

# Sovereign Credit Ratings and Their Determination by the Rating Agencies

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## Abstract

The credit risk premium moves in function of the initial assessment or rating and its possible changes over the course of time. In addition, the sovereign ratings usually act as a ceiling for the debt issues of local companies; therefore there is a double effect. A country's rating affects, directly, its issues of Public Debt and, indirectly, those of the companies based in that country.

Our aim in this article is to give a picture of the procedures utilized by the rating agencies in the assessment of sovereign risks. Using data provided by the principal world agencies, Fitch, Standard and Poor's and Moody's, we have established a series of linear regressions between the rating given to the sovereign issuers and certain relevant macroeconomic variables cited by the agencies themselves and in the scientific literature on the subject.

It is not a totally transparent process made clearly explicit by the rating agencies (for legitimate commercial reasons) and there is thus an apparent divergence between the rating models utilized by them. In spite of these handicaps, our most significant result shows that models with relatively few variables seem to provide satisfactory fits of the linear regressions, with high explanatory power.

**Key words:** Rating, sovereign issuer, risk premium, macroeconomic variables.

**JEL classification:** F30, F34, G10 and G15

*“The rating of sovereigns depends more on the art of political economy than on the science of econometrics”.*

Fitch Ratings

## 1. Introduction

The credit assessments that the rating agencies award to sovereign issuers sometimes generate controversy in the financial markets, above all when the agencies' ratings for the same country do not coincide, which can occur. Furthermore, the yield that is required from the issues of Public Debt of the various national states depends, in a large part, on the credit ratings of these states, which underlines the importance of these ratings.

Therefore, the process of rating in itself is of some interest for the international financial community, even more so considering that sovereign risks are determined under a practically monopolistic regime by three agencies that are recognized world-wide: Fitch, Standard and Poor's, and Moody's. Another factor is that the rating methodology is complex, particularly when compared with the rating of corporate debt, and includes both qualitative and quantitative aspects that make it not only a technique but also an art. As a result, it is not easy to identify the relevant variables that the agencies utilize when they give an opinion on the level of sovereign risks. And the statistical studies to be found in the scientific literature on this topic do not offer definitive conclusions, although they do shed a certain light on the rating procedure.

In what follows, the article we present deals with the following aspects:

- Sovereign credit ratings and their assessment
- Explanatory variables
- Models for the determination of sovereign risks
- Conclusions

## 2. Sovereign Credit Ratings and Their Assessment

A credit rating, whether sovereign or not, is effectively the issue of an evaluation or informed judgment on the probability that a particular borrower may fail to meet its commitments with respect to the service of its debt. The credit rating or assessment has in recent years become an evaluation procedure widely-accepted for application to all type of issuers of debt, whether these are sovereign, sub national like quasi-autonomous regions and local authorities, supranational like certain international institutions, or else of corporate or commercial character.

The situation is such that the big issuers of fixed income debt, such as those that utilize the Euromarket, know very well that without a prior rating their issues would be very difficult to offer and trade in the market. In addition, as already stated, the determination of the coupon of the bonds or obligations and the subsequent yield demanded by investors will depend on the credit risk in respect of the issues that the rating agencies assign.

The rating procedure is similar in the three agencies cited and usually follows approximately the lines described here:

The first point to make is that the process is cooperative in character, and based on a good understanding between the issuer and the rating agency. Thus, once a sovereign state reaches an agreement with the rating agency to be classified as an issuer, it receives a questionnaire requesting information on its degree of indebtedness and on its capacity for servicing the debt. The questionnaire follows a standard format but is adapted to the specific circumstances of each country. Next, interviews are held with the appropriate economic authorities of the country in question; usually they are carried out by at least two analysts of the agency during a visit of approximately one week.

After the analysts' visit a report is drafted that is sent to the authorities of the sovereign country for their review and comments. The report includes a comparison between the country assessed and other similar countries of its region. Once the sovereign issuer indicates its conformity or objections to the report of the agency, this is passed to the Sovereign Risks Committee of the agency, which assigns the definitive rating and issues a press release to publicize the rating granted, in the market, through the customary communications media.

An important aspect to take into account in respect of these ratings is that the agencies monitor them over time. This monitoring is performed not only for the sovereign debt but also for corporate debt, and can give rise to changes in the assessment, either upgrades or downgrades. These rating changes in turn lead to changes in the yields required in the secondary debt markets. We are thus faced with a methodology that is continuous rather than "one-off" in character, because over the course of time, the economic and financial circumstances of the borrowers may vary widely. The case of Argentina, for example, should be remembered, where there were successive downgradings of its credit rating, until the feared situation of default was reached.

The process of review of the ratings is announced by the agencies to the market, with statements to the effect that outlook for a rating may be positive, negative or stable, depending on the circumstances of the issuer.

Also in the case of the sovereign risks, it is extremely important to know what type of indebtedness we are referring to. In general the agencies recognize four classes:

Foreign currency debt:

Long term  
Short term

Debt in local currency:

Long term  
Short term

Of the four classes, the most important is usually the long term foreign currency debt, and the credit rating of a country refers to this class of debt unless specified otherwise. In fact, historically, the first ratings made were based on this type of debt. Later, when issues in local currencies began to compete with public loans in the so-called global currencies, such as the dollar, the euro and the yen, this type of debt also began to be rated.

Normally, for a sovereign state, it will be easier to service its debt in local or domestic currency than in foreign currency since it will only have reserves of these latter in limited quantities, whereas its own currency can be issued in the amount necessary, or at least with a certain discretionality. For this reason, in certain cases, the rating for the debt in local currency may be slightly superior to that for the foreign currency debt.

Another aspect of utmost importance to bear in mind is that the rating of the sovereign issuer usually acts as a ceiling or upper limit for the ratings of all the other debt issued by sub-national entities or companies, based in the country in question. All the agencies usually observe this rule, which is based fundamentally on the theory of the risk-free asset that can be identified with some issues of Public Debt. Thus, in the case of Spain in 2003, the rating of its issues of long term debt, in both foreign and local currency, was AA<sup>+</sup> by Standard and Poor's<sup>1</sup>. As already commented, the AA<sup>+</sup> rating would be the maximum to which any of the large Spanish companies, such as those comprising the selective IBEX-35 index, could aspire.

The universe of countries given a rating as sovereign issuers by the rating agencies has been increasing steadily with the passage of time, since the procedure was first set in motion in the mid-1970's. At the present time, the three big agencies rate a total of some 80 countries; thus there are some minor states that do not yet have such a rating. It can be stated, consequently, that the universe of states with rating is significant, especially since all the larger developed countries are represented.

The number of countries, limited for the moment and unlikely to be increased, raises the statistical problem of sample size; the maximum sample we can devise must coincide with that of the universe.

In other words, we can utilize the asymptotic sample of 80 countries as the maximum. This problem of small sample size is inherent to the analysis of sovereign risks but does not apply in the case of corporate risks where the samples can be much larger in number<sup>2</sup>.

### 3. Explanatory Variables

The assessment of credit risk, both for sovereign issuers and for companies, is not intended to be an exact science. The utilization of statistical models, more or less complex, is of great help but certainly the good judgment of the analysts also counts, above all where it is necessary to assess qualitative aspects and variables that are difficult to quantify. The rating agencies are the first to be aware of these limitations and thus in Fitch (2003a) the opinion is expressed that the rating of sovereign issuers depends more on the art of political economy than on the science of econometrics and that the determination of a rating requires more value judgments than the case of corporate risk since there are fewer events of success and failure to be considered.

Notwithstanding this situation, however, it is evident that the rating agencies deal with a set of variables that are incorporated in a risk model to give a particular score to each sovereign issuer. This score is then converted into the current rating in the form of a combination of letters with which investors are familiar. But it is worth stating that these ratings form a classification that is ordinal in character, and that there is a division between what is known as investment debt, rated from AAA to BBB according to Standard & Poor's and Fitch, and from Aaa to Baa according to Moody's, and what is termed speculative debt, rated from BB to C or from Ba to C, respectively. The credit rating actually awarded is effectively based on a mixture, more or less weighted, of quantitative and qualitative variables.

We shall now look at the groups of variables that are usually taken into consideration. According to Fitch (2003a) the following can be distinguished:

- Economic policy variables

<sup>1</sup> In fact, in 2003, both Standard and Poor's and Fitch rated the long-term debt in foreign and local currency of the Kingdom of Spain as AA<sup>+</sup>, but the rating according to Moody's was Aaa. There thus existed some discrepancy, to the effect that Moody's awarded the highest or best possible level of rating, but the other two agencies only their second best.

<sup>2</sup> In the study by Cantor and Packer (1996) on sovereign risks, the data of 49 countries rated by Standard & Poor's and Moody's in September 1995 were utilized. As can be confirmed, there has been a considerable increase in the number of sovereign ratings awarded since then.

- Variables of the economic sectors
- Variables of stress
- Variables of political risk

Among the economic policy variables most utilized, the fiscal balance of the country analyzed, the surplus or deficit in the public accounts, and the study of the compatibility of the possible deficit with the economic development of the country can be cited. Then there are other variables or ratios, such as "public sector debt/ gross domestic product", which is one of the most relevant. Another four key indicators are the growth of GDP, inflation, external balance or Balance of payments, and the level of unemployment.

But the rating agencies also take into account other variables such as the rate of growth of the population and its age distribution, the differences of productivity between the agricultural and industrial sectors, the degree of urbanization of the economy, and the effectiveness of the educational system.

Lastly, more qualitative variables such as the efficiency of the public administration of the country, the skill of the Treasury in managing the external debt and its understanding of the international financial markets, are also taken into account.

Regarding the variables of the economic sectors, consideration is given firstly to those that may influence the balance of payments on current account. Thus market shares, the geographic diversity of markets, and the composition of exports between raw materials and manufactured products are examined. In short, the capacity of a particular country to generate foreign exchange earnings is investigated.

Within this group of variables, other aspects analyzed include the openness of the national economy to international influences and innovations and the existence of possible tariff barriers that could degenerate into excessive protectionism. Lastly, the attitude to investment, particularly foreign investment, is studied and the possibility of repatriating profits and dividends is taken into account. One interesting ratio within this set of variables is usually that of "Investment/ GDP".

Regarding the variables of stress, the objective with these is to assess the possible reactions of a country when faced with problematic international scenarios such as a world recession, excessive rises in interest rates, or sharp changes in the prices of raw materials in international markets. In this group, some of the variables most utilized are those that measure the flexibility of the labor market.

Although the variables employed in the rating of sovereign risks are mainly economic in character, political factors certainly cannot be forgotten. Thus, it is fundamental to evaluate the stability of the Government of the nation in function of the country's particular idiosyncrasy. In developed countries we could be speaking of a parliamentary democracy but in underdeveloped countries, a military-based government could be stable.

War or imminent war is a fundamental political variable and this will always tend drastically to reduce the sovereign rating<sup>1</sup>.

We may also comment that, among the variables that measure political risks, the membership of the country analyzed of supranational organizations such as the IMF, the OECD or the EU should be considered. Obviously, the compliance of a country with the standards of institutions such as these should be taken as a positive element.

Having succinctly defined the groups of quantitative and qualitative variables that are studied by the rating agencies to give a rating to sovereign issuers, it must be added that these variables are utilized in accordance with a certain time horizon<sup>2</sup>. Usually, historical data for the past

<sup>1</sup> The defaults of Russia in 1917 and of Japan in 1941, both nations then in a state of war, serve to show how situations of military conflict often lead to the interruption of the servicing of the Public Debt of the countries affected.

<sup>2</sup> The list of variables to consider in the rating of sovereign issuers, according to Fitch (2003a), is much more detailed than has been described so far in this article. Thus up to fourteen subgroups are distinguished, as follows: demographic, educational and structural factors; labour market analysis; structure of output and trade; dynamism of the private sector; balance of supply and demand in the economy; balance of payments; constraints to medium term growth; macroeconomic policy; trade and foreign investment policy; banking and finance; external assets; external liabilities; politics and the State; international position.

In total 128 individual variables are monitored

five years and projections for the next two are considered. As the process of assigning ratings is essentially prospective in character, the utilization of both historical and forecast data is clearly understandable.

#### 4. Models of Determination of Sovereign Risks

For developing a specific procedure that retains certain similarities with that which the rating agencies follow when determining the credit risk of sovereign issuers, the most commonly used methodology involves selecting a set of macroeconomic variables of the countries in question and devising multiple linear regression models in which the dependent variable is the rating.

An initial problem arises in respect of the ordinal categorical character of the credit ratings; these could, in principle, be treated using models of ranked and categorical discrete dependent variable, such as those of the logit or ranked probit type. However, as the ratings of the three agencies are comparable, by taking the rating categories to be equidistant from the ones above and below, and by utilizing in our models an average of the three ratings for a particular country given by the three agencies, we can resolve the problem in another way. In agreement with the scientific literature on this topic, numerical values can be given to the ratings thus transforming the ordinal scale into a cardinal one (Table 1). All of this is to explain why and how multiple linear regression models have been utilized in our study.

Table 1

Credit ratings of long term debt and numerical conversion

Fitch	S&P	Moody's	Assigned value
AAA	AAA	Aaa	8
AA+	AA+	Aa1	7.33
AA	AA	Aa2	7
AA-	AA-	Aa3	6.66
A+	A+	A1	6.33
A	A	A2	6
A-	A-	A3	5.66
BBB+	BBB+	Baa1	5.33
BBB	BBB	Baa2	5
BBB-	BBB-	Baa3	4.66
BB+	BB+	Ba1	4.33
BB	BB	Ba2	4
BB-	BB-	Ba3	3.66
B+	B+	B1	3.33
B	B	B2	3
B-	B-	B3	2.66
CCC+	CCC+	Caa1	2.33
CCC	CCC	Caa2	2
CCC-	CCC-	Caa3	1.66
CC	CC	Ca	1.33
C, DDD	SD	C	1

The second question to resolve is that of the choice of variables; this is obviously a crucial factor, which is usually solved by including in the regression models those variables most fre-

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Regarding the variables utilized by Moody's, the agency divides them into the following subgroups: performance and economic structure; fiscal indicators; external payments and debt; monetary, liquidity and vulnerability indicators. Moody's examine a total of 39 variables, notably fewer than the number stated by Fitch.

quently cited as relevant by the rating agencies themselves, and those tested as most significant by other researchers. Naturally, to make the regressions manageable and to avoid problems of multicollinearity, the number of variables must not be too large.

Regarding the data bases utilized, these have been provided by the agencies themselves, specifically Fitch (2003b), Standard & Poor's (2003) and Moody's (2003). Table 2 presents the ratings of 80 countries, dated 28 of March 2003, issued by these three agencies, with the warning that some countries not are rated by all three agencies, although these are very minor countries.

Table 2

Sovereign ratings dated 28 of March 2003 (long term debt in foreign currency)

	Fitch rating	S&P rating	Moody's rating
Austria	AAA	AAA	Aaa
Finland	AAA	AAA	Aaa
France	AAA	AAA	Aaa
Germany	AAA	AAA	Aaa
Ireland	AAA	AAA	Aaa
Luxembourg	AAA	AAA	Aaa
Netherlands	AAA	AAA	Aaa
Norway	AAA	AAA	Aaa
Switzerland	AAA	AAA	Aaa
United Kingdom	AAA	AAA	Aaa
United States of America	AAA	AAA	Aaa
Australia	AA+	AAA	Aaa
Canada	AA+	AAA	Aaa
Denmark	AA+	AAA	Aaa
Singapore	AA+	AAA	Aaa
Spain	AA+	AA+	Aaa
Sweden	AA+	AA+	Aaa
Belgium	AA	AA+	Aaa
Bermuda	AA	AA	Aa1
Italy	AA	AA	Aaa
Japan	AA	AA-	Aaa
New Zealand	AA	AA+	Aaa
Portugal	AA	AA	Aaa
San Marino	AA		Aaa
Hong Kong	AA-	A+	A3
Iceland	AA-	A+	Aaa
Kuwait	AA-	A+	A2
Cyprus	A+	A	A2
Taiwan	A+	AA-	Aa3
Greece	A		Aaa
Korea	A	A-	A3
Malta	A	A	A3
Slovenia	A	A+	Aa3
Bahrain	A-		Baa3
Chile	A-	A-	Baa1
China	A-	BBB	A3
Estonia	A-	A-	A1

Table 2 (continuous)

	Fitch rating	S&P rating	Moody's rating
Hungary	A-	A-	A1
Israel	A-	A-	A2
Czech Republic	BBB+	A-	A1
Malaysia	BBB+	BBB+	Baa1
Poland	BBB+	BBB+	A2
Aruba	BBB		
Latvia	BBB	BBB+	A2
Lithuania	BBB	BBB+	Baa1
Slovakia	BBB	BBB	A3
Tunisia	BBB	BBB	Ba2
Croatia	BBB-	BBB-	Ba1
Mexico	BBB-	BBB-	Baa2
South Africa	BBB-	BBB	Baa2
Thailand	BBB-	BBB-	Baa3
Egypt	BB+	BB+	Ba1
El Salvador	BB+	BB+	Baa3
Kazakhstan	BB+	BB+	Baa3
Panama	BB+	BB	Baa1
Philippines	BB+	BB+	Ba1
Bulgaria	BB	BB+	B1
Colombia	BB	BB	Ba2
Costa Rica	BB	BB	Ba1
India	BB	BB	Ba1
Azerbaijan	BB-		
Peru	BB-	BB-	Ba3
Romania	BB-	BB-	B1
Russia	BB-	BB	Ba2
Vietnam	BB-	BB-	B1
Iran	B+		B2
Lesotho	B+		
Papua New Guinea	B+	B	B1
Brazil	B	B+	3
Indonesia	B	B-	B3
Ukraine	B	B	B2
Gambia	B-		
Lebanon	B-	B-	B2
Moldova	B-		Ca
Turkey	B-	B-	B1
Ecuador	CCC+	CCC+	Caa2
Venezuela	CCC+	CCC+	Caa1
Turkmenistan	CCC-		B2
Uruguay	CCC-	CCC	B3
Argentina	DDD	SD	Ca

The variables selected are given in Table 3, and the criterion followed was to select a group of variables from among those most utilized by the rating agencies and by some of the authors who have previously investigated this question, such as Cantor and Packer (1996) already cited.

Table 3

## Description of variables

1. GDP per capita (1998 to 2002e)	Converted into USD at annual average market exchange rate.
2. GDP growth (2000 to 2004e)	Annual % change in constant prices, i.e. volume terms.
3. Increase of the CPI (2000 to 2004e)	Annual % change.
4. Fiscal Balance / GDP (2000 to 2004e)	Consolidated balance of central government, provincial, regional and local governments, social security funds and other extra- budgetary funds, as a % of GDP.
5. Balance of payments on current account / GDP (1999 to 2003e)	Balance of payments on current account as a % of GDP.
6. Gross external debt / earnings from the Balance of payments on current account (1998 to 2002e)	Outstanding debt liabilities of residents to non-residents expressed as a % of the earnings from the Balance of payments on current account. These liabilities may be denominated in foreign or local currency.
7. Internal Debt of the State / GDP (2002)	General Government debt issued in the country's domestic capital market, as a % of GDP.
8. Liquidity Ratio (2000 to 2004e)	Liquid external assets as a % of liquid external liabilities. The assets include international reserves plus gold and bank's external assets. The liabilities comprise the external debt service in the current year plus the stock of short term external debt.
9. Industrialized country or not (2003)	According to the IMF: 1 for industrialized countries and 0 for not industrialized.

Notes: Variables described in Fitch (2003b).  
In some years the values are estimated (e).

Table 4 shows the median values of the variables cited, for each of the agencies considered, Fitch being the source of this data; however we have obviously utilized the mean values when calculating the parameters of the multiple regressions applied.

The variables 1 and 2, "GDP per capita" and "GDP Growth", should theoretically be relevant for determining the rating of a sovereign issuer, since they measure the potential tax base of the borrower country, in other words, its capacity to service the debt by way of taxes.

Variable 3, "Increase of the CPI", measures the rate of inflation in the issuer country. A high CPI usually arises from structural economic problems and could be an indication that the country is financing its budget deficit by extending the monetary base instead of by increased taxation or Public Debt.

The variables 4 and 5, "Fiscal Balance/ GDP" and "Balance of payments on current account/ GDP", refer to the possible surpluses or deficits of the general budgets of the State and of the Balance of payments on current account, respectively. If there are deficits, this should in theory reduce the rating of the borrower country.

The variables 6 and 7, "Gross external debt/ earnings from the Balance of payments on current account" and "Internal Debt of the State/ GDP", are representatives of the degree of indebtedness of the country in question. High ratios should indicate increased possibilities of the appearance of situations of insolvency.

Similarly variable 8, the "Liquidity Ratio", should indicate problems of technical or short term insolvency in borrower countries. Lastly, the dichotomous variable 9 indicates whether or not the country is classified as industrialized according to the IMF. The purpose of using this variable is to capture a certain threshold effect that the agencies seem to take into account<sup>1</sup>.

<sup>1</sup> The variables utilized by Cantor and Packer (1996) are very similar to those of our study. Specifically, the following variables are included by these authors: 1. GNP per capita. 2. Growth of GDP. 3. Increase of the CPI. 4. Fiscal Balance /GDP. 5. Surplus of the Balance of payments on current account/ GDP. 6. External foreign currency debt/ Exports. 7. Industrialized country or not. 8. Previous cases of default.



Table 4

## Medians values of the variables per agency and credit rating

	Agencies	Rating						
		AAA/Aaa	AA/Aa	A/A	BBB/Baa	BB/Ba	B/B	CCC- DDD,SD/ Caa-C
1. GDP per Capita	Fitch	24.909.4	22.920.3	9.596.0	3.767.6	1.731.9	717.9	4410.5
	S&P	24.838.4	19.773.0	9.823.3	3.026.3	1.780.3	2.837.8	5034.8
	Moody's	24.657.1	12.829.0	5.622.7	3.248.8	2.042.5	1.691.3	5034.8
2. GDP growth	Fitch	2.178	2.489	3.869	3.622	4.101	3.638	-1.840
	S&P	2.197	1.954	3.355	4.289	4.001	2.284	-2.087
	Moody's	2.197	2.988	3.636	3.307	3.609	3.386	-2.087
3. Increase of the CPI	Fitch	2.240	2.392	3.204	3.202	4.140	9.648	15.933
	S&P	2.291	2.379	3.240	2.360	4.140	10.060	20.290
	Moody's	2.379	2.540	3.096	2.677	4.140	10.219	20.290
4. Fiscal Balance / GDP	Fitch	-0.320	0.253	-2.319	-3.661	-2.865	-2.614	-3.520
	S&P	0.557	-0.660	-3.250	-2.893	-3.037	-4.468	-3.000
	Moody's	0.167	-1.551	-4.154	-2.191	-3.940	-3.369	-3.000
5. Balance of payments on current account / GDP	Fitch	1.784	1.991	-1.611	-3.842	-1.509	-2.363	-1.173
	S&P	1.926	2.650	-4.355	-3.733	-1.137	-1.407	0.197
	Moody's	0.487	5.722	-4.450	-1.080	-1.137	-0.055	0.197
6. Gross external debt / earnings from the Balance of Payments on current account	Fitch	273.917	232.749	105.468	90.211	128.265	159.561	196.779
	S&P	261.173	241.082	125.229	83.588	128.319	209.053	284.297
	Moody's	260.792	76.459	85.708	96.027	128.319	168.369	284.297
7. Internal Debt of the State / GDP	Fitch	46.231	39.001	30.851	24.561	10.807	25.636	20.483
	S&P	46.231	47.453	31.406	23.218	11.483	54.451	24.392
	Moody's	46.231	23.040	26.981	23.218	28.217	25.314	24.392
8. Liquidity Ratio	Fitch	55.839	40.831	131.395	114.36	145.501	120.638	87.756
	S&P	55.839	36.247	132.506	129.97	145.146	68.207	76.441
	Moody's	45.414	198.508	132.506	98.759	145.146	103.513	76.441
9. Industrialized country or not	Fitch	1	1	0	0	0	0	0
	S&P	1	1	0	0	0	0	0
	Moody's	1	0	0	0	0	0	0

Source: Fitch Investor Service.

#### 4.1. Regression models of 9 variables

In Table 5 we present the model that utilizes the 9 variables, previously detailed in Table 3, taking as dependent variable four possibilities, first the average rating, then individual ratings given by Fitch, Standard & Poor's and Moody's. For the case of the average rating, the regression is based on a sample of 77 countries, and the correlations between the variables seem acceptable, as there are no serious multicollinearity problems<sup>1</sup>. It should also be observed that, to improve the

<sup>1</sup> We have tested for the possible existence of problems of multicollinearity in each of the variables utilized in this and in the following models, confirming that the variance inflation factor is always  $FIV < 10$  and the tolerance  $TOL > 0.1$ . It should be remembered that the relationship between both measures is inverse,  $TOL = 1/FIV$ .

We have also utilized another test of multicollinearity, the condition index or CI, that warns of this type of problem in the regression performed, if values larger than 30 are found. The models of nine variables utilized present CI values of around 40, which thus indicates the existence of multicollinearity. For the models of five variables, the CI takes a value of around 35, and for the four variables model, a value close to 30.

fit of the regressions, we have taken Napierian logarithms for variables 1, "GDP per capita", and 3, "Increase of the CPI".

Table 5

## Regression models of nine variables

		Dependent variable			
		Average rating	Fitch rating	S&P rating	Moody's rating
Sample size		77	77	67	73
Corrected R <sup>2</sup>		0.891	0.868	0.896	0.878
Durbin-Watson		1.782	1.516	1.827	2.166
Independent variables					
Constant	B	-1.370	-0.491	-2.092	-2.362
	t	-1.390	-0.466	-1.943*	-2.045**
1. In GDP per capita	B	0.881	0.773	0.937	1.035
	t	8.846***	7.259***	8.282***	8.466***
2. GDP growth	B	0.121	0.101	0.234	0.153
	t	3.130***	2.456*	4.776***	3.437
3. In increase of the CPI	B	-0.658	-0.692	-0.700	-0.709
	t	-6.300***	-6.198***	-5.193***	-5.890***
4. Fiscal Balance / GDP	B	0.041	0.054	-0.004	0.008
	t	1.948*	2.4**	-0.141	0.294
5. Balance of payments on current account / GDP	B	-0.027	-0.021	0.012	-0.026
	t	-1.960*	-1.435	0.671	-1.388**
6. Gross external debt / earnings from the Balance of payments on current account	B	-0.003	-0.024	-0.002	-0.004
	t	-4.873***	-3.620***	-2.935***	-5.356***
7. Internal Debt of the State / GDP	B	0.001	-0.001	-0.003	0.020
	t	0.322	-0.171	-0.880	0.511
8. Liquidity Ratio	B	-0.001	-0.001	-0.002	-0.002
	t	-1.427	-1.105	-2.137**	-2.115**
9. Industrialized country or not	B	1.237	1.219	1.118	1.150
	t	5.429***	5.005***	4.165***	4.141***

B: Regression coefficients

t: Student t-statistic

\* Confidence level 90%

\*\* Confidence level 95%

\*\*\* Confidence level 99%

The explanatory power of the model, for the average rating, is found to be fairly high, since the corrected coefficient of determination R<sup>2</sup> is 0.891, in other words, the regression explains almost 90% of the variations in the rating given by the three agencies. With respect to the Durbin-Watson index, its value of 1.782 tells us that, by falling outside the range " $d_u/(4-d_u)$ " we are, in principle, in a zone of indecision with respect to the existence of positive autocorrelation of the residuals of the regression<sup>1</sup>.

<sup>1</sup> It will be recalled that Durbin-Watson test is intended to detect the serial correlation of the residuals of a regression. In function of the number of independent variables and of the size of the sample, a table establishes the critical upper and lower values,  $d_u$  and  $d_l$ , of the statistic. If the result of the test is found to be in the range " $d_u/(4-d_u)$ " it can be considered that there is neither a positive nor negative correlation. Results below this range point to positive correlations and above to negative correlations, although with certain zones of indefiniteness.

Considering the non-standardized coefficients of the independent variables, the following is found:

Of the 9 variables, 3 do not present the sign that would be expected. In particular, numbers 5 and 8, referring to the surplus of the balance on current account and to the coefficient of liquidity, appear with a negative sign when they should be positive, at least on the face of it. And variable 7, referring to the National Debt, appears with a positive sign when one would have expected the contrary. In addition, the degree of significance for variable 5 is 10% and the other two are not significant.

Regarding the rest of the variables, all are significant to 1% except that referring the Fiscal Balance, which is to 10%, and the constant that is not significant<sup>1</sup>.

If the regressions are performed with the particular ratings given by one agency rather than the average of the ratings given by the three, the results presented in Table 5 can be summarized in the following way:

Utilizing the data of Fitch, the corrected coefficient  $R^2$  reaches the value of 0.868 and the value of the Durbin-Watson statistic is 1.516, taking a sample of 77 countries; the results are also in a zone of indefiniteness with respect to the existence of positive autocorrelation in the residuals of the regression. In relation to the coefficients of the variables, these appear with the same signs as in the previous case, except that referring to the Internal Debt of the State, which now takes a more logical negative sign, although the variable is again without significance, nor is the Liquidity Ratio.

With the ratings of Standard and Poor's, the corrected coefficient  $R^2$  is 0.896 and the Durbin-Watson test gives a value of 1.827, indicating a certain indefiniteness with respect to the existence of positive autocorrelation in the residuals of the regression. The sign of the coefficients of the variables are those expected, with the exception of the Fiscal Balance and the Liquidity Ratio, which appear with negative sign, although none of the variables is significant. There are 67 countries in the sample, in this case.

Lastly, the ratings of Moody's present a corrected coefficient  $R^2$  of 0.878 and a value of 2.166 for the Durbin-Watson statistic, which points to a certain degree of negative autocorrelation in the residuals. The sample in this case covers 73 countries.

Regarding the coefficients of the variables, the surplus of the Balance of payments, the Internal Debt of the State and the Liquidity Ratio appear with signs contrary to expected, although the second of these is not significant.

In summary, we find very similar regressions utilizing either average ratings or the individual ratings of each agency, within the range one would expect.

#### **4.2. Regression models of 5 variables**

In the light of the results obtained from the regression model of 9 variables, and particularly taking into account the limited or non significance of some of the variables employed, we studied a second model utilizing only 5 variables. The variables eliminated were those found to be not significant or significant to 10% in the previous model. Table 6 presents the results of the new regression performed taking the 5 variables included. Again four regressions were carried out, on the average and 3 individual ratings.

The regression with average ratings presents a value of the corrected coefficient  $R^2$  of 0.862 and covers data of 78 countries. The Durbin-Watson test gives a value of 1.819, falling within the desirable range that indicates absence of autocorrelation in the residuals of the regression. In this case the coefficients of the variables present the signs expected and all are significant.

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<sup>1</sup> Cantor and Packer (1996), with their regression model of 9 variables, obtain a coefficient  $R^2$  of 0.924, with data of 49 countries. These authors also find problems with certain variables, and the coefficients of the Fiscal Balance and of the surplus of the Balance on current account appear with signs contrary to the expected, as well as not being significant.

Table 6

## Regression models of five variables

		Dependent variable			
		Average rating	Fitch rating	S&P rating	Moody's rating
Sample size		78	78	68	74
Corrected R <sup>2</sup>		0.862	0.842	0.879	0.842
Durbin-Watson		1.819	1.632	1.733	2.012
Independent variables					
Constant	B	-2.827	-2.071	-3.645	-3.977
	t	-2.949***	-2.072**	-3.630***	-3.384***
1. In GDP per capita	B	0.955	0.869	1.002	1.095
	t	9.158***	7.986***	9.087***	8.499***
2. GDP growth	B	0.159	0.141	0.268	0.183
	t	3.931***	3.335***	5.872***	3.920***
3. In increase of the CPI	B	-0.557	-0.614	-0.53	-0.514
	t	-5.564***	-5.890***	-5.375***	-4.516***
6. Gross external debt / earnings from the Balance of payments on current account	B	-0.0007622	-0.0006115	-0.0004605	-0.000868
	t	-2.102**	-1.618	-1.319	-2.108**
9. Industrialized country or not	B	1.099	1.076	1.037	1.023
	t	4.503***	4.226***	4.290***	3.579***

B: Regression coefficients

t: Student t-statistic

\* Confidence level 90%

\*\* Confidence level 95%

\*\*\* Confidence level 99%

Utilizing the ratings awarded by Fitch, the corrected coefficient R<sup>2</sup> of the regression is 0.842, also with data of 78 countries. The Durbin-Watson statistic presents a value of 1.632, slightly outside the desirable range. The coefficients of the variables are significant, with the exception of that referring to the External Debt, and present the signs expected.

Estimating the regressions with Standard & Poor's data, the corrected coefficient R<sup>2</sup> is 0.879, and in this case 68 countries are included. The Durbin-Watson statistic takes the value 1.733, which is outside the theoretical range. The coefficients of the variables are significant, but with the exception again of the External Debt, and they also show the signs expected.

Lastly, employing the ratings of Moody's, the corrected coefficient of determination R<sup>2</sup> is 0.842, the regression being estimated with 74 countries. The Durbin-Watson statistic takes a value of 2.012, which is within the acceptable range. In this case, the coefficients of the variables are also of the sign expected and are all significant to 1% except the External Debt, which is significant to 5%.

We may therefore conclude that models of only five independent variables provide results that explain reasonably well the ratings that these agencies assign to sovereign issuers.

Making a diagnosis by case, in other words, observing country by country the difference between the real rating, either the average or that given by one or other agency, and the predicted rating, the errors are always concentrated in the lower rated issuers. Thus the cases of countries like Turkmenistan, Uruguay and Argentina stand out<sup>1</sup> all with very low rating (CCC<sup>-</sup> for the two first, and the third in "default" according to Fitch) where the models assign them ratings that are

<sup>1</sup> In fact, Argentina as a sovereign issuer is a true "outlier", and the regressions improve if this country is omitted from the database.

about 6 "notches" higher<sup>1</sup>. However, for more normal countries, the errors or differences are of around 2 "notches", both upward and downward.

### 4.3. Regression models of 4 variables

A final step in the research study undertaken was to consider models of 4 variables, and for this we decided to eliminate variable number 6, Gross External Debt/ earnings from the Balance of payments on current account, as being less significant. Table 7 presents these regressions, both for average ratings and for those given by one individual agency. As can be observed, the corrected coefficients  $R^2$  continue to be high, between 0.838 and 0.856, and the Durbin-Watson statistic falls within acceptable levels that indicate null or low autocorrelations of the residuals.

Table 7

Regression models of four variables

		Dependent variable			
		Average rating	Fitch rating	S&P rating	Moody's rating
Sample size		78	78	68	74
Corrected $R^2$		0.856	0.838	0.878	0.840
Durbin- Watson		1.752	1.585	1.691	1.946
Independent variables					
Constant	B	-2.405	-1.733	-3.341	-3.406
	t	-2.507**	-1.753*	-3.398***	-2.906***
1. In GDP per capita	B	0.879	0.807	0.951	0.999
	t	8.787***	7.834***	9.163***	8.092***
2. GDP growth	B	0.166	0.146	0.276	0.189
	t	4.018***	3.437***	6.059***	3.974***
3. In increase of the CPI	B	-0.554	-0.612	-0.536	-0.515
	t	-5.409***	-5.803***	-5.399***	-4.409***
9. Industrialized country or not	B	1.213	1.167	1.103	1.159
	t	4.980***	4.650***	4.639***	4.065***

B: Regression coefficients

t: Student t-statistic

\* Confidence level 90%

\*\* Confidence level 95%

\*\*\* Confidence level 99%

The sample of countries ranges between 68 and 78 and all the variables appear with the signs theoretically expected, all being significant to 1%. It appears, therefore, that models with very few variables, four in our case, are able to explain a high percentage of the process of rating sovereign risks carried out by the rating agencies. In addition, of these variables two refer to GDP, one to the CPI or inflation, and the other refers to what is not unlike an alternative rating, by the IMF in this instance, the status of the country as industrialized or not.

## 5. Conclusions

It is clear that, when they analyze sovereign risks, the rating agencies utilize a wide battery of macroeconomic indicators supplied, in part, by the actual authorities of the country in question. In addition to this, the visit of the analysts and contact with those responsible for economic affairs of the issuer state is another of the procedures on which the final report and the definitive

<sup>1</sup> The term "notch" is taken to indicate minimum differentiation or jump between two possible ratings, for example between AA and AA<sup>+</sup> or between CCC<sup>+</sup> and B<sup>-</sup>.

rating is based. Therefore, we are dealing with several processes in which the degree of discretionality of the agencies is relatively important and where the final opinion has a strong influence on the financing, external and internal, of the sovereign state in question. Thus, a good rating will reduce the costs of financing by means of the issue of Public Debt, both in foreign currencies and in local currency, and a downgrading of the rating will cause an increase in the differential of interest over the appropriate "benchmark", normally the interest payable on U.S. Treasury bonds for issues in dollars and on the German Treasury bonds for debt in euros.

In summary, the credit risk premium moves in function of the initial assessment or rating and of its possible changes over the course of time. In addition, the sovereign ratings usually act as a ceiling for the issues of debt of local companies; therefore there is a double effect. A country's rating affects, directly, its issues of Public Debt and, indirectly, those of the companies based in that country.

It is worth stating that, although there are similarities in procedures, important differences exist between the "industry" of rating sovereign risks and that of rating corporate risks. The rating of sovereign issuers is a fairly closed universe and is monopolistic in character. Currently some 80 countries are rated and the relevant rating organizations on the world scale are always the three agencies cited; these agencies also usually coincide fairly closely in the ratings awarded.

However, the rating of companies is a much more open world, where issues of debt are considerably more numerous and where agencies of local or national character have a place, in addition to the big three so often cited<sup>1</sup>.

From our study it appears to be demonstrated that the utilization of a few macroeconomic variables, appropriately selected, between 4 and 9, provides sufficient explanatory power of the average rating, or that of a single agency, awarded to the corresponding issuers. This result is in line with earlier studies in the literature scientific on this topic. Not surprisingly, variables such as GDP per capita, the growth of GDP and the increase of the CPI, the gross external debt relative to the earnings from the Balance on current account, and the classification of the country as industrialized or not, serve to explain a large part of the level of rating given to issues of long term foreign currency debt.

There is thus an apparent divergence between the rating models utilized by the ratings agencies, based on a large number of variables, and our regression models that only utilize a reduced number of variables with a high explanatory power of the rating given. How can such divergence in respect of the number of variables utilized be explained? There are various possible answers: Probably, the agencies do not actually utilize all the many variables listed in the documentation available; these variables are likely to represent more a panel or menu of data series, from which are selected only those considered more relevant for the specific country being assessed. One should also bear in mind that several of the variables are very strongly correlated one to another; the effect of this is that, in practice, a number of these may be redundant. Moreover, it is possible that some variables with a high degree of significance, such as those utilized in this study, serve to give a first approach to the rating, and that later, more variables of lower significance are used for a finer fit. Lastly, the evident existence of qualitative variables that are impossible to quantify, like the risk of an armed conflict or a change of political regime, can also influence the final decision on the rating given the agencies.

We can conclude, in general, that the process of rating sovereign risks, as performed by the big rating agencies, presents notable characteristics of congruence, normalization and rationality and that, for this reason, the financial markets for Public Debt attach exceptional credibility to the ratings published, clearly altering the risk premiums demanded, in consonance with differences in the ratings.

Nevertheless, as it is not a totally transparent process made clearly explicit (for legitimate commercial reasons), it may be that the procedures are not actually as complex as they appear, and that with a very reduced number of variables, a good first approach may be made to the level of rating to assign.

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<sup>1</sup> For example, Altman (2002), in a 1994 study, utilizes data of 750 issues of U.S. corporate bonds. However many more new nations are born in the world, it seems very unlikely that we will one day see a similar number of sovereign issuers.

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