Inflation volatility, financial institutions and sovereign debt rating

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Abstract

This study analyzes the impact of reducing inflation volatility versus the impact of improving financial institutions with regard to the country's sovereign debt rating. An empirical analysis of the impact of inflation, inflation volatility and financial institutions on a country's sovereign debt rating is undertaken using a sample of 37 developed and developing countries over the period 1989–2006. The study estimates a non-linear rating regression that interacts inflation volatility with an index for financial institutions developed in this paper using the principal component analysis. The results suggest that reducing inflation volatility can have a statistically and economically significant positive effect on a country's sovereign debt rating as compared to the level of inflation. The results also show that improving financial institutions has a statistically and economically significant positive direct and indirect effect on a country's sovereign debt rating. A decrease of one standard deviation in inflation volatility leads to an increase of about two classifications in a country's sovereign debt rating. The increase in sovereign debt rating leads to a reduction in the average annual long-term bond yield by about 4.4%. On the other hand, an increase of one standard deviation in the financial institutions' index leads to an increase in the ratings class of about one class, which in turn reduces the average annual long-term bond yield by about 4.27%.

JEL classification*:* O16; O43; N20
Keywords**:** Institutions; Inflation; Inflation Volatility; Sovereign Debt Rating; Bond Yield

Introduction

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This paper attempts to investigate the impact of inflation volatility versus financial institutions on a country's sovereign debt rating. Any decrease in inflation volatility or any improvement in institutions tends to lead to a higher rating classification in a developing economy. As the rating increases, the cost of borrowing decreases and the economy can make use of cheap credit. Such an economy accumulates more capital and, therefore, its output increases.

This study contributes to the sovereign debt rating literature by demonstrating that the negative impacts of high inflation volatility influence a country's sovereign debt rating more than the negative impacts of high levels of inflation. Once the volatility of inflation is included in the regression, the level of inflation turns insignificant. In addition, the study shows that improving financial institutions has a statistically significant positive direct and indirect effect on sovereign debt rating; the indirect effect occurs through a positive interaction with inflation volatility which helps to reduce the negative impacts of inflation volatility on the sovereign debt rating.

Despite the importance of inflation volatility and financial institutions to sovereign debt rating, the economic literature on the determinants of sovereign debt rating has mostly ignored the role played by these two factors. The literature on sovereign debt rating has mainly categorized the sovereign debt rating determinants into four main groups: (a) liquidity and solvency variables; (b) macroeconomic variables; (c) external shock variables; and (d) dummy variables. The liquidity and solvency variables usually include ratios of debt to GDP, international reserves to GDP, debt service to exports and the current account to GDP. The macroeconomic variables usually include real growth, inflation rate, fiscal balance and real exchange rate; the external shock variables usually include international interest rates; and finally, the dummy variables usually include those variables that reflect economic crises and other structural problems.[2]

For instance, using an ordinary least squares (OLS) analysis on pooled data for 35 developed and developing countries, Cantor and Packer (1996) studied the effect of the level of inflation in addition to other macroeconomic variables and a dummy variable for the country's default history. Their study finds that both inflation and the ratio of foreign currency external debt to exports have a negative statistical significant effect on rating while both per capita income and GDP growth have a positive significant effect.

Using a stepwise procedure, Haque et al (1998) tested the importance of macroeconomic determinants versus political determinants in affecting a country's credit worthiness. The study finds that inflation has a statistically significant negative impact on the country's credit worthiness, using both the credit worthiness rating provided by institutional investors and Euro money.

Afonso (2003) applied the same methodology as in Cantor and Packer (1996) to a sample of 81 developed and developing countries, except that he used both the linear and logistic transformation of the rating. In line with Cantor and Packer (*op. cit.*), the study shows a statistically significant negative effect of inflation on sovereign debt rating.

[2] Min (1998) provides a good literature review on these four groups.

Since the determinants of sovereign debt rating tend to be similar to those of the spreads, being that both are measures of risk, the literature on the spreads is also relevant. For instance Min (1998) analyzes the determinants of yield spread of US dollar-denominated fixed income securities using panel least squares methodology on 11 countries over the period 1991–1995. The results emphasize the importance of macroeconomic fundamentals, including inflation − if a country were to gain access to the international bond market. Similarly, Eichengreen and Mody (1998) and Kamin and Kleist (1999) stress the importance of "market sentiment," in addition to country-specific fundamentals and external factors, to explain variations in sovereign spreads in emerging markets.

Using a panel least squares regression estimation for a sample of 16 emerging countries, Rowland and Torres (2004) studied the macroeconomic determinants of spread for the US Treasuries of emerging market sovereign issues and the issuers' credit worthiness based on the institutional investor credit worthiness index. Although the authors used the same macroeconomic determinants for both the spread and the credit worthiness regressions, their results show that inflation significantly affects the credit worthiness of the issuing country, but it does not have a significant effect on the spread.

Bissoondoyal-Bheenick, Brooks, and Yip (2005) made a study of the determinants of sovereign debt rating using two different approaches: (a) ordered probit and (b) case-based reasoning. Their results show that inflation and GDP appear to be the most significant macroeconomic variables, following the significance of the proxy for technological development. Similarly, using an OLS regression framework, Rowland (2005) finds that inflation is one of six macroeconomic variables that significantly affect credit ratings, credit worthiness and spreads.

Finally and more recently, using panel regression estimation for 27 emerging countries, Remolona, Santigna, and Wub (2007) find that inflation is one among many other variables that have a significant effect on their constructed measure of sovereign default risk which they call Rating-Implied Expected Loss (RIEL).[3] The results are confirmed with another measure of country risk, namely average agency rating.

Unfortunately, the literature on the impact of macroeconomic policy volatility in general, and of inflation volatility in particular, on sovereign debt rating, is quite sparse. For instance, Eaton and Gersovitz (1981) investigate the impact of macroeconomic volatility on sovereign default risk. Their study concludes that in the presence of unexpected adverse shocks, a positive relation exists between the volatility of macroeconomic aggregates and default.

Using the logit estimation technique, Catao (2002) tested whether macroeconomic volatility helps explain the variation in sovereign default probability. His paper distinguishes between externally induced volatility and policy-induced volatility. Using a sample of 25 emerging economies over the period 1970–2001, he concludes that there is a positive relation between macroeconomic volatility and sovereign default.

[3] The RIEL is measured with the agency credit rating and the historical default risk. As mentioned in their paper, it decomposes the spread into a risk component and a risk premium component.

Despite the growing body of literature on the importance of institutions to a country's long-term economic growth, to the best of our knowledge, there are only two studies on the impact of institutions on sovereign debt rating. Using the Two-Stage Least Squares (TSLS) on a sample of 86 developed and emerging countries, Butler and Fauver (2006) investigated the effect of legal and political institutions, in addition to macroeconomic variables and the level of inflation on the sovereign debt rating measured by the institutional investor.[4] They report that inflation, besides other macroeconomic variables, has a statistical significant effect on rating. Adding a composite index representing the effect of the legal environment, the study finds that legal environment is the most influential variable in their regression.

More recently using linear and ordered response models, Afonso, Gomes, and Rother (2011) studied the short- and long-run determinants of sovereign debt ratings from three main rating agencies, for the period 1995-2005. Their study shows that short-run determinants include the changes in GDP per capita, GDP growth, government debt and government balance. ON the other hand, long-run determinants include government effectiveness, external debt, foreign reserves and default history.

Against the above background, using a sample of 37 developed and developing countries over the period 1989–2006, this study extends the previous literature on sovereign rating in several ways. Firstly, it empirically tests the role of inflation volatility alongside the role of the inflation level to explain variations in the sovereign debt rating. Secondly, it empirically tests the direct and the indirect role of financial institutions in determining sovereign debt rating. Thirdly, it computes the total effect of a one standard deviation reduction in inflation volatility, as compared to the total effect of a one standard deviation improvement in the financial institutions' index. Finally, this study links the changes in sovereign debt rating to the changes in annual long-term average annual bond yield.

Empirical Specification

The TSLS methodology with regional dummies and period fixed effects is used to estimate the determinants of sovereign debt rating for the sample of 37 developed and developing countries over the period 1989–2006. Using three-year period averages, there are six periods to work with.

Equation 1 represents the base model of the estimation:

$$Sov_{i,t} = \beta_0 + \beta_1 Sov_{i,t-v} + \beta_2 CV_{i,t} + \beta_3 Infvol_{i,t} + d_t + \varepsilon_{i,t} \ . \qquad \text{(Equation 1)}$$

[4] The paper uses the governance indicators provided by the World Bank database and measured by Kaufman, Kraay and Mastruzzi (2003). These governance indicators include the voice of the people, political stability, government effectiveness, regulatory quality, rule of law and corruption control. In addition, the authors developed a composite index for these six indices.

The subscripts *i* and *t* represent the country and the time period, respectively. The variable $Sov_{i,t}$ is the Moody's sovereign debt rating. The set of explanatory variables consists of $Sov_{i,t-\upsilon}$, which represents the first lag of the sovereign debt rating, and $CV_{i,t}$ which represents the set of control variables that are measured as an average over period υ, where υ= 3. This set of control variables includes the average level of inflation, the average ratio of private domestic credit to GDP, the average ratio of per capita GDP and three regional dummies for Latin American countries, Asian countries and African and Middle Eastern countries: D_L, D_A, and D_{AM} respectively[5]. $Infvol_{i,t}$ represents the average log of inflation volatility over the three-year period. Finally, d_t represents the time period dummies.

It is worth noting that additional variables were considered for the model, but were excluded due to their statistically insignificant coefficients. These variables included the current account as a percentage of GDP, the log of the nominal GDP, unemployment as a percentage of the labor force and the total reserves minus gold. Their statistical insignificance is probably due to the high correlation between the variables. For example, the current account is highly correlated with the total reserves minus gold. Likewise, the nominal GDP is highly correlated with the per capita GDP. Equation 1 constitutes the base of a parsimonious model that estimates the relations of interest for the purposes of this study.

The base model is expanded to include a term for the interaction of inflation volatility with the Chinn and Ito (2005) index of financial institutions called LEGAL2. The index is estimated using a principal component analysis of four indices: (a) protection of creditors' rights; (b) protection of shareholders' rights; (c) transparency of companies' accounts; and (d) enforcement of laws . The data on these four indices are time invariant and are collected from La Porta *et al.* (1998).

The objective of including the interaction term is to estimate the indirect effect of financial institutions on the relation between inflation volatility and sovereign debt rating. The interaction term is estimated by adding $\beta_4(L2_i * Infvol)$ to the right-hand side of Equation 1 where $L2_i$ represents the Legal2 Index for country *i*.

After adding the interaction term to Equation 1, the new model is shown below:

$$Sov_{i,t} = \beta_0 + \beta_1 Sov_{i,t-\upsilon} + \beta_2 CV_{i,t} + \beta_3 Infvol_{i,t} + \beta_4(L2_i * Infvol_{i,t}) + d_t + \varepsilon_{i,t} \quad \text{(Equation 2)}$$

It is important to note that the estimation of Equation 2 is crucial to computing the total effect of inflation volatility on sovereign debt rating. This total effect is computed by adding up the estimated coefficient of inflation volatility $\hat{\beta}_3$ to the estimated coefficient of the interaction

[5] To avoid the dummy variable trap, the dummy that represents countries in the Organization for Economic Cooperation and Development (OECD) is omitted, but its effect is picked up by the intercept β_0 .

term $\hat{\beta}_4$ where this later coefficient is multiplied by the $L2_i$ index. Thus, the total effect of inflation volatility is equal to $\hat{\beta}_3 + \left(\hat{\beta}_4 * L2_i\right)$ in Equation 2.

Additionally, when Equation 2 is augmented by $\beta_4(L2_i * Infvol_{i,t})$ to represent the indirect effect of financial institutions, the variable $L2_i$, or the direct effect of financial institutions, is included in the set of instruments of the TSLS.

Next, the total effect of a one standard deviation change in the Legal2 Index is computed by adding $L2_i$ to Equation 2 as shown in Equation 3. The total effect of Legal2 Index is be calculated as $(\hat{\beta}_4 * Infvol_{i,t} + \hat{\beta}_5)$.

$$Sov_{i,t} = \beta_0 + \beta_1 Sov_{i,t-\upsilon} + \beta_2 CV_{i,t} + \beta_3 Infvol_{i,t} + \beta_4(L2_i * Infvol_{i,t}) + \beta_5 L2_i + d_t + \varepsilon_{i,t} \quad \text{(Equation 3)}$$

Data

The data set is constructed as a panel of country observations from the World Development Indicators of the World Bank's database. The data set includes 37 developed and developing countries over the period 1989-2006. The data set is averaged into three-years time periods and thus, is available for six-time series observations for each country. The list of countries included in the sample is reported in Table 1 and the data on the dependent and independent variables are plotted in Figure 2 of the Appendix.

The data on the sovereign debt rating, or the dependent variable, is collected from the Moody's sovereign debt ratings [6]. It is worthwhile to note that there are two other alternative sovereign debt-rating measures provided by Standard and Poor (S&P) and Fitch, Inc. as revealed in Gaillard (2009). These three measures are very similar in terms of their rating scale, where both Moody's and S&P's have 23 rating categories and Fitch's has 24, with a higher scale, implying higher values.

Following the literature that started with Horrigan (1966) through Billet (1996), Cantor and Packer? (1996) and more recently, Gaillard (2009), the paper assigns numerical values to the Moody's letter ratings as follows: C = 1, Ca = 2, and so on through Aaa =23. A complete list of the ratings and the assigned numerical values are available in Table 13 of the Appendix.

The sovereign debt rating indicates the capacity and willingness of a government to repay back its obligations in full and on time. The Moody's rating, which relates to foreign currency, focuses on measuring the expected credit loss, which depends on the probability of default, and

[6] Aaa, Aa1, Aa2, Aa3,Aa, A1, A2, A3, A, ,Baa1, Baa2, Baa3,Ba1, Ba2, Ba3, B1, B2, B3,Caa1, Caa2, Caa3, Ca, C. For detailed definition on each rating classification, check Rowland (2005).

the expected recovery rate after the default has occurred.[7] More specifically, the sovereign debt rating for a given government is defined as the risk facing an investor who holds debt securities issued by that government which in turn reflects its credit worthiness.

Table 1. List of Countries Included in the Sample

1	Argentina (Arg)	20	Korea, Rep. (Kor)
2	Australia (Ausl)	21	Malaysia (Mal)
3	Austria (Aus)	22	Mexico (Mex)
4	Belgium (Bel)	23	Netherlands (Neth)
5	Brazil (Bra)	24	New Zealand (N.Z)
6	Canada (Can)	25	Norway (Nor)
7	Chile (Chi)	26	Peru (Per)
8	Colombia (Col)	27	Portugal (Por)
9	Denmark (Den)	28	Singapore (Sin)
10	Egypt (Egy)	29	South Africa (S.A)
11	Finland (Fin)	30	Spain (Spa)
12	France (Fra)	31	Sweden (Swe)
13	Germany (Ger)	32	Switzerland (Swi)
14	Greece (Gre)	33	Thailand (Tha)
15	Hong Kong (HK)	34	Turkey (Tur)
16	India (Ind)	35	United Kingdom (UK)
17	Israel (Isr)	36	United States (US)
18	Italy (Ita)	37	Uruguay (Uru)
19	Japan (Jap)		

N.B. Letters in parentheses represent the abbreviation used for each county.

Moreover, as noted in the Moody's guide provided by Moody's Investor Service-Global Credit Research of Cailleteau, Cipriani, Lindow, and Byrne (2008), that despite the fact that assigning a rating classification to each country depends on a group of economic, financial, social and political factors, the rating is *"strictly constructed as assessing credit risk. Therefore, one cannot directly infer general assessments about a country's economic prosperity, dynamism, competitiveness or governance from Moody's government bond ratings.*"

Table 2 provides definitions on the data set used in this study. Inflation rate is computed as the average of the growth of the consumer price index over each of the six periods. Additionally, the domestic credit data is calculated as the average of the domestic credit to the private sector as a percentage of GDP over each of the six periods. Similarly, the per capita GDP is computed as the average of GDP per capita (constant $2000) over each of the six periods.

[7] $L_e = \rho(d).(1 - r_e)$, where L_e is the expected loss, $\rho(d)$ is the probability of default, and r_e is the expected recovery rate as noted in Bhatia (2002).

Table 2. Definition of Variables

Variable Name	Definition	Unit of Measurement	Data Source
Sovereign Debt Rating	Ratings assigned by Moody's	Aaa=23, Aa1=22…..,C=1	Moody's
Inflation	Percentage change in consumer price index	%	World Development Indicators
InflationVolatility	Log of the square root of the conditional variance series of inflation calculated by GARCH(1,1) model	%	World Development Indicators
Per capita GDP	GDP per capita (constant 2000 US$)	US$ (thousands)	World Development Indicators
Domestic Credit	Domestic credit to private sector as a percentage of GDP	%	World Development Indicators
LEGAL2 Index	Following Chinn and Ito (2005), LEGAL2 is the principal component of Creditors' rights, Shareholders 'rights, Accounts, and Enforcement indices. It depicts the overall development of the legal system governing financial transactions.	Units within the interval -2.90 and 1.83	La Porta *et al.* (1998)
Creditors' Rights Index	It is composed of the variables that incorporate the automatic stay proposition on the assets of a failing firm, the continuation of the old managers in a reorganization process, restrictions for going into reorganization and the seniority system of secured creditors.	Units within the interval 0 to 4	La Porta *et al.* (1998)
Shareholders 'Rights Index	This index is composed of the sum of the one share-one-vote, proxy by mail, shares not blocked before meeting, cumulative voting/proportional presentation, oppressed minorities, preemptive right to new issues and percentage of share capital to call an emergency shareholder meeting less than 10%.[8]	Units within the interval 0.05 to 5.10	La Porta *et al.* (1998)
Accounts Index	This index reflects the transparency and comprehensiveness of companies' accounting reports	Units within the interval 24 to 83.	La Porta *et al.* (1998)
Enforcement Index	It consists of the average of the efficiency of judicial system, rule of law, risk of expropriation and risk of contract repudiation.	Units within the interval 4.87 to 9.99	La Porta *et al.* (1998)

Inflation volatility is calculated as the log of the square root of the conditional variance series of inflation calculated by GARCH(1,1) model. Specifically, an inflation AR(1) model is

[8] More details on these indices are provided in La Porta *et al.* (1998).

first estimated as $\inf_t = \gamma_0 + \gamma_1 \inf_{t-1} + \varepsilon_t$ where $\inf_t$ refers to inflation and ε_t denotes the error term. The error term is defined as $\varepsilon_t = \sigma_t z_t$, where z_t is N(0,1) and σ_t^2 takes the following form $\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2$ with $\alpha_0 \succ 0$, $\alpha_1 \geq 0$, and $\beta_1 \geq 0$. Inflation volatility is thus computed as $\sqrt{\sigma_t^2} = \sqrt{\alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2}$.

Clark (1997) notes that measuring inflation volatility as the coefficient of variation of the level of inflation provides an assurance that the level of inflation is not correlated with its variance and hence, does not pose any imperfect multicollinearity issues when both the level and volatility of inflation are included.

Inflation volatility series is computed from the time series data of each country separately over the period 1989 - 2006. It is then averaged over each of the six periods as done with the other regressands. For three countries in the sample − Argentina, Brazil and Uruguay − the data of inflation volatility far exceeds the rest in the sample. To deal with this problem, a non-subjective criterion is used such that the top 10% of the volatility distribution is discarded. Hence, the data on the log of inflation volatility falls within an interval of [-0.98, 1.3].

Concerning the Legal2 Index, it varies only across countries but not over time. It ranges within the interval [-2.90, 1.83] where the higher the index is, the more developed the financial institutions. The Legal2 Index consists of four components: (a) protection of creditors' rights; (b) protection of shareholders' rights; (c) transparency of companies accounts; and (d) enforcement of laws.

The Index of Creditors' Rights is composed of the variables that incorporate the automatic stay proposition on the assets of a failing firm, the continuation of the old managers in a reorganization process, restrictions for going into reorganization and the seniority system of secured creditors. This index ranges from a minimum of zero to a maximum of 4, where more protection for creditors implies a higher index.

The degree of Law Enforcement Index consists of the average of the efficiency of judicial system, rule of law, risk of expropriation and risk of contract repudiation. This index ranges from a minimum of 4.87 to a maximum of 9.99, where a higher index implies a stricter system of law enforcement.

The Index of Shareholder's Rights is composed of the sum of the one share-one-vote, proxy by mail, shares not blocked before meeting, cumulative voting/proportional presentation, oppressed minorities, preemptive right to new issues and percentage of share capital to call an emergency shareholder meeting less than 10%. This sub-index ranges from a minimum of 0.05 to a maximum of 5.10, where the higher the index is, the better is the shareholders' protection.

Finally the Account's Index measures the transparency and comprehensiveness of companies' accounting reports. This index ranges from a minimum of 24 to a maximum of 83. Again a higher index implies more transparency and better comprehensiveness of the reports.

The set of regional dummies includes: (a) dummy for Latin American countries; (b) dummy for OECD countries; (c) dummy for Asian countries; and (d) dummy for the African and the Middle Eastern countries. The classification of countries among these four regions appears in Table 11 of the Appendix.

Before proceeding into more details on these regressors, it is helpful to have a quick description of the relation between each variable and a country's sovereign debt rating:

- Inflation: the level of inflation acts as a proxy for the quality of the economic management of the country. It is an indicator of the government's control over fiscal and monetary policy. High inflation is expected to have a negative impact on sovereign debt rating.
- Inflation Volatility: A high variation in the level of inflation creates an environment of uncertainty in the economy which is expected to have an additional impact on the credit worthiness of a country. High inflation volatility is expected to add to the negative effect of high inflation on sovereign debt rating.
- Per Capita Income: The greater the per capita income of a country, the greater is its potential tax base which increases the country's ability to repay its debts. A high per capita income is expected to lead to a high sovereign debt rating.
- Domestic Credit: A high ratio of domestic credit to the private sector as a ratio of GDP indicates the government's policy towards encouraging the engagement of the private sector into the economy. This variable can serve as a proxy of financial deepening of the economy. A high ratio of domestic credit to GDP is expected to have a positive impact on sovereign debt rating.
- Legal2 Index: As defined by Chinn and Ito (2005), this index pertains to the level of development of legal systems and institutions closely related to financial transactions. This variable can serve as a proxy for a country's financial institutions. Where better financial institutions is stemmed from better protection of creditors' rights and shareholders' rights, better law enforcement and more transparency in the companies' accounts**.** All of these components combined are expected to encourage national and international investments, which lead to higher economic growth. Higher economic growth increases the country's ability to pay its existing debt burdens which would consequently lead to higher sovereign debt rating.

Estimation Results

To avoid the endogeneity problem that might arise between the determinants of the sovereign debt rating, the TSLS methodology is used. Before performing such a methodology, each series is first tested for stationarity using the panel unit root test developed by Levin, Lin and Chu (2002) with a lag selection based on the Schwarz Information Criterion (SIC). Assuming common unit root process, the results of the test suggest a rejection of a unit root for each of Moody's rating, inflation, inflation volatility, per capita GDP, and domestic credit as a percent of GDP. [9]

[9] Results are available from the author upon request.

After ensuring that the independent variables of the model pass the unit root test, the TSLS model is estimated under eight specifications of the independent variables. In each specification, the dependent variable is sovereign debt rating. The focus is on the partial correlations between sovereign debt rating and the measures of inflation volatility, financial institutions and their interaction term.

To estimate the model using TSLS, the correct set of instruments must first pass the instrument relevance test, as well as the instrument exogeneity test. For the former test, the F-statistic for the regressions in which each regressor is regressed on the whole set of instruments including regional and period dummies must exceed 10. This implies that the bias of the TSLS is at most 10% of the bias of the OLS estimator.

For the instrument exogeneity test, or overidentification test, the hypothesis that the instruments are exogenous to the error term is tested. The hypothesis is rejected if the calculated J-statistic[10] exceeds a chi-squared with *m* minus *k* restrictions at a chosen significant level, where *m* and *k* refer to the number of instruments and the number of endogenous regressors respectively. In addition, the Sargan p-value is calculated.

The set of endogenous variables includes the level of inflation, volatility of inflation, domestic credit as a ratio to GDP, and GDP per capita. The set of exogenous variables, which are not correlated with the error term, include the constant term, the first lag of the sovereign debt rating, the Legal2 Index, the period fixed effects and the regional dummies.

The set of instruments consists of all the exogenous variables in the model plus the first lag for each of the endogenous variables, the average value taken by each of the endogenous variables in the major trading partners for each country, longitudes, latitudes, and a dummy for English origin. The English origin dummy takes 1 if the legal origin of the country's law is English common law and 0 otherwise.[11]

This set of instrument passed both the relevance test and the exogeneity test. For the former test, each one of the endogenous regressors is regressed in a turn on the whole set of instruments. Based on the values of the first stage F-statistic – shown in Table 3 – the set of instruments is relevant. In addition, the p-values of the Sargan test of all the regressions – shown in Table 4 − indicate that the hypothesis of over-identifying moment conditions cannot be rejected, and hence the instruments are exogenous to the error term.

Table 3. First Stage F-statistic of the TSLS

Endogenous Variable	First Stage F-Statistic
Inflation	47.71
Inflation Volatility	79.93

[10] Equal to the number of instruments multiplied by the second stage F-statistic.
[11] The data for the English origin dummy are taken from La Porta *et al.* (1998).

Domestic Credit	58.38
Per Capita GDP	4136.77

Table 4 shows the results of estimating eight regressions. Column 1 shows the results of the sovereign regression with only an AR(1) term in addition to regional dummies. The sign and significance of the lagged rating is expected. When the average of the period level of inflation is added to the regression (Column 2), the coefficient of the lagged rating remains significant. The coefficient of inflation is also significant and the magnitude of this coefficient indicates that a one percent increase in the average over the period level of inflation corresponds to about 0.06 drop in sovereign debt rating which is a minimal impact.

Table 4. Sovereign Debt Rating and Inflation Volatility
Cross-country panel data consist of non-overlapping 3-year averages spanning 1989-2006.

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Constant	5.63***	7.79***	8.59***	8.33***	-1.23	2.57	0.92	2.22
	(1.24)	(2.19)	(2.03)	(1.96)	(3.02)	(3.36)	(2.84)	(3.48)
Lagged rating	0.73***	0.64***	0.61***	0.56***	0.44***	0.42***	0.44***	0.43***
	(0.06)	(0.96)	(0.90)	(0.1)	(0.09)	(0.10)	(0.09)	(0.09)
Inflation		-0.06*	-0.03	-0.04	-0.03	-0.03	-0.001	-0.01
		(0.035)	(0.041)	(0.04)	(0.03)	(0.03)	(0.03)	(0.04)
Inflation volatility			-1.48*	-1.17	-1.82**	-1.60**	-	-1.53**
			(0.87)	(0.85)	(0.81)	(0.76)	1.58***	(0.65)
							(0.60)	
Domestic Credit/GDP				0.011**	0.001	0.001	-0.001	-0.001
				(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
per capita GDP					3.08***	2.27***	2.66***	2.36***
					(0.75)	(0.76)	(0.72)	(0.80)
LEGAL2						0.60*		0.34
						(0.32)		(0.44)
Interaction of							1.04***	0.60
Volatility LEGAL2							(0.38)	(0.51)
Dummy Latin	-1.20	-1.71*	-1.71**	-1.73**	-1.38*	-1.15*	-1.27	-1.19
	(0.88)	(0.87)	(0.84)	(0.79)	(0.73)	(0.70)	(0.80)	(0.73)
Dummy Africa/Middle-East	-0.56	-1.08	-1.77	-1.58	-0.91	-1.14	-1.20	-1.23
	(0.83)	(1.21)	(1.32)	(1.36)	(1.09)	(1.08)	(1.11)	(1.08)
Dummy Asian	-1.48**	-2.01**	-2.06**	-2.21**	-0.58	-1.32	-1.28	-1.43
	(0.71)	(0.95)	(0.99)	(1.11)	(1.10)	(1.09)	(0.97)	(1.01)
Countries/Observations	34/167	34/167	34/166	34/166	34/165	34/165	34/165	34/165
Adjusted R-squared	0.836	0.835	0.843	0.845	0.875	0.878	0.880	0.890
J-Statistic / Sargan P-value	4.31	15.35	14.55	15.40	12.97	10.39	10.48	9.58
	[0.97]	[0.34]	[0.41]	[0.42]	[0.67]	[0.92]	[0.92]	[0.94]

Notes: Dependent variable: Sovereign Debt Rating.
Estimation Method: TSLS with Regional Dummies and Period Fixed Effects.

***, ** and * denote statistical significance at the 1%, 5% and 10% levels respectively
Numbers in round parentheses (.) are the standard errors, and numbers in square parentheses [.] are the Sargan P-values.

Adding the average over the period inflation volatility to the regression (Column 3), the coefficient of the lagged rating remains significant. Interestingly, once the inflation volatility is included in the regression, the coefficient of the average over the period inflation turns insignificant and its magnitude decreases by almost 50%. The coefficient of inflation volatility

on the other hand, is significant and with the expected negative sign and magnitude. A one percent increase in the average over the period of inflation volatility corresponds to about a one classification decrease in the sovereign debt rating.[12]

When private domestic credit as a ratio of GDP is added to the regression (Column 4), the coefficients of the lagged rating and average over the period inflation does not change in terms of the signs and statistical significance. The average over the period inflation volatility turns insignificant with the expected sign. The coefficient of the domestic credit indicates a positive and statistically significant impact on sovereign debt rating, albeit of a negligible magnitude. This indicates that the effect of domestic credit on sovereign debt rating is small and not economically significant, although it is statistically significant.

Adding the log of per capita GDP to the regression (Column 5), the coefficient of inflation volatility turns significant. In addition, all the previous results in terms of significance and magnitudes do not change much except for the coefficient of private domestic credit as a ratio to GDP which turns insignificant. This might be due to the high and positive correlation between the per capita GDP and the private domestic credit as a ratio to GDP which is equal to 0.53. Hence, the results of Column 5 indicate that there is at best, a weak, indirect relationship between domestic credit and sovereign debt rating that is completely dwarfed by the per capita GDP. As Column 5 indicates, the coefficient of the per capita GDP proves to be highly significant and large in magnitude. A unit increase in per capita GDP corresponds to about three classifications increase in the sovereign debt rating.

In order to estimate the direct effect of financial institutions on sovereign debt rating, the Legal2 Index is added to the regression. As obvious from Column 6, the impact of financial institutions on sovereign debt rating appears with the expected positive sign, magnitude, and statistical significance. A one unit increase in the Legal2 Index corresponds to about one unit increase in sovereign debt rating. In other words, a country with well developed financial institutions has high sovereign debt rating. Concerning the other coefficients in Column 6, the coefficient of the private domestic credit as a ratio to GDP stays insignificant. This might be explained by the relatively high positive correlation of 0.64 between the private domestic credit as a ratio to GDP and the Legal2 Index. It is important to note that the correlation between per capita GDP and sovereign debt rating is stronger than the correlation between the private domestic credit as a ratio to GDP and sovereign debt rating. So it might be the case that the impact of per capita GDP overshadows the private domestic credit as a ratio to GDP in the regression.

In order to estimate the indirect effect of financial institutions, the interaction term of Legal2 Index with inflation volatility is added to the rating regression (Column 7) while keeping the Legal2 Index in the set of instruments. The results show a statistically significant negative coefficient for the average over the period inflation volatility. A one percent increase in inflation volatility leads to a drop in sovereign debt rating by about two rating classifications. The Legal2 Index indirectly reduces this negative impact on sovereign debt rating through its positive

[12] To account for a possible non-monotonic impact of the level of inflation on the sovereign debt rating, the square of the level of inflation was added to the regressions above. The results suggest that the coefficient of the level of inflation remains statistically insignificant. Results are available from the author upon request.

interaction term with inflation volatility. In other words, the results of Column 7 seem to show that strong financial institutions do significantly enhance the relationship between inflation volatility and sovereign debt rating in such a way that countries with high inflation volatility but well developed financial institutions, will have higher sovereign debt rating over the next three years. [13]

When adding both the financial institutions' index and its interaction term with inflation volatility, or the direct and indirect effects of the financial institutions (Column 8), the results show that neither is statistically significant. One possible explanation here is the possibility of the presence of imperfect multicollinearity between the two terms where the correlation between the financial institutions' index and its interaction term is around 0.74 as shown in Table 10 of the Appendix. Furthermore, as shown in Table 12 of the Appendix, the F-statistic of the test that $\beta_{LEGAL2} = 0$ and $\beta_{\text{int}eraction} = 0$ is equal to about 3.77 which exceeds the critical value of the $F_{2,\infty}$ distribution, implying that the null hypothesis is rejected. Thus, at least one of the coefficients is significant. This suggests that the insignificance of the two coefficients β_{LEGAL2} and $\beta_{\text{int}eraction}$ in Table 4 above is due to the imperfect multicollinearity between the Legal2 Index and its interaction with inflation volatility.

In conclusion, this section provides empirical evidence that the magnitude of the negative impact of inflation volatility on sovereign debt rating is more important in terms of size and statistical significance as compared to the level of inflation. In addition, the negative impact of inflation volatility on sovereign debt rating is reduced with the presence of well developed financial institutions. Finally, financial institutions have a positive direct and indirect impact on sovereign debt rating, where the **latter** impact works through the institutions' interaction term with inflation volatility.

Calculating the Total Effects

The previous discussion has shown that policies aiming at reducing inflation volatility would have positive significant impacts on sovereign debt rating. In addition, policies aiming at improving financial institutions have a positive significant impact on sovereign debt rating − either a direct or an indirect impact. In this section, the total effect of a one standard deviation decrease in inflation volatility versus the total effect of a one standard deviation increase in the Legal2 Index on the sovereign debt rating are compared.[14]

Total Effect of Inflation of Volatility

[13] A robustness check is undertaken using Panel Least Squares with Dummies Variables (LSDV) and period fixed effects for the regressions in Table 4. The results of LSDV confirm the results of TSLS. All results are available from the author upon request.

[14] A robustness check is undertaken on the total effects of both inflation volatility and financial institutions using LSDV. The results are robust to the use of a different estimation methodology and this confirms that the instruments used are good enough to well estimate the relations of interest. The results are available from the author upon request.

As the Column 7 of Table 4 shows, improving financial institutions lessens the harmful effects of inflation volatility on sovereign debt rating. However, the question remains: What is the total effect of decreasing inflation volatility on the sovereign debt rating? To answer this question, the total effect of a one standard deviation decrease in inflation volatility under different levels of LEGAL2 is calculated.

As Table 5 shows, the total effect is calculated by multiplying the coefficient of inflation volatility, $\hat{\beta}_3$ of Equation 2, with the standard deviation of inflation volatility $\text{std}(\text{infvol}_{i,t})$ to get $[\hat{\beta}_3 * \text{std}(\text{infvol}_{i,t})]$. Similarly, the coefficient of the interaction term of LEGAL2 with inflation volatility, $\hat{\beta}_4$ of Equation 2, is multiplied by $\text{std}(\text{infvol}_{i,t})$ to get $[\hat{\beta}_4 * \text{std}(\text{infvol}_{i,t})]$. Next, this **latter** product is multiplied by the Legal2 Index which is divided into five quintiles. Each quintile is multiplied by $[\hat{\beta}_4 * std(infvol)]$ to get $[LEGAL2_i * [\hat{\beta}_4 * std(infvol)]]$.

The first column of Table 5 shows the quintiles of the index. The first number of this column (-2.90) refers to the minimum value of the index; then the next value -1.95 refers to the 0 – 20th percentile of the index; -1.01 refers to the 20th – 40th percentile; -0.06 refers to the 40th – 60th percentile; 0.88 refers to the 60th– 80th percentile; and finally 1.83 refers to the 80th – 100th percentile of the index.

Table 5. Total Effect of a One Standard Deviation Change in Inflation Volatility
(Given the Legal2 Index)

(4) L2 Index	(5) equals (3) times (4)	Total Effect (2)+(5)	Variance	Confidence Interval	t-stat
-2.90	-2.37	-3.61***	0.93	[-5.50 , -1.72]	-3.75
-1.95	-1.60	-2.84***	0.54	[-4.28 , -1.40]	-3.87
-1.01	-0.82	-2.07***	0.30	[-3.15 , -0.99]	-3.75
-0.06	-0.05	-1.29***	0.23	[-2.22 , -0.36]	-2.72
0.88	0.72	-0.52	0.30	[-1.60 , 0.56]	-0.94
1.83	1.49	0.25	0.54	[-1.18 , 1.69]	0.35
(1) Standard Deviation Of Volatility		0.79			
(2) Volatility Coefficient times (1)		-1.24			
(3) Interaction Coefficient times (1)		0.82			

N.B. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

As obvious from the "Total Effect" Column of Table 5, with the minimum value of the Legal2 Index, a one standard deviation decrease in inflation volatility leads to about four rating classifications increase. As shown in Table 6, this is the case for a country like Peru which has the worst level of financial institutional development in the sample.

With a relative improvement in financial institutions, or at the 20th percentile for example, a one standard deviation decrease in inflation volatility results in about 3 rating classifications increase. As may be observed in Table 6, this is the case for Argentina, Egypt and Uruguay.

Countries under the 40th percentile − like Brazil, Colombia, Greece, Mexico, Portugal, and Turkey − are all having a lower total effect of inflation volatility. For this group of countries, a one standard deviation decrease in the inflation volatility leads to about 2 classifications increase in the sovereign debt rating.

Table 6. Percentiles of the Data on the Legal2 Index

Min -2.9		20th -1.95		40th -1.01		60th -0.06		80th 0.88		Max 1.83	
Per	-2.9	Arg	-1.98	Bra	-1.24	Chi	-0.80	Ausl	0.44	Aus	1.07
		Egy	-2.68	Col	-1.92	Ind	-0.41	Bel	0.54	Can	1.04
		Uru	-2.25	Gre	-1.12	Kor	-0.20	Den	0.87	Fin	1.23
				Mex	-1.32	S.A	-0.11	Fra	0.3	H.K	1.16
				Por	-1.61	Tha	-0.48	Ger	0.73	Mal	1.09
				Tur	-1.64			Isr	0.36	N.Z	1.34
								Ita	0.11	Nor	1.40
								Jap	0.84	Sin	1.76
								Neth	0.8	Swe	1.76
								Spa	0.1	U.K	1.83
								Swi	0.85	U.S.A	1
Avg	-2.9	Avg	-2.30	Avg	-1.48	Avg	-0.40	Avg	0.54	Avg	1.33

N.B. Check Table 1 for reference on the above abbreviations.

For the more institutionally developed countries above the 60thpercentile, the total effect of inflation volatility on sovereign debt rating is statistically insignificant. As Table 5 shows, at the 60th percentile, the total effect would be about 1 rating classification increase for each one standard deviation decrease in inflation volatility. Countries in this category include: Australia, Belgium, Denmark, France, Germany, Israel, Italy, Japan, Netherlands, Spain and Switzerland. Finally, at both the 80th percentile and at the top quintile of the Legal2 Index, the total effect is insignificant and ranges around zero. This case include countries like Austria, Canada, Finland, Hong Kong, Malaysia, New Zealand, Norway, Singapore, Sweden, United Kingdom, and the United States.

It is interesting to note that countries with relatively underdeveloped institutions have higher response to changes in inflation volatility as compared to countries with relatively developed institutions. For instance, a one standard deviation reduction in inflation volatility at the 40th percentile of LEGAL2 (e.g. Mexico) leads to about two rating classifications increase. Furthermore, a one standard deviation reduction in inflation volatility under the 80th percentile of LEGAL2 (e.g. Japan) leads to about one rating classification increase. This suggests that countries with relatively well developed financial institutions; inflation volatility has smaller negative effect on ratings.

The results discussed here, are intuitive in the sense that well financially developed economies have more ways of controlling inflation volatility and dealing with its effects than less

institutionally developed economies, and therefore investors do not care as much about the consequences of inflation volatility.

Total Effect of Financial Institutions

Using the results of Table 4 Column 8, the total effect of in LEGAL2 is calculated as $(\hat{\beta}_4 * Infvol_{i,t} + \hat{\beta}_5)$. In order to calculate the total effect of a one standard deviation increase in Legal2 Index, the interaction coefficient $\hat{\beta}_4$ and $\hat{\beta}_5$ are multiplied by the standard deviation of the Legal2 Index. Thus the total effect of a one standard deviation is calculated as $(std(L2_i) * \hat{\beta}_4 * Infvol_{i,t}) + \hat{\beta}_5 * std(L2_i)$, where $std(L2_i)$ refers to the standard deviation of the Legal2 Index. The $Infvol_{i,t}$ is substituted for its values at the 20th, 40th, 60th, 80th, and 90th percentiles each one in a turn.

The first column of Table 7 shows the quintiles of the log inflation volatility data. The first number of this column (0.02%) refers to the minimum value of the log of inflation volatility; the next value -0.08 refers to the 0 – 20th percentile of the index; 0.22 refers to the 20th – 40th percentile; 0.37 refers to the 40th – 60th percentile; 0.70 refers to the 60th– 80th percentile; and finally, 2.94 refers to the 80th – 100th percentile of the index. It may be recalled that the 90th percentile (1.3%) is the cutoff point above which the extremely high log inflation volatility data are discarded from the sample.

Table 7. Total Effect of a One Standard Deviation Change in LEGAL2 (Given Inflation Volatility)

(4) Volatility Percentiles	(5) equal (3) times (4)	Total Effect (2)+(5)	Variance	Confidence Interval	t-stat
0.02	0.02	0.46	0.31	[-0.63 , 1.54]	0.83
0.08	0.06	0.50	0.28	[-0.53 , 1.53]	0.96
0.22	0.17	0.61	0.22	[-0.30 , 1.53]	1.32
0.37	0.29	0.73*	0.17	[-0.08 , 1.54]	1.76
0.70	0.54	0.99***	0.14	[0.24 , 1.73]	2.60
1.30	1.01	1.45**	0.33	[0.32 , 2.59]	2.51
2.94	2.28	2.73*	2.46	[-0.35 , 5.80]	1.74
(1) Standard Deviation Of LEGAL2		1.29			
(2) LEGAL2 Coefficient times (1)		0.44			
(3) Interaction Coefficient times (1)		0.78			

N.B. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively

Additionally, for all the countries on the 40th percentile of inflation volatility and below, the total effect of a one unit improvement in the standard deviation of the Legal2 Index has a statistically insignificant impact on sovereign debt rating and the magnitude of the total effect reaches 0.61 rating classifications at the most.

Table 8. Percentiles of the Average of the Log of Inflation Volatility Data (1989-2006)

Min		20th		40th		60th		80th		90th		Max	

0.02		0.08		0.22		0.37		0.70		1.30		2.94	
Neth	0.02	Aus	0.07	Fra	0.19	Austl	0.29	Chi	0.40	Isr	1.28	Arg	2.39
Fin	0.02	Bel	0.05	Nor	0.15	Col	0.30	Egy	0.64	Mex	1.12	Bra	2.77
		Can	0.04	Spa	0.14	HK	0.26	Ger	0.50	Tur	1.23	Per	2.94
		Ita	0.07	UK	0.16	Jap	0.28	Gre	0.50	Uru	1.28		
		Swe	0.08	Den	0.19	Mal	0.28	Ind	0.59				
		Swi	0.08			NZ	0.34	Kor	0.42				
		US	0.04			SA	0.31	Por	0.58				
						Tha	0.35	Sin	0.50				
Avg	0.02	Avg	0.06	Avg	0.17	Avg	0.30	Avg	0.52	Avg	1.23	Avg	2.70

Furthermore, all countries falling under the 60th percentile and above have a significant positive total effect. For instance, under the 90th percentile, a one standard deviation increase in Legal2 Index, leads to about one classification increase in sovereign debt rating. As shown in Table 8, this is the case with countries like Israel, Mexico, Turkey and Uruguay.

At this point, it is important to know how a developing country, for example Mexico, can achieve this one standard deviation increase in its Legal2 Index. An illustrative way to think about it is as follows. A one standard deviation increase in the Legal2 Index moves Mexico's index to a value very close to the Legal2 Index for countries like Switzerland, France, Hong Kong, Japan, Netherland, South Africa, New Zealand and United States. By computing the averages of the individual components of the Legal2 Index, creditors' rights, shareholders' rights, enforcement and accounts for these eight countries, the averages are 2, 2.95, 68.25, and 9.10. Comparing these values to their equivalent ones in Mexico, these values are 0, 1.33, 60, and 6.2. The differences between the average values of these four indices for the eight countries and the four indices for Mexico, imply that Mexico needs a major improvement in all the four components of the Legal2 Index. The protection of creditors' rights, for example, is considered one of the greatest problems facing businessmen in Mexico. Creditors are afraid to provide finances for current or new projects as long as they do not have a direct control over the goods provided by debtor as collateral in case of the debtor's default. The improvement in the financial institutions in Mexico is crucial for it to enjoy the benefits of the one standard deviation increase in the Legal2 Index.

Impact of the Increase in Sovereign Rating on Long-Term Bond Yield

The previous discussion signifies that a country can increase its sovereign debt rating by either following a monetary policy that decreases inflation volatility or by improving its financial institutions. The aim of this section is to link the changes in the sovereign debt rating to the changes in the average annual long-term bond yield. A country with low rating is expected to pay more premiums on its foreign borrowings and therefore, its long-term bond yield is expected to be relatively high when compared with a higher rated country.

It has been observed that under the 40th percentile of the Legal2 Index, where a country like Mexico belongs, a one standard deviation decrease in inflation volatility leads to about 2 rating classifications increase, given the institutions index. From Table 13 of the Appendix,

these 2 rating classifications increase means an increase from the lowest level in the investment grade category of "Baa3" or 12 points, to which Mexico belonged in the first quarter of the year 2000, up to "Baa1" or 14 points.

A possible way of linking this increase in the sovereign debt rating to the annual long term bond yield is by plotting a bar chart linking the data of these two variables together. As shown in Figure 1 (at the Appendix), a negative non-linear relationship is observed between the sovereign debt rating and the average annual 5-year bond yield. A country with high rating is associated with low average long-term bond yield, and vice versa.

Back to Mexico's example again, Figure 1 and Table 14 show that the two classifications increase in rating from Baa3 to Baa1 are equivalent to a drop in the average annual 5-year bond yield from 12.21% to 7.81%. Hence, a one standard deviation decrease in inflation volatility leads to a drop in cost of borrowings by about 4.4%.

Similarly, the link between one standard deviation increase in Legal2 Index and the drop in the average annual 5-year bond yield is found. Again for Mexico's case, a one standard deviation increase in the Legal2 Index leads to about one classification increase in rating from "Baa3" or 12 points, to which Mexico belonged in the first quarter of the year 2000, up to "Baa2" or 11 points. From Figure 1 and Table 14, the one classification increase in rating, from Baa3 to Baa2, is equivalent to a drop in the average annual 5-year bond yield from 12.21% to 7.94%. Thus, a one standard deviation increase in the Legal2 Index leads to a drop of about 4.27% in the country's cost of borrowings.

Conclusion

While many studies have concentrated on the role of macroeconomic fundamentals in affecting sovereign debt rating, few of these studies have addressed the role of the second moments of macroeconomic aggregates. Additionally, while there is a growing literature on the importance of institutions for a country's economic growth, there have been very few studies on the importance of improving institutions in relation to the sovereign debt rating.

This study contributes to the sovereign debt rating literature by first showing that the level of inflation loses its significant impact on sovereign debt rating once inflation volatility is included in the regression. Secondly, reducing inflation volatility has a statistically significant positive direct impact on sovereign debt rating where a one standard deviation decrease in inflation volatility leads to about two rating classifications increase. Thirdly, improving institutions has a statistically significant positive direct and indirect impact on sovereign debt rating where a one standard deviation increase in the index of financial institutions leads to about one rating classification increase. Finally, the increase in sovereign debt rating − either due to one standard deviation decrease in inflation volatility or to a one standard deviation increase in institutions' index − leads to drops in the average annual long-term bond yield by about 4.4% and 4.27% respectively.

Possible future research can depart from this last point where the welfare implications of the exogenous drops in the cost of borrowing versus the welfare impacts of the exogenous

improvement in institutions for a small open economy are computed. A good candidate for this model is a country like Mexico which fell on the border line between an investment grade and a speculative grade in the first quarter of the year 2000. It will be interesting to see how the welfare impacts of the shocks coming from the drop in the cost of borrowing, due to the reduction in inflation volatility, compare with welfare impacts of the shocks coming from the improvement in institutions, where the latter has two positive welfare effects − one that passes through the drop in the cost of borrowing and another, direct exogenous effect through reducing the resource waste in the economy.

The study concludes by drawing attention to some important confines of this study that are mainly related to measurement errors. The assigning of a linear numerical value to each rating letter might not be the optimal strategy. A nonlinear relationship between assigned numbers and rating letters should be considered in future research on the subject matter. Furthermore, given the data limitation, measurement errors could arise from the assumption that each country has a time invariant index for financial institutions. Particularly, this could be a strong assumption given the improvement in the financial institutions for some countries included in the sample.

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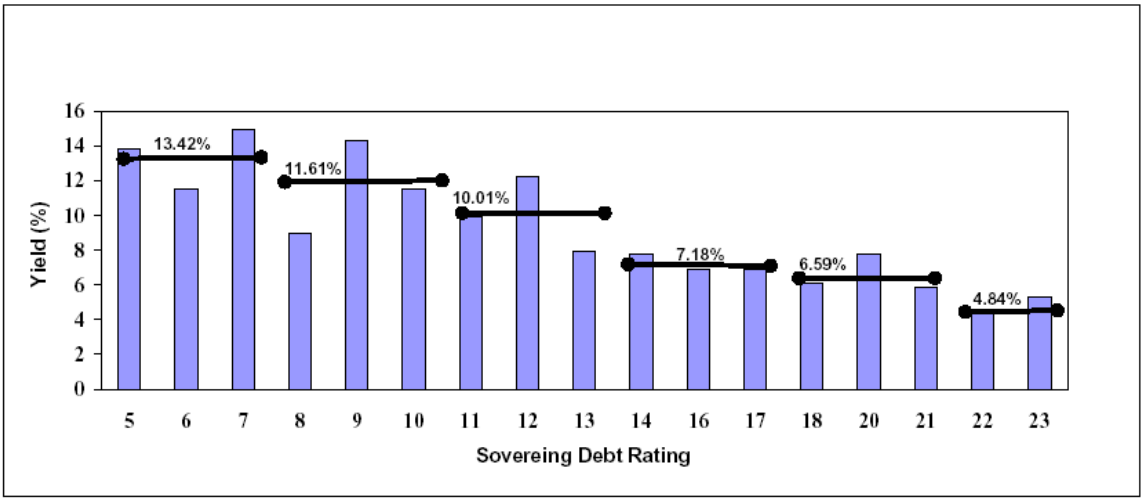
Appendix

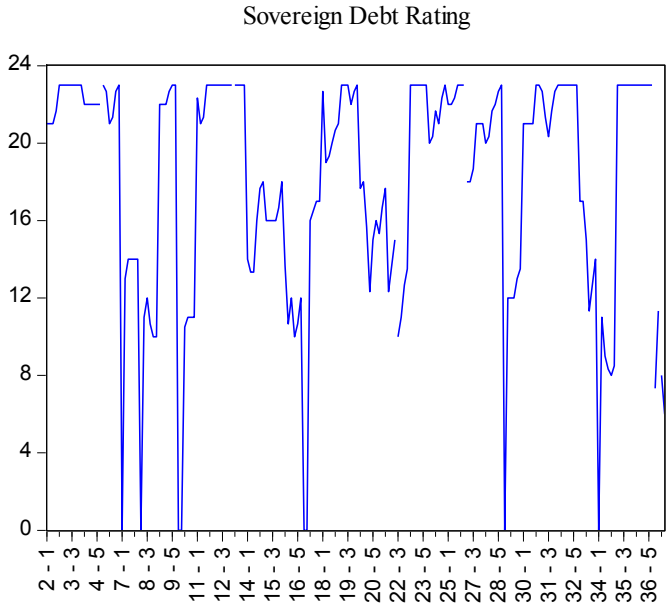
Figure 1: The negative relationship between Moody's rating in 2000 (first quarter)
And 5-year Annual Bond Yield in 2000 (first quarter)



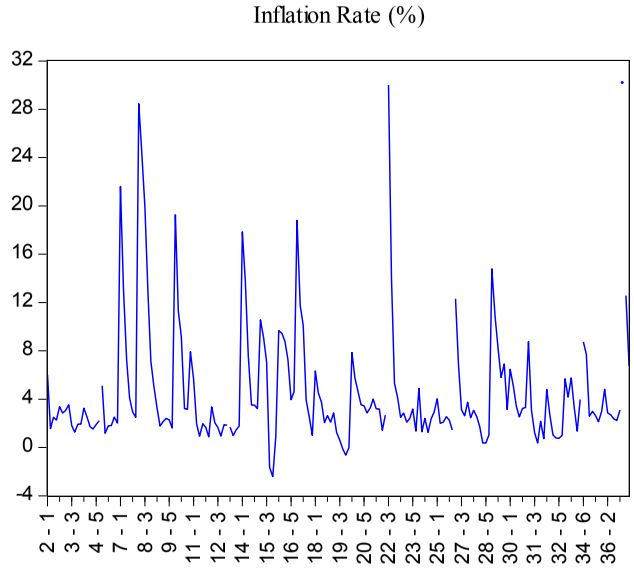
Source: Global Financial database for the annual 5-year Bond Yield.

Figure 2. Data Plot for the Dependent and Independent Variables
For All the Countries in the Sample

Figure 2 A

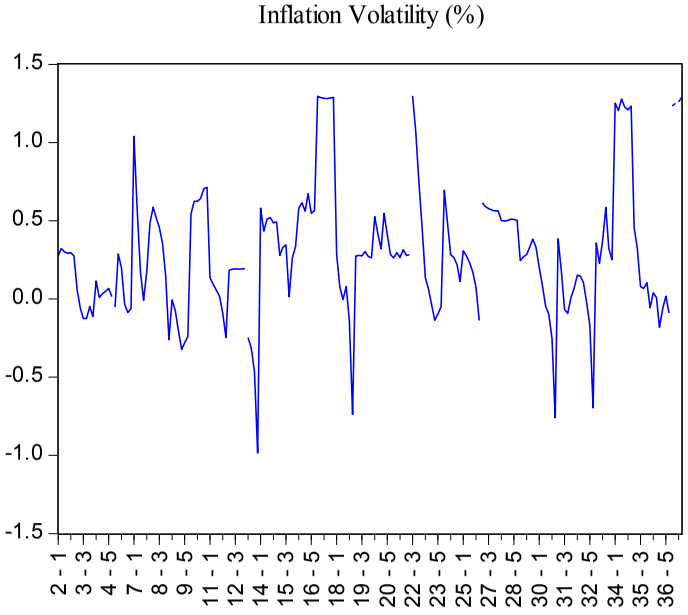


Source: Moody's Sovereign Debt Rating Data

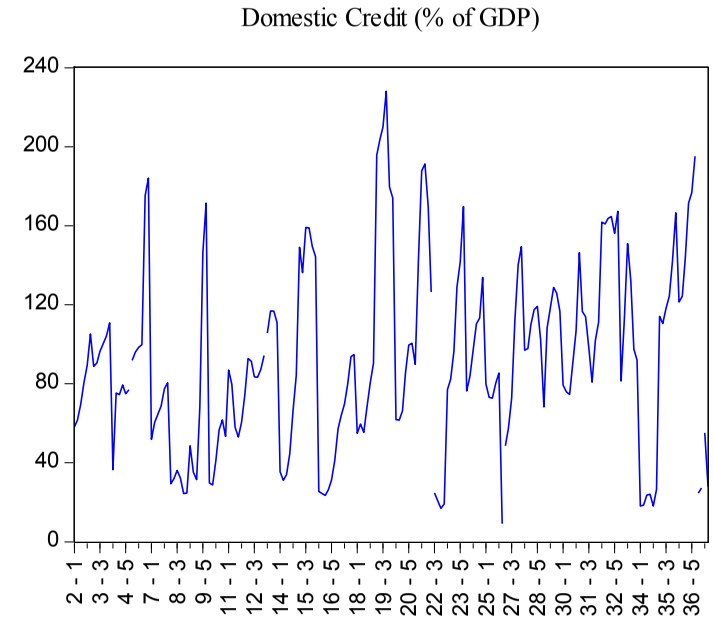


Source: Data from World Development Indicators, World Bank Database, 2011

Figure 2 B

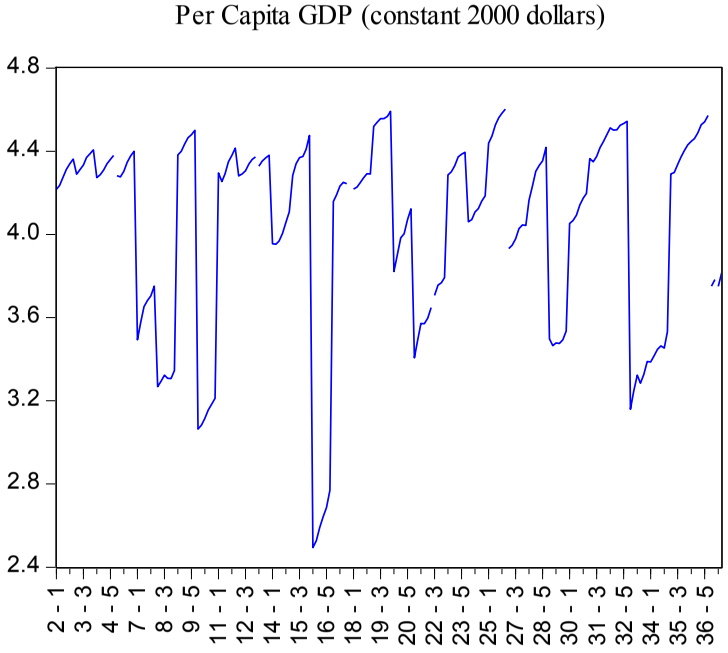


Source: Author constructed using Consumer Price Index (CPI) data from World Development Indicators, World Bank Database, 2011



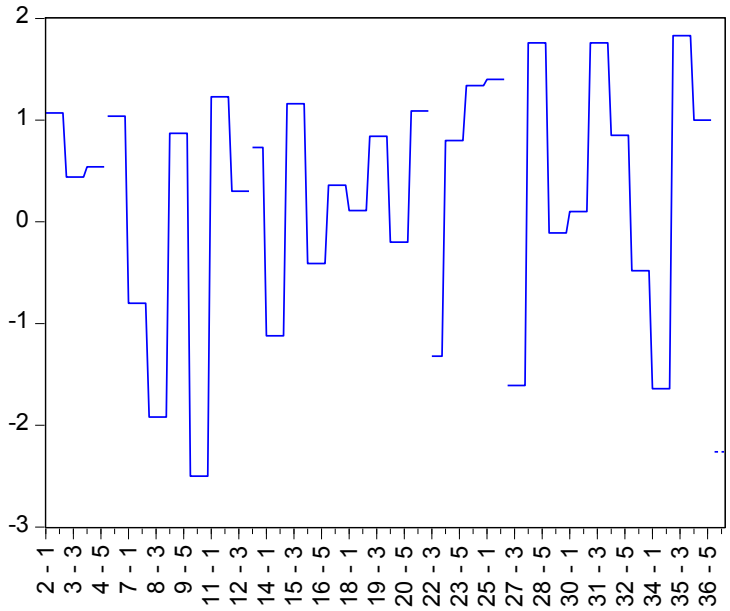
Source: World Development Indicators, World Bank Database, 2011

Figure 2 C



Source: World Development Indicators, World Bank Database, 2011

Financial Institutions (Index)



Source: LEGAL2 Index (Financial Institution Index), Chinn and Ito (2005).

Table 9. Descriptive Statistics

	Rating	Inf	Inf Vol	DC	GDP/cap	L2	intL2
Mean	16.88	48.43	0.51	86.04	4.00	-0.01	-0.68
Median	20.33	3.45	0.28	80.84	4.19	0.36	-0.05
Maximum	23.00	3398.68	3.27	228.07	4.60	1.83	0.93
Minimum	0.00	-1.58	-0.99	9.17	2.49	-2.90	-9.49
Std. Dev.	6.75	328.58	0.79	48.99	0.48	1.32	1.78
Skewness	-0.94	8.92	1.78	0.48	-0.93	-0.58	-2.89
Kurtosis	2.90	84.89	5.97	2.57	3.12	2.17	12.00
Jarque-Bera	32.13	64102.52	195.56	10.18	31.77	18.50	1044.83
Probability	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Sum	3696.00	10605.80	111.61	18842.17	875.35	-1.82	-149.21
Sum Sq. Dev.	9945.84	23536444.00	135.43	523284.60	49.67	379.61	693.75
Observations	219.00	219.00	219.00	219.00	219.00	219.00	219.00

Legend: Inf refers to inflation; Inf vol refers to inflation volatility; DC refers to Domestic credit as a ratio to GDP; GDP/cap is the per capita GDP; L2 is the Legal2 Index; intL2 is the interaction term of the Legal2 Index with inflation volatility.

Table 10. Correlation Matrix

	Rating	Inf.	Inf. Vol.	DC	GDP/cap.	L2	intL2
Rating	1.00	-0.30	-0.72	0.59	0.76	0.77	0.62
Inf.	-0.30	1.00	0.41	-0.15	-0.15	-0.22	-0.42
Inf. Vol.	-0.72	0.41	1.00	-0.51	-0.48	-0.65	-0.84
DC	0.59	-0.15	-0.51	1.00	0.53	0.64	0.50
GDP/cap.	0.76	-0.15	-0.48	0.53	1.00	0.70	0.43
L2	0.77	-0.22	-0.65	0.64	0.70	1.00	0.74
intL2	0.62	-0.42	-0.84	0.50	0.43	0.74	1.00

N.B. Please see Legend of Table 9.

Table 11. Regional Dummies

Code	Countries	Dasian	Doecd	Dlatin	Dafmid
1	Argentina	0	0	1	0
2	Australia	0	1	0	0
3	Austria	0	1	0	0
4	Belgium	0	1	0	0
5	Brazil	0	0	1	0
6	Canada	0	1	0	0
7	Chile	0	0	1	0
8	Colombia	0	0	1	0
9	Denmark	0	1	0	0
10	Egypt	0	0	0	1
11	Finland	0	1	0	0
12	France	0	1	0	0
13	Germany	0	1	0	0
14	Greece	0	1	0	0
15	Hong Kong,Chi	1	0	0	0
16	India	1	0	0	0
17	Israel	0	0	0	1
18	Italy	0	1	0	0
19	Japan	0	1	0	0
20	Korea, Rep.	0	1	0	0
21	Malaysia	1	0	0	0
22	Mexico	0	1	0	0
23	Netherlands	0	1	0	0
24	New Zealand	0	1	0	0

25	Norway	0	1	0	0
26	Peru	0	0	1	0
27	Portugal	0	1	0	0
28	Singapore	1	0	0	0
29	South Africa	0	0	0	1
30	Spain	0	1	0	0
31	Sweden	0	1	0	0
32	Switzerland	0	1	0	0
33	Thailand	1	0	0	0
34	Turkey	0	1	0	0
35	United Kingdom	0	1	0	0
36	United States	0	1	0	0
37	Uruguay	0	0	1	0

Legend: Dasian refers to the dummy for Asian countries
Doecd refers to the dummy for the OECD countries (includes Japan , Mexico, and Turkey)
Dlatin refers to the dummy for the Latin American countries.
Dafmid refers to the dummy for the North African and Middle Eastern countries (includes South Africa)

Table 12. Wald Coefficients Test

Wald Test:
Equation: BASE

Test Statistic	Value	df	Probability
F-statistic	3.766590	(2, 150)	0.0253
Chi-square	7.533179	2	0.0231

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(7)	0.341208	0.438961
C(8)	0.604794	0.514689

N.B. Restrictions are linear in coefficients.

Table 13. Definition of Moody's Sovereign Debt Rating

	Moody's Rating	Classification
Investment Grade	23	Aaa
	22	Aa1
	21	Aa2
	20	Aa3

	19	Aa
	18	A1
	17	A2
	16	A3
	15	A
	14	Baa1
	13	Baa2
	12	Baa3
Speculative Grade	11	Ba1
	10	Ba2
	9	Ba3
	8	B1
	7	B2
	6	B3
	5	Caa1
	4	Caa2
	3	Caa3
	2	Ca
	1	C

Table 14. Annual Yield in 2000 (first quarter) and Moody's rating in 2000

Country	Yield	Rating	Average Yield
Australia	6.40	23	
Austria	5.46	23	
Denmark	5.39	23	
Finland	4.91	23	
France	4.96	23	
Germany	4.86	23	
Ireland	5.06	23	
Netherlands	5.03	23	
Norway	6.18	23	
Switzerland	4.18	23	
UK	5.86	23	
US	5.88	23	5.30
Belgium	5.09	22	
Canada	6.07	22	
Japan	1.07	22	
Singapore	3.72	22	
Sweden	5.32	22	4.37
New Zealand	7.02	21	
Portugal	5.25	21	
Spain	5.09	21	5.86
Iceland	10.50	20	
Italy	5.04	20	7.80

Czech Republic	6.11	18	6.11
Botswana	8.00	17	
Cyprus	7.35	17	
Greece	6.03	17	
Israel	5.60	17	6.87
Hong Kong	6.90	16	
Hungary	8.33	16	
Malta	5.33	16	6.85
Chile	5.90	14	
Estonia	10.82	14	
Poland	6.70	14	7.81
Korea	9.54	13	
Latvia	9.13	13	
Malaysia	5.15	13	7.94
Mexico	17.40	12	
South Africa	13.57	12	
Thailand	5.67	12	12.21
Lithuania	11.62	11	
Morocco	5.80	11	
Philippines	13.50	11	
Slovak Republic	8.64	11	9.89
Colombia	18.00	10	
Fiji	5.26	10	
India	11.32	10	11.53
Jamaica	24.75	9	
Jordan	7.00	9	
Peru	11.21	9	14.32
Argentina	9.73	8	
Brazil	11.31	8	
Kazakhstan	9.98	8	
Lebanon	8.99	8	
Turkey	4.87	8	8.97
Bulgaria	9.31	7	
Honduras	14.16	7	
Venezuela	21.42	7	14.96
Indonesia	11.48	6	
Ecuador	13.66	5	
Pakistan	13.98	5	13.82

Source: Global Financial Database for the annual yield data