Debt and Sovereign Credit Ratings: Evidence from Panel Causality Tests

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Abstract

Much empirical work has been done on the determinants of sovereign credit ratings. As expected, the level of external debt was found to be one of the main determining factors. However, more often than not a country's credit rating can also influence the external debt level; a lower rating could raise the cost of borrowing, which, as external debt dynamics would dictate, could increase the level of external debt in periods ahead. This paper empirically explores the direction of causality between external debt stocks and credit ratings by the leading rating agencies. In so doing, panel causality tests are conducted for both developed and developing countries, controlling for GDP, the fiscal deficit and inflation. The results indicate that for the majority of countries in the panel there appears to be a bi-directional causal relationship between external debt and sovereign ratings.

JEL Classification:

Keywords: External public debt, sovereign ratings, panel data causality

Introduction

In the management of its external debt one of the concerns of or variables monitored by a government is its credit rating. There are several rating agencies, with the popular ones being Standards and Poor's' and Moody's, and they arrive at a country's rating after considering a number of factors. Such determining factors generally include per capita GDP, inflation rate, fiscal balance, current account balance, but most importantly the existing level of external debt.

The credit rating assigned to a country's debt instruments is one of the key considerations of lenders who are contemplating extending credit; it can determine whether or not loans are given, and terms and conditions attached, particularly the rate of interest. Credit ratings therefore have implications for interest costs and, by extension, the fiscal deficit, and can also be instrumental in determining future debt levels. Hence, there is a strong possibility of bi-directional causality between external debt and sovereign credit ratings.

This study aims to define the relationship between external debt and sovereign credit ratings for a set of 32 developed and developing countries. In so doing, three different panel causality tests - a pooled model (OLS in levels), the fixed effects (LSDV in levels) model and the differenced model (OLS – Differences) - are conducted over various lag lengths, controlling for GDP, the fiscal deficit and inflation. These homogenous and heterogeneous panel Granger causality techniques are preferred as opposed to time series Granger causality analysis, because they enhance the efficiency of the tests and allows for a greater number of observations and degrees of freedom (Hurlin and Venet, 2001).

In the next section there is a review of the existing literature on debt and sovereign ratings, and the relationships between them. The following section provides a description of the methodology and data used in the study. The results of the empirical analysis and their policy implications are presented in the fourth section. This is followed by some concluding remarks.

Brief Literature Review

Sovereign credit ratings are the risk assessments assigned by the credit rating agencies to the obligations of central governments. They are supposed to reflect the relative likelihood that a borrower will default on its obligations. As such, the ratings provide useful information to potential investors concerning the risk of governments defaulting on debt. In recent years, there has been an increased demand for and attention paid to sovereign credit ratings as more governments of developing countries, presumable where there are greater default risks, are borrowing in international capital markets. In addition, governments may also seek sovereign ratings in pursuit of wider objectives such as fostering deeper local capital markets, attracting foreign direct investment, and supporting private-sector access to the global capital markets. Governments may also request a rating in order to demonstrate fiscal transparency in their operations.

There are three main international rating agencies that provide sovereign credit ratings; Moody's, Standard & Poor's (S&P) and Fitch Ratings (see Table 1). These three agencies do not employ the same qualitative codes, though there is general correspondence between each agency rating level. Standard and Poor's and Fitch use a similar qualitative letter rating in descending order form AAA to CCC-, while Moody's system goes from Aaa to Caa3.

On the question of what determines sovereign credit ratings, Afonso et al (2007) conducts an extensive review of the literature and conclude that the differences in credit rating across countries can be explained by a relatively small set of variables. The authors grouped these explanatory variables in four categories: macroeconomic performance (per capita GDP, unemployment rate, inflation rate, real GDP growth), government performance (government debt, fiscal balance and government effectiveness), external balance (external debt, foreign reserves and current account balance) and other explanatory variables (default history, Economic Unions and regional dummies).

Table 1: Sovereign Credit Ratings

Moody's		Standard & Poor's		Fitch			
Long-term	**Short-term**	**Long-term**	**Short-term**	**Long-term**	**Short-term**		**Characterisation of debt**
Aaa		AAA		AAA		**Investment Grade**	Prime
Aa1		AA+		AA+			
Aa2		AA		AA			
Aa3		AA-	A-1+	AA-	F1+		High grade
A1		A+		A+			
A2	P-1	A	A-1	A	F1		
A3		A-		A-			Upper medium grade
Baa1	P-2	BBB+	A-2	BBB+	F2		
Baa2		BBB		BBB			
Baa3	P-3	BBB-	A-3	BBB-	F3		Lower medium grade
Ba1		BB+		BB+		**Speculative Grade**	Non-investment grade
Ba2		BB		BB			speculative
Ba3		BB-		BB-			
B1		B+		B+			
B2		B		B			
B3		B-	B	B-	B		Highly speculative
Caa1		CCC+					Substantial risks
Caa2		CCC					Extremely speculative
Caa3		CCC-					In default with little
		CC					prospect for recovery
Ca		C	C	CCC	C		
C				DDD			
/	Not			DD			
/	prime	D	/	D	/		In default

Afonso et al (2007) also expound on how the individual determinants are likely to impact on sovereign credit ratings. In general, any variable that leads to an improvement in a country's external position, macroeconomic performance or in its government fiscal operations will have a positive impact on its sovereign ratings. Similarly, countries with more favourable indicators in these areas would tend to have better credit ratings than those that do not. Thus, in the case of external debt, there is a negative relationship between a country's overall external indebtedness and its sovereign rating. This is

because higher debt levels usually means additional fiscal burdens and reduced fiscal space which, in tough economic times, may place pressure on government's ability to meet its debt obligations.

Methodology and Data

Methodology

The paper adopts a panel causality approach to examine the debt-ratings linkage. This technique is chosen because it exploits both cross-sectional and time series information to test the causality relationships, which, by utilising a larger number of observations, increases the degrees of freedom and reduces any collinearity among explanatory variables, and should lead to improved efficiency in the causality analysis (Holtz-Eakin *et al*., 1988 and Hurlin and Venet, 2001).

In this regard, there are basically two approaches to examining causality within a panel framework. The first, popularised by Holtz-Eakin *et al*. (1988), Weinhold (1996) and Nair-Reichert and Weinhold (2001), allows the autoregressive coefficients and regression coefficients slopes of the panel to vary. This reduces significantly the degrees of freedom and relies on the 'large time dimension' assumption to derive consistent estimates. The second, suggested by Hurlin and Venet (2001) and Hurlin (2004) treats these coefficients as constant and is perhaps more appropriate for the current data set. The procedure, which is detailed in Hurlin (2004), is summarised below.

Consider the following time-stationary bi-variate vector auto-regression (VAR) representation in panel form for *N* countries over *T* time periods:

$$y_{i,t} = \alpha_i + \sum_{k=1}^{p} \beta_{i,k} y_{i,t-k} + \sum_{k=1}^{p} \phi_{i,k} x_{i,t-k} + \varepsilon_{i,t} \qquad (1)$$

where the individual effects α_i are presumed fixed. It is assumed that the autoregressive coefficients β_k and the regression coefficients Φ_k's are constant for $k \in [1, N]$ and the parameters β_k are identical for all individuals, while the coefficients Φ_k could have individual dimensions. Hence, it is a fixed coefficients model with fixed individual effects. In addition, suppose that the lag orders *k* is identical for all cross-section units of the panel and the panel is balanced. Hurlin (2004) argues that causality testing in this framework also needs to take in consideration the different sources of heterogeneity between the individual units. The first source of heterogeneity is caused by permanent cross-sectional disparities. Estimating the model and ignoring heterogeneous intercepts could lead to a bias of the slope estimates and fallacious inferences about causality. The other source of heterogeneity relates to the regression coefficients Φ_k. Again, the imposition of homogeneity on Φ_k when its true nature is heterogeneous can lead to erroneous conclusions.

Consequently, the following procedure is recommended for causality analysis within the panel framework[2]. First, homogenous and instantaneous non-causality (*HINC*) is checked. This is based on the following Wald test that determines whether or not the Φ_k's are simultaneously zero for all individuals *i* and all lags *k:*

$$F_{HINC} = \frac{(SSR_r - SSR_u)/Np}{SSR_u/\left[NT - N(1+p) - p\right]}$$

where SSR_u is the sum of squared residuals from Equation 1 and SSR_r is the restricted sum of squared residuals under null hypothesis that Φ_k is zero for all *i* and *k*. If it is not significant (note that F_{HINC} does not follow a standard distribution when T is small, however, Hurlin (2004) provides the exact critical values), the *HINC* hypothesis is accepted. This result implies that the variable *x* is not causing *y* in all the countries of the sample. Hence, the non-causality result is then totally homogenous and the testing procedure goes no further.

[2] Hurlin and Venet (2001) contains an exposition of the various causality tests and their sample properties.

If the *HINC* is rejected then two possibilities exist. The first is that there is a causal relationship between the two variables for each country and that this relationship is identical for all countries in the sample. This is termed homogenous causality (*HC*) and occurs if all the coefficients on the explanatory variable are not significantly different across countries, for all lags, and are statistically different from zero. In other words, the test is whether the Φ_k's are identical, which is formally a test of $H_0 : \phi_{i,k} = \phi_{j,k} \ \forall i, j \in [1, N], \forall k \in [0, p]$ against $H_1 : \phi_{i,k} \neq \phi_{j,k} \ \exists (i, j, k)$. *HC* is rejected if the Wald statistic given by $F_{HC} = \frac{(SSR_r^{'} - SSR_u)/[(N-1)p]}{SSR_u / [NT - N(1+p) - p]}$ is significant (again, the critical values are provided in Hurlin (2004)), where $SSR_r^{'}$ is the residual sum of squares obtained from Equation 1 under H_0.

If the *HC* hypothesis is rejected then the second (but more plausible) hypothesis is that the causal relationships differ across countries. In other words, the check is whether or not the coefficients on the explanatory variable are significant for each country. This is referred to as heterogeneous non-causality (*HENC*) and is the test of $H_0 : \phi_{i,k} = 0 \ \forall i \in [1, N], \forall k \in [0, p]$ against $H_1 : \phi_{i,k} \neq 0 \ \forall i \in [1, N], \forall k \in [0, p]$; whether all the coefficients of the lagged explanatory variable for the individual country are equal to zero or not. The corresponding statistic for this is given as $F_{HC} = \frac{(SSR_r^{''} - SSR_u)/p]}{SSR_u / [NT - N(1+2p) - p]}$ where $SSR_r^{''}$ is the residual sum of squares from Equation 1 under the hypothesis that the *k* coefficients are equal to zero only for country *i*.

To check for the robustness of the results to model misspecification, the causality test equations are also augmented with other macroeconomic variables that could influence the evolution of debt and sovereign ratings. Consequently, economic growth measured as the percent change in gross domestic product (GDP), inflation, fiscal balance and per capita income are included in the test equations as control variables.

Data

To arrive at consistent data set countries has been reduced to 32 and estimated over the annual period 1998 to 2008. After the conference a concerted effort would be made to improve the data set.

Long- and short-term, foreign currency and local currency ratings were sourced from Standard and Poor's(S&P) website. For use in the analysis, ratings in each scale are numbered in descending order, with the highest number assigned to the symbol at the top of the scale, and the number "1" designated to the symbol at the bottom of the scale. In some instances, sometimes because of insufficient information, S&P is unable to provide a rating; in such cases, a "0" is assigned.

The external debt data, expressed as a percentage of exports of goods, services and income, was obtained from the World Bank's (WB's) World Development Indicators (WDI). Also sourced from the WB's WDI were per capita income (in current US dollars) and the fiscal balance, given as the cash surplus/deficit as a percentage of GDP. The other variables – gross domestic product (GDP) growth (percentage change in GDP volume) and inflation (percentage change in the consumer price index) – were extracted from the IMF's International Financial Statistics database.

Empirical Results

Table 2 provides the **Homogenous and Instantaneous Non-Causality (**HIC) results with no controls for the influence of other possible exogenous variables. Test statistics are given for lags 1 to 3 as well as three different estimation approaches - a pooled model (OLS in levels), the fixed effects (LSDV in levels) model and the differenced model (OLS – Differences). The pooled model assumes that the intercept (α) and slope coefficients (γ and β) do not vary across countries, while LSDV in levels allows the intercept to vary for each country. The differenced model utilizes the same assumptions as the pooled model but employs the first differences of the variables in the model. If the test statistics are significant they suggest that the null of no causality

cannot be accepted. Except for the differenced model (OLS – Differences) where LCST and FXST does not appear to cause external debt, in general, the test statistics across the three estimation approaches used and the lag lengths all suggest that the null of no homogenous and instantaneous causality between external debt and sovereign ratings, or from sovereign ratings to external debt cannot be accepted at conventional significant levels. In other words, there appears to be a bi-directional causal relationship between external debt and sovereign ratings.

Table 3 shows that these results are robust to the inclusion of controls variables that capture the effects of per capita income, inflation and GDP growth rate on external debt and sovereign ratings. Given that there is evidence of causality between these two variables, the authors then investigate whether the causality is sourced from heterogeneous causal relationships for each country (see Tables 4 and 5).

To identify the source of this heterogeneity, Equation (1) is re-estimated, but the β_{ik}'s are allowed to differ for each country, and the HENC hypothesis is then evaluated for each country. The F-statistics are provided in Table 5. The results show that there is a bi-directional relationship between sovereign ratings and external debt in 26 of the 32 countries studied; the other 6 - BOLIVIA, BRAZIL, INDIA, PAKISTAN, PERU, and URUQUAY - reveals no causality between external debt and sovereign ratings

Table 2 Homogenous and Instantaneous Non-Causality Tests (No controls)

	Lags	OLS	LSDV	OLS –
$EDEBT \rightarrow LCLT$	1	22.32***	-4.82***	-2.40***
	2	21.00***	-5.31***	-2.53***
	3	19.85***	-4.21***	-0.39
$EDEBT \rightarrow LCST$	1	23.04***	-4.24***	-4.06***
	2	21.74***	-4.64***	-1.67
	3	20.69***	-3.83***	-0.26
$EDEBT \rightarrow FXLT$	1	22.31***	-7.08***	-2.94***
	2	21.06***	-7.28***	-2.81***
	3	19.96***	-5.26***	-0.13
$EDEBT \rightarrow FXST$	1	23.94***	-3.64***	-2.87***
	2	22.61***	-3.68***	-0.46
	3	21.27***	-2.80***	-0.34
$LCLT \rightarrow EDEBT$	1	23.12***	-0.97	-1.13
	2	22.81***	2.08**	0.90
	3	22.22***	5.20***	1.72*
$LCST \rightarrow EDEBT$	1	23.82***	-0.64	-0.58
	2	23.41***	1.63	-0.11
	3	22.76***	4.26***	1.04
$FXLT \rightarrow EDEBT$	1	23.01***	-3.38***	-2.00**
	2	22.85***	0.019	0.51
	3	22.37***	3.23***	1.24
$FXST \rightarrow EDEBT$	1	24.26***	-1.69*	-1.38
	2	24.02***	0.422	0.95
	3	23.23***	1.69*	0.44

Table 3 Homogenous and Instantaneous Non-Causality Tests (With controls for the effects of Inflation, Per capita income and GDP growth rate)

	Lags	OLS	LSDV	OLS – Differences
$EDEBT \rightarrow LCLT$	1	21.74***	-4.79***	-2.38**
	2	20.46***	-5.32***	-2.51**
	3	19.37***	-4.09***	-0.44
$EDEBT \rightarrow LCST$	1	22.62***	-4.00***	-4.06***
	2	21.38***	-4.56***	-1.63
	3	20.43***	-3.68***	-0.29
$EDEBT \rightarrow FXLT$	1	21.75***	-7.14***	-2.93***
	2	20.55***	-7.36***	-2.79***
	3	19.52***	-5.00***	0.16
$EDEBT \rightarrow FXST$	1	23.37***	-3.74***	-2.85***
	2	22.13***	-3.70***	-0.41
	3	20.89***	-2.58**	-0.35
$LCLT \rightarrow EDEBT$	1	22.56***	-1.07	-1.13
	2	22.29***	2.03**	0.95
	3	21.70***	6.20***	1.84*
$LCST \rightarrow EDEBT$	1	23.45***	-0.66	-0.58
	2	23.08***	1.59	-0.07
	3	22.39***	4.81***	1.09
$FXLT \rightarrow EDEBT$	1	22.45***	-3.57***	-2.02**
	2	22.33***	-0.05	0.63
	3	21.85***	4.36***	1.51
$FXST \rightarrow EDEBT$	1	23.68***	-2.01**	-1.41
	2	23.42***	0.35	1.08
	3	22.61***	2.45**	0.62

Table 4 Heterogeneous Granger Causality Tests

Country	$EDEBT \rightarrow LCLT$	$EDEBT \rightarrow LCST$	$EDEBT \rightarrow FXLT$	$EDEBT \rightarrow FXST$
ARG	-2.80***	-2.09**	-2.85***	-1.93*
BGR	4.29***	3.90***	4.31***	4.15***
BOL	-1.47	-1.46	-1.51	-1.09
BRA	-0.54	-0.94	-0.92	-0.61
CHL	6.65***	7.00***	5.66***	6.98***
COL	2.65***	2.22**	1.72*	1.53
CRI	6.75***	5.39***	6.69***	6.37***
DOM	4.14***	5.24***	4.56***	6.17***
EGY	4.07***	3.82***	3.81***	3.27***
IDN	0.49	0.21	-0.03	0.78
IND	4.04***	3.21***	4.05***	3.84***
JAM	2.47**	3.19***	2.59**	3.91***
JOR	4.87***	4.29***	3.68***	3.66***
KAZ	3.93***	3.51***	3.91***	3.89***
LTU	7.66***	7.93***	8.12***	9.14***
LVA	3.29***	3.28***	3.55***	3.86***
MAR	4.48***	3.68***	3.50***	3.08***
MEX	8.18***	8.14***	7.0***	7.08***
MYS	11.96***	12.06***	11.25***	11.45***
PAK	-0.17	-0.27	-0.69	0.25
PER	0.092	-0.46	-0.26	-0.14
PHL	4.63***	4.11***	3.78***	3.64***
POL	6.39***	6.43***	6.25***	6.88***
PRY	2.50**	2.82***	2.11**	2.93***
ROM	4.78***	4.25***	4.72***	4.85***
RUS	4.16***	3.78***	4.18***	4.47***
SLV	4.66***	3.60***	5.17***	4.36***
THA	8.09***	8.21***	7.19***	7.93***
TTO	2.08**	2.15**	1.75*	2.16**
TUN	6.11***	5.88***	5.16***	4.89***
URY	0.07	2.41**	0.14	0.64
ZAK	10.28***	10.30***	9.06***	9.44***

Table 5 Heterogeneous Granger Causality Tests (With controls for the effects of Inflation, Per capita income and GDP growth rate

Country	$LCLT \rightarrow EDEBT$	$LCST \rightarrow EDEBT$	$FXLT \rightarrow EDEBT$	$FXST \rightarrow EDEBT$
ARG	4.32***	4.95***	4.90***	4.45***
BGR	-4.12***	-2.39**	-2.66***	-2.24**
BOL	-1.03	0.99	0.29	0.93
BRA	-1.94*	0.25	-0.28	0.24
CHL	-5.97***	-4.16***	-4.01***	-3.46***
COL	-4.25***	-2.29**	-2.16**	0.94
CRI	-5.74***	-3.56***	-4.22***	-3.24***
DOM	-3.34***	-2.86***	-3.20***	-2.90***
EGY	-5.57***	-3.99***	-3.79***	-.2.66***
IDN	-2.11**	-0.28	-0.39	-0.38
IND	-5.33***	-3.18***	-3.52***	-2.54**
JAM	-3.04***	-1.81*	-1.69*	-1.03
JOR	-5.38***	-3.50***	-3.37***	-2.40**
KAZ	-3.31***	-1.21	-1.80*	-1.21
LTU	-5.63***	-3.78***	-3.91***	-3.29***
LVA	-3.42***	-1.40	-1.84*	-1.01
MAR	-5.64***	-3.60***	-3.67***	-2.67***
MEX	-6.04***	-4.21***	-4.04***	-3.25***
MYS	-7.07***	-5.23***	-5.23***	-4.43***
PAK	-1.70*	-0.11	0.51	-0.14
PER	-2.99***	-0.74	-1.31	-0.33
PHL	-5.23***	-3.49***	-3.31***	-2.056**
POL	-5.59***	-3.83***	-3.79***	-3.10***
PRY	-4.36***	-2.83***	-2.50**	-1.90*
ROM	-3.65***	-1.73*	-2.05**	-1.76*
RUS	-4.06***	-2.49**	-2.31**	-2.44**
SLV	-4.94***	-3.01***	-3.25***	-2.00**
THA	-6.71***	-4.77***	-4.85***	-4.13***
TTO	-3.48***	-1.73*	-1.71*	-1.14
TUN	-5.41***	-3.36***	-3.43***	-2.46**
URY	-1.48	-1.43	0.13	0.53
ZAK	-6.57***	-4.74***	-4.71***	-3.91***

Conclusion

This paper investigates the causal relationship between sovereign rating and external debt for 32 countries over the period 1998-2009. Specifically, it addresses the question as to whether or not the rating assigned to a sovereign government's capacity and willingness to service its debt obligations in full and on time impacts on the actual level of debt. To the best of our knowledge no research has been conducted in this area but has tended to focus on the impact on currency and debt crises. Nonetheless, it is an important area because the credit rating assigned to a country's debt instruments is one of the key considerations of lenders who are contemplating extending credit and therefore has implications for interest costs and, by extension, the fiscal deficit, and can also be instrumental in determining future debt levels.

The findings from panel causality analysis show that there is a bi-directional causal relationship between sovereign ratings and external debt in 26 of the 32 countries studied. These results hold even after we control for the effects of per capita income, inflation and GDP growth rate on external debt and sovereign ratings. One implication of these results is that the downgrading of a country's sovereign rating, particularly in tough times when a country may need to secure additional debt, can actually exacerbate the debt problem. Not only will the cost of hedging against losses on the country's debt rise but the downgrade means some institutional investors will no longer be allowed to buy the country's debt under the terms of their investment mandate and could lead to still higher borrowing costs.

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Appendices