan. Limitations in data gathering meant that EMBI spreads were only available for 32 of the 39 nations originally identified, and only from 2006 onwards, which necessitated changes to both sample size (32 nations) and the length of the time period under consideration (2006 – 2017). The time period under consideration was divided into four three-year periods, i.e. 2006 – 2008, 2009 – 2011, 2012 – 2014 and 2015 – 2017. The rationale for this was to examine the relationship between average

[3] The EMBI was constructed by J.P. Morgan in 1992 and incorporates Brady bonds, dollar-denominated loans and Eurobonds, i.e. debt that is repaid in US dollars. The index value (i.e. spread) is calculated by taking into account the total size of the above-mentioned debt instruments held by a given nation, as well the relative proportion that each instrument contributes to the total. The yields on these debt instruments are then weighted accordingly, and compared to the yields on comparable U.S. debt instruments.

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ratings and average spreads in each of these individual time periods and identify changes therein. Hence, the first time period (2006 – 2008) studies the relationship in a largely pre-financial crisis setting. 2009 – 2011 roughly covers the immediate aftermath of the global financial crisis, while 2012 – 2014 sees the emergence of the Eurozone debt crisis. 2015 – 2017 covers the sovereign debt market most recently. In order to identify differences between the relationship in the individual periods and the overall period, average ratings and average spreads were also calculated for the entire 2006-2017 period.[4]

For each time period, the average spread across all 32 nations was calculated, as well as the range of the spreads, i.e. the difference between the average maximum and average minimum spread for the period. However, in order to account for possible distortions arising from an unusually high or unusually low average spread, the range for each period was also calculated after excluding the highest and lowest average spreads in the sample. This was done to avoid undue influence on the calculated range coming from single outliers in the data.

In addition, for all four time periods, as well as for the overall period, the above analysis was performed for just those nations with average credit ratings in the six-notch range between A- and BB-. The motivation for this is to study behaviour only in the area just above and below the investment-grade threshold, BBB-.[5]

3.2 Regression analysis

The above analysis was necessary to determine the overall investment climate in which individual countries' credit spreads might be changing. The logic is that in a period of strong credit appetite, overall spreads are likely to be relatively small. In a period of lower credit appetite they are likely to widen. Thus the impact on credit spreads of a one-notch credit upgrade or downgrade, or a

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[4] EMBI spreads were not available for all nations from the beginning of 2006 onwards. As a result, the 2006-2008 period compares the average ratings and average spreads of the 25 sovereigns for which data was available. For the 2007-2009 period, 27 nations are considered, while 2012-2014 analyses the relationship for 29 nations. The final time period (2015-2017) includes all 32 nations. For the overall (2006-2017) time period, only the 25 nations for which data was available for the entire period were included.

[5] The A- and BB- ratings grades carry numerical values of 7 and 13, respectively. The BBB- ratings grade, which represents the investment-grade threshold, carries a value of 10, and hence falls in the middle of the above-mentioned range.

switch between investment-grade and "junk" status is likely to be quantitatively different depending on the market's appetite for risk at a point in time.

In order to analyse the effects of sovereign ratings changes on mean monthly bond spreads, regression analysis was performed on the sample of 25 nations falling within the narrow ratings range 3 notches above and 6 below the investment-grade threshold and for which EMBI spreads were available for the period January 2006 – December 2017. Based on the panel nature of the sample in question, a fixed effects model with a monthly frequency of the following specification was constructed, similar to that used by Jaramillo and Tejada (2011):

$$\log(Spreads)_{it} = \beta_0 + \beta_1 GDPGR_{it} + \beta_2 EXDBTGDP_{it} + \beta_3 PUBDBTGDP_{it} + \beta_4 Ratings_{it} + \beta_5 VIX_{it} + \delta_i + \varepsilon_{it}$$

The dependent variable is the natural logarithm of sovereign bond spreads, based on each sovereign's EMBI spread. The natural logarithm of the spreads was used in order to express changes in spreads in terms of percentage changes. As mentioned earlier, spreads were sourced from J.P. Morgan. The model includes a constant (β_0), as well as making provision for fixed effects differences across nations, given by δ_i. In order to isolate the effects of ratings changes on spreads, certain macroeconomic variables found to be significant in the literature were included as explanatory variables. Early work by Cantor and Packer (1996) includes a plethora of macroeconomic variables, but only six (GDP per capita, inflation, external debt as a proportion of GDP, GDP growth rate, level of economic development and default history) were found to be significant. This thesis follows the findings of Jaramillo and Tejada (2011) and uses only variables which they found to have the most notable effects on spreads.

The selected macroeconomic variables were real GDP growth (given by $GDPGR_{it}$), external debt as a percentage of GDP ($EXDBTGDP_{it}$) and public debt as a percentage of GDP ($PUBDBTGDP_{it}$). It is expected, *a priori,* that real GDP growth would have a negative relationship with spread size, given that a higher level of growth makes it easier for a nation to service its debts (Jaramillo and Tejada, 2011). By contrast, the public debt to GDP ratio is expected to have a positive relationship with spreads, since a higher level of public debt increases the debt burden that a nation has to service, implying a higher potential for default. Jaramillo and Tejada (2011) use external government debt as one of their macroeconomic variables, but due to difficulties in obtaining data of just government's external debt for all 32 countries modelled, external debt for the nations as a whole was used instead. Data for all three variables were obtained from Thomson Reuters Eikon Datastream. The data in question was available only in an annual frequency. As a result, the data was interpolated using Eviews 10 in order to match the monthly frequency of the other variables in the model, following the methodology of Aziakpono (2005).

Ratings$_{it}$ is a vector containing dummy variables for each ratings category under observation. In total, the vector includes 9 dummies, representing the range of ratings between BBB+ and B- , with each dummy variable becoming active, i.e. being set equal to 1, for the period during which a given sovereign held the rating in question. Hence, if a sovereign holds a given rating in a certain month, the dummy associated with that rating is set equal to one. Since a sovereign can hold only one rating at a time, the other ratings dummies are set equal to 0 during that month. The appropriate ratings dummy remains active until the sovereign has its rating changed, at which point the old dummy is set equal to zero, and the ratings dummy becomes active. This is done in order to isolate the effect on spreads of holding a particular rating versus the average spreads for the remaining group of ratings, while holding the other variables constant. In order to account for possible endogeneity in the relationship between spreads and ratings, the dummies are lagged by one period, i.e. the average spread in a given month is compared to the credit rating held in the previous month (Jaramillo and Tejada, 2011). For this purpose, monthly ratings data (specifically for foreign currency denominated debt) were obtained from both S&P and Moody's. The ratings assigned by both agencies for a given month were averaged, with this average determining which dummy variable in the Ratings$_{it}$ vector is active for the month in question. The expectation is that a more favourable credit rating should lead to lower bond spreads, though the magnitude of this effect, and whether it is constant across the entire range of ratings classes will be indicated by the results.

While Jaramillo and Tejada (2011) make use of a fixed effects model of the above specification, a random effects model is also utilised in the present study and the results compared to those

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obtained from the fixed effects model. All models use robust standard errors, in order to correct for heteroscedasticity.

Interpreting the influence of each of the ratings dummies in isolation implies comparing the average spread when a given ratings dummy is active versus the average spreads obtained when the omitted dummies are active. As noted by Jaramillo and Tejada (2011) the percentage effect of each ratings dummy variable's coefficient is isolated by use of the formula:[6]

$$Impact = (e^{coefficient} - 1) * 100$$

It was decided to include a proxy for global risk appetite, with the *a priori* expectation that a greater appetite for risk would lead to a greater willingness to hold riskier assets, implying a lower spread on emerging market debt. The converse holds in periods of higher expectations of future volatility, which would likely require riskier markets to offer a more attractive return (i.e. a higher risk premium), which would imply higher bond spreads. As in Jaramillo and Tejada (2011), the selected proxy for global risk appetite was the Chicago Board Options Exchange (CBOE) Volatility Index (VIX), represented by the variable VIX_{it}.[7] Daily data on the VIX were obtained from the CBOE. The data were averaged on a month-by-month basis in order to conform to the remainder of the model.

In light of the previously identified differences (Jaramillo and Tejada, 2011) between the relationship before and after the financial crisis, it was decided to perform the same regression analysis, but to vary the periods under observation. Hence, the regression analysis was initially performed on the period spanning 2006 – 2017, before being repeated on just the 2010 – 2017 period, in order to focus specifically on the relationship between ratings and spreads after the financial crisis.

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[6] So, for example, a significant coefficient with a value of 0.1 would imply spreads that were 10.51% higher for the ratings dummy in question than for the rest of the sample, *ceteris paribus*. Similarly, a coefficient value of -0.12 would imply spreads that were 11.31% lower than for the rest of the sample, *ceteris paribus.*

[7] The VIX is an index of the market's expectations of future volatility, based on options on the S&P 500 Index. CBOE.com (2018) considers the VIX to be the world's leading measure of U.S equity market volatility.

4. Findings and interpretation of results

4.1 Mean spreads versus average ratings

The results of the calculations for the four separate 3-year time periods are summarized in Table 2 below. Graphs relating to the four individual time periods may be found in Annexure A. In each graph, the vertical line represents the investment-grade threshold. Ratings to the left of the vertical line represent investment-grade ratings, while those to the right of the vertical line represent speculative-grade ratings. In Table 2 below, all figures are in basis points. The figures in brackets represent the difference (in basis points) from the previous 3-year period.

Table 2: Spread Mean, Range and Median: 2006 - 2017

Spread Mean, Range and Median: 2006 - 2017				
Entire Sample				
Time Period/Calculation	**Mean Spread**	**Spread Range**	**Spread Range (excl. outliers)**	**Median**
2006 - 2017	277	868	572	230
2006 - 2008	244	850	430	203
2009 - 2011	348 (+104)	1211 (+361)	1010 (+580)	247 (+44)
2012 - 2014	306 (-42)	1163 (-48)	844 (-166)	198 (-49)
2015 - 2017	283 (-23)	969 (-194)	808 (-38)	234 (+36)
A- to BB-				
Time Period/Calculation	**Mean Spread**	**Spread Range**	**Spread Range (excl. outliers)**	**Median**
2006 - 2017	205	228	132	212
2006 - 2008	180	227	182	187
2009 - 2011	252 (+72)	440 (+213)	333 (+151)	234 (+47)
2012 - 2014	206 (-46)	307 (-133)	237 (-106)	187 (-47)
2015 - 2017	210 (+4)	285 (-22)	258 (+21)	213 (+36)

Source: Author's own calculations. Note: Bracketed figures are changes (in basis points) from the previous period.

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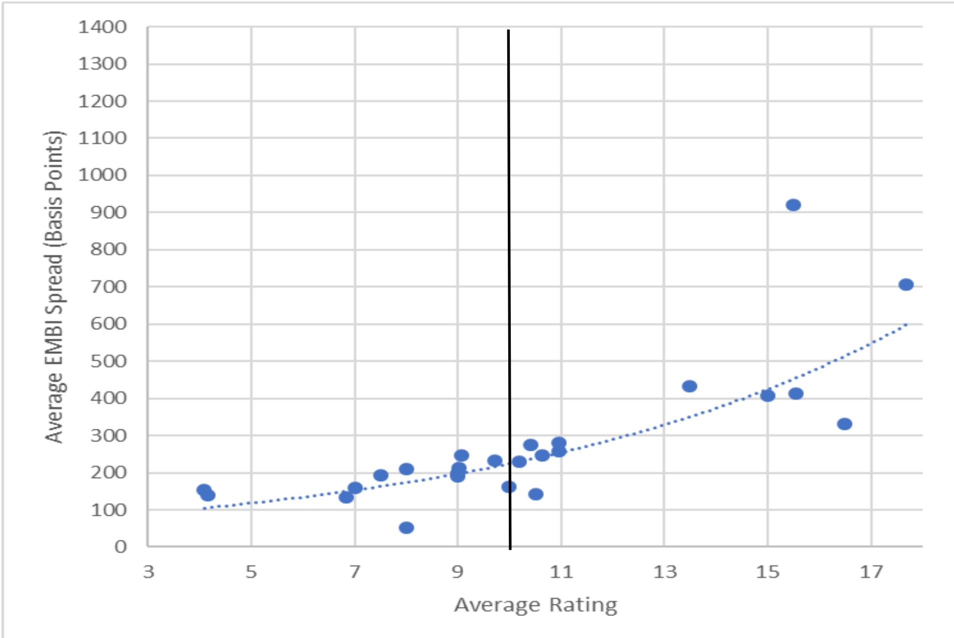

Figure 1: EMBI Spreads vs Average Ratings, 2006 – 2017.
Source: Author's own calculations. Note: Spread data is in basis points.

The mean spread for the sample over the period as a whole is 277 basis points. The range on spreads is 868 basis points, but once the top and bottom values are excluded, this figure drops to 572 basis points. This large difference is due to the high spreads associated with those nations rated far below the investment-grade threshold. For only those nations rated in the A- to BB- range, the mean spread is lower, at 205 basis points, and the spread range is more compressed, at 228 basis points. Once the highest and lowest values are discarded for these countries, the spread range is reduced to 132 basis points. These findings demonstrate the enormous discrepancy in spreads at the lower and higher ends of the ratings distribution, with ratings classes in the middle returning much tighter spread differences. This observation is supported by the finding that the median for the sample is 230 basis points, while the median of the A- to BB- ratings distribution is 212 basis points.

The results demonstrate noticeable changes in spreads across the different time periods. Initially, for the 2006 – 2008 period, all spread metrics were substantially lower than those for the overall time period. The only exception is the sample range for nations rated in the A- to BBsub-sample, and only once the two outermost values are removed. The second period saw an increase in all calculated metrics, in particular in mean spreads. The most dramatic change, however, took place in the spread range. Even after removing the highest and lowest values for both the overall sample and the A- to BB- range, the calculated spread range for 2009 – 2011 remained higher than the spread range from the previous period, even with extreme values included. Clearly, for the second period, there was not only a noticeable increase in average spreads when compared to the 2006 – 2008 period, but also a greater variability in spreads. It is especially notable that even amongst nations with similar average ratings, substantial differences in spreads were observed, as can be observed from the graphs included in Appendix A. While this phenomenon was not wholly absent in the first period, it was far more obvious in the second period.

Period 3, 2012 – 2014, saw the calculated metrics return to lower levels across the board compared to the second period. However, all metrics remained noticeably higher than in the first period, and also higher than the values for the overall period, median spreads being the only exception. The final period, covering 2015 – 2017, witnessed a slowing, and in some cases, even a reversal of the tendency towards lower spread metrics during the previous period. While some measures, specifically mean spreads, spread range for the sample (including and excluding extreme values) and spread range for the A- to BB- group (including extreme values) still fell, the rate of decline slowed. By contrast, the remaining measures increased slightly. The overall results for the 2015 – 2017 period appear similar to the average results for the entire period in some respects, but with values noticeably higher than for the 2006 – 2008 period, which preceded the global financial crisis.

The substantial movements in the calculated statistics discussed demonstrates that the relationship between average ratings and average spreads fluctuated considerably over the sample period. While there generally appears to be a clear link between a lower sovereign credit rating and higher spreads (as expected), it does not appear that the extent of this relationship can be predicted with certainty over a given period of time. The above results suggest that while the *a priori* expectations surrounding the negative relationship between ratings and yield spreads

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are confirmed, the amount by which a lower credit rating coincides with higher average spreads changes over time. It is particularly striking how each post-crisis period of analysis witnessed the gradual return of the average spread versus average rating relationship to almost pre-crisis levels. However, this return was incomplete, as at the end of the sample period (2015 – 2017) most measures were still higher than for both the pre-crisis period (2006 – 2008) and the overall sample period. While such an outcome was to be expected in the immediate aftermath of the financial crisis, the above-mentioned incomplete return to pre-crisis levels nearly a decade after the worst of the crisis is possibly unexpected. The incomplete return to pre-crisis levels in the average spread versus average rating relationship nearly a decade after the worst of the crisis raises the question of whether a return to 2006 – 2008 levels is likely to occur before the global economy enters its next recession, or whether the relationship has altered fundamentally.

The finding that while there is a clear negative relationship between sovereign credit ratings and the cost of sovereign debt the absolute value of this relationship changes over time may be due to investors relying on signals other than credit ratings to determine the desirability of investing in specific sovereign debt. Such an outcome has been suggested in the literature discussed earlier. In the aftermath of the financial crisis, increased emphasis on other measures, such as macroeconomic fundamentals, rather than a pure reliance on sovereign ratings was to be expected.

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4.2 Regression analysis

It is unclear from the above statistical findings how much the changed relationships between ratings and spreads is affected by an altered appetite for risky investments or by the influence of macroeconomic factors. In order to isolate the effects of sovereign ratings changes on the cost of sovereign debt more precisely, it is necessary to control for the influence of these macroeconomic factors, as well as the global appetite for risk. It is also clear that these relationships must be examined for different time periods because of the changed outcomes in terms of credit spreads. In Models 1 and 2 the time period is 2006-2017 but in Models 3 and 4 the time period analysed is reduced to 2010 – 2017. This is done to remove the impact of the overall very low spreads for the 2006-2008 period shown in Table 2 above.

4.2.1. Regression analysis: 2006-2017

The regression results for both the fixed effects (Models 1 & 3) and random effects (Models 2 & 4) models for the periods 2006-2017 and 2010-2017 are summarized in Tables 3 and 4 below.

Table 3: Fixed and Random Effects Models Regression Results (2006 – 2017).

2006 – 2017		
Dependent Variable: Log (Spreads)		
Variable	**Model 1 (Fixed Effects)**	**Model 2 (Random Effects)**
C	4.4824***	4.5331***
	(0.0679)	(0.1605)
GDPGR	-0.0464***	-0.0468***
	(0.0037)	(0.0036)
PUBDBTGDP	0.0095***	0.0089***
	(0.0013)	(0.0014)
EXDBTGDP	0.0036***	0.0035***
	(0.0006)	(0.0004)
VIX	0.0231***	0.0230***
	(0.0009)	(0.0009)
BBB+(-1)	-0.1368***	-0.1493***
	(0.0278)	(0.0278)
BBB(-1)	0.0022	0.0012
	(0.0768)	(0.0286)
BBB-(-1)	-0.0050	-0.0024
	(0.0300)	(0.0316)
BB+(-1)	-0.0893**	-0.0897**
	(0.0348)	(0.0350)
BB(-1)	0.0557	0.0627
	(0.0424)	(0.0426)
BB-(-1)	0.1275***	0.1393***
	(0.0377)	(0.0373)
B+(-1)	0.2355***	0.2429***
	(0.0373)	(0.0373)
B(-1)	0.2421***	0.2536***
	(0.0381)	(0.0377)
B-(-1)	0.3070***	0.3255***
	(0.0436)	(0.0425)
Adjusted R-squared	0.7864	0.4344
F-Statistic	356.5427***	212.0937***

Source: Author's own estimation using Eviews 10.
Note: The significance of individual coefficients is indicated by *** for significance at the 1%

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level, ** for significance at the 5% level and * for significance at the 10% level. Robust standard errors are reported in brackets below each individual coefficient. Table B.1. in Annexure B depicts the cross-sectional fixed and random effects for each model.

Table 4: Fixed and Random Effects Models Regression Results (2010 – 2017).

2010 – 2017		
Dependent Variable: Log (Spreads)		
Variable	**Model 3 (Fixed Effects)**	**Model 4 (Random Effects)**
C	4.3031***	4.4492***
	(0.0796)	(0.1388)
GDPGR	-0.0345***	-0.0381***
	(0.0025)	(0.0028)
PUBDBTGDP	0.0061***	0.0059***
	(0.0015)	(0.0012)
EXDBTGDP	0.0131***	0.0106***
	(0.0008)	(0.0008)
VIX	0.0217***	0.0215***
	(0.0021)	(0.0021)
BBB+(-1)	-0.0916***	-0.1114***
	(0.0245)	(0.0239)
BBB(-1)	-0.1049***	0.1014***
	(0.0217)	(0.0210)
BBB-(-1)	-0.1337***	-0.1389***
	(0.0188)	(0.0211)
BB+(-1)	-0.1638***	-0.1754***
	(0.0329)	(0.0317)
BB(-1)	-0.1182***	-0.1209***
	(0.0327)	(0.0292)
BB-(-1)	0.0462	0.0655**
	(0.0342)	(0.0334)
B+(-1)	0.0939***	0.1159***
	(0.0345)	(0.0324)
B(-1)	0.1304***	0.1568***
	(0.0331)	(0.0317)
B-(-1)	0.0656	0.1003**
	(0.0467)	(0.0485)
Adjusted R-squared	0.8403	0.2933
F-statistic	338.3799***	76.7458***

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Source: Author's own estimation using Eviews 10.
Note: The significance of individual coefficients is indicated by *** for significance at the 1% level, ** for significance at the 5% level and * for significance at the 10% level. Robust standard errors are reported in brackets below each individual coefficient. Table B.2. in Annexure B depicts the cross-sectional fixed and random effects for each model

4.2.2 Hausman tests for fixed versus random effects models

In order to determine which of the above models are most reliable, the Hausman test was applied to both the 2006 – 2017 and 2010 – 2017 time periods. According to Gujarati and Porter (2009) the null hypothesis of the Hausman test is that the fixed effects estimators and random effects estimators do not differ substantially. The alternative hypothesis is that that there is a substantial difference between the estimators. Gujarati and Porter (2009) note that if the null hypothesis is rejected, the fixed effects model is preferred due to possible correlation between the random effects and the regressors. The results of the Hausman tests for both time periods are reported below.

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Table 5: Hausman Test, 2006 2017.

Test Summary	Chi-Squared Statistic	Chi-Squared d.f.		Prob.
Cross-Section Random	44.536607	13		0.0000
Cross-Section Random Effects Test Comparisons				
Variable	Fixed	Random	Var (Diff.)	Prob.
GDPGR	-0.046362	-0.046763	0.000000	0.0050
PUBDBTGDP	0.009539	0.008586	0.000000	0.0013
EXDBTGDP	0.003641	0.003538	0.000000	0.2764
VIX	0.023130	0.022958	0.000000	0.0025
BBB+	-0.136756	-0.149301	0.000018	0.0031
BBB	0.002208	0.001202	0.000015	0.7931
BBB-	-0.004972	-0.002426	0.000016	0.5195
BB+	-0.089260	-0.089712	0.000013	0.9017
BB	0.055704	0.062675	0.000017	0.0896
BB-	0.127497	0.139252	0.000021	0.0111
B+	0.235533	0.242864	0.000019	0.0905
B	0.242071	0.253623	0.000011	0.0005

B-	0.306951	0.325462	0.000012	0.0000

Source: Author’s own estimations using Eviews 10.

Given that the chi-squared statistic is significant at the 1% level, the null hypothesis is rejected. Following Gujarati and Porter (2009) this implies that the fixed effects model is preferred for the above time period.

Table 6: Hausman Test, 2010 - 2017.

Test Summary	Chi-Squared Statistic	Chi-Squared d.f.		Prob.
Cross-Section Random	121.934997	13		0.0000
Cross-Section Random Effects Test Comparisons				
Variable	Fixed	Random	Var (Diff.)	Prob.
GDPGR	-0.034450	-0.038102	0.000000	0.0000
PUBDBTGDP	0.006065	0.005918	0.000000	0.8277
EXDBTGDP	0.013172	0.010551	0.000000	0.0000
VIX	0.021665	0.021495	0.000000	0.2875
BBB+	-0.091607	-0.111407	0.000025	0.0001
BBB	-0.104898	-0.101364	0.000035	0.5513
BBB-	-0.133707	-0.138850	0.000035	0.3853
BB+	-0.163754	-0.175401	0.000033	0.0430
BB	-0.118163	-0.120937	0.000037	0.6477
BB-	0.046159	0.065455	0.000031	0.0005
B+	0.093918	0.115884	0.000061	0.0048
B	0.130371	0.156836	0.000020	0.0000
B-	0.065602	0.100302	0.000024	0.0000

Source: Author’s own estimations using Eviews 10

As for the 2006 – 2017 period above, the chi-squared statistic is highly significant, implying a rejection of the null hypothesis. Once again, the fixed effects model is also preferred for 2010 – 2017.

4.2.3 Interpretation of results

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4.2.3.1 2006-2017

For the whole time period 2006 – 2017 the coefficient of real GDP growth is significant at the 1% level, and in line with *a priori* expectations, carries the anticipated negative sign, implying that stronger economic growth is correlated with lower spreads, holding all else constant. Similarly, the coefficients of both external debt as a percentage of GDP and public debt as a percentage of GDP are significant at the 1% level, with a positive sign, as expected. The coefficient of VIX is significant at the 1% level and carries a positive sign, implying that expectations of higher volatility in the future are, as expected, correlated to higher spreads in emerging markets, holding all else constant. In summary, all four of the included macroeconomic control variables were found to be highly significant, and all carried the expected sign.

The results further indicate that sovereigns with a credit rating of BBB+ (the highest considered for the sample) enjoy spreads that are 12.79% lower than those holding the remaining ratings, on average, *ceteris paribus*.[8] The coefficient is significant at the 1% level. The coefficients of the BBB and BBB- dummy variables are insignificant. The coefficient for the BB+ rating class is significant at the 5% level and implies spreads 8.54% lower than for the other ratings under consideration, on average, *ceteris paribus*. The coefficient for the BB dummy variable is insignificant. The BB- ratings class has a highly significant coefficient, implying spreads that are 13.60% higher than for the remaining group, on average, *ceteris paribus*. The coefficient for the B+ dummy variables is highly significant and implies spreads that are 26.56% higher than for the remaining group, on average, *ceteris paribus*. The observed effect of higher spreads is carried on through the final two ratings classes under consideration, i.e B and B-, both of which are found to be significant at the 1% level. Sovereigns holding the rating of B return spreads that are 27.39% higher than for the remaining group, on average, *ceteris paribus*. Sovereigns in the B- ratings class return spreads that are, on average, 35.93% higher than for the remaining group, c*eteris paribus*.

[8] As mentioned earlier, this is calculated as:$-12.79\% = (e^{-0.1368} - 1) * 100$. This means in practice that nations holding a BBB+ rating in the sample enjoyed spreads 12.79% lower than the average spread enjoyed by the remaining group of nations, holding all else constant.

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Overall, the results display the expected result that higher-rated nations enjoy lower average sovereign spreads, with a gradual decline in the positive effect as the ratings decline towards the investment/speculative-grade threshold. When the BB- rating is reached, nations begin to see higher average spreads, an effect which is carried through to the bottom of the ratings range under consideration. Interestingly, the most substantial difference in spread size appears to occur between the BB- and B+ ratings classes (13.60% higher versus 26.57% higher, a difference of 13.27 percentage points). This is despite the afore-mentioned ratings classes both being below the investment-grade/speculative-grade threshold. Below B+ the higher average spreads observed appear to increase at a more gradual rate, from 26.56% higher to 27.39% higher between the B+ and B ratings classes, an increase of just 0.83 percentage points. This is followed by a larger increase between the B and B- ratings classes (from 27.39% higher to 35.93% higher), an increase of 8.54 percentage points.

The regression has reasonably strong explanatory power, with an adjusted R-squared of 0.786.[9] The p-value of the F-statistic indicates that the regression as a whole is significant at the 1% level, implying that overall, the independent variables are jointly successful in explaining changes in the values of the dependent variable.

4.2.3.2 2010-2017

The coefficients of the macroeconomic variables specified earlier (real GDP growth, external debt as a percentage of GDP, public debt as a percentage of GDP and the VIX) remain highly significant, with all coefficients significant at the 1% level. Furthermore, all four coefficients still carry the expected sign. The coefficients demonstrate minor differences in magnitude compared with the models of the 2006 - 2017 time period. The influence of real GDP growth and public debt as a percentage of GDP on spreads is slightly diminished in the shorter period. By contrast, external debt as a percentage of GDP now appears to have a larger influence on changes in average spreads. The impact of changes in the VIX appears largely unchanged, with only a marginally

[9] The adjusted R-squared value, which can range between 0 and 1, indicates that 78.6% of the variation in the dependent variable can be explained by changes in the independent variables.

smaller value of the coefficient for the 2010 – 2017 period compared to the larger 2006 – 2017 time period.

The most noticeable differences between the results of the two fixed effects models (Model 1 and Model 3, respectively) for the two time periods under consideration are found in the coefficient and significance values of the ratings dummy variables. The BBB+ variable has retained its negative coefficient. However, the coefficient now implies that, between 2010 and 2017, sovereigns with a rating of BBB+ enjoyed average spreads 8.75% lower than the remaining group, *ceteris paribus* (compared with 12.78% lower for the 2006 - 2017 period). The coefficient remains significant at the 1% level.

In contrast to the 2006 – 2017 period, the coefficients for both the BBB and BBB- ratings dummies are now significant, and at the 1% level. Furthermore, both coefficients now carry the expected (negative) sign. The coefficient of the BBB variable implies that over the 2010 – 2017 time period sovereigns with a BBB rating enjoyed spreads 9.96% lower than those with ratings from the remaining group, on average, *ceteris paribus*. The coefficient of the BBB- rating suggests that average spreads were 12.51% lower for nations holding this rating between 2010 and 2017, on average, *ceteris paribus*.

Crossing the investment-grade threshold, the coefficient of the BB+ dummy variable retains both its significance at the 1% level, as well as its negative sign. The influence of the coefficient is greater, however, and implies average spreads 15.11% lower than for the remaining group, *ceteris paribus*. In the shortened time period under consideration, this is the largest influence from any single rating dummy variable.

In contrast to the 2006 – 2017 time period, the coefficient of the BB ratings dummy is significant over the 2010 – 2017 period, at the 1% level, with spreads, on average, 11.15% lower for nations with a BB rating than for the rest of the sample, *ceteris paribus*. The coefficient of the BB- variable is no longer significant at conventional levels.

Towards the lower end of the ratings range, the coefficients of the B+ and B ratings remain significant, while the B- rating coefficient becomes insignificant at conventional levels. In addition, the impact of the two significant coefficients is smaller than in the former specification. The B+ coefficient implies average spreads that are 9.85% higher than for the remaining group, compared to 26.56% higher in the former model, ceteris paribus. Similarly, the impact of the B coefficient implies spreads 13.93% higher than previously, compared to 27.39% higher, *ceteris paribus.*

The adjusted R-squared of the fixed effects regression for 2010 – 2017 is noticeably higher than that of the longer time period, at 0.849267 vs. 0.786407. The p-value of the F-statistic indicates that the regression remains highly significant overall, i.e. at the 1% level.

5. Conclusions

Overall, the findings from the regression analysis conform to *a priori* expectations. Lower credit ratings appear to imply higher spreads, with the majority of coefficients across all models significant at conventional levels, similar to the results of Jaramillo and Tejada (2011) and Cantor and Packer (1996). Varying the time periods under consideration did not materially alter the general findings of the analysis, although changes in the size of individual coefficient impacts was observed. Interestingly, it appears that the point at which spreads begin to rise lies below the investment-grade/speculative-grade threshold, once differences in the included macroeconomic factors have been controlled for. In addition, given the differences in the magnitude of the impact from each ratings dummy variable coefficient, the influence of holding individual ratings on spreads differs at different points of the ratings scale. This is observed in Model 3 and Model 4, where the (negative) coefficient of the BB+ ratings variable is larger than the (also negative) coefficient of the higher ratings that precede it. In other words, the ratings themselves have a smaller impact on spreads at say BBB+ than at BB+. This may indicate investors' greater reliance on macroeconomic factors and global risk appetite as ratings worsen and sovereigns cross the investment-grade threshold. Given that Model 3 and Model 4 cover the period following the global financial crisis, this result is consistent with the notion that investors are basing their investment decisions on wider information than previously, particularly as ratings worsen.

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Hence, the above regression results suggest that for the sample and time period under consideration, crossing the threshold does not necessarily imply an increase in spreads. This phenomenon might be the result of investors relying on other information over and above sovereign ratings in order to assess the feasibility of a given investment, a possibility which was also raised in certain sections of the literature (González-Rozada and Levy-Yeyati, 2010, Sy, 2001). In effect, investors appear willing to tolerate the speculative-grade status of certain investments, provided that they remain confident of receiving the anticipated return on their investments.[10] However, below the BB rating, investors demand higher yields.

Given the events of the global financial crisis, the finding that investors prioritised additional metrics in order to make their investment decisions is unsurprising. As a result, the cost of sovereign debt does not appear to swing between two binary options. While investment-grade status largely seems to confer lower sovereign spreads, a speculative-grade rating does not necessarily appear to imply that the cost of sovereign debt will rise dramatically. This points to further nuances in market decision-making as concerns the pricing of sovereign debt that extend beyond simply looking at sovereign credit ratings.

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[10] This excludes those investors that are constrained by a mandate that compels them to invest exclusively in investment-grade debt.

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ANNEXURES

Annexure A: average ratings versus average spreads

A.1. Period 1 (2006 – 2008)

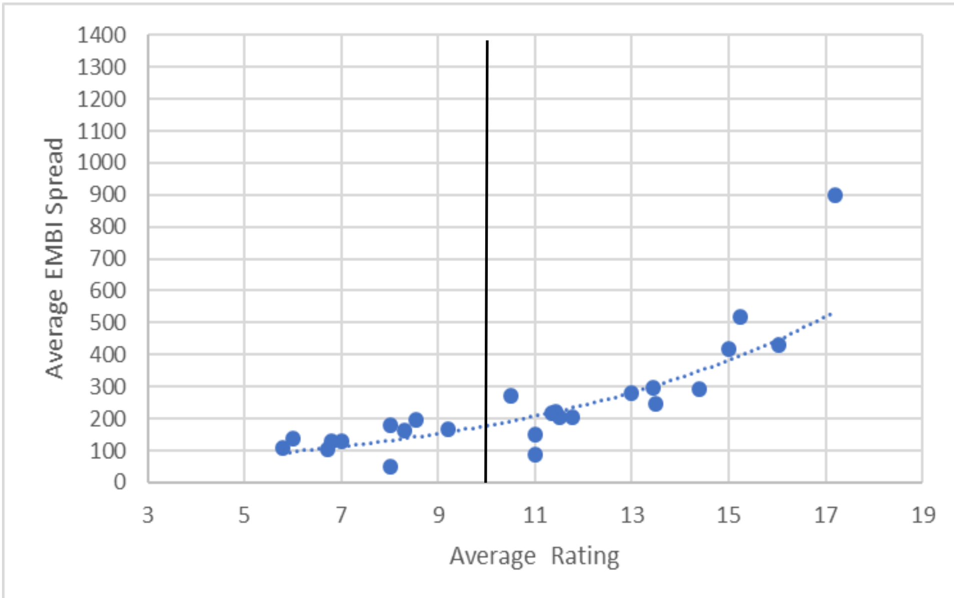


Figure A.1: EMBI Spreads vs Average Ratings, 2006 – 2008 (entire sample).
Source: Author's own calculations in Microsoft Excel. Spread data obtained from J.P. Morgan (2018).
Ratings data obtained from Standard and Poor's (2018) and Moody's Investor Services (2018).

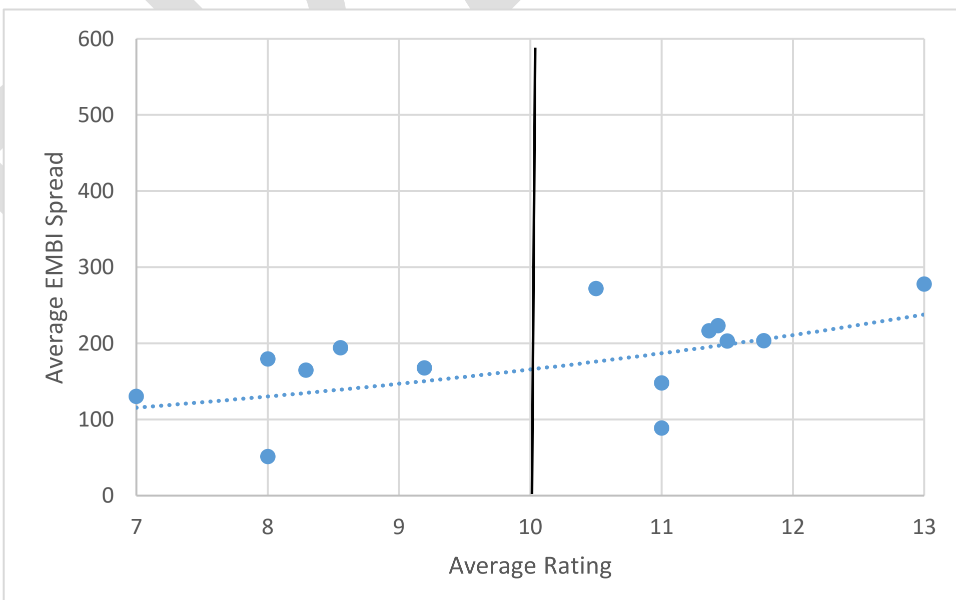
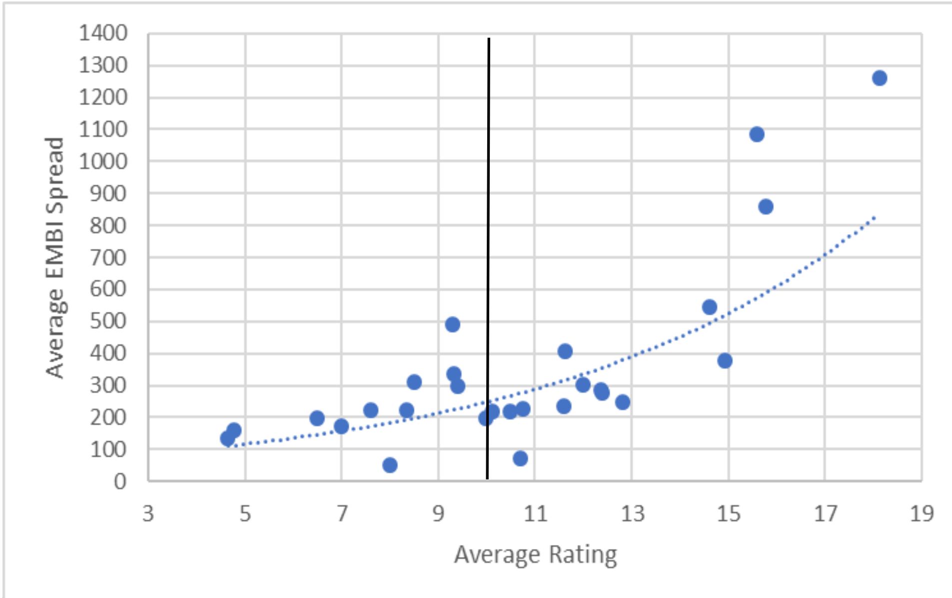


Figure A.2: EMBI Spreads vs Average Ratings, 2006 – 2008 (only countries rated A- to BB-).
Source: Author's own calculations in Microsoft Excel. Spread data obtained from J.P. Morgan (2018).
Ratings data obtained from Standard and Poor's (2018) and Moody's Investor Services (2018).

A.2.Period 2 (2009 – 2011)



Source: Author's own calculations in Microsoft Excel.
Spread data obtained from J.P. Morgan (2018).
Ratings data obtained from Standard and Poor's (2018) and Moody's Investor Services (2018.

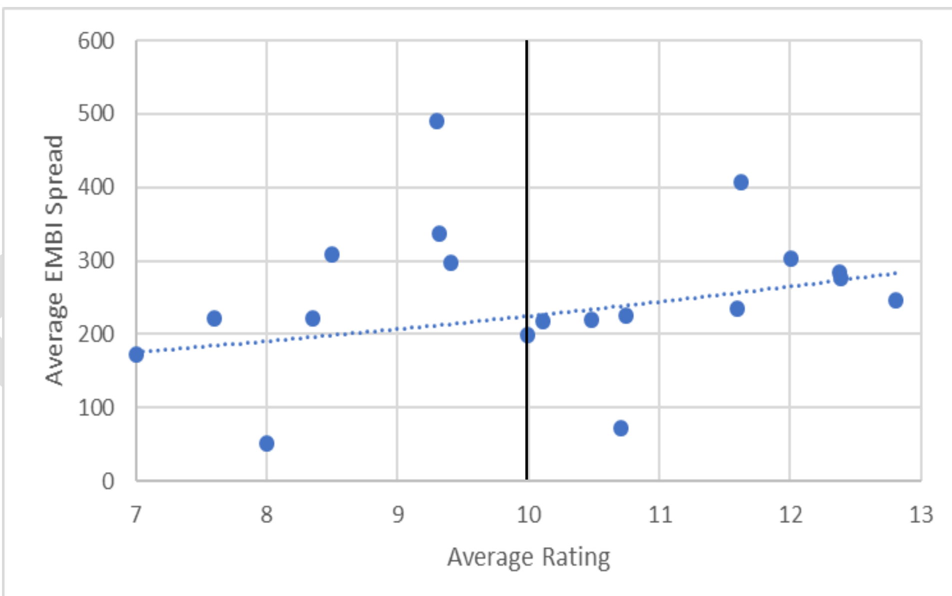
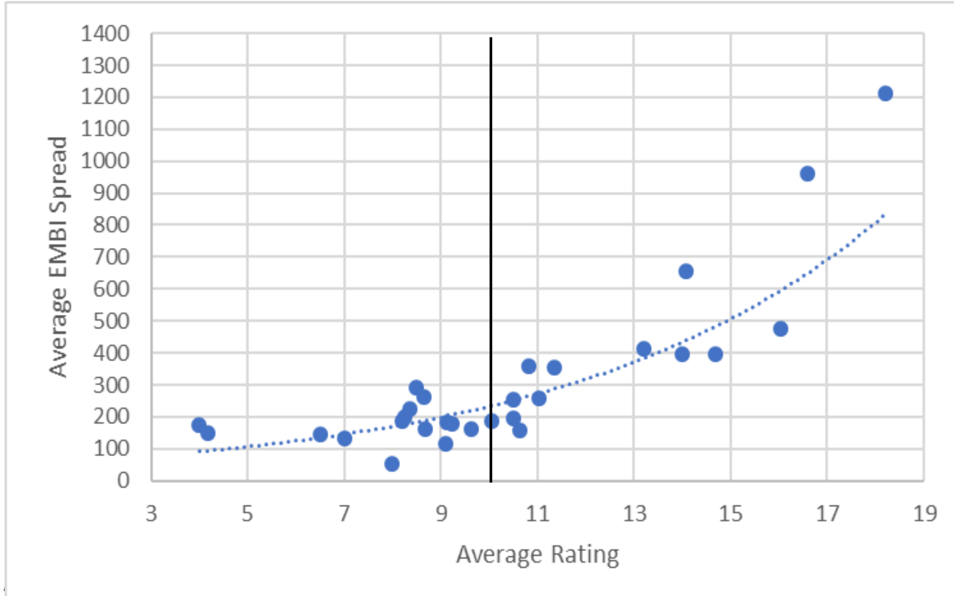


Figure A.4: EMBI Spreads vs Average Ratings, 2009 – 2011 (only countries rated A- to BB-).
Source: Author's own calculations in Microsoft Excel.
Spread data obtained from J.P. Morgan (2018).
Ratings data obtained from Standard and Poor's (2018) and Moody's Investor Services (2018).

A.3. Period 3 (2012 – 2014)



Source: Author's own calculations in Microsoft Excel.
Spread data obtained from J.P. Morgan (2018).
Ratings data obtained from Standard and Poor's (2018) and Moody's Investor Services (2018).

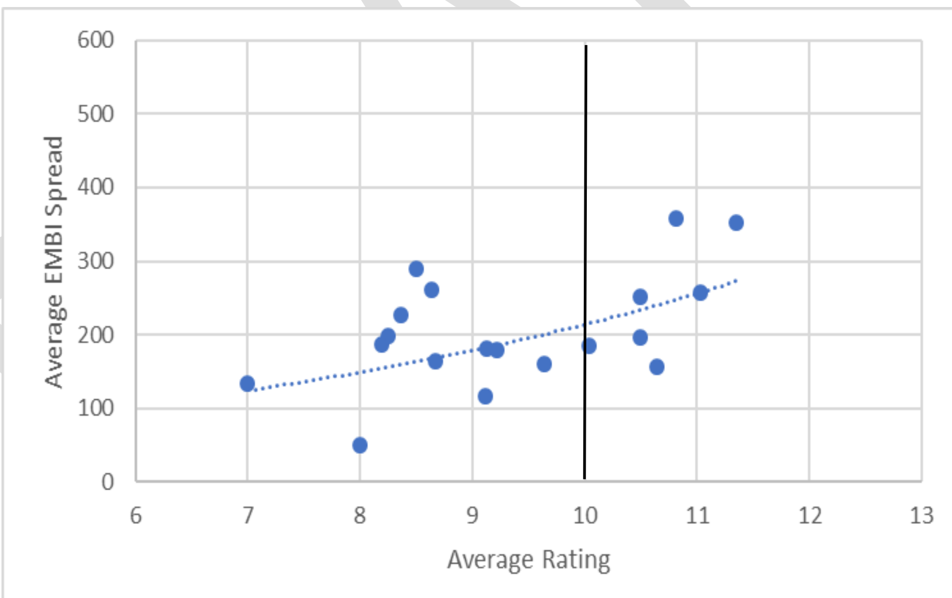


Figure A.6: EMBI Spreads vs Average Ratings, 2012 – 2014 (only countries rated A- to BB-).
Source: Author's own calculations in Microsoft Excel.
Spread data obtained from J.P. Morgan (2018).
Ratings data obtained from Standard and Poor's (2018) and Moody's Investor Services (2018).

A.4. Period 4 (2015 – 2017)

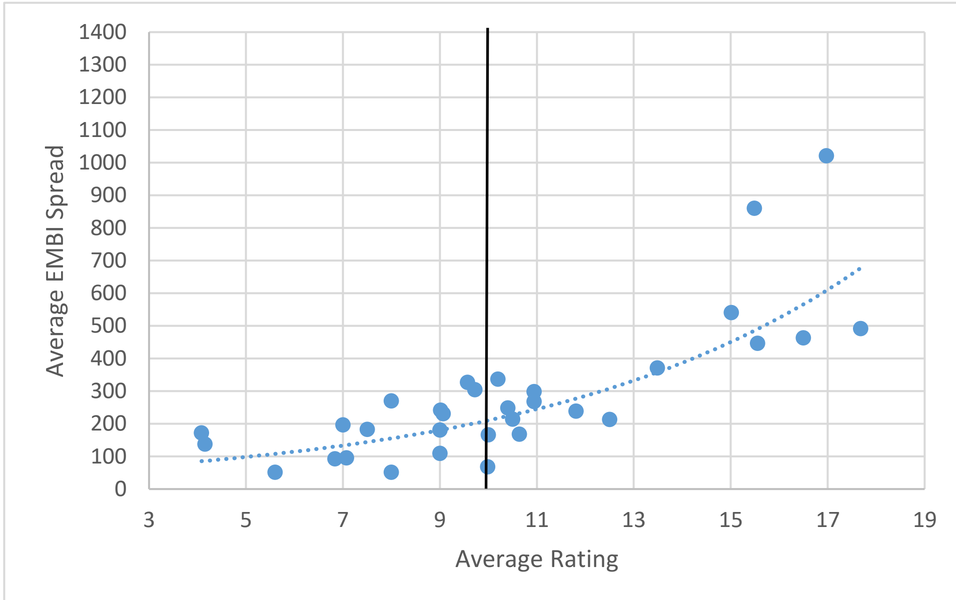


Figure A.7: EMBI Spreads vs Average Ratings, 2015 – 2017 (entire sample).
Source: Author's own calculations in Microsoft Excel. Spread data obtained from J.P. Morgan (2018).
Ratings data obtained from Standard and Poor's (2018) and Moody's Investor Services (2018).

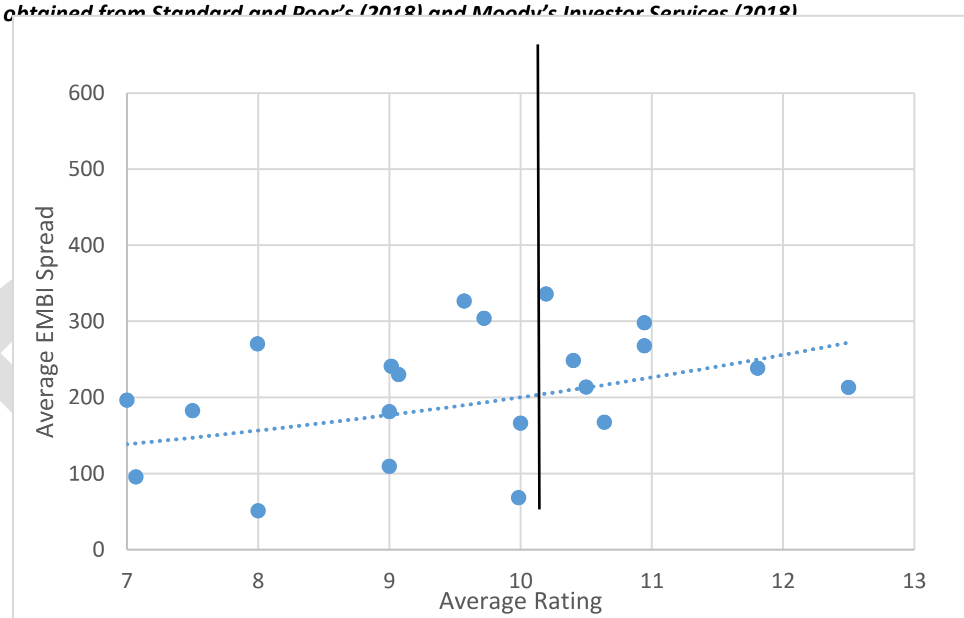


Figure A.8: EMBI Spreads vs Average Ratings, 2015 – 2017 (only countries rated A- to BB-).
Source: Author's own calculations in Microsoft Excel.
Spread data obtained from J.P. Morgan (2018).
Ratings data obtained from Standard and Poor's (2018) and Moody's Investor Services (2018).

Annexure B: cross section fixed and random effects

B.1. 2006 – 2017

Table B.1: Country Specific Coefficient Difference from Model Average (2006 – 2017).

Country	Cross-Section Fixed Effects (Var.)	Cross-Section Random Effects (Var.)
Argentina	0.872618	0.854838
Brazil	-0.075678	-0.066262
Bulgaria	-0.484224	-0.500105
Chile	-0.071019	-0.100205
China	0.153629	0.125505
Colombia	0.129188	0.123255
Dominican Republic	0.710648	0.681843
Ecuador	1.450723	1.413361
Egypt	-0.159857	-0.125642
El Salvador	0.350594	0.349789
Hungary	-0.619223	-0.580423
Indonesia	0.463999	0.440103
Lebanon	-0.672455	-0.578230
Malaysia	-0.372957	-0.364583
Mexico	0.127267	0.125654
Morocco	-0.686015	-0.660921
Panama	-0.235380	-0.224372
Peru	0.181701	0.162696
Philippines	-0.147970	-0.147148
Poland	-0.695203	-0.681024
Russia	0.545461	0.515660
South Africa	0.101555	0.101271
Thailand	-1.076486	-1.074519
Turkey	0.397297	0.381430
Uruguay	-0.189332	-0.171970

Source: Author's own estimations using Eviews 10.

B.2. 2010 – 2017

Table B.2: Country Specific Coefficient Difference from Model Average (2010 – 2017).

Country	Cross-Section Fixed Effects (Var.)	Cross-Section Random Effects (Var.)
Argentina	1.212887	1.129070
Brazil	0.324857	0.231317
Bulgaria	-1.017978	-0.928320
Chile	-0.323873	-0.309466
China	0.329425	0.246393
Colombia	0.171877	0.127237
Dominican Republic	0.725443	0.675752
Ecuador	1.527432	1.434850
Egypt	0.641637	0.545532
El Salvador	0.416503	0.422183
Hungary	-0.879421	-0.693010
Indonesia	0.553299	0.516469
Lebanon	-0.417335	-0.384413
Malaysia	-0.582391	-0.531402
Mexico	0.162373	0.129841
Morocco	-0.349066	-0.359555
Panama	-1.482805	-1.165442
Peru	0.155392	0.115727
Philippines	-0.014617	-0.060666
Poland	-0.962982	-0.899526
Russia	0.574027	0.527686
South Africa	0.147926	0.123682
Thailand	-1.117376	-1.131869
Turkey	0.545634	0.540172
Uruguay	-0.356476	-0.302242

Source: Author's own estimations using Eviews 10.

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