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Non-Linear Determinants of Developing Countries' Sovereign Ratings: Evidence from a Panel Threshold Regression (PTR) Model

Sami Ben Mim ¹, Ridha Nouria ² and Fatma Mabrouk ^{3,*} 

¹ IHEC, LaREMFiQ, Sousse University, Sousse 4000, Tunisia

² LAMIDED & ISFF, Sousse University, Sousse 4000, Tunisia

³ Department of Economics, College of Business and Administration, Princess Nourah bint Abdulrahman University, P.O. Box 84428, Riyadh 11671, Saudi Arabia

* Correspondence: fmmabrouk@pnu.edu.sa

Abstract: This paper investigates the non-linear effects produced by the main determinants of the sovereign ratings issued by Moody's agency. Using a sample of 29 countries observed over the 2000–2019 period, we identify the factors leading a country to be classified, respectively, in the speculative, moderately speculative, and highly speculative grades. The fixed effect logit estimates reveal that the effects produced by the independent variables on the ratings are largely different from one class of assets to another. The second and main contribution of this study is that it highlights the non-linear effects produced by macroeconomic variables on the probability of downgrading a country from the investment to the speculative grade and from the moderately speculative to the highly speculative grade. Panel threshold regression (PTR) results reveal that control of corruption, external debt, government effectiveness, and domestic credits are the main variables producing such non-linear effects.

Keywords: sovereign rating; developing countries; panel threshold regression



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1. Introduction

The catching-up process in which most developing countries are engaged requires massive investments in various fields. Most of these investments are carried out by governments and public firms [1]. In most developing countries, important social transfers are also made in order to alleviate poverty and develop human capital. Consequently, public debts in developing countries rose sharply during the last decades. According to World Bank statistics, low-income countries' debt reached a record level of USD 860 billion in 2020. The sustainability of public finance in these countries became highly reliant on foreign funding [2]. In this respect, access to international financial markets became an economic survival issue for a number of developing countries.

The capacity of a given country to raise funds on capital markets is highly dependent on its perceived sovereign risk [3]. In particular, highly indebted countries, those exhibiting major macroeconomic imbalances or facing periods of strong political and social instability, would incur high debt-servicing costs, as interest rates claimed by investors are closely tied to the country's risk level [4]. Sovereign debt markets have always been dominated by banking institutions. As a result, sovereign defaults have often led to spectacular bank failures. It follows that banks were the pioneers in assessing the default risk of states. In this respect, some banks have developed their own scoring function to evaluate the risk they incur when lending to states seeking external funding [5]. However, such a crucial task proved to be complicated because sovereign risk stems from various economic, political, and social factors [6]. It was not until 1918 that Moody's made its first independent sovereign risk assessment, giving rise to the rating industry. This industry has grown

rapidly, as the number of states and firms seeking funding on the bond market has steadily increased. The rating industry is however still dominated by the three major rating agencies, Moody's, Fitch, and Standard and Poors. Until the early 2000s, these three agencies were the unique actors on the market, and they still hold 95% of the market share despite the introduction of many new agencies during the last two decades [7]. As a result, ratings issued by these agencies produce a major impact on investors' decisions, and FDI flows toward developing countries became particularly sensitive to these ratings [8,9]). Indeed, and beyond its impact on funding conditions, the sovereign rating is regarded as a real barometer of the quality of the macroeconomic environment in a particular country. It also offers important insights relative to its future economic perspective ([10]).

A particularly important implication of the sovereign rating is that it largely conditions the ratings of the private firms operating in a given country. Gaillard (2012b) [11] asserted that the sovereign rating is usually the maximum rating that a private firm should expect. According to Standard and Poor's (2011) [12], only 103 private firms and public organizations managed to obtain better ratings than their respective countries. Most of these firms are multinational subsidiaries that enjoy easy access to financial markets due to the support of their parent holding companies. Conscious of these facts, states became highly concerned about improving their sovereign ratings. However, the way these ratings are designed is tainted by a high degree of subjectivity [6,13,14]. Although the methodology leading to these ratings is explicitly detailed by each of the big three agencies, the variables driving the attributed score and the voting process leading to that final decision are still discretionary. The ratings do not rely on any scoring function or any pre-established model, but rather on the opinion of a panel of experts. In this vein, Hervé Phaire, Associate Director of Risk Advisory at Deloitte, considered that agencies are at the center of a complex network that includes the market, policies, and funding. Ratings and their evolution are, therefore, increasingly difficult to manage, including for agencies. There is no full magic calculator but always, in the end, an expert decision can impact the note. A rating represents a compromise between the historical behavior of the rated entity, the current context, and the anticipation of the rated entity's ability to withstand adverse situations.

Given the discretionary nature of sovereign ratings, a large body of empirical investigations focused on the determinants of these scores. This main stream of the literature tried to identify the macroeconomic and institutional indicators that contribute the most to explaining the ratings provided by the three major agencies. While some studies tried to assess the optimal weights attributed to each macroeconomic aggregate, others highlighted the differences among groups of countries, focusing particularly on developing countries. The main limit of the empirical literature dealing with sovereign ratings is that has neglected the non-linearity issue. Most of these studies supposed that experts are applying the same evaluation standards for countries ranked in the investment grade and those belonging to the speculative grade. We argue that it is likely that emphasis should be put on a different set of aggregates for each group of countries. Experts should pay particular attention to variables reflecting public finance sustainability when evaluating countries at the bottom of the ranking, while they should focus on a different set of indicators when dealing with weakly indebted countries. Moreover, when a key macroeconomic variable exceeds a critical threshold it may produce a different effect on the rating decision, leading to a relationship characterized by two different regimes. To sum up, the relationship between the sovereign ratings and their determinants can be subject to two sources of non-linearity: the first stems from the differences across the classes of assets, while the second is in relation to the critical values of the explanatory variables themselves.

This study tries to fill this gap by addressing the non-linearity issue for a panel of 29 developing countries over the 2000–2019 period. Our contribution is twofold. Based on Moody's ratings, we first seek to identify the main determinants which lead to downgrading a country from the investment grade to the speculative grade. Moreover, within the speculative grade, we distinguish two classes of countries: those belonging to the moderately speculative grade (ratings from Ba1 to B3) and those belonging to the highly

speculative grade (ratings between Caa1 and C). Both downgrading probabilities are modeled using a fixed effects logit model. It is particularly important for investors and decision-makers to identify the main factors leading to classifying sovereign assets as highly speculative. The second and main contribution of this study is that it highlights the non-linear effect of the macroeconomic variables on the downgrading probabilities. Using the panel threshold regression (PTR) model introduced by Hansen (1999) [15] we test for the existence of significant thresholds for each of the independent variables and compare their effects across the different regimes. To our knowledge, this is the first study employing this empirical methodology to assess non-linearity while investigating the determinants of the sovereign rating.

The remainder of this paper is organized as follows. The second paragraph is dedicated to a review of the main results obtained by previous empirical studies dealing with the determinants of sovereign ratings. The methodology and the sample are presented in paragraph three, while paragraph four summarizes and discusses the main results. Conclusions and policy recommendations are formulated in the last paragraph.

2. Literature Review

Explaining sovereign ratings and identifying their determinants is a topic that has been widely debated in the literature. One of the pioneering works is that of Cantor and Packer (1996) [16]. Using cross-sectional data relative to 49 countries and controlling for eight independent variables, they found that the model explains more than 90 percent of the variance of the sovereign ratings. Among the retained explanatory variables, only per capita income, external debt, inflation, default history, and the level of economic development produced consistent and significant effects, while GDP growth produced different effects on Moody's and Standard and Poor's ratings. The fiscal balance and external balance proxies were found to be statistically non-significant. Another important finding of this seminal paper is that it has also proved that sovereign ratings explain to a large extent the bond market spread, which confirms that sovereign risk is highly influential on the funding conditions of private firms. Cantor and Packer (1996) [16] have also drawn attention to the non-linearity of the relationship between the sovereign rating and income level, considering that beyond a certain income threshold, a country's default risk decreases significantly. However, they handled this problem by introducing a dummy variable reflecting if a country is classified as industrial by the International Monetary Fund. Similar results were obtained by Afonso (2003) [17] for a sample of 81 developed and developing countries. In addition to the five variables detected by Cantor and Packer (1996) [16], Afonso (2003) [17] found that GDP growth produces a significant impact on the linear and logistic transformations of the rating levels. Gaillard (2012a) [7] contented that sovereign ratings are dependent on five main factors: GDP per capita, institutional and political stability, indebtedness level, the inflation rate, and default history. He also argued that exchange reserves and workers' remittances are two additional determinants that are particularly relevant for developing countries. However, Hill et al. (2010) [18] pointed out that Moody's, Fitch, and Standard and Poor's assign different weights to the various determinants of sovereign ratings. Their empirical findings identified a set of six common determinants, including GDP growth and its square. Such a result offers additional evidence for a non-linear effect of growth on the ratings. Takawira and Mwamba (2022) [19] investigated the sovereign rating determinants in South Africa. Their logistic regression results showed that household debt to disposable income is a crucial determinant of the sovereign rating. Their estimation outcomes also revealed that the exchange rate and the inflation rate are important determinants of the ratings assigned by the three major agencies. Afonso et al. (2011) [20] opted for a different approach by trying to distinguish between the short-run and the long-run determinants of sovereign ratings. Their results suggest that changes in GDP per capita, GDP growth, government debt, and government balance produce a significant short-run effect on a country's credit rating, while government effectiveness, external debt, foreign reserves, and default history are important long-run determinants.

Another source of non-linearity has been highlighted by Reusens and Croux (2017) [21], who argued that the factors guiding the rating decisions may change considerably during periods of financial turmoil. Empirical evidence suggests that the three main rating agencies have put further stress on financial balance, economic development, and external debt during the European debt crisis. Moreover, a negative effect was associated with countries belonging to the Eurozone during the crisis period. Teixeira et al. (2018) [22] confirmed that different regions are affected differently during periods of the financial crisis. Using data relative to 83 countries over the 1993–2013 period, they found that the rating of the Asian countries was the most affected during the Asian crisis, while the Eurozone countries were particularly penalized during the subprime crisis. In a recent study, Zwart (2022) [23] found that the impact of public debt on sovereign rating is non-linear and highly dependent on a country's level of GDP per capita. Particularly, countries with high levels of GDP per capita are more likely to experience a change in their sovereign rating as a result of a change in their debt ratio.

Another stream of literature argued that rating agencies, Moody's in particular, are putting growing emphasis on sustainability issues. In this respect, Flavelle (2019) [24] revealed that *"Moody's Corporation has purchased a controlling stake in a firm that measures the physical risks of climate change, the latest indication that global warming can threaten the creditworthiness of governments and companies around the world"*. Similarly, Wallace (2021) [25] reported that Moody's has recently acquired RMS for approximately USD 2 billion. RMS is a global provider of climate and natural disaster risk modeling covering 120 countries. This reflects Moody's growing interest in environmental issues while assessing sovereign risk. In a recent study, Arsh et al. (2023) [26] pointed out that the ESG scores obtained from three different rating agencies contribute to decreasing the structural sovereign credit risk, particularly by reducing the distance to default. However, the magnitude of this effect varies across ESG score providers due to a lack of standardization. Despite this growing interest, Gratcheva et al. (2022) [27] outlined that addressing sustainability issues by rating agencies continues to fall short of expectations. In particular, they noticed that the governance dimensions are often taken into consideration during the risk assessment process, while the inclusion of social and environmental factors is still extremely limited.

Various other studies have pointed out the importance of institutional and political factors in explaining the way rating agencies are conducting their scoring process. In this respect, Biglaiser and Staats (2012) [2] found that adherence to the rule of law and property protection, as well as the strength and independence of the legal system, all contribute significantly to enhancing the sovereign ratings. They believe that an independent and efficient legal system will allow a smooth transmission of power between political parties and prevent social instability which should impact positively economic performance. Moreover, the democratic process will force the governments willing to maintain power to achieve better economic results. Therefore, they strongly encourage developing countries to reform their legal systems in order to benefit from the expected payoffs. In a similar setting, Montes et al. (2016) [28] confirmed that fighting corruption and promoting democracy, law, and order are important mechanisms to improve sovereign ratings. Similarly, Beaulieu et al. (2012) [29] confirmed that democratic countries obtain easier access to international financial markets. In a more recent work, Bodea and Hicks (2018) [30] emphasized the impact of the central bank governance on sovereign credit rating, arguing that *"central bank governance serves as a forward looking signal of policy and institutional stability"*. Their empirical findings suggest that the legal central bank's independence contributes significantly to improving sovereign ratings, while the opposite outcome is generated by conflicts between governments and central banks, which lead to central bankers' turnover. However, the obtained results do not provide any support for the positive effect of the central bank's transparency on credit ratings. Bodea and Hicks (2018) [30] also stressed that the governance of central banks produces different effects on Moody's and Standard and Poor's ratings, which confirms the methodological differences across rating agencies, as highlighted by Fuchs and Gehring (2013) [31].

Oppositely, another stream of studies dealing with the impact of the institutional framework on sovereign ratings obtained a different set of conclusions. Acher et al. (2007) [3] questioned the importance of political and institutional factors in the ratings provided by the three main agencies. Using both regression analysis and interviews, they found that these factors produced little effect on the ratings of fifty developing countries compared to the economic factors that enhance a country's ability to meet its commitments. They concluded that policymakers in developing countries should focus on the factors that support bond repayment in order to improve their ratings. In the same vein, Cordes (2012) [32] contended that a contested electoral process does not affect the rating outcome. More recent studies considered that taking into account political and institutional factors induced a high degree of subjectivity in the evaluation process, leading to biased ratings [31]. In this respect, Gaillard (2012b) [11] reported that Japanese agencies were particularly indulgent when rating Asian governments, while Fuchs and Gehring (2013) [31] pointed out a similar behavior for the Chinese agencies which, compared to the US agencies, are assigning higher ratings for China and BRIC countries and lower ratings to Western countries. Examining closely the ratings provided by the three big US agencies, De Moor et al. (2018) [6] detected that they embed a large subjective component that positively affects countries belonging to the investment grade and negatively those ranked in the speculative grade. Consequently, subjectivity seems to affect most developing countries. Considering data from six different countries, Fuchs and Gehring (2013) [31] showed that agencies do not only assign higher ratings to their home countries, but also to countries showing high cultural similarities and those where home-country banks are holding large investments. McDaniels et al. (2021) [33] reported that following the subprime crisis, the Financial Stability Board strongly recommended reducing reliance on ratings assigned by the rating agencies. Such a recommendation is mainly due to the incapacity of the rating agencies to detect financial distress sufficiently in advance.

3. Model, Methodology, and Data Description

This study empirically assesses the determinants of sovereign ratings. More specifically, we intend to explain the probability that the sovereign rating of a given country ranges, respectively, in the investment grade, speculative grade, moderately speculative grade, and highly speculative grade. To that end, we decompose the Moody's rating grid in the following way:

Investment Grade (Green Zone)	Aaa,Aa1,Aa2,Aa3,A1,A2,A3,Baa1,Baa2,baa3	
Speculative grade (Red zone)	Moderately speculative (Light red zone)	Ba1,Ba2,Ba3,B1,B2,B3
	Highly speculative (Dark red zone)	Caa1,Caa2,Caa3,Ca,C,WR

We first consider a linear framework defined by the following model:

$$SR_{it} = \mu_i + \alpha_1 Unemp_{it} + \alpha_2 Inv_{it} + \alpha_3 Growth_{it} + \alpha_4 FDI_{it} + \alpha_5 Inf_{it} + \alpha_6 Corr_{it} + \alpha_7 Debt_{it} + \alpha_8 Stab_{it} + \alpha_9 Deficit_{it} + \alpha_{10} Gov_{it} + \alpha_{11} Credit_{it} + \varepsilon_{it} \quad (1)$$

where μ_i represents the country fixed effects and ε_{it} is the error term.

The dependent variable (*sovereign rating*, *SR*) is a dummy variable taking the value of 1 if the sovereign rating is, respectively, classified in the speculative grade, soft speculative grade, and highly speculative grade. Model (1) is, therefore, estimated for each of the three following configurations (Table 1):

Table 1. Dependent variables.

Specification	Dependent Variables' Definitions
Specification (1)	Probability to be downgraded from the investment to the speculative grade. SR = 1 if the sovereign rating is in the speculative grade (red zone). SR = 0 if the sovereign rating is in the investment grade (green zone).
Specification (2)	Probability to be downgraded from the investment to the soft speculative grade. SR = 1 if the sovereign rating is in the moderately speculative grade (light red zone). SR = 0 if the sovereign rating is in the investment grade (green zone).
Specification (3)	Probability to be downgraded from the soft speculative grade to the highly speculative grade. SR = 1 if the sovereign rating is in the highly speculative grade (dark red zone). SR = 0 if the sovereign rating is in the moderately speculative grade (light red zone).

Data relative to the sovereign ratings were extracted from *the Interactive Data Credit Ratings International database*.

Following the relevant literature, a set of frequently employed sovereign rating determinants has been selected, including the unemployment rate, the investment rate, economic growth, foreign direct investment, the inflation rate, external debt, domestic credits, and the government budget deficit. The recent literature emphasized that the institutional framework is playing a key role in shaping the sovereign ratings. Accordingly, we included three governance indicators reflecting different dimensions of the institutional framework: control of corruption, government effectiveness, and political stability. The sources and definitions of the variables are given in Table 2.

Table 2. Independent variables.

Variable	Definition	Source
Unemployment rate (<i>Unemp</i>)	Total unemployment as a percentage of the total labor force	World Development Indicators (WDI), World Bank
Investment rate (<i>Inv</i>)	Gross fixed capital formation (% of GDP)	World Development Indicators (WDI), World Bank
Economic growth (<i>Growth</i>)	GDP per capita growth rate (annual %)	World Development Indicators (WDI), World Bank
Foreign direct investment (<i>FDI</i>)	Net foreign direct investment inflows (% of GDP)	World Development Indicators (WDI), World Bank
Inflation rate (<i>Inf</i>)	Variation rate of consumer prices (annual %)	World Development Indicators (WDI), World Bank
External debt (<i>Debt</i>)	Total external debt stocks to gross national income (% of GNI)	World Development Indicators (WDI), World Bank
Domestic credits (<i>Credit</i>)	Domestic credit to the private sector by banks (% of GDP)	World Development Indicators (WDI), World Bank
Government budget deficit (<i>Deficit</i>)	Current account balance (% of GDP)	World Development Indicators (WDI), World Bank
Control of corruption (<i>Corr</i>)	The extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as the "capture" of the state by elites and private interests. Estimates range from −2.5 to 2.5.	Worldwide Governance Indicators

Table 2. Cont.

Variable	Definition	Source
Government effectiveness (<i>Gov</i>)	The quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. Estimates range from −2.5 to 2.5.	Worldwide Governance Indicators
Political stability (<i>Stab</i>)	The likelihood of political instability and/or politically-motivated violence, including terrorism. Estimates range from −2.5 to 2.5.	Worldwide Governance Indicators

In the second step, we opt for the fixed-effect panel threshold model developed by Hansen (1999) [15] in order to check the existence of a nonlinear relationship between the sovereign rating and its determinants. The advantage of this method is threefold. First, it illustrates how the control variables may impact differently on the dependent variable across different regimes. The threshold model can, for example, capture how the unemployment rate may produce different effects on the sovereign rating above and below a certain critical level of unemployment. Secondly, the threshold values associated with the different control variables are determined endogenously. Finally, this approach allows for several coefficients to change simultaneously from one regime to another. To the best of our knowledge, this study is the first to employ the panel threshold approach while assessing the determinants of the sovereign rating.

The panel threshold regression (PTR) examines if the relationship between the variables x and y changes depending on whether a variable z is below or above a threshold level $\bar{z}$. To illustrate, consider the following basic regression:

$$y_{it} = \mu_i + \beta'(\bar{z})x_{it} + e_{it} \quad (2)$$

where β is the estimated coefficients vector and x_{it} is a vector of explanatory variables. If the relationship between y_{it} and x_{it} is linear, $\bar{z}$ can be dropped from the equation. Estimating (2) using the standard fixed-effects estimator gives the best fit of the data. However, if the true model is nonlinear, then there exists at least one threshold value, ($\bar{z}$). In this case, the estimation method should determine the threshold and test whether it is significant within the variation interval of the variable z . If the threshold is not significant within such an interval, it is not binding and (2) can be estimated using the standard panel data techniques. If the threshold ranges within the variation interval, model (2) can be represented by the following equation [15] (Hansen, 1999):

$$y_{it} = \mu_i + \beta_1'x_{it}(z < \bar{z}) + \beta_2'x_{it}(z \geq \bar{z}) + e_{it} \quad (3)$$

where z is the threshold variable and $\bar{z}$ is the threshold value which divides the equation into two regimes. The coefficients vectors, β_1 and β_2 , can be estimated using the least squares estimator defined by Hansen (1999) [15] as follows:

$$\hat{\beta}(z) = (X^*(z)'X^*(z))^{-1}X^*(z)'Y^* \quad (4)$$

The vector of residual and the sum of squared errors are defined, respectively, as follows:

$$e^*(z) = Y^* - X^*(z)\hat{\beta}(z) \text{ and } S_1(z) = e^*(z)'e^*(z)$$

The least squares estimator of $\bar{z}$ is: $\hat{z} = \argmin(S_1(z))$.

The threshold is the value that minimizes the residual sum of squares. It is important to determine whether the threshold effects are statistically significant within the variation interval of the variable z . This corresponds to a test of the following hypotheses:

$$H_0 : \beta_1 = \beta_2 \text{ versus } H_1 : \beta_1 \neq \beta_2$$

Under the null hypothesis of no threshold, the model is:

$$y_{it} = \mu_i + \beta_1' x_{it} + e_{it} \quad (5)$$

After applying the fixed-effect transformation, we have:

$$y_{it}^* = \beta_1' x_{it}^* + e_{it}^* \quad (6)$$

The sum of squared errors is $S_0 = e^* e^*$. The likelihood ratio test of H_0 is:

$$F_1 = \frac{S_0 - S_1(\hat{z})}{S_1(\hat{z})/nT} \quad (7)$$

which has a non-standard asymptotic distribution. We rely on the bootstrapping procedure to determine the distribution.

Before implementing the Hansen estimator, we should transform the binary sovereign ratings (SR_{it}) into a continuous variable (π_{it}) which measures the probability to associate the value 1 to the dependent variable (if $SR_{it} = 1$, we obtain π_{it} and if $SR_{it} = 0$, we obtain $1 - \pi_{it}$). The logit transformation is one-to-one. The inverse transformation, called the anti-logit, allows us to go back from logits to probabilities:

$$\pi_i = \frac{e^{Z_i}}{1 + e^{Z_i}} \text{ with } Z_i = \text{logit}(\pi_i) = X_i \beta.$$

Our sample is a balanced panel data set covered the period 2000–2019 and included 29 developing countries. To ensure the representativeness of the sample we included countries from Latin America, the MENA region, Asia, and Sub-Saharan Africa. The list of countries is presented in Table 3. Descriptive statistics relative to the control variables are provided in Table 4. Most of the macroeconomic aggregates are showing satisfactory means values for the full sample, but are characterized by extremely high standard deviations, suggesting that the macroeconomic performances differ dramatically from one country to another. The country mean values summarized in Table 5 confirm the existence of significant cross-country disparities in terms of macroeconomic performance. On the other hand, the three governance proxies are showing negative means values for the full sample, which confirms the lack of effective governance in developing countries. However, the disaggregated statistics in Table 5 show that some countries such as Chile, Malaysia, Uruguay, or the Bahamas are performing well with respect to governance compared to many other countries in the sample. Pairwise correlation coefficients are provided in Table 6. We notice that the inflation rate and the debt ratio increase the probability of belonging to the speculative grade. Surprisingly, this probability is exhibiting negative correlations with the unemployment rate and the current account deficit. We also note the high correlation among the governance proxies, which suggests that countries actively fighting corruption are also those exhibiting greater political and social stability and high government effectiveness.

Table 3. Country list.

Country			
Argentina	Costa Rica	Kenya	South Africa
Bahamas	Ecuador	Malaysia	Thailand
Bolivia	Egypt	Mexico	Tunisia
Botswana	El Salvador	Morocco	Turkey
Brazil	Guatemala	Pakistan	Uruguay
Chile	Honduras	Paraguay	
China	India	Peru	
Colombia	Indonesia	Philippines	

Table 4. Descriptive statistics, full sample.

	Observation	Mean	Std. Dev	Min	Max
Unemployment	580	7.58	5.72	0.21	33.29
Investment	580	23.22	6.64	10.85	46.66
Growth	580	2.52	2.94	−11.85	13.63
FDI	580	2.79	2.17	−5.01	11.78
Inflation	580	6.27	7.82	−30.24	96.09
Corruption	580	−0.18	0.68	−1.39	1.59
Debt	580	37.56	19.58	3.87	159.89
Instability	580	−0.42	0.81	−2.81	1.28
Budget Deficit	580	−2.78	3.25	−23.9	12.98
Governance	580	−0.008	0.54	−11.5	1.31
Domestic Credit	580	46.79	28.85	9.50	165.39

Source: Authors' calculations.

Table 5. Mean values by country, 2000–2019.

Country	Infl	FDI	Growth	Invest	Unemp	Corr	Debt	Credit	Instab	Deficit	Gov
Argentina	22.62	2	0.92	16.99	10.34	−0.35	56.86	14.3	−0.06	−2.25	−0.09
Bahamas	2.69	4.18	−0.28	27.84	10.98	1.31	34.02	54.6	0.96	−2.22	0.99
Bolivia	4.68	3.03	2.45	17.47	2.83	−0.63	45.07	45.99	−0.49	−3.05	−0.5
Botswana	6.79	2.78	2.3	31.55	18.24	0.92	10.84	25.96	1.02	−0.15	0.51
Brazil	6.36	3.28	1.36	18.47	9.15	−0.12	27	48.27	−0.15	−4.58	−0.11
Chile	3.16	6.68	2.61	22.72	8.42	1.39	13.36	71.13	0.53	0.36	1.15
China	2.23	3.07	8.43	42.13	4.41	−0.41	12.82	128.77	−0.44	−2.01	0.13
Colombia	5	3.77	2.5	21.27	11.52	−0.29	31.57	34.03	−1.51	−2.06	−0.11
Costa Rica	7.03	5.72	2.57	19.86	7.57	0.65	35.62	44.92	0.65	−4.11	0.31
Ecuador	10.2	1.11	1.65	24.83	4.02	−0.71	43.55	25.26	−0.51	−1.55	−0.66
Egypt	10.29	2.93	2.34	17.41	10.7	−0.62	26.54	38.82	−0.93	−7.56	−0.5
El Salvador	2.38	2.41	1.5	17.82	5.35	−0.43	63.55	48.06	0	−3.85	−0.27
Guatemala	5.53	0.85	1.5	16.79	2.86	−0.7	32.61	28.03	−0.72	−1.94	−0.64
Honduras	6.45	5.6	1.91	25.88	4.8	−0.84	45.33	47.81	−0.42	−2.04	−0.64
India	6.43	1.63	5.02	34.2	5.58	−0.38	19.66	44.61	−1.11	−8.04	−0.03
Indonesia	6.6	1.27	3.9	29.47	5.7	−0.69	44.18	26.94	−1.06	−1.34	−0.22
Kenya	8.97	1.1	1.99	19.06	2.81	−0.96	32.39	29.04	−1.22	−4.27	−0.51
Malaysia	2.16	3.2	3.27	23.74	3.31	0.21	47.51	114.89	0.2	−3.56	1.05
Mexico	4.59	2.79	0.72	22.51	3.96	−0.45	27.19	19.1	−0.56	−2.62	0.16
Morocco	1.53	2.76	2.79	32.19	10.06	−0.26	37.11	57.19	−0.38	−3.78	−0.13
Pakistan	7.76	1.2	1.95	16.59	1.65	−0.91	32.33	20.65	−2.17	−5.05	−0.62
Paraguay	6.22	1.07	1.84	21.11	5.77	−1.03	56.81	26.91	−0.57	−0.23	−0.89
Peru	2.7	3.91	3.62	21.36	3.95	−0.35	38.72	31.38	−0.75	−0.4	−0.29
Philippines	3.84	1.59	3.65	20.48	3.38	−0.59	36.55	34.69	−1.31	−1.33	−0.01
South Africa	5.3	1.57	1.22	19.13	27.16	0.21	32.61	68.2	−0.12	−2.8	0.48
Thailand	2.02	2.73	3.4	24.83	1.1	−0.33	37.15	101.03	−0.77	−0.35	0.3
Tunisia	3.94	2.99	2.14	23.01	14.64	−0.1	64.87	56.42	−0.29	−3.54	0.2
Turkey	16.3	1.6	3.42	26.59	9.99	−0.1	44.97	39.39	−1.06	−4.45	0.17
Uruguay	8.31	4.21	2.4	18.32	9.79	1.19	58.72	30.76	0.88	−1.88	0.51

Source: Authors' calculations.

Table 6. Correlation matrix.

	PROB	Unemp	Growth	Inflation	Investment	FDI	Deficit	Debt	Credit	Stab	Corr	Gov
PROB	1											
Unemp	−0.292 ***	1										
Growth	−0.139 ***	−0.179 ***	1									
Inflation	0.301 ***	0.060	−0.148 ***	1								
Investment	−0.482 ***	−0.026	0.411 ***	−0.153 ***	1							
FDI	−0.390 ***	0.032	0.138 ***	−0.100 **	0.108 ***	1						
Deficit	−0.084 **	−0.027	0.288 ***	−0.146 ***	0.073 *	0.167 ***	1					
Debt	0.314 ***	0.011	−0.204 ***	0.176 ***	−0.367 ***	−0.139 ***	−0.009	1				
Credit	−0.621 ***	−0.021	0.205 ***	−0.316 ***	0.429 ***	0.184 ***	−0.007	−0.132 ***	1			
Stab	−0.568 ***	0.323 ***	−0.095 **	−0.081 *	0.115 ***	0.365 ***	0.170 ***	−0.021	0.201 ***	1		
Corr	−0.646 ***	0.444 ***	−0.046	−0.099 **	0.117 ***	0.425 ***	0.154 ***	−0.176 ***	0.205 ***	0.743 ***	1	
Gov	−0.697 ***	0.333 ***	0.039	−0.157 ***	0.248 ***	0.346 ***	0.119 ***	−0.195 ***	0.470 ***	0.608 ***	0.837 ***	1

Source: Authors' calculations. *, **, and *** indicate significance at 10%, 5%, and 1% levels.

Figure 1 highlights the dynamics of the sovereign rating specific to each country over the sample period. While the ratings of countries such as Morocco and Botswana were stable over the sample period, countries such as Paraguay, Uruguay, Turkey, and Brazil witnessed important fluctuations in their sovereign ratings. We also notice that some countries achieved sustained improvements in their ratings and succeeded to integrate the investment grade (Mexico, India, Indonesia, and Peru). Oppositely, other countries followed a downward trend and witnessed important deteriorations of their sovereign ratings (Bahamas, Salvador, Egypt, and Tunisia).

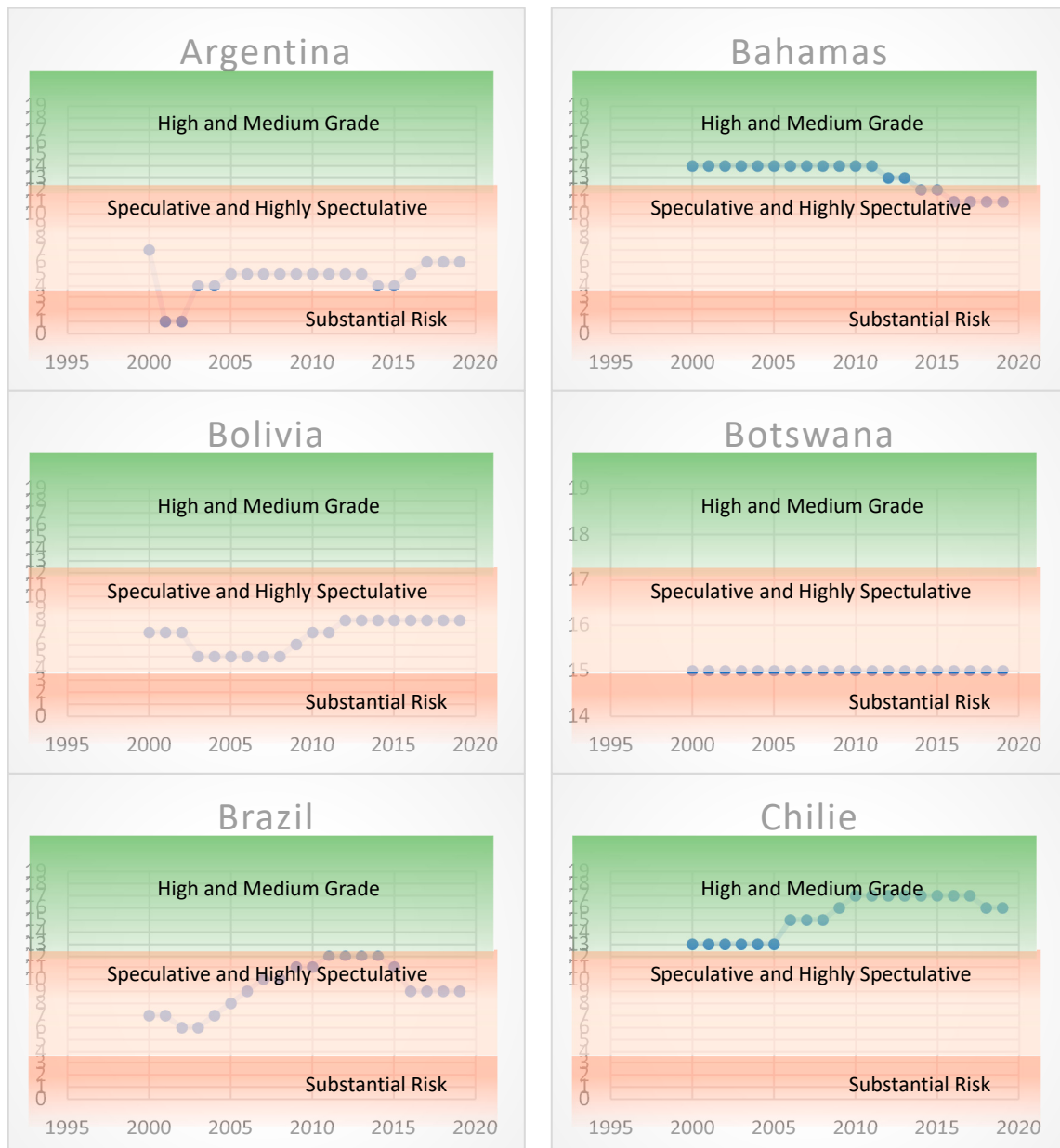


Figure 1. Cont.

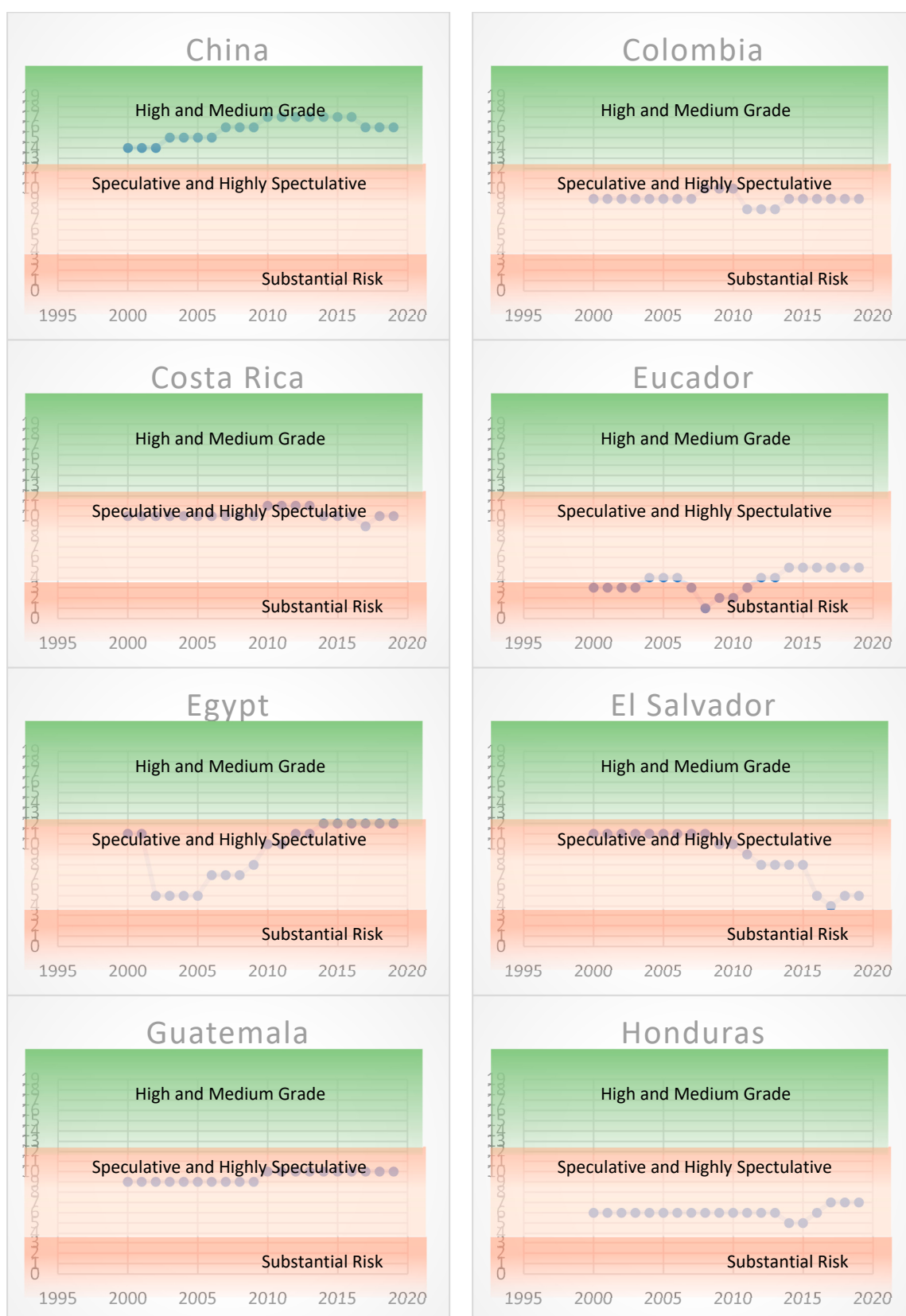


Figure 1. Cont.

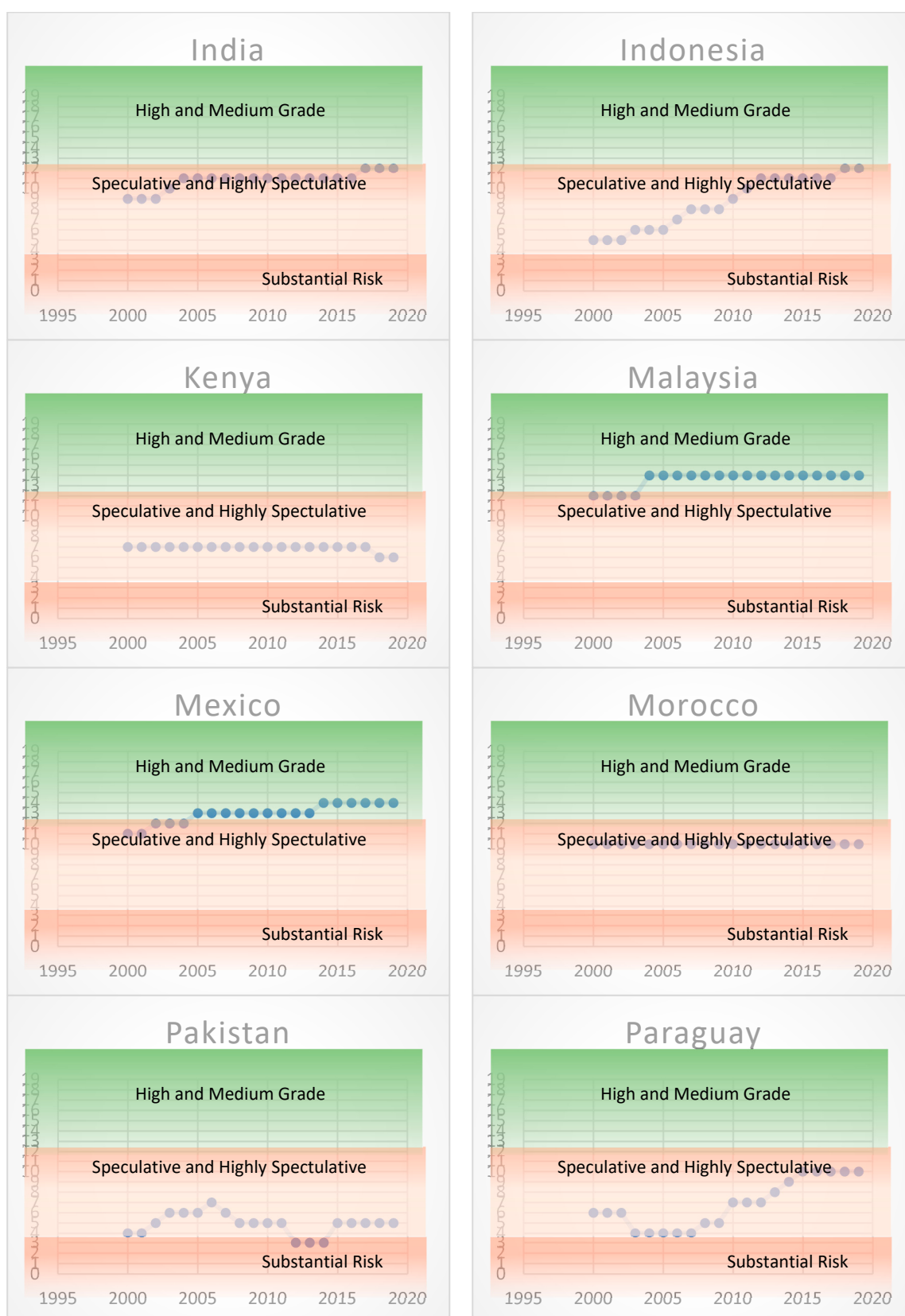


Figure 1. Cont.

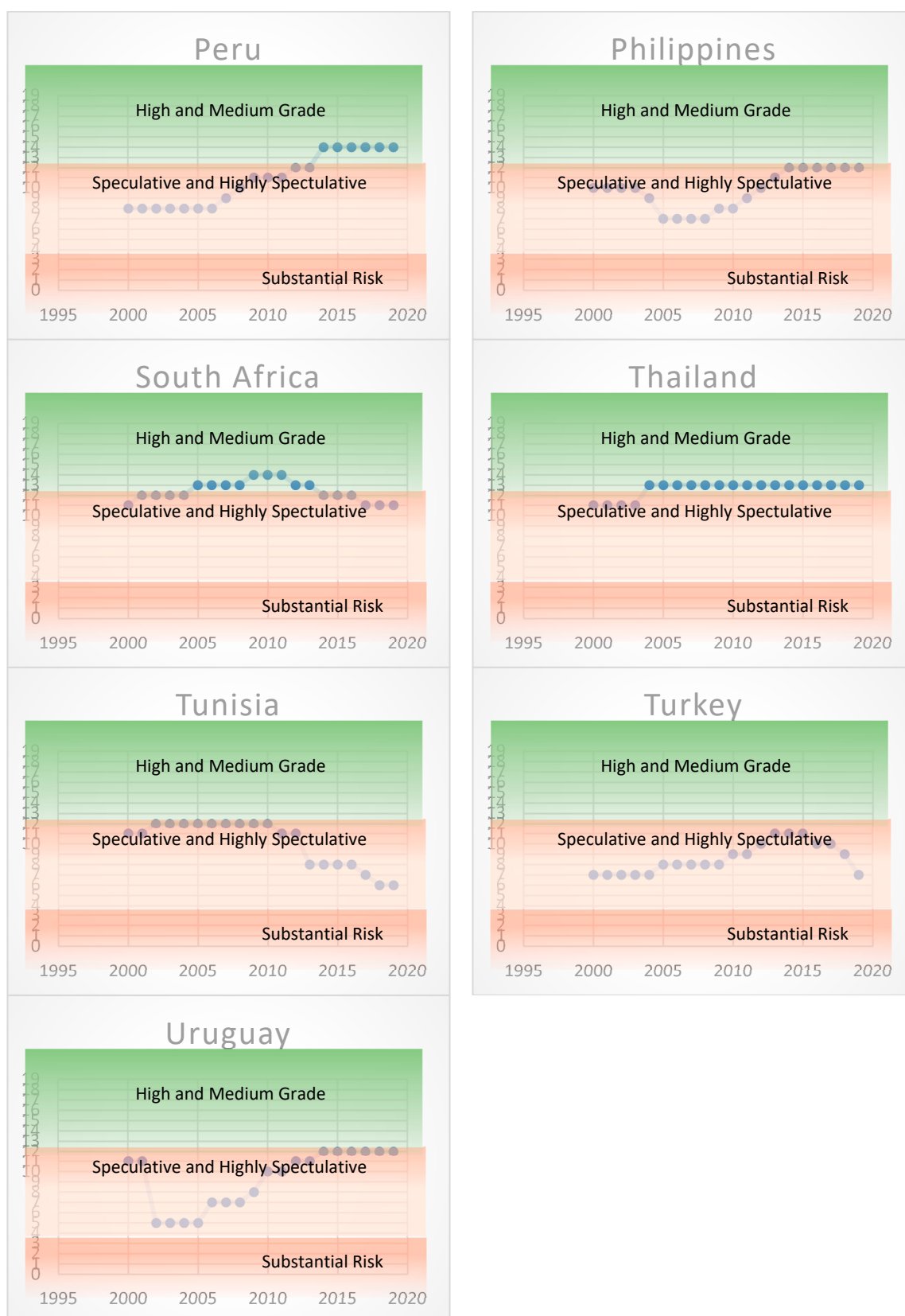


Figure 1. Sovereign ratings by country, 2000–2019. Source: Authors' presentations.

4. Results and Discussion

The objective of this study is to identify the main factors leading the rating agencies to classify a country's sovereign debt within the speculative grade. Further, it seeks to verify whether the effects produced by the explanatory variables vary according to whether the sovereign securities are considered weakly or highly speculative. Finally, the paper tests the existence of possible critical thresholds above which the effects of the explanatory variables could be associated with a change in direction or intensity.

The estimation results relative to the linear model are reported in Table 7.

Table 7. Logit estimation results, 2000–2019.

	Specification 1 (1)	Specification 2 (2)	Specification 3 (3)
Unemployment	0.11 (0.96)	0.11 ** (1.99)	0.91 *** (2.44)
Investment	−0.17 ** (−1.97)	−0.16 * (−1.82)	−0.5 (−1.1)
Growth	0.14 (1.27)	−0.12 * (−1.74)	−0.67 *** (−2.97)
FDI	−0.22 (−1.75)	−0.22 * (−1.74)	−5.23 *** (−5.47)
Inflation	0.14 (1.55)	0.14 (1.6)	0.09 (1.42)
Credit	−0.15 *** (−4.88)	−0.16 *** (−5.36)	−0.84 *** (−3.44)
Debt	0.1 *** (3.98)	0.1 *** (4.14)	0.05 * (1.71)
Deficit	−0.088 (−0.63)	−0.08 * (−1.68)	−3.6 (−1.21)
Corruption	−4.31 *** (−2.61)	−0.75 *** (−2.83)	−0.16 * (−1.67)
Governance	−1.63 (−1.12)	−1.44 * (−1.72)	−28.61 *** (−3.4)
Instability	−1.41 * (−1.84)	−1.69 ** (−2.29)	7.9 *** (3.89)
Constant	1.97 (0.74)	2.05 (0.76)	3.89 (0.27)
Nb. of countries	25	29	16
Nb. of obs	500	580	320

Source: Authors' calculations. *, **, and *** indicate significance at 10%, 5%, and 1% levels. T-statistics are between parentheses.

The first column in Table 7 (specification 1) provides information on the determinants of the probability to move from the investment grade to the speculative grade. As expected, countries with good economic performances are more likely to be classified in the green zone. Indeed, a high growth rate, high domestic and foreign investment rates, and an increase in bank loans significantly reduce the probability of belonging to the speculative grade, while a high unemployment rate and a high debt ratio contribute to increasing this probability. These results are in line with the findings of the seminal paper of [16] and those of [17]. We also note that a high budget deficit significantly reduces the probability of deteriorating the sovereign rating. Such a result can be explained by the positive impact that an expansive fiscal policy is likely to produce on short-term economic activity. Public spending also performs a relevant redistributive role which helps to guarantee social stability. Further, the estimation results reveal that the quality of the institutional framework is a

determining factor in the assessment of the sovereign risk. Tighter control of corruption, stronger social stability, and better government effectiveness contribute to reducing the risk of incurring a downgrade of the sovereign rating. Biglaiser and Staats (2012) [2] and Montes et al. (2016) [28] emphasized the importance that rating agencies are attaching to institutional development in their assessment process, while Connolly (2007) [34] highlighted the negative effect that corruption is producing on sovereign bond ratings.

Column 2 of Table 7 (specification 2) summarizes the factors leading to classifying sovereign debt in the moderately speculative class (light red zone). In particular, findings show that a slowdown in investments and loans, as well as a deterioration of the institutional framework (corruption and political instability) contribute significantly to the downgrading of a country from the green zone toward the moderately speculative class.

Results in column 3 of Table 7 (specification 3) shed light on the factors which lead rating agencies to downgrade a country's sovereign debt from the moderately speculative class to the highly speculative class of assets. Some interesting findings can be drawn from these results. First, the coefficients associated with some control variables have increased in a spectacular way, thus contributing more strongly to explaining the probability of a move toward the highly speculative grade. Such findings suggest that the importance attributed by the rating agencies to macroeconomic and institutional indicators differs according to the situation of the considered country. These indicators weigh more heavily on the decision when the financial and economic situation of the country is seriously deteriorating. Oppositely, the impact produced by the debt ratio is weakened, while other variables, such as the investment rate or the budget deficit, are no longer impacted by the decision of the rating agencies. These results confirm the conclusions of earlier studies which highlighted the non-linearity of the decision-making process and emphasized the existence of a large part of subjectivity in the assigned ratings [28]. On the other hand, the estimation outcomes reveal that coefficients showing the largest variations and contributing the most strongly to explaining the downgrading probability are those associated with foreign direct investment and government efficiency. According to these results, when a country is on the verge of default, the rating agencies pay particular attention to the confidence level shown by foreign investors toward the country. They also focus on the government's ability to implement the necessary reforms allowing a rapid and sustainable recovery of the economic and financial situation.

Finally, we notice that the political stability indicator has a positive and significant effect on the probability of the sovereign rating deterioration. This counterintuitive result can be explained by the fact that rating agencies tend to classify a country as potentially defaulting (dark red zone) when its financial difficulties stem from major structural imbalances and poor economic governance, rather than when they are resulting from short-term political and social turmoil. In case of political instability, the situation can be redressed quickly once the country regains a peaceful political atmosphere. However, recovery is much more difficult and painful when it comes to addressing major structural deficiencies.

In the second series of estimations, we attempt to highlight the non-linearity of the relationship between the control variables on sovereign ratings. Indeed, the impacts produced by some independent variables may vary considerably depending on whether they lie below or beyond a certain threshold value. Tables 8–10 report the results of the threshold effect models where the dependent variable represents, respectively, the probability that sovereign debt is classified as speculative, moderately speculative, or highly speculative.

Table 8. Probability of downgrading to the speculative grade, PTR results.

	Unemp	Investment	Growth	FDI	Inflation	Corruption	Debt	Instability	Deficit	Government	Credit
	Threshold level										
	4.69 ** (0.049)	41.93 * (0.09)	6.62 ** (0.05)	2.91 (0.45)	8.01 ** (0.05)	−0.58 * (0.08)	48.28 * (0.06)	−0.57 * (0.08)	−2.7 ** (0.05)	−0.67 (0.43)	38.96 *** (0.00)
Unemployment		0.0004 (0.09)	0.002 (0.51)	0.001 (0.37)	0.001 (0.41)	0.009 * (1.66)	0.004 * (1.65)	0.001 (0.27)	0.001 (0.23)	0.001 * (1.77)	0.005 * (1.68)
Investment	−0.014 *** (−5.05)		−0.015 *** (−5.13)	−0.015 *** (−5.22)	−0.02 *** (−5.8)	−0.01 *** (−5.1)	−0.014 *** (−4.9)	−0.01 *** (5.26)	−0.014 *** (−4.9)	−0.017 *** (−5.2)	−0.018 *** (−6.58)
Growth	0.001 *** (2.92)	0.01 *** (3.3)		0.009 *** (2.8)	0.009 *** (2.89)	0.008 *** (2.66)	0.01 *** (2.8)	0.009 *** (2.79)	0.008 *** (2.75)	0.009 *** (2.84)	0.01 *** (3.93)
FDI	−0.001 *** (−2.13)	−0.01 * (−1.66)	−0.008 ** (−2.01)		−0.01 *** (−2.4)	−0.009 ** (−2.13)	−0.01 ** (−2.33)	−0.007 * (−1.71)	−0.01 ** (−2.15)	−0.007 * (−1.81)	−0.008 (−2.21)
Inflation	0.002 ** (1.97)	0.002 ** (1.99)	0.001 * (1.8)	0.002 ** (2.27)		0.002 ** (2.08)	0.003 *** (2.82)	0.002 ** (2.06)	0.002 * (1.87)	0.002 * (2.43)	0.002 (2.63)
Corruption	−0.07 (−1.48)	−0.07 (−1.48)	−0.07 (−1.5)	−0.08 * (−1.74)	−0.05 (−1.08)		−0.08 * (−1.72)	−0.08 * (−1.75)	−0.07 (−1.48)	−0.05 (−1.15)	−0.13 ** (−2.81)
Debt	0.003 *** (5.77)	0.003 *** (5.96)	0.003 *** (6.46)	0.003 *** (6.1)	0.003 *** (6.29)	0.003 *** (6.3)		0.003 *** (5.98)	0.003 *** (6.26)	0.003 *** (5.87)	0.003 *** (5.96)
Instability	−0.15 *** (−6.46)	−0.16 *** (6.6)	−0.17 *** (−7.15)	−0.17 *** (−7.07)	−0.15 *** (−6.4)	−0.15 *** (−6.35)	−0.18 *** (−7.35)		−0.17 *** (−6.92)	−0.18 *** (−7.48)	−0.15 *** (−6.61)
Deficit	−0.012 *** (−4.47)	−0.01 *** (−4.6)	−0.012 *** (−4.42)	−0.011 *** (−4.06)	−0.01 *** (−4.8)	−0.01 *** (−4.27)	−0.01 *** (−3.7)	−0.012 *** (−4.3)		−0.012 *** (−4.2)	−0.011 *** (−4.16)
Governance	−0.07 (−1.41)	−0.09 * (−1.85)	−0.08 * (−1.65)	−0.04 (−0.86)	−0.06 (−1.23)	−0.08 * (−1.69)	−0.04 (−0.82)	−0.05 (−1.12)	−0.06 (−1.23)		−0.055 (−1.14)
Credit	−0.007 *** (−10.2)	−0.01 *** (−10)	−0.008 *** (−10.58)	−0.08 *** (−10.45)	−0.01 *** (−9.6)	−0.007 *** (−9.8)	−0.007 *** (−10)	−0.007 *** (−9.4)	−0.008 *** (−10.2)	−0.007 *** (−10)	
Constant	0.93 *** (11.01)	1.001 *** (11.41)	0.9 *** (10.54)	0.9 *** (10.54)	0.9 *** (10.59)	0.87 *** (10.24)	0.81 *** (9.19)	0.86 *** (10.1)	0.89 *** (10.37)	0.96 *** (11.15)	0.68 *** (8.24)
Regime 1	−0.038 *** (−3.69)	−0.01 *** (−6.14)	0.014 *** (4.21)	0.01 (1.24)	0.001 (1.58)	0.07 (1.23)	0.002 *** (4.08)	−0.01 (−0.35)	−0.005 (−0.11)	0.034 (0.59)	0.003 *** (2.43)
Regime2	0.001 (0.004)	−0.01 *** (−3.82)	−0.022 (−0.46)	−0.008 ** (−2.1)	0.009 *** (4.33)	−0.13 *** (−2.7)	0.004 *** (7.23)	−0.18 *** (−7.58)	−0.015 *** (−4.97)	−0.13 *** (−2.42)	−0.004 *** (−5.22)

Source: Authors' calculations. *, **, and *** indicate significance at 10%, 5%, and 1% levels. T-statistics are between parentheses.

Table 9. Probability of downgrading to the moderately speculative grade, PTR results.

	Unemp	Investment	Growth	FDI	Inflation	Corruption	Debt	Instability	Deficit	Government	Credit
Threshold level											
	3.69 (0.4)	41.93 * (0.1)	8.28 ** (0.02)	2.91 (0.17)	3.75 (0.65)	−0.59 ** (0.03)	61.39 (0.15)	−1.99 (0.57)	−3.7 (0.29)	0.72 ** (0.04)	37.2 (0.00)
Unemployment		0.008 * (1.84)	0.01 *** (2.39)	0.009 ** (2.12)	0.01 ** (2.18)	0.009 ** (2.07)	0.1 ** (2.3)	0.01 ** (2.2)	0.2 ** (2.25)	0.01 ** (2.33)	0.013 *** (3.13)
Investment	−0.012 *** (−4.18)		−0.012 *** (−4.28)	−0.012 *** (−4.32)	−0.01 *** (−4.3)	−0.012 *** (−4.2)	−0.01 *** (−4.34)	−0.012 *** (−4.2)	−0.011 *** (−3.82)	−0.01 *** (−3.49)	−0.01 *** (−5.26)
Growth	0.009 ** (2.54)	0.01 *** (2.95)		0.009 ** (2.55)	0.01 ** (2.65)	0.007 ** (2.09)	0.008 ** (2.37)	0.009 ** (2.5)	0.008 ** (2.22)	0.01 ** (2.33)	0.01 *** (3.65)
FDI	−0.009 ** (−2.23)	−0.007 * (−1.73)	−0.009 ** (−2.19)		−0.01 ** (−2.29)	−0.009 ** (−2.27)	−0.008 * (−1.95)	−0.009 ** (−2.27)	−0.01 ** (−2.54)	−0.01 *** (−3.13)	−0.008 ** (−2.21)
Inflation	0.0064 *** (4.29)	0.006 *** (3.97)	0.006 *** (3.99)	0.006 *** (4.32)		0.006 *** (4.55)	0.006 *** (4.17)	0.006 *** (4.18)	0.005 *** (3.81)	0.006 *** (4.2)	0.007 *** (4.97)
Corruption	−0.13 *** (−2.74)	−0.14 ** (−2.83)	−0.17 *** (−3.5)	−0.16 *** (3.15)	−0.14 *** (−2.7)		−0.15 *** (−2.99)	−0.13 *** (−2.7)	−0.13 *** (−2.67)	−0.11 *** (−3.14)	−0.2 *** (−4.29)
Debt	0.007 *** (10.55)	0.007 *** (10.63)	0.007 *** (10.97)	0.007 *** (10.99)	0.007 *** (10.7)	0.007 *** (11.25)		0.007 *** (10.8)	0.007 *** (11.04)	0.008 *** (11.99)	0.006 *** (10.49)
Instability	−0.21 *** (−8.36)	−0.21 *** (−8.83)	−0.22 *** (−9.2)	−0.23 *** (−9.35)	−0.22 *** (−8.9)	−0.2 *** (−8.35)	−0.25 *** (−8.64)		−0.22 *** (−8.81)	−0.2 *** (−8.25)	−0.2 *** (−8.84)
Deficit	−0.007 ** (−2.59)	−0.008 *** (−2.7)	−0.006 ** (−2.33)	−0.006 ** (−2.11)	−0.007 ** (−2.5)	−0.006 ** (−2.24)	−0.007 *** (−2.6)	−0.007 ** (−2.42)		−0.007 ** (−2.54)	−0.006 *** (−2.42)
Governance	−0.011 (−0.23)	−0.036 (−0.68)	−0.009 (−0.19)	0.02 (0.44)	0.01 (0.2)	−0.02 (−0.49)	−0.02 (−0.5)	0.001 (0.03)	−0.006 (−0.13)		0.35 (0.72)
Credit	−0.008 *** (−11.1)	−0.01 *** (−11.7)	−0.009 *** (−12.01)	−0.009 *** (−11.6)	−0.01 *** (−10)	−0.008 *** (−11)	−0.008 *** (−11)	−0.008 *** (−11)	−0.009 *** (−11.5)	−0.008 *** (−11)	
Constant	0.65 ** (7.33)	0.71 *** (7.86)	0.63 *** (7.25)	0.61 *** (6.92)	0.61 *** (6.92)	0.57 *** (6.58)	0.67 *** (7.49)	0.61 *** (6.86)	0.6 *** (6.85)	0.5 *** (5.68)	0.38 *** (4.42)
Regime1	−0.029 *** (−2.62)	−0.01 *** (−5.21)	0.01 *** (3.3)	0.01 * (1.85)	−0.0005 (−0.13)	−0.22 *** (−4.32)	0.005 *** (5.88)	−0.2 *** (−5.6)	−0.01 *** (−3.27)	−0.11 ** (−2.03)	0.001 *** (11.07)
Regime2	0.009 ** (2.05)	−0.009 *** (−3.1)	−0.01 ** (−2.33)	−0.008 ** (−2.1)	0.006 *** (4.5)	0.01 (0.35)	0.007 *** (10.55)	−0.23 *** (−8.96)	0.003 (0.81)	0.22 *** (3.36)	−0.005 *** (−6.25)

Source: Authors' calculations. *, **, and *** indicate significance at 10%, 5%, and 1% levels. T-statistics are between parentheses.

Table 10. Probability of downgrading to the highly speculative grade, PTR results.

	Unemp	Investment	Growth	FDI	Inflation	Corruption	Debt	Instability	Deficit	Government	Credit
Threshold level											
	4.67 (0.36)	21.95 (0.18)	7.67 (0.51)	4.08 (0.26)	8.13 (0.49)	−1.14 *** (0.00)	76.6 *** (0.005)	−0.77 (0.38)	1.87 (0.62)	−0.34 * (0.07)	13.62 *** (0.00)
Unemployment		0.0129 ** (2.24)	0.012 ** (2.25)	0.009 * (1.9)	0.012 ** (2.22)	0.008 * (1.72)	0.008 (1.45)	0.01 ** (1.96)	0.012 ** (2.16)	0.011 * (1.93)	0.017 *** (3.05)
Investment	−0.018 *** (−4.18)		−0.015 *** (−4.16)	−0.009 *** (−2.91)	−0.015 *** (−4)	−0.012 *** (−3.8)	−0.01 *** (−2.84)	−0.01 *** (−3.52)	−0.015 *** (−4.04)	−0.015 (−4.07)	−0.013 *** (−3.84)
Growth	−0.005 (−0.15)	−0.006 (−0.18)		0.008 (0.28)	−0.001 (−0.38)	0.004 (1.38)	−0.009 (−0.27)	−0.001 (−0.52)	−0.0001 (−0.03)	0.006 (0.17)	−0.003 (−1.03)
FDI	−0.029 *** (−5.79)	−0.028 *** (−5.4)	−0.02 *** (−5.67)		−0.028 *** (−5)	−0.03 *** (−6.52)	−0.025 *** (−5.1)	−0.029 *** (−5.7)	−0.029 *** (−5.62)	−0.02 *** (−5.73)	−0.027 *** (−5.43)
Inflation	0.003 *** (2.89)	0.003 *** (3.06)	0.003 *** (3.17)	0.003 *** (3.45)		0.004 *** (4.36)	0.002 *** (2.62)	0.003 *** (3.1)	0.003 *** (3.24)	0.003 *** (3.39)	0.004 *** (4.01)
Corruption	−0.24 *** (−4.09)	−0.26 *** (−4.57)	−0.27 *** (−4.67)	−0.24 *** (−4.93)	−0.28 *** (−4.9)		−0.21 *** (−3.81)	−0.24 *** (−4.22)	−0.26 *** (−4.56)	−0.25 *** (−4.27)	−0.19 *** (−3.45)
Debt	0.002 *** (4.27)	0.002 *** (4.31)	0.002 *** (4.35)	0.002 *** (5.72)	0.002 *** (4.22)	0.002 *** (4.24)		0.002 *** (4.06)	0.002 *** (4.36)	0.002 *** (4.43)	0.001 *** (3.34)
Instability	−0.009 (−0.34)	−0.018 (−0.63)	−0.011 (−0.39)	−0.002 (−0.11)	−0.004 (−0.14)	−0.008 (−0.34)	0.002 (0.1)		−0.013 (−0.48)	−0.01 (−0.37)	−0.01 (−0.39)
Deficit	0.004 (1.23)	0.006 ** (2.04)	0.006 ** (1.96)	0.005 ** (1.96)	0.007 ** (2.25)	0.003 (1.08)	0.004 (1.4)	0.006 ** (1.96)		0.005 * (1.74)	0.006 ** (1.98)
Governance	−0.18 ** (−2.58)	−0.19 *** (−2.78)	−0.18 *** (−2.61)	−0.1 * (−1.74)	−0.18 *** (−2.5)	−0.14 ** (−2.24)	−0.15 ** (−2.17)	−0.001 (−0.52)	−0.17 *** (−2.47)		−0.18 *** (−2.65)
Credit	−0.003 *** (−3.81)	−0.002 *** (−3.2)	−0.003 *** (−3.51)	−0.002 *** (−2.97)	−0.003 *** (−3)	−0.001 (−1.37)	−0.002 *** (−2.9)	−0.003 *** (−3.6)	−0.003 *** (−3.63)	−0.002 *** (−3.2)	
Constant	−0.77 *** (−3.45)	−0.49 *** (−4.32)	−0.41 *** (−3.61)	−0.34 *** (−3.68)	−0.41 *** (−3.7)	−0.3 *** (−3.07)	−0.17 (−1.5)	−0.32 *** (−2.92)	−0.37 *** (−3.41)	−0.38 *** (−3.42)	−0.37 *** (−3.51)
Regime1	−0.015 (−1.16)	−0.022 *** (−5.1)	0.002 (0.61)	−0.2 *** (−12.93)	0.012 *** (3.51)	−0.05 (−0.89)	−0.0007 (−0.11)	−0.01 (−0.68)	−0.02 (−1.57)	0.06 (0.71)	0.02 *** (4.88)
Regime2	0.01 ** (1.95)	0.017 *** (−4.7)	−0.01 * (−1.84)	−0.007 *** (−3.53)	0.004 *** (3.74)	−0.45 *** (−8.17)	0.003 *** (5.67)	−0.13 *** (−2.86)	−0.008 *** (−2.51)	−0.2 *** (−2.87)	−0.002 *** (−2.77)

Source: Authors' calculations. *, **, and *** indicate significance at 10%, 5%, and 1% levels. T-statistics are between parentheses.

Results in Table 8 detect significant thresholds for nine out of the eleven variables explaining the probability of belonging to the speculative class. For instance, an unemployment rate below 4.69% contributes to a significant reduction in the probability of belonging to the speculative class. Similarly, political stability, control of corruption, and government effectiveness indicators reduce this probability only when their values are, respectively, above -0.57 , -0.58 , and -0.67 . We also note that the probability of assigning a sovereign rating belonging to the speculative grade is boosted by an increase in public debt. However, this probability is intensified when the debt ratio exceeds the critical threshold of 48.28% (the coefficient passes from 0.002 to 0.004). Results also suggest that an inflation rate above 8.01% and a growth rate below 6.62% deteriorate the sovereign assets' quality. Further, results indicate that a credit ratio exceeding 38.96% reduces the probability of falling into the speculative class, while it contributes to amplifying this probability below this critical value. Finally, we note that FDI contributes significantly to reducing sovereign risk only when it exceeds 2.91%. All these results suggest that the control variables are producing non-linear effects on sovereign ratings.

Results in Table 9 indicate that a growth rate above the critical threshold reduces the probability of downgrading from the green zone to the moderately speculative class. Similarly, higher investment rates contribute to reducing this probability. Surprisingly, when control of corruption and government effectiveness are below their respective critical thresholds, they contribute to improving the sovereign rating. Such a result can be explained by the fact that some countries have managed to improve their sovereign ratings despite their deteriorated institutional frameworks, while others, showing satisfactory institutional indicators, witnessed a decline in their ratings due to events such as financial crises or sudden changes in the political regime. Even though the rating agencies are attaching increasing importance to the institutional criteria, it seems that the macroeconomic indicators are still prevailing in the rating process.

Table 10 investigates the determinants of the probability of downgrading sovereign bonds from the class of moderately speculative assets to that of regrouping highly speculative assets. The results show that only four control variables are producing significant threshold effects on this probability. The first two variables are relative to the institutional framework. Indeed, control of corruption and government efficiency contribute to reducing this probability only when they exceed a certain critical threshold. Compared to previous results reported in Table 8, the critical value associated with government effectiveness has shown an important increase passing from -0.67 to -0.34 . This result suggests government effectiveness should be particularly high in countries experiencing a deteriorated financial situation, in order to redress the situation and reduce the risk of being classified among the countries whose sovereign assets are considered toxic. Such a result offers strong support to the conclusion drawn from Table 7, according to which government effectiveness is one of the variables that weigh the most on the rating agencies' decisions for countries exhibiting high levels of sovereign risk. Turning to the macroeconomic indicators, we note that public debt produces a non-linear effect on the dependent variable: a debt ratio above 76.6% increases the probability of being classified within the highly speculative class. Such a result confirms that the level of indebtedness increasingly weighs on the decisions of the rating agencies as the financial situation of the country deteriorates. Finally, results indicate that beyond 13.62%, bank loans positively affect the assessment of the rating agency. A substantial contraction in the volume of credits indicates a lack of confidence among bankers in the country's economic prospects, which negatively impacts the sovereign rating, while a high level of banking loans should produce the opposite effect.

5. Conclusions and Recommendations

This study aims to identify the main factors leading to classifying sovereign securities, respectively, among the speculative, moderately speculative, and or highly speculative assets. We also seek to verify whether the determinants of the sovereign ratings vary

according to the sovereign asset's class. Another main objective of this study is to highlight the non-linearity of the effects produced by the control variables on the rating process.

As expected, the estimation results confirm that sovereign ratings are highly dependent on key macroeconomic and financial aggregates in addition to governance indicators. Nevertheless, our results differ from the previous literature on three main points. First, we demonstrate that the weights given to the different control variables vary according to the asset's class. The coefficients associated with most of these variables increase significantly as sovereign risk increases. In particular, estimation results show that government effectiveness and FDI inflows weigh more heavily on the probability of downgrading the sovereign debt toward the highly speculative class. Such an increase in the coefficients suggests that the rating agencies are realizing the true extent of the sovereign risk, which partly explains their recurrent inability to predict payment defaults.

Secondly, our results reveal that most of the control variables produce a non-linear effect on the rating process. When these variables reach their critical thresholds, their effects on the downgrading probability intensify, weaken, or radically change direction. In this respect, the governance proxies produce opposite effects when sovereign assets move from the moderately speculative to the highly speculative class. Finally, the detected thresholds vary from one asset class to another. In particular, the critical threshold associated with the debt ratio increases from 48.28% to 76.6% when it comes to classifying sovereign securities as highly speculative. These results reveal a strong instability in the evaluation criteria used by the rating agencies and confirm that the rating process is vitiated by a significant amount of subjectivity.

Two key recommendations emerge from these findings. The first recommendation concerns the rating agencies, which must further stabilize their evaluation criteria, in particular by smoothing the weights associated with the variables taken into account during the rating process. This should enhance the sovereign ratings' credibility, not only by making the rating process more transparent but also by improving the ability of the rating agencies to predict at an early stage the deterioration in the quality of sovereign securities and the advent of default payment. The final recommendation is dedicated to states seeking to improve their sovereign ratings. First, it is important to identify the rating levers corresponding to their sovereign risk level since the determinants of the sovereign rating and their effects differ largely from one class of assets to another. Secondly, it is important to identify the critical thresholds beyond which the targeted variables produce a significant effect on the rating process. This will enable the authorities to identify the extent of the reforms and policies to be implemented in order to achieve the expected objectives.

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