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Modeling and Estimating Shadow Sovereign Ratings

Zoran Ivanovic[1], Sinisa Bogdan[1], Suzana Baresa[1]

ABSTRACT This paper describes and evaluates "shadow" sovereign credit ratings, which represent the credit ratings of countries that are not rated by credit rating agencies. Credit ratings represent the creditworthiness of companies or governments. They are important in attracting foreign capital. Countries without credit ratings can face greater difficulties than countries with low credit ratings, for example paying a higher price for capital. This paper has two objectives. The primary objective of this paper was to estimate a rating prediction model to the assess credit ratings of countries that are not yet rated. Large numbers of potential determinants were tested, and nine variables were selected that play a key role in assessing credit ratings. According to the chosen determinants, a highly precise model was calculated (80% of the estimated ratings were identical to the corresponding actual ratings or only one notch different). The purpose of this analysis was to estimate credit ratings for a sample of 31 unrated countries. The results are statistically significant and explained in detail. The second objective of this paper was to demonstrate that countries that are not ranked would not necessarily receive the lowest rating, and the results supported that hypothesis.

KEY WORDS: credit rating agency, credit ratings, determinants of sovereign credit ratings, Standard & Poor´s, unrated countries

JEL Classification: G24

[1] University of Rijeka - Faculty of tourism and hospitality management, Croatia

Introduction

A sovereign credit rating can be defined as a "*ticket that provides access to the international capital market*". Sovereign ratings are assessments that measure the capability and willingness to pay off debts. Investors and fund managers, make their own investment decisions but base them on the decisions of credit rating agencies. Changes in credit ratings may be the primary motive for buying or selling a particular security. While credit ratings have benefits, authors such as Bolton, Freixas, and Shapiro (2012) caution that credit rating agencies also have negative effects, which result from two situations. In the first situation, because the main goal of credit rating agencies is to obtain profits, competition among agencies can reduce efficiency, as it facilitates ratings shopping. Second, ratings are more likely to be inflated during booms and when investors are more trusting.

According to Bissoondoyal-Bheenick, Brooks and Yip (2006), the "ultimate value of credit rating agencies is to contribute the market efficiency that depends on the ability to provide ratings that are clear, credible, accurate opinions which are based on a fundamental understanding of credit risk" (p. 136). As reported by

Correspondence concerning this article should be addressed to: **Zoran Ivanovic**, University of Rijeka - Faculty of tourism and hospitality management, Primorska 42, 51410 Opatija, Croatia. T: +385 51 294 755, F: +385 51 292 945. E-mail: zorani@fthm.hr

the official website of Standard & Poor's, sovereign ratings have increased dramatically over the last twenty years. In 1993, approximately 40 countries were ranked; since then, that figure has risen to nearly 126 countries, but a large number of developing countries have yet to be rated. According to Cantor (2004), "credit risk has been one of the most active areas of recent financial research" (p. 2565). Credit ratings determine the cost of capital and reduce the information asymmetry between investors and debt issuers. There is a strong connection between government borrowing and credit ratings. Afonso, Furceri and Gomes (2012) discovered that credit ratings and outlook changes have a significant influence on government bond yields. According to Bhatia (2002), "sovereign ratings are fundamental *building blocks* for a global *credit risk architecture*" (p. 3). Canuto, Santos and Porto (2012) defined "sovereign risk as a credit risk associated with operations involving credit for sovereign states" (p. 4). Sovereign credit ratings play an important role in capital markets, as the country's rating serves as a *ceiling* for the ratings of corporations and other entities within that country's borders (Borensztein, Cowan, & Valenzuela, 2013). Williams, Alsakka and Gwilym (2013) found that sovereign rating upgrades and downgrades have substantial impacts on bank rating upgrades or downgrades. A sovereign risk assessment is an evaluation of a government's capacity for debt repayment. Why are credit ratings important? According to Hooper, Hume and Kim (2008), impact of a rating change is experienced in both the capital and foreign exchange market, indicating that rating changes may contribute to capital movement. Credit ratings play an especially important role in the emerging markets, and there are numerous papers on the subject. According to Larraín, Reisen, and Von Maltzan (1997), the "sovereign rating industry has the potential to help dampen excessive private capital inflows into the emerging markets with negative rating announcements" (p. 5). Reisen and Von Maltzan (1998; 1999) reported that credit ratings can intensify or attenuate boom-bust cycles in emerging markets. Brooks et al., (2004) found no evidence that emerging markets are particularly sensitive to rating changes; however, the results of an empirical study by Kraüssl (2005) show that credit rating agencies influence the size and volatility of lending in emerging markets. Kraüssl found that downgrades of government ratings have a stronger impact than do rating upgrades. For further details on emerging markets and credit rating agencies, see Kaminsky and Schmukler (2002), Sy (2002), Kim and Wu (2008), Jaramillo and Tejada (2011), and Erdem and Varli (2014). Sovereign debt ratings can spill over, even into international stock markets, and Ferreira and Gama (2007) show that sovereign ratings and outlook changes affect the stock market returns of other countries. Gande and Parsley (2005) also confirmed the existence of an international spillover effect in sovereign debt markets. More about role, interests and critics of credit rating agencies in Baresa, Bogdan and Ivanovic (2012).

Cantor and Packer (1996) wrote one of the first studies on sovereign ratings. That study examined the criteria that credit rating agencies employ to determine credit ratings. They used cross-sectional data on 49 countries (27 high–income and 22 developing countries). Cantor and Packer considered six crucial criteria in determining the rating and thus provided an important stimulus for future research on this subject. According to Cantor and Packer, the main determinants are the following: per capita income, GDP growth, inflation, fiscal balance, external debt, an indicator of economic development and an indicator of default history. Haque et al, (1996) analyzed the economic determinants of developing country creditworthiness indicators for over 60 developing countries. Their results suggest that these determinants explain variations in credit ratings: the ratio of non-gold foreign exchange reserves to imports, the ratio of the current account balance to GDP, growth and inflation. Ferri, Liu and Stiglitz (1999) researched how credit rating agencies aggravated the East Asian crisis. Credit rating agencies have downgraded countries to a greater extent than economic fundamentals would justify. To empirically verify this result, Ferri et al., (1999) used pooled cross-sections and time series data on 6 high-income and 11 developing countries over a period of 10 years (1989–1998). They also used following determinants: GDP per capita, real GDP growth, inflation rate, budget deficit, current account balances, development index and external debt. Afonso (2003) used cross-sectional data on 81 countries (29 developed countries and 52 developing countries, as reported by the IMF). That study examined the following determinants: GDP per capita, external debt, the level

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of economic development, an indicator of default history, the real growth rate and the inflation rate on sovereign credit ratings assigned by Standard & Poor's and Moody's. Afonso used a linear transformation as well as both a logistic and an exponential transformation of the qualitative rating data. Afonso, Gomes and Rother (2009) also considered the determinants of sovereign debt ratings. They concluded that estimations using the logistic transformation produced better results for the overall sample, particularly for countries at the top end of the rating scale. Eliasson (2002) calculated three different models using macroeconomic variables to predict sovereign ratings. The results of that study suggest that actual rating adjustments have been more volatile than economic fundamentals would justify. Bissoondoyal-Bheenick (2005) tested local currency ratings, foreign currency ratings, bond and note ratings, and bank deposits ratings using an ordered response model using the following determinants: GNP per capita, inflation, government fiscal balance, government debt, the real exchange rate, foreign reserves, net exports, the unemployment rate, unit labor cost, current account and foreign debt. Rowland and Torres (2004) analyzed eight variables that play an important role in determining credit ratings. These variables were: the economic growth rate, the debt-to-GDP ratio, the reserves-to-GDP ratio, the debt-to-exports ratio, exports-to-GDP ratio, the debt-service-to-GDP ratio, inflation and a default dummy variable. Valle and Marin (2005) used the following determinants to assess sovereign credit ratings: GDP per capita, GDP growth, CPI increase, the central government's consolidated fiscal balance, outstanding debt liabilities, general government debt liabilities, general government debt, liquid external assets and an indicator of whether the country is classified as industrialized. These determinants served to explain a large share of the rating assigned to issues of long-term foreign currency debt. Gaillard (2009) found three main determinants that explain 80% of sub-sovereign ratings given by Moody's, which were: default history of sovereign issuer, GDP per capita and the net direct debt to operating revenue ratio of the local government. Ratha, De and Mohapatra (2011) wrote one of the first papers on the issue of shadow sovereign ratings. They used the following determinants in their model: GDP growth, GNI per capita, reserves to imports and ST debt, external debt to exports, GDP volatility, rule of law and inflation. They discovered that many unrated poor countries might be more creditworthy than is currently believed. Bozic and Magazzino (2013) found that GNI per capita, inflation, unemployment, fiscal balance, government debt and default history significantly affect credit ratings while GNI growth and the current account balance are less relevant. Polito and Wickens (2014) researched a new methodology for generating sovereign credit ratings by mapping the probability that the debt-to-GDP ratio might exceed a maximum debt limit at some point in the future. Such a debt limit can be determined ad hoc or based on the financial capacity of a government. Polito and Wickens (2015) also constructed a model-based measure of sovereign credit ratings derived solely from the fiscal position of a country for calculating the credit ratings of 14 European countries.

The main contribution of the present study is based on the calculation of a highly accurate model that can assign ratings to unrated countries. These unrated countries are mostly low- and middle-income countries. The importance of assigning credit ratings is that investors will always prefer financial instruments that are rated to those that are not.

Data and methodology

The study was conducted based on a full sample that consisted of 81 countries, 50 of which were used to estimate the model, and credit ratings were estimated for 31 unrated countries. Because most of the unrated countries are low- or middle-income countries, following the World Bank classification, the countries were placed into four classes: low-income, lower-middle-income, upper-middle-income and high-income countries. First, all countries were classified into two group based on GNI per capita: those with values up to $12,615 and those with values above $12,615. Different criteria were applied when evaluating high-income and developing countries. Only countries with GNI per capita values equal to or below $12,615 were included in the estimation model. Of a total of 213 countries, according to the World Bank, 75 are high-income countries, 54 are upper-middle-income countries, 48 are lower-middle-income countries and 36 are low-income countries. In total, 138 countries had GNI per capita values equal to or below $12,615. Of these 138 countries, 65 are rated and 73 are unrated. Of the 65 rated countries, 50 were included in the analysis, as

Table 1. Classification of countries according to GNI per capita, 2012

GNI per capita 2012		Sample data	Forecasting sample
Low income	< $1,035	13	7
Lower middle income	$1,036 – $4,085	15	16
Upper middle income	$4,086 – $12,615	22	8
Total		50	31

Table 2. Foreign currency ratings

	S&P	Moody's	Fitch
S&P	1.00		
Moody's	0.97	1.00	
Fitch	0.98	0.98	1.00

Table 3. Local currency ratings

	S&P	Moody's	Fitch
S&P	1.00		
Moody's	0.98	1.00	
Fitch	0.97	0.96	1.00

all macroeconomic data used as determinants in the estimated credit rating model were available for those countries. Of the remaining 73 (unrated) countries, 31 were selected for which data were available. Table 1 shows the statistics of the selected sample of rated and unrated countries. Table 1 describes the structure of the data sample used for estimating the model and the forecasting sample. The sample data were divided into 13 low-income countries (26%), 15 lower-middle-income countries (30%) and 22 upper-middle-income countries (44%). The forecasting sample contains 7 low-income countries (22%), 16 lower-middle-income countries (52%), and 8 upper-middle-income countries (26%). Ferri, Liu and Majnoni (2001) researched the impact of sovereign ratings on bank and corporate ratings in non-high-income countries as in our sample. They report strong connection between sovereign ratings and the ratings of banks or corporations, and therefore, the sovereign rating is more important for the sample of middle- and low-income countries than for high-income countries.

The so-called Big Three (Standard & Poor's, Moody's and Fitch Ratings) account for a very large share of the ratings market. Sovereign credit ratings issued by Standard & Poor's, Moody's and Fitch Ratings tend to be highly correlated. For further information on differences in sovereign ratings among Standard & Poor's, Moody's and Fitch, see Hill, Brooks and Faff (2010). This paper only considers credit ratings issued by the world's largest debt ratings agency, Standard & Poor's, for local and foreign currency ratings (henceforth, foreign currency will be denoted FC and local currency LC). Only Standard & Poor's is considered because the ratings of all three agencies are highly correlated. FC credit ratings represent an entity's creditworthiness in meeting its FC-denominated financial obligations. LC credit ratings represent an entity's creditworthiness in meeting its LC-denominated financial obligations. Tables 2 and 3 present correlation matrices for FC and LC credit ratings in 2013 issued by Standard & Poor's, Moody's and Fitch for the sample of 86 countries. As table 2 and table 3 illustrate, the correlations among the rating agencies' FC ratings are in the range 0.97–0.98, while the correlations in LC ratings are in the range 0.96–0.98 All credit ratings are transformed into numbers in the range 1–21. A rating score of 1 corresponds

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to the letter grade AAA. All credit ratings are divided into two main grades: investment and speculative grade. Investment grade bonds haves scores ranging from AAA to BB +; the bonds of countries with ratings below BB+ are considered speculative grade. The following figures depict the structure of the sample for FC and LC ratings. In addition to ratings, the rating agencies also provide *outlooks*: "positive, negative, stable or developing". S&P, Moody's, and Fitch began issuing outlooks for sovereign entities in 1989, 1997 and 2000, respectively (Gaillard, 2011). Rating watches or outlooks indicate the probability of a rating change and the direction of that change; however the issuance of a watch or outlook does not necessarily mean that there will be a change in the credit rating. According to Cavallo, Powell and Rigóbon (2008), the outlook was altered at least one year before most rating changes. Watchlist and outlook will not be considered here, as this study is focused on identifying the determinants that affect the credit rating.

According to Figures 1 and 2, FC and LC ratings range between ratings of B- and AA-. China has the best credit rating of the countries considered, which is precisely due to the large number of residents in the group of countries with GNI per capita values below $12,615. According to Figure 1, 40% of FC ratings are grades B or BB-. Figure 2 indicates that LC ratings exhibited the same structure, with ratings ranging from B- (16 countries) and AA- (4 countries), and 40% of ratings are B or BB-. Both FC and LC ratings were collected in 2013.

According Standard & Poor's, the key rating factors in assessing sovereign risk are: institutional and governance effectiveness, economic structure and growth prospects, external liquidity and international investment position, fiscal flexibility and fiscal performance, and debt burden and monetary flexibility. Using these five determinants, Standard & Poor's creates two main profiles for each country. The first is the institutional and economic profile, and the second is the flexibility and performance profile. By combining these two profiles, it creates a sovereign indicative rating level, which is it used in further analysis of FC and LC currency ratings. This paper uses similar but not identical determinants to those employed by Standard and Poor's in assessing credit ratings. According to Elkhoury (2008), when assessing sovereign risk, the credit rating agencies devote particular attention to several types of risk: economic, political, fiscal and monetary flexibility, and the debt burden. Unfortunately, it is impossible to quantify all types of risk. For example, considering political determinants, Eichler (2014) concluded that political determinants have a more pronounced impact on sovereign bond yield spreads in autocratic and closed regimes than in democratic and open countries. In an attempt to capture the most relevant determinants, this paper examines the criteria that form the basis of the sovereign ratings. From the overall group of determinants, nine are considered key for assigning ratings. Determinants that are relevant in forecasting credit ratings are described detail in Table 4. These determinants are: Heavily Indebted Poor Countries (HIPC), external debt, GDP per capita, government deficit/surplus, inflation, investments, legal rights, total reserves and government effectiveness.

HIPC: This is a dummy variable to indicate whether a country is included in the Heavily Indebted Poor Countries group. The main aim of the HIPC initiative is to reduce the debt burden of poor countries to sustainable levels that would allow them to manage their debts. These countries can borrow from the World Bank's International Development Agency and from the IMF's Poverty Reduction and Growth Trust and receive interest–free loans and grants or loans at subsidized rates. The following countries included in the sample are also included in HIPC group: Burkina Faso, Senegal, Benin, Bolivia, Ghana, Honduras, Mozambique, Cameroon, Uganda and Zambia. The HIPC included in the forecasting sample are: Chad, Nicaragua, Togo, Central African Republic, Guyana, Madagascar, Mauritania, Sudan, Burundi, Comoros, Guinea-Bissau, Malawi, Mali, Niger, Sierra Leone, and Tanzania. In the full sample, there are 26 countries that are included in the HIPC group.

External debt: Total external debt is given as percentage of gross national income. It is calculated as the sum of public, publicly guaranteed, and private nonguaranteed long–term debt, IMF credits, and short–term debt (all debt having an original maturity of one year or less). According to the World Bank, gross national income (GNI) is the sum of the value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts from primary income (employee compensation and property income) from abroad. According

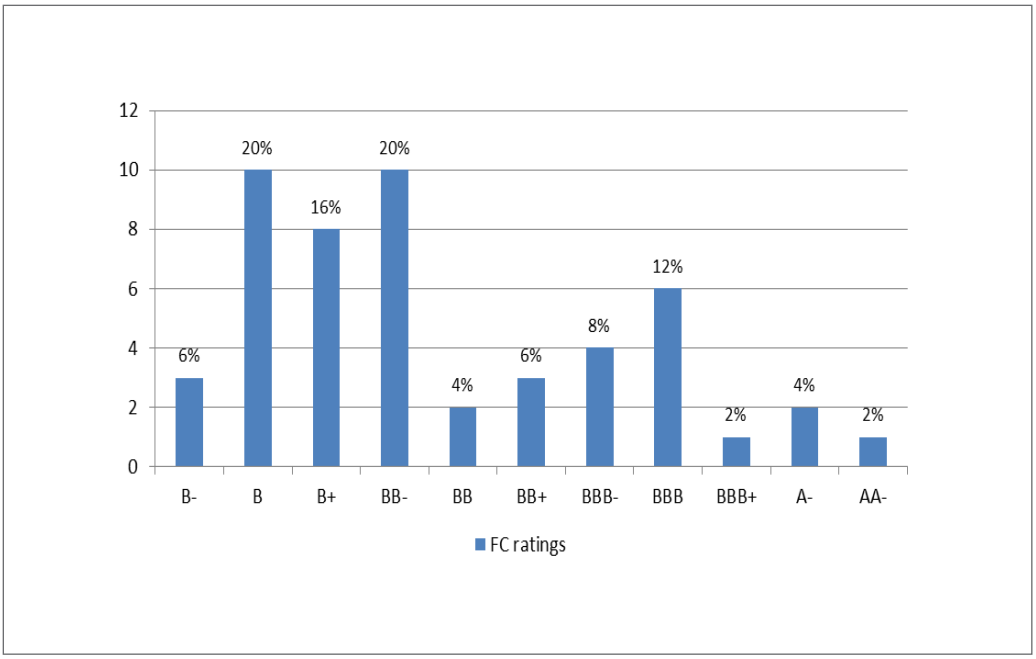

Figure 1. FC ratings of 50 countries

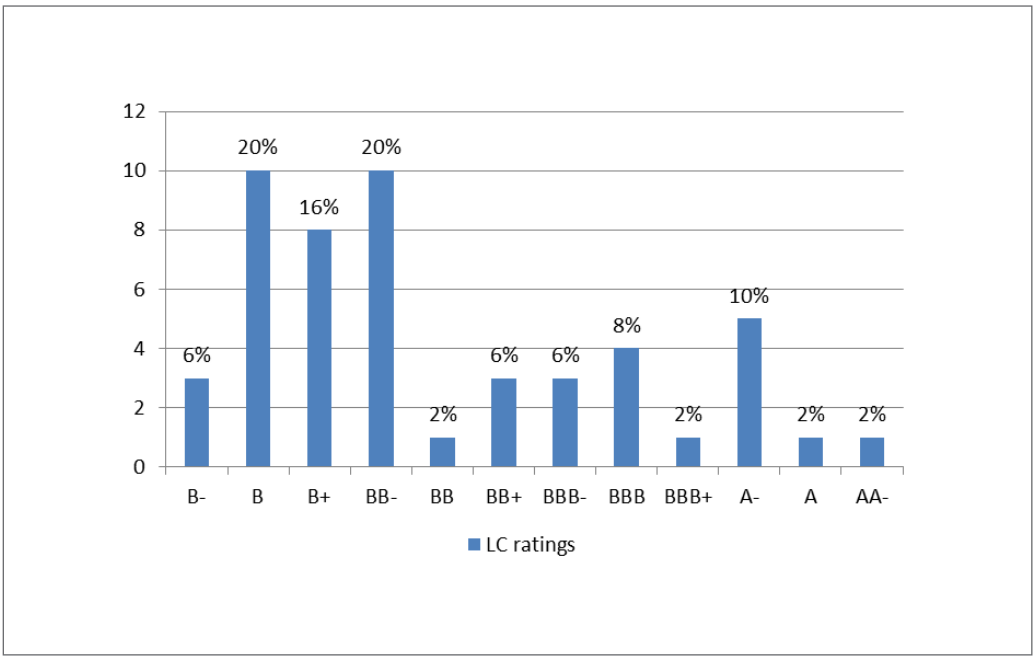

Figure 2. LC ratings of 50 countries

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Table 4. Description of variables

Variable name	Definition	Unit of Measurement	Data Sources
HIPC	Heavily Indebted Poor Countries	Dummy variable	World Bank
External debt	External debt to GNI	Percent	World Bank
GDP per capita	Gross domestic product divided by midyear population	US$	World Bank
Government deficit/surplus	General government primary net lending/borrowing. Net lending (+)/ borrowing (?) is calculated as revenue minus total expenditure.	US$	IMF
Inflation	Consumer prices (average annual % for the last 3 years)	Percent	World Bank
Investments	Total investments as a percent of GDP	Percent	World Bank
Legal rights	Strength of legal rights index (0 = weak to 10 = strong)	Index	World Bank
Total reserves	Total reserves include gold	US$	IMF
Government Effectiveness	Government effectiveness captures perceptions of the quality of public services (range: -2.5 to 2.5)	Index	World Bank

to the World Bank, the ratio of external debt to GNI in developing countries averaged 22% in 2011 compared with the 124% observed for G7 countries.

GDP per capita: The gross domestic product divided by midyear population. It is one of the primary indicators used to measure a country's economic performance and can also be employed as an indicator of the standard of living. A higher GDP per capita implies a higher standard of living. GDP represents the total value of all finished goods and services produced within a country's borders within a given period. GDP includes private consumption, or consumer spending, government spending, gross investment and total net exports (calculated as total exports minus total imports). Data are in current US$.

Government deficit/surplus: Government finance statistics (GFS) reflect the economic activities of a government, including: government revenue, expenditure, deficit, transactions in assets, transactions in liabilities, other economic flows and balance sheets. General government net lending/borrowing is a core component of the GFS balance that measures the extent to which the general government is either placing financial resources at the disposal of other sectors of the economy and nonresidents or utilizing financial resources generated by other sectors and nonresidents.

Inflation: Inflation is given as average growth in consumer prices average over the last 3 years (%). Inflation is observed over the last three years because it is a macro variable that is considered volatile to the extent that observing it for a single year can be misleading. Inflation is most commonly defined as the rise in the general price level. Purchasing power declines when the general level of prices for goods and services rises. Factors that affect aggregate supply and demand also affect inflation. A high inflation rate is indicator of economy in which the demand for goods and services exceeds productive capacity, thereby exerting greater price pressures. High inflation can cause political instability because of public discontent. There must be an inverse relationship between inflation and credit ratings. The Laspeyres formula is generally used to produce the inflation indicator.

Investments: Investments are expressed as a ratio of total investment in current local currency to GDP

in the current local currency. Investments generally stimulate economic development. Investment is a prerequisite for economic development; the rate of investment reflects the support for the development process.

Legal rights: This index ranges from 0 to 10, where a higher score indicates that laws are better designed to expand access to credit. This strength of legal rights index measures the extent to which collateral and bankruptcy laws protect the rights of borrowers and lenders. Legal rights are positively correlated with credit ratings.

Total reserves: According to official webpage of the World Bank, total reserves compromise holdings of monetary gold, special drawing rights, reserves of IMF members held by the IMF, and holdings of foreign exchange under the control of monetary authorities. The gold component of these reserves is valued at year–end London prices. Higher total reserves should result in higher ratings.

Government Effectiveness: Government effectiveness reflects estimated governance performance; the indicator ranges from approximately -2.5 (weak) to 2.5 (strong). This indicator is a crucial determinant of credit ratings. According to the World Bank, this indicator consists of a series of evaluations of government performance. The government effectiveness indicator describes the perception of the quality of public services, the quality of the civil service and the extent to which it is independent of political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. A higher government effectiveness score will also result in a better credit rating.

Results and discussion

Financial indicators cannot determine credit ratings when considered individually. It is necessary to observe them as a group to determine the economic situation of a country and its future potential. According to Bissoondoyal-Bheenick (2005), economic variables do not have the same significance for low-ranking countries as they do for high-ranking countries. In this study, countries have been classified into two groups with respect to GNI per capita: up to $12,615 and over $12,615.

This section analyzes the individual impact and significance of the variables described above. FC and LC credit ratings were collected from the Standard & Poor's official website. Credit ratings agencies use information from the past to describe the present and the future status of a country, corporation or security. Economic determinants were collected to calculate the relationships among them and between these determinants and the assigned ratings. Table 5 shows the regression results for significant variables employed in the allocation of FC and LC ratings. Based on the results of the analysis reported in Table 5, that the coefficient of determination between the FC and LC credit rating with respect to the nine independent variables is 0.83, meaning that 83% of the variation in the dependent variable is caused by variations in the selected independent variables. All FC and LC variables are statistically significant at the 1% or 5% level.

According to the classical linear regression model:

$$Y_i = \alpha+\beta_1X_1+\beta_2X_2 - \beta_3X_3 - \beta_4X_4+ \beta_5X_5 - \beta_6X_6 - \beta_7X_7 - \beta_8X_8 + - \beta_9X_9 + e_i \quad (1)$$

Credit ratings models are calculated as follows:

$$FCR=\alpha+ \beta_1HIPC+\beta_2ED-\beta_3GDPpC-\beta_4GD/S+\beta_5INF+ -\beta_6INV-\beta_7LR-\beta_8TR-\beta_9GE \quad (2)$$

$$LCR=\alpha+ \beta_1HIPC+\beta_2ED-\beta_3GDPpC-\beta_4GD/S+\beta_5INF+ -\beta_6INV-\beta_7LR-\beta_8TR-\beta_9GE \quad (3)$$

Where:

FCR	Foreign currency rating
LCR	Local currency rating
ED	External debt
GDPpC	GDP per capita
GD/S	Government deficit/surplus
INF	Inflation
INV	Investments
LR	Legal rights
TR	Total reserves
GE	Government effectiveness
HIPC	Heavily Indebted Poor Countries

After estimating the parameters, the assumptions of multiple linear regression models were tested.

First, a general specification test was performed for the linear regression model; the Ramsey RESET test was used for this purpose. The null hypothesis is that the model is correctly specified, and there is no alter-

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Table 5. Regression results using explanatory variables for credit ratings in 2013

Explanatory variables	Standard & Poor's	
	Foreign currency	Local currency
Heavily Indebted Poor Countries	1.6070**	1.5557**
	(0.0069)	(0.0193)
External debt	0.0436*	0.0526*
	(0.0000)	(0.0000)
GDP per capita	-0.0002**	-0.0003*
	(0.0251)	(0.0027)
Government deficit/surplus	-0.2067*	-0.1770**
	(0.0020)	(0.0167)
Inflation	0.0888**	0.0942**
	(0.0179)	(0.0258)
Investments	-0.0667*	-0.0571**
	(0.0042)	(0.0268)
Legal rights	-0.2083**	-0.2433*
	(0.0105)	(0.0084)
Total reserves	-0.0000[1]*	-0.0000[2]**
	(0.0080)	(0.0320)
Government Effectiveness	-2.1549*	-2.2890*
	(0.0007)	(0.0014)
Observations	50	50
R-squared	0.83	0.83
F-value	21.92	21.30
Significance F	0.0000	0.0000
Durbin Watson	2.2579	2.2419

Note: Values in parentheses are p-values
* Denotes statistical significance at 1%
** Denotes statistical significance at 5%
[1] Exact calculated value is -1.21208801397714E-12
[2] Exact calculated value is -1.09165942363536E-12

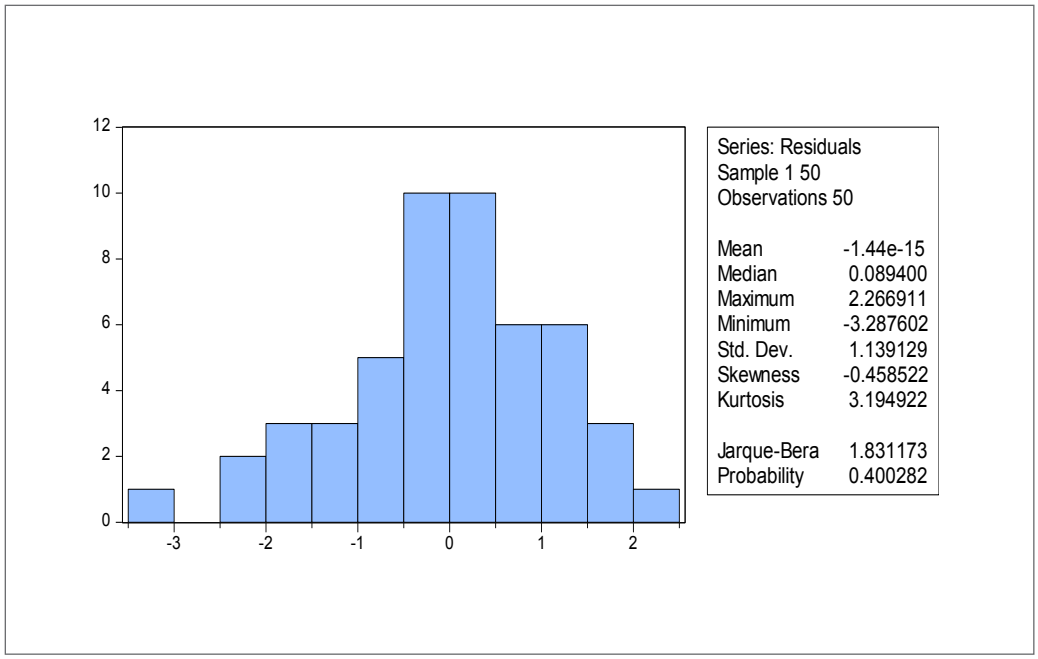

Figure 3. FCR Residual normality – JB test

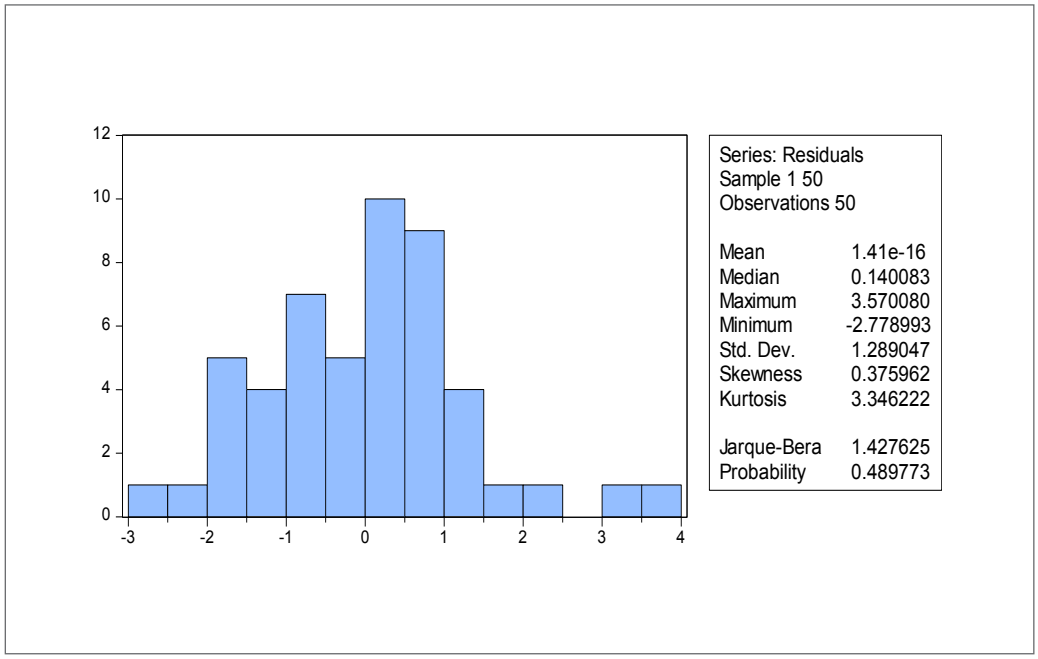

Figure 4. LCR Residual normality – JB test

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Table 6. FCR and LCR heteroscedasticity Test: White

	FCR	LCR		FCR	LCR
F-statistic	1.209	0.883	Prob. F(9,40)	0.317	0.549
Obs · R-squared	10.695	8.284	Prob. Chi-Square(9)	0.297	0.506
Scaled explained SS	7.512	6.220	Prob. Chi-Square(9)	0.584	0.718

Table 7. FCR Variance Inflation Factors

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	1.318	41.469	NA
X_1	0.318	2.002	1.601
X_2	8.44E-05	5.853	1.321
X_3	9.21E-09	8.460	2.621
X_4	0.004	2.805	1.385
X_5	0.001	3.089	1.313
X_6	0.000	11.312	1.389
X_7	0.006	7.598	1.098
X_8	1.89E-25	1.352	1.291
X_9	0.347	3.077	2.284

Table 8. LCR Variance Inflation Factors

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	1.688	41.469	NA
X_1	0.408	2.002	1.601
X_2	0.000	5.853	1.321
X_3	1.18E-08	8.460	2.621
X_4	0.005	2.805	1.385
X_5	0.002	3.089	1.313
X_6	0.001	11.312	1.389
X_7	0.008	7.598	1.098
X_8	2.41E-25	1.352	1.291
X_9	0.444	3.077	2.284

native hypothesis. The rejection of the null hypothesis indicates that the model is incorrectly specified. Because the calculated F-value for the FCR model ($F_{(1.39)}$ = 0.0180) is below the critical threshold, and the p-value exceeds α (p-value = 0.89), the null hypotheses cannot be rejected. In the case of the LCR model because the F-value ($F_{(1.39)}$ = 0.0920) is less than the critical threshold, and the p-value exceeds α (p – value = 0.76), null hypothesis cannot be rejected. The FCR and LCR models are correctly specified.

The second test was for the normality of residuals, and we used the Jarque–Bera test for thus purpose. The normality of residuals enables us to construct an F-test that is used to test the hypothesis of the significance of the regression (pooled test). The null and alternative hypotheses in the Jarque–Bera test are as follows:

H_0 = normal distribution

H_1 = non-normal distribution

The Jarque–Bera statistic is 1.83 for the FCR model and 1.43 for the LCR model; both are less than the

critical value and indicate that the residuals are normally distributed. In addition, the calculated p-values are larger than α (0.40>0.05), (0.49>0.05), which supports the previous conclusion. The calculation and histograms of the residuals are depicted in Figures 3 and 4.

Autocorrelations were tested using Durbin Watson test. The null and alternative hypotheses for this test are as follows:

H_0 = there is no autocorrelation in data

H_1 = there is autocorrelation in data

If $d_U \leq d \leq 4$, H_0 is accepted; the results of the Durbin Watson test for FCR (d = 2.26) and for LCR (d = 2.24) indicate that $1.805 \leq 2.26 \leq 4$ (for FCR) and $1.805 \leq 2.24 \leq 4$ (for LCR); H_0 can be accepted – there is no autocorrelation in the data in the FCR and LCR models.

The next test checks for the presence of heteroskedasticity. If heteroskedasticity is not present, the data are homoskedastic. As Table 6 shows, Prob. Chi-Square (for the FCR data) is larger than α (0.29>0.05), and thus it can be concluded that there is no heteroskedasticity and the data are homoskedastic. Prob. Chi-Square for the LCR data is larger than α (0.50>0.05), and hence it can be concluded that there is no heteroskedasticity; the data are also homoskedastic in the LCR model.

Multicollinearity is present if two regression variables are dependent or approximately linearly dependent (Bahovec & Erjavec, 2009). The standard indicator of multicollinearity is the variance inflation factor (VIF). The results of the multicollinearity test are shown in tables 7 and 8: The VIF for each of explanatory variables is quite small, suggesting that the null hypothesis, which assumes the presence of multicollinearity, should be reject for the FCR and LCR models. When the empirical VIF values are less than five (VIF<5), it can be concluded that there is no multicollinearity in the observed sample.

Forecasting

In Table 9, the ratings are calculated according to formulas (2) and (3). The FC and LC values presented in the table represent the credit ratings assigned by Standard & Poor's. Table 9 shows the actual and estimated credit ratings and forecasting errors, denominated in FC and LC for 50 countries. (FCR denotes Foreign Currency Rating, FFCR denotes Forecasted Foreign Currency Rating, FCFE denotes Foreign Currency Forecast Error, LCR denotes Local Currency Rating, FLCR denotes Forecasted Local Currency Rating, and LCFE denotes Local Currency Forecast Error). The second and third columns report the values of the actual and estimated FC credit rating, which are then used to calculate the forecasting errors (column 4). The remaining three columns are also actual and forecasted credit ratings with calculated forecasted errors, but these are LC values.

Table 10 shows the statistics of predicted credit ratings in the sample. This table reports the statistics of successfully assigned forecasted ratings. Based on a sample of 50 countries, 40% of the estimated ratings are equivalent to the actual assigned ratings, 40% of the estimated ratings are +/- one notch from the actual rating, 18% are +/- two notches from the actual rating, and only 2% were +/- three notches from the actual rating. In the LC estimates, 30% of estimated credit ratings are correct, 48% of the ratings are +/- one notch from the actual rating, 16% are +/- two notches from the actual rating, 4% are +/- three notches from the actual rating, and only 2% are +/- four notches from the actual rating.

Therefore, these two models are very precise. After evaluating credit rating models within the sample, we estimate FC- and LC-denominated credit ratings for 38 countries out of the sample. The selected countries represent unrated countries. As Table 11 shows, this sample consists of 31 unrated countries. After obtaining the ratings estimates, we analyzed them on the basis of the descriptive statistics. The mean value of both (FC and LC) estimated ratings is 14 (B+). The median predicted rating in both samples is 15; half of the countries are rated B and lower, and the other half is rated B and higher. For the FC estimates, the highest credit rating is A-, and the lowest is CCC-, while for the LC estimates, the highest rating is A and the lowest is CC. In most cases, the estimated credit ratings denominated in foreign and local currency are equal, and those credit ratings that differ for a given country when evaluated in foreign and local currency differ by

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Table 9. Sample forecasting

Country	FCR	FFCR	FCFE	LCR	FLCR	LCFE	Country	FCR	FFCR	FCFE	LCR	FLCR	LCFE
Angola	BB-	BB-	0	BB-	BB-	0	Philippines	BBB-	BB	-2	BBB-	BB	-2
Brazil	BBB	BBB-	-1	A-	BBB	-2	Romania	BB+	BB	-1	BB+	BB+	0
Burkina Faso	B	B	0	B	B	0	Serbia	BB-	B+	-1	BB-	B+	-1
Cape Verde	B+	BB-	1	B+	BB-	1	Belarus	B-	B-	0	B-	B-	0
China	AA-	AA-	0	AA-	AA-	0	Bosnia and Herzegovina	B	B+	1	B	B+	1
Dominican Republic	B+	B+	0	B+	BB-	1	Botswana	A-	A-	0	A-	A	1
Ecuador	B	BB	3	B	BB+	4	Cambodia	B	BB-	2	B	B+	1
India	BBB-	BB	-2	BBB-	BB+	-1	Cameroon	B	B+	1	B	B+	1
Kenya	B+	BB-	1	B+	BB-	1	Colombia	BBB	BBB	0	BBB+	BBB	-1
Morocco	BBB-	BB	-2	BBB	BB	-3	Costa Rica	BB	BBB-	2	BB	BBB	3
Senegal	B+	B+	0	B+	B+	0	El Salvador	BB-	BB-	0	BB-	BB-	0
Sri Lanka	B+	BB-	1	B+	BB-	1	Guatemala	BB	BB-	-1	BB+	BB-	-2
Vietnam	BB-	B+	-1	BB-	B+	-1	Jamaica	B-	B+	2	B-	B	1
Azerbaijan	BBB-	BBB-	0	BBB-	BBB-	0	Jordan	BB-	B+	-1	BB-	B+	-1
Benin	B	B+	1	B	B+	1	Malaysia	A-	A-	0	A	A+	1
Bolivia	BB-	B+	-1	BB-	B	-2	Mongolia	BB-	BB-	0	BB-	BB-	0
Bulgaria	BBB	BB+	-2	BBB	BB+	-2	Nigeria	BB-	BB-	0	BB-	BB	1
Georgia	BB-	BB+	2	BB-	BB+	2	Pakistan	B-	B-	0	B-	B-	0
Ghana	B	B	0	B	B	0	Peru	BBB+	BBB	-1	A-	BBB	-2
Honduras	B	B+	1	B	B+	1	South Africa	BBB	BBB	0	A-	BBB+	-1
Indonesia	BB+	BB+	0	BB+	BB+	0	Tunisia	B	BB-	2	B	BB-	2
Mexico	BBB	BBB	0	A-	BBB+	-1	Turkey	BB+	BBB-	1	BBB	BBB	0
Mozambique	B+	B	-1	B+	B	-1	Uganda	B+	B	-1	B+	B	-1
Panama	BBB	BBB-	-1	BBB	BBB	0	Ukraine	B	B	0	B	B-	-1
Paraguay	BB-	B+	-1	BB-	B+	-1	Zambia	B+	B+	0	B+	B+	0

one notch. In some instances, ratings agencies will assign a higher rating to domestic currency obligations than to foreign currency obligations, but it is clearly important to highlight that the rating difference between these two types of credit ratings are not uniform. This analysis also confirms the second hypothesis of this study, which claims that unrated countries are not necessarily at the bottom of the rating scale. The sample is graphically depicted in Figures 5 and 6.

Table 10. Forecasted ratings for the sample of 50 countries

	% of hit	% of miss			
	+/- 0 notch	+/- 1 notch	+/- 2 notches	+/- 3 notches	+/- 4 notches
FC Forecasting error	40%	40%	18%	2%	-
LC Forecasting error	30%	48%	16%	4%	2%

Table 11. Forecasted foreign and local currency ratings

Country	FFCR	FLCR	Country	FFCR	FLCR
Algeria	BBB-	BBB-	Nepal	BB-	BB-
Armenia	BB-	BB-	Seychelles	B+	B
Chad	B	B	Solomon Islands	BB	BB-
Dominica	BBB-	BBB	Sudan	CCC-	CC
Nicaragua	CCC	CCC-	Tonga	BBB-	BBB-
St. Lucia	BBB-	BBB	Burundi	CCC	CCC
Swaziland	BB	BB	Comoros	B-	CCC+
Togo	CCC+	CCC+	Guinea-Bissau	CCC+	CCC+
Bhutan	BB	BB-	Malawi	B	B
Central African Republic	B-	B-	Mali	B-	B-
Guyana	B-	B-	Moldova	B	B
Kyrgyz Republic	B-	CCC+	Niger	BB-	B+
Madagascar	CCC+	CCC+	Sierra Leone	CCC	CCC
Maldives	B	B+	Tajikistan	B-	B-
Mauritania	B	B-	Tanzania	B	B-
Mauritius	A-	A			

Conclusion

Sovereign ratings present an unavoidable stop on the road to international capital markets. Despite numerous criticisms in recent years, credit ratings continue to have a substantial impact on the market, especially regarding the cost of capital. A higher risk exhibited by the debt issuer implies a lower credit rating, which means that debt issuer pays a higher interest rate on borrowed capital. This paper assesses the economic determinants of sovereign credit ratings assigned by Standard & Poor's in local and foreign currency. The aim of this study was to identify a forecasting model

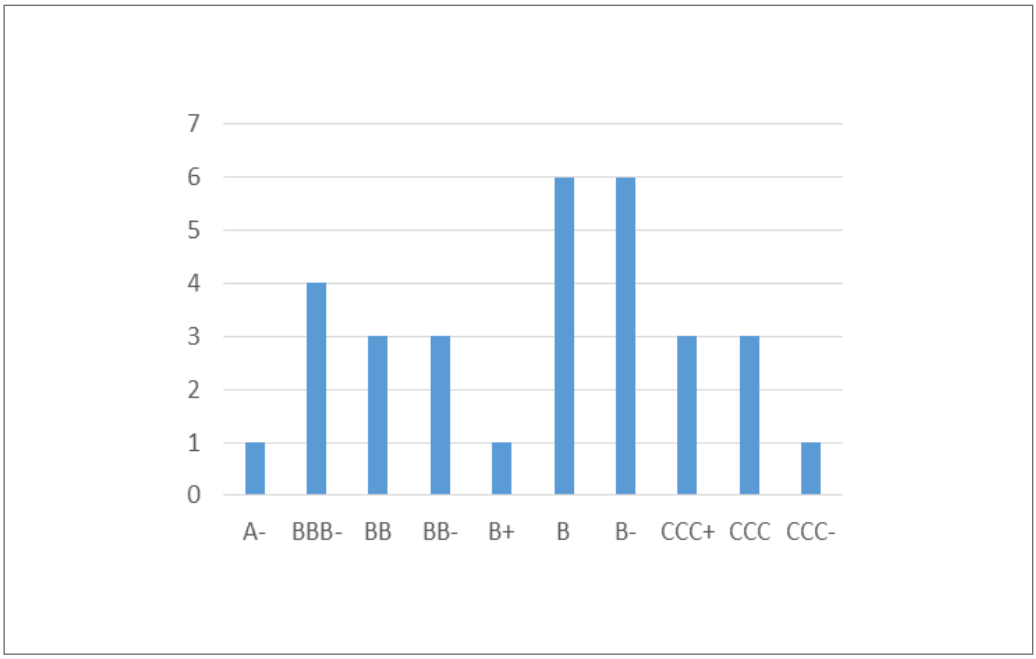

Figure 5. Statistics of FFCR ratings

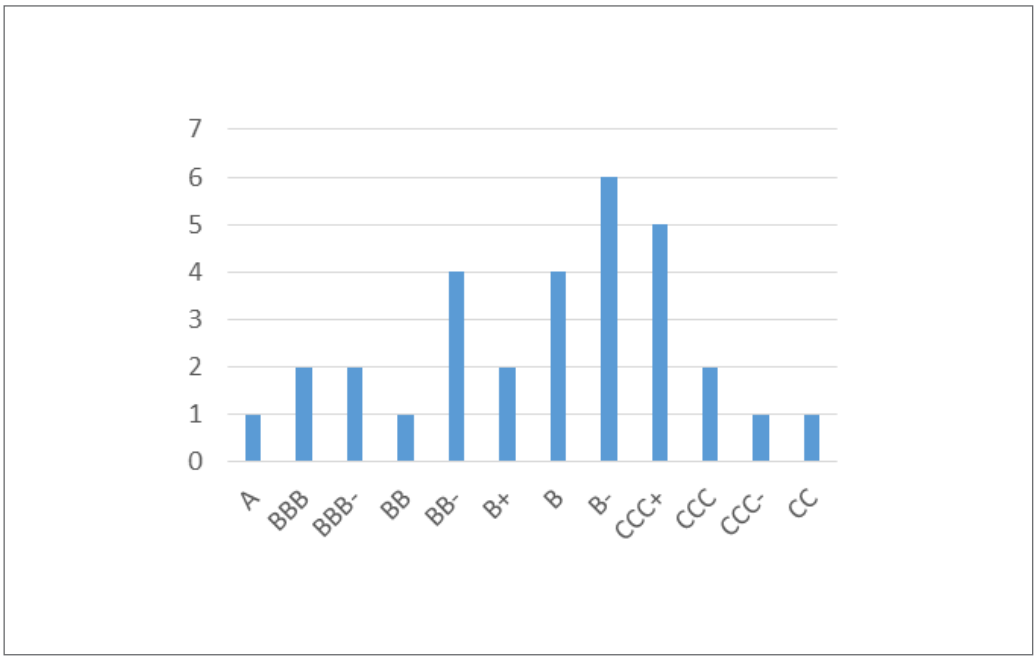

Figure 6. Statistics of FLCR ratings

with high predictive power; the second aim was to demonstrate that unrated countries are not necessarily at the bottom of rating scale. After testing a number of possible determinants, nine were found to have a significant impact on credit ratings (at confidence levels of 95% and 99%). These determinants are: HIPC (dummy variable), external debt, GDP per capita, government deficit/surplus, inflation, investments, legal rights, total reserves and government effectiveness. Using a sample of 50 countries, two rating prediction models were constructed to estimate ratings: an FC model and a LC model. Both models have large coefficients of determination (0.83), and after comparing the within-sample ratings estimates, 40% were correct for FC and 30% for LC; 40% were +/- 1 notch from the actual rating for FC and 48% were +/- 1 notch from the actual rating for LC. Only 2% were +/- 3 notches from the actual rating for FC; in the LC model only 4% of estimates were +/- 3 notches from the actual ratings and only 2% in were by +/- 4 notches from the actual rating. This analysis confirms the high precision of these models. Note that all of the assumptions required for a linear regression model are satisfied. Among the unrated countries, the best estimated rating is exhibited by Mauritius: A in LC and A- in FC. There are five countries that have investment-grade FC ratings. These countries are: Mauritius, Dominica, St. Lucia, Tonga and Algeria. According to the FC rating, 20 countries would classify as speculative or highly speculative. Only 7 countries are considered to have high or very high credit risk. The secondary hypothesis of this paper is also confirmed—unrated low- and middle-income countries need not occupy the bottom of the ratings scale. It is important to further emphasize that the credit rating agencies, beyond the objective factors, also include subjective factors, which makes it difficult to exactly quantify ratings. For this reason, it is not possible to construct a model capable of reflecting current credit ratings with 100% accuracy.

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