CREDIT RATING AGENCIES: THE IMPORTANCE OF FUNDAMENTALS IN THE ASSESSMENT OF SOVEREIGN RATINGS

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Credit Rating Agencies: The Importance of Fundamentals in the Assessment of Sovereign Ratings

I Introduction

In recent decades the relevance of sovereign ratings has grown and the number of governments asking for initial ratings is increasing every day. Three main credit rating agencies (CRAs), namely Standard and Poor's Ratings Services, Fitch and Moody's Investors Service rated barely 17 sovereigns in the late eighties, whereas currently they publish approximately 140 sovereign ratings.

Numerous researches were undertaken over the years in order to find out which economic variables influence rating and in which measure, as the understanding of the relationship between sovereign ratings and the fundamentals could have important policy implications.

Given these premises, the aim of this paper is to examine the significance of the fundamental variables used by the top three CRAs in the assessment of sovereign ratings. An innovative feature of this research is that the countries are divided in groups, depending on the level of development and indebtedness. Furthermore, the whole period is divided in two sub-periods: before and after the Asian crisis. We can, therefore, conclude if there are changes of the weights assigned to the indicators by the agencies due to the global economic situation.

The remainder of the paper is organized as follows. Section II contains the literature overview of the most important articles in the field. Two main streams are reported: one that revises the determinants and the behavior of ratings, and another that investigates ratings the causality. In Section III we present an economic analysis of the main issues regarding rating agencies behaviour. In Section IV the main features of the dataset are explained in details. In Section V a descriptive statistical analysis of data is provided and main issues concerning the methodology used in the analysis are explained. Furthermore, in Section VI the empirical results of the analysis are discussed in detail. Finally, Section VII provides main findings and concluding remarks.

II Related works

Existing literature regards two main streams, one that revises the determinants and behaviour of ratings, and another that examines the causality of ratings.

A pioneering study by Cantor and Packer (1996) examines the determinants and the influence of sovereign credit ratings assigned by Moody's Investors Service and Standard and Poor's Ratings Services. The dataset consists of 49 countries. Using the cross-sectional ordinary least squares (OLS) model they estimate the influence of eight variables on the sovereign rating. The results show that five of those variables might explain the assigned ratings (*per capita* income, GDP growth,

external debt, inflation, degree of economic development and default history), but neither fiscal nor external balance significantly influences the dependent variable. Using the same methodology and data on 81 countries, Afonso (2003) shows the influence of: *per capita* GDP, inflation rate, external debt, default history, real growth rate and the level of economic development on sovereign rating. The rating scale was transformed using linear, logistic and exponential transformation. The logistic transformation provided better results in respect to the others[1]. Many researchers found numerous other variables that significantly influenced ratings, like unemployment rate and unit labour cost (Bissoondoyal-Bheenick, 2004); foreign reserves, current account balance and exports (Monfort and Mulder, 2000); budget balance, government debt, corruption degree and social indexes (Depken *et al.*, 2006); government effectiveness, foreign reserves, European Union accession and geographical location (Afonso *et al.*, 2007). Guttler and Wahrenburg (2007) examine whether there are biases and lead-lag relationships in credit ratings near-to-default issuers. They find evidence that Moodys seems to adjust its ratings to increasing default risk in a timelier manner than S&P. Moreover, they discover that given a downgrade (upgrade) by the first rating agency, subsequent downgrades (upgrades) by the other, with a greater magnitude in the short-run. In addition, rating changes by the second rating agency are significantly more likely after downgrades than after upgrades by the first rating agency. Hill *et al.* (2010) find that rating transition probabilities tend to increase as the rating level decreases across all agencies. Moreover, empirical findings underline that material heterogeneity exists between the agencies. Evidence of interdependence in rating actions has been discovered by Alsakka and Gwilym (2010). In fact, upgrade (downgrade) probabilities are much higher, and downgrade (upgrade) probabilities are much lower for a sovereign issuer with a recent upgrade (downgrade) by another agency. Moreover, their results show that S&P tends to demonstrate the least dependence on other agencies, while Moody's tends to be the first mover in upgrades. Alsakka and Gwilym (2012) show that the agencies' actions imply different policies: S&P devotes more emphasis on short-run accuracy, while Moody's actions are consistent with greater stability. As in their previous study, the results that Moody's tends to be the first mover for positive outlook and watch signals is confirmed.

Furthermore, other two crucial points should be investigated in respect to ratings issue: endogeniety and causality. The endogeneity between ratings and bond yields is the major cause of the restrictive number of articles on the rating causality literature. Larrain *et al.* (1997) and Reisen and von Maltzan (1999) find a significant influence of sovereign bond downgrades on the dollar bond yields spread in the period from 1989 to 1997, which led them to think that the downgrades may have intensified the boom-boost cycle. On the other side, positive rating announcements do not show a significant effect on bond spreads. They also test for Granger causality finding mutual interdependence between dollar bond yield spread and sovereign ratings. Ferri *et al.* (1999) argue

[1]The author also examines the significance of the variables both for developed and developing countries.

that rating agencies' downgrades aggravated the East Asian crisis as rating agencies were releasing procyclical ratings. On the other side, Mora (2006) questions the previous opinion and argues that rating agencies simply reacted to new information in the market, and by using an ordered probit methodology, finds that ratings are found to be sticky rather than procyclical.

Table 1: A comparison of studies about sovereign ratings

Author(s)	Countries	Time/Period	Significant explanatory variables
Ades *et al.* (2000)	15 emerging countries	1996-2000	GDP growth rate, total external amortizations/reserves, total external debt/GDP, fiscal balance/GDP, exports/GDP, REER misalignment, LIBOR, and default history
Afonso (2003)	81 countries	2001	Per capita GDP, external debt, level of economic development, default history, real growth rate, and inflation
Afonso *et al.* (2007)	130 countries	1995-2005	Per capita GDP, real GDP growth, government debt, government effectiveness, external debt, external reserves, sovereign default indicator, and EU accession
Alexe *et al.* (2003)	68 countries	1998	Financial and depth efficiency, per capita GDP, debt to GDP ratio, political stability, and government efficiency
Alesina *et al.* (1992)	12 OECD countries	1974-1989	Industrial production index growth rate, debt to GNP ratio, debt accumulation, and debt maturity
Bissoondoyal-Bheenick (2005)	95 countries	1995-1999	Per capita GNP, inflation, government financial balance/GDP, government debt/GDP, foreign reserve, current account/GDP, and net exports/GDP
Bissoondoyal-Bheenick *et al.* (2004)	60 countries	2001	GDP, inflation, real interest rates, and technological development
Borio and Packer (2004)	52 countries	1996-2003	Per capita GDP, inflation, GDP growth, corruption perceptions index, political risk score, and default history
Budina and Manchew (2000)	Bulgaria	1994-1998	Gross foreign reserves, exports, REER, and Mexicos nominal exchange rate
Butler and Fauver (2006)	93 countries	2004	Legal environment, Per capita GDP, inflation, foreign debt per GDP, underdevelopment index, and default history
Caceres *et al.* (2010)	10 advanced countries	2005-2010	Index of Global risk aversion, spillover coefficient, overall balance, and debt-to-GDP ratio
Cantor and Packer (1996)	49 countries	1991-1995	Per capita GDP, GDP growth, inflation, external debt, economic development, and default history
Canuto *et al.* (2004)	66 countries	1998-2002	Real GDP growth, Central Government Gross debt, and total net external debt
Catao and Sutton (2002)	25 emerging countries	1970-2001	Real GDP growth, debt service-export ratio, ratio of net international reserves to debt, fiscal balance, US interest rate, REER, and policy volatility
Cosset and Roy (1991)	71 countries	1982-1987	Per capita GNP, propensity to invest, and net foreign debt/export
Edwards (1983)	19 developing countries	1976-1980	Reserves/GNP, debt/GNP, debt service/exports, and investment/GNP
Eichengreen and Mody (1998)	37 countries	1991-1996	Debt maturity, debt/GNP, debt services/exports, GDP growth, reserves/GNP, deficit/GDP, and US Treasury rate
Eliasson (2002)	38 emerging countries	1990-1999	Current account to GDP, external debt, per capita GDP, GDP annual growth, inflation, and external debt to export
Ferri *et al.* (1999)	17 countries	1989-1998	Real GDP growth, budget deficit, current account balance, development level, external debt, and foreign exchange reserves
Ferrucci (2003)	39 countries	1992-1998	External debt/GDP, openness, amortization/reserves, interest payments/external debt, current account/GDP, and US T-bill
Gaillard (2009)	105 subnational entities	2004	Per capita GDP net direct and guaranteed debt to operating revenue ratio, interest payments to operating revenue ratio, and default history
Haque *et al.* (1996)	Over 60 developing countries	1980-1993	Non-gold foreign exchange reserves to imports ratio, current account balance/GDP, GDP growth, international interest rates, countrys regional location, exports structure, and inflation
Hill *et al.* (2010)	129 countries	1990-2006	Beginning of period watch status, changes in GDP growth, direction of the last rating change, and probabilities derived from the rating levels equation
Hu *et al.* (2002)	12 to 92 countries	1981-1998	Past default, reserves, inflation, debt to GNP ratio, being a non-industrial country, and ratio of debt service to exports
Min (1998)	11 emerging countries	1991-1995	Private issuer, total external debt/GDP, issue spread, foreign reserves/GDP, debt service/exports, imports growth rate, exports growth rate, net foreign assets, CPI inflation rate, terms-of-trade index, nominal exchange rate adjusted by CPI, maturity, and issue size
Monfort and Mulder (2000)	20 emerging countries	1995-1999	Investment to GDP ratio, inflation, export growth, crisis indicators, and REERs
Nogues and Grandes (2001)	Argentina	1994-1998	EMBI total-return index Mexico, external debt service/exports, GDP growth rate, fiscal balance, and 30-year US Treasury yield (-)
Oliveira *et al.* (2012)	7 EMU countries	2000-2010	Stock returns, interest rate, inflation rate, public debt level, current account deficit, government investment, and state of the business cycle
Reinhart *et al.* (2001)	53 countries	1824-1999	Inflation, default history, external debt/GNP
Reisen and von Maltzan (1999)	14 countries	1988-1997	Past ratings, government bond yield spread, stock market return, reserves, real exchange rate, terms of trade
Remolona *et al.* (2007)	26 emerging countries	1990-2005	Nominal GDP, per capita GDP, inflation, current account balance/GDP, external debt/GDP, political risk, default history, and currency mismatch
Rojas and Jaque (2003)	Chile	1999-2002	Short-term debt/reserves, total external debt/reserves, exports, economic activity, and US Federal funds rate
Rowland and Torres (2004)	19 countries	1998-2002	Real GDP growth, debt/GDP, reserves/GDP, default history, and debt service/exports

Source: our elaborations.

III Economic Analysis

Nowadays, rating agencies play an important role on the global financial market. Ratings are supposed to reduce the asymmetries between the lenders or investors on one side and the issuers

on the other. Furthermore, due to the regulation policy on investments, investors themselves prefer rated bonds to the non-rated ones. Credit ratings express forward-looking opinions of rating agency about the relative creditworthiness of borrowers. According to S&P, the likelihood of default of a borrower on its obligations is the indicator that best represents way the creditworthiness of a borrower itself. Besides being a measure of solvency and the capacity for repaying debt, sovereign ratings themselves provide an overall socio-economical and political situation of the country. In the sovereign ratings market, high rating facilitates the access to the international financial markets, attracts foreign investments and lowers the interest rates at which country borrows.

Sovereign ratings are similar to the corporate ratings, except for one thing, while the corporations have to declare default in the moment of insolvency, governments are exposed to additional source of funds - international emergency credit, and they can save themselves from declaring a default. Particularity of the sovereign debt is the dependence of default on the ability and willingness of the country to pay its financial obligations both in principal and interest on time. Governments can default on some of their obligations, even if being financially capable to service their debt. This is mainly a political decision and depends on the difference between the loss caused by the default and the money saved on debt payment, taking into account future losses and penalties imposed by lenders [2]. This is the reason why it is difficult to include those qualitative measures in the rating process in order to predict sovereign ratings.

Sovereign ratings are published on short-term or long-term domestic or foreign currency. Generally, ratings on the local currency are higher than the foreign currency ones, as the defaults on foreign currency obligations are more common than the defaults on the local currency obligations. The reason is that governments, with the instruments of taxing domestic income or printing local currency, are more capable of servicing domestic currency debt. Some sovereign ratings are issued at the request of the countries themselves, which can be useful tool to enable them to access capital markets. In those circumstances, countries pay credit rating agencies for assigning ratings, and agencies operate under an issuer-pays business model. CRAs have meetings on a regular basis with government officials of those countries, who may provide them with confidential information. Furthermore, the objective of those meetings is to seek to understand government policy objectives and the direction of fiscal policy. On the other side, there are some sovereign ratings that are unsolicited and CRAs do not receive any revenue for releasing those ratings, and when this is the case, CRAs do have to rely more on public information and they interact with other people in the country concerned and the broader economic policy making establishment in the private sector.

As in the case of corporate bond ratings, rating agencies are neither giving recommendation for making investment decision nor a measure of the rated obligation, but rather an opinion about

[2]For more information about the difference between sovereign and corporate ratings see (Bulow and Rogoff, 1988).

the creditworthiness of the rated entity. Credit rating agencies in general provide little information about the weights assigned to the variables that have influence on the sovereign rating. Moreover, the variables are interrelated and the weights are not fixed over time. Considering that the agencies assess ratings using numerous data, it would be useful to find a reduced set of variables that can explain the levels and the changes of the sovereign ratings over time.

So far it is clear that ratings have a great economic importance, as they constitute the main drivers for attracting foreign investments and can influence the dynamics of interest rates. Furthermore, it could be of interest to verify if they reflect the fundamentals of a country, or if they follow the sentiment markets. The test can be performed using a model that regresses the historical ratings on main macroeconomic variables. However, it must be stressed that the lack of information provided by the the backward looking analysis may be due to the fact that the agencies are forward-looking. Then, the assessment might be built on the expected rather then historical trends of the relevant variables. Another source of bias can be due to the agencies' beliefs regarding the possibility of a government voluntary default on some (or all) of its obligations. This information can be hardly obtained, but it could strongly affect the significance of the regression model. Finally, it is important to focus on long-term foreign currency ratings, following most academic articles, as they exhibit the highest risk profiles.

IV Data

The analysis is undertaken on an unbalanced panel, consisting of 139 countries, in the period 1975-2010. Mainly, the source of data regarding the economic variables are the World Development Indicators (WDI), the Global Development Finance (GDF) database from the World Bank, and some OECD data. The dependent variable consists of the long-term foreign currency ratings, published by the main three rating agencies. Ratings scale has been transformed into numerical values in order to be estimated. Using a linear scale, ratings are grouped in 21 categories. Although agencies use different symbols for ratings, each rating grade has its counterpart in other agency's scale. This allows an easy comparison among the rating levels, as represented in the Table 7. Published ratings are multiple in some years, but due to the availability of only yearly data on most of independent variables, ratings included in the dataset are those valid on 31^{st} of December of each year. Furthermore, we constructed one more variable, namely average rating, representing the medium value of the three ratings (when all three are available).

It is important to mention that ratings released by the leading rating agencies are quite similar. Spearman's rank order correlation determines the relationship between ratings of different rating agencies, and correlation found among the agencies' ratings is quite high, as can be seen in table below. The highest coefficient of rho correlation is between S&P and Fitch (0.99), while the

correlation between S&P and Moody's and the one between Fitch and Moody's is slightly lower (0.97).

Table 2: Spearman's correlation

	S&P	Fitch	Moody's
S&P	1.00		
Fitch	0.99	1.00	
Moody's	0.97	0.97	1.00

In their seminal paper, Cantor and Packer (1996) use a four-years average of the independent variables, considering it to be a more reliable measure, as it avoids fluctuation in different years. The other strand of literature uses yearly data, and not the average. Eliasson (2002) shows that there are no "conspicuous differences between the two considering variables". As the process of "averaging" data reduces the dataset, single-year data are used in this analysis. Furthermore, we divided countries in different groups, based on the level of the development and their indebtedness. Furthermore, given that the period in which the rating agencies assign ratings may influence the rating itself, we perform the analyses on full-period sample, on the sub-sample begining in 1975 to 1996 and the last period from 1997 to 2010. The indicators used in the analysis are presented in Table 3.

Table 3: Description of variables

Variable	**Description**	**Unit of measure**	**Expected sign**
GNI growth	The sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad	%	+
Per capita GNI	The gross national income, converted to U.S. dollars using the World Bank Atlas method, divided by the midyear population. GNI, calculated in national currency, is usually converted to U.S. dollars at official exchange rates for comparisons across economies, although an alternative rate is used when the official exchange rate is judged to diverge by an exceptionally large margin from the rate actually applied in international transactions. To smooth fluctuations in prices and exchange rates, a special Atlas method of conversion is used by the World Bank	US$	+
Current account balance	Current account balance is the sum of net exports of goods, services, net income, and net current transfers	%	+
Inflation	The annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly	%	-
Unemployment	The share of the labor force that is without work but available for and seeking employment.	%	-
Fiscal balance	Cash surplus or deficit is revenue (including grants) minus expense, minus net acquisition of nonfinancial assets	%	+
Government debt	The entire stock of direct government fixed-term contractual obligations to others outstanding on a particular date. It includes domestic and foreign liabilities such as currency and money deposits, securities other than shares, and loans	%	-
Real interest rate	The lending interest rate adjusted for inflation as measured by the GDP deflator	%	-
Reserves	Holdings of monetary gold, special drawing rights, reserves of IMF members held by the IMF, and holdings of foreign exchange under the control of monetary authorities	%	+
Default history	Dummy variable that takes value 1 if the country i has defaulted in the previous period and zero otherwise	0/1	-

V Econometric Methodology

In the existing literature, the econometric methodology used was either ordinary least square or the ordered response model. Mainly discussed and criticized was the linear regression model on a linear numerical representation of ratings because of its cardinality measure. That implies that the difference between two rating categories is identical for any two adjacent categories. Logistic transformation, instead, implies that the risk perceptions initially deteriorates slowly as ratings level decreases, then faster in the region where ratings decrease from the investment grade to the speculative one, and then slowly again when close to the end of the rating scale. Logistic function is "S-shaped", demonstrating that the distance between ratings in the middle of the scale is bigger than the distances in the beginning and at the end of the rating scale. Indeed, the change from investment to speculative grade for a country has a huge impact, whereas slighter change can be noted within one of the two main ratings' categories. Reisen and Maltzan (1999) and Afonso (2003) use logistic or both logistic and exponential transformation to ratings. On the other hand, ordered response models itself defines the size of the differences between each category.

The empirical analysis here performed includes the study of the sovereign ratings and the publicly available data on the countries' fundamentals. In order to capture which are the variables that historically influence ratings the most, simple model is constructed. The aim of this research is not to create a model that would perfectly represent ratings assessment process, but contrary: to find out the main ingredients of the sovereign ratings, and to analyse if ratings are related to fundamental variables in expected directions. Ratings assessment is a complex process, since it includes various qualitative variables that are not included in this model.

A. Descriptive Analysis

The dataset is composed of 5143 observations (139 countries times 37 years). We have an unbalanced panel data. It is worth noticing how some ratings changes might be particularly volatile even if the upgrade/downgrade happened slowly during the year. As the time-interval is yearly, indeed, the value observed may be the product of several changes of the same sign happened during the same year. The set of the regressors consists of 10 variables of macroeconomic interest: GNI growth, *per capita* GNI, inflation, unemployment, fiscal balance, current account balance, government debt, default history, real interest rate and reserves.

The annual transition matrices in the Appendix represent moving probabilities from one rating level to all other rating levels within selected agency. The matrices are available for Standard and Poor's, Fitch and Moody's. It can be noticed that the percentage of the countries that have AAA (or Aaa) rating varies from around 19% (Fitch) to around 28% (Moody's). This variation is due to the fact that different agencies rate different nations. Around 79 countries are rated by all three

agencies, while other nations are rated by one or two agencies. Furthermore, number of countries that went into default varies across the agencies. It is important to mention that the percentage of the nations that went into default, rated by Moody's is much lower (0.21%) than the percentage of those rated by Fitch (0.87%).

B. Linear Regression Model

Consider the model:

(1) $y_{it} = \alpha_0 + \sum_{i=1}^{n} \beta_1 X_{it} + \varepsilon_{it}$

with $i = 1, ..., N$ $t = 1, ..., T$, applied to a dataset with large N and T. y_{it} is a dependent variable, and it represents the numeric rating assigned by the agencies to the respective country at time t, β is a vector of unknown parameters, X_{it} is a vector of economic explanatory variables for country i at time t and ε_{it} is a random disturbance term for country i at time t.

In order to estimate the model, the variables that create X_i have to be selected. Previously, the most important economic variables that can affect ratings have been discussed, as well as how they may and their influence ratings. The regression model is the following:

(2) $y_{it} = \beta_1$ GNI growth$_{it}$ + β_2 *per capita* GNI$_{it}$ + β_3 Inflation$_{it}$ + β_4 Fiscal balance$_{it}$ + β_5 Current account balance$_{it}$ + β_6 Government debt$_{it}$ + β_7 Unemployment$_{it}$ + β_8 Default history$_{it}$ + β_9 Real interest rate$_{it}$ + β_{10} Reserves$_{it}$+ε_{it}

The model above is estimated using POLS and PCSE estimation methods. Furthermore, we employ a Granger causality test in order to establish the extent to which sovereign ratings lead or cause changes in *per capita* GNI beyond and above other observable ratings determinants, considering yearly data and two lags for both variables. The Granger causality test (Granger, 1969) can be performed by the estimation equations:

(3) $Y_{i,t} = \alpha_i + X_{i,t-1} + mW_{i,t-1} + U_{i,t}$

(4) $X_{i,t} = \lambda_i + Y_{i,t-1} + nW_{i,t-1} + V_{i,t}$

where subscripts i and t denote countries and years respectively, where $\alpha$and λ are country-specific intercepts (fixed effects), and U and V residuals. *Per capita* GNI is represented by vector Y, the numerically transformed rating levels announced by the three agencies by a vector X, and exogenous macroeconomic determinants of sovereign ratings by a vector W_t, which also includes the lagged endogenous variables. As clarified in Reisen and von Maltzan (1999), ideally, the vector

W should represent the determinants of default cited in the literature on sovereign credit risk (see Section II). The default variables repeatedly cited in rating agency reports as determinants of sovereign ratings are the same as we used above, in the equation (2): *per capita* GDP, real annual GDP growth, annual change of consumer prices, current account/GDP, government balance/GDP, government debt/GDP, and default history. The structure of Granger causality tests in the context of a fixed effect model requires the application of a dynamic model, which can be estimated efficiently by using a General Methods of Moments (GMM) technique (Arellano and Bond, 1991). In order to avoid the autocorrelation problem, we differentiated the equations and applied the $Y_{i,t-2}$ as instruments. In theory, if rating would Granger cause economic growth, the estimation should find a feedback from $X_{i,t-1}$ on $Y_{i,t}$ (with $\beta \neq 0$). Simultaneously, unidirectional Granger causality requires that lagged GDP growth rate should not influence ratings and causality would imply that the history of ratings matters for the evolution of GDP growth, but not *vice versa*.

VI Empirical results

As we can see, the Table 4 presents an overview of different estimations performed on a certain set of indicators. The models performed are the following: POLS, Random and Fixed Effects and PCSE. Results show that some of examined regressors share a certain degree of significance in all regressions. Fundamental variables that result as significant in almost all regressions and for all rating agencies are: *per capita* GNI, inflation, unemployment, fiscal balance and debt and default history. On the contrary, current account balance results to be statistically significant only in some regressions run. An interesting result obtained by performing different estimation models demonstrate that there is no significant difference among the weights assigned by different CRAs. Furthermore, it can be noticed that the R^2 is quite high - in a range of 80-90 % everywhere, and it points to a good explanatory power of the model underlying the equations; the t-statistics of the underlying parameters are generally significant. Furthermore, the Breusch-Pagan test indicates that the random effects are to performed instead of the POLS, while the results of the Hausman test suggest that the random effects estimator will be inconsistent and fixed effect estimation method is preferable.

Table 4: Static Panel Estimates

Variable	**POLS S&P**	**POLS Fitch**	**POLS Moody's**	**RE S&P**	**RE Fitch**	**RE Moody's**	**FE S&P**	**FE Fitch**	**FE Moody's**	**PCSE S&P**	**PCSE Fitch**	**PCSE Moody's**
GNI growth	2.937**	2.805**	1.656	.0365*	.0443**	.105*	.024	1.194*	.048**	.004	.159	.938
	(1.267)	(1.239)	(1.288)	(.021)	(.019)	(.059)	(.019)	(.641)	(.019)	(.021)	(.521)	(.684)
Per capita GNI	2.741***	2.833***	3.220***	1.370***	1.608***	2.278***	.0612***	.756***	1.553***	3.136***	2.873***	3.282***
	(.105)	(.101)	(.097)	(.189)	(.198)	(.184)	(.206)	(.255)	(.327)	(.143)	(0.1)	(.124)
Current account balance	.0423***	.0378***	.002	.025	.028	.016	.006	.007	.008	.026*	.041**	.008
	(.014)	(.014)	(.014)	(.019)	(.025)	(.015)	(.022)	(.029)	(.012)	(.014)	(.019)	(.014)
Inflation	-.187***	-.147***	-.114***	-.066***	-.0503**	-.081***	-.068***	-.046*	-.016*	-.058***	-.041***	-.037**
	(.029)	(.028)	(.025)	(.012)	(.024)	(.0216)	(.014)	(.025)	(.009)	(.014)	(.014)	(.019)
Unemployment	-.084***	-.056**	-.043*	-.080**	-.081**	-.049**	-.098**	-.087**	-.061**	-.079**	-.099***	-.039*
	(.028)	(.027)	(.025)	(.041)	(.034)	(.023)	(.038)	(.036)	(.031)	(.031)	(.034)	(.021)
Fiscal balance	.052**	.047*	.003	.059*	.0627*	.0404**	.044	.066**	.082***	.082***	0.067***	.026
	(.022)	(.025)	(.021)	(.035)	(.033)	(.019)	(.039)	(.031)	(.012)	(.017)	(.016)	(.031)
Government debt	-.012***	-.007**	-.009***	-.015*	-.005	-.0164***	-.018*	-.009	-.021***	-.013***	-.005	-0.016***
	(.003)	(.003)	(.003)	(.035)	(.009)	(.003)	(.009)	(.011)	(.005)	(.004)	(.003)	-.004
Default history	-.938*	-1.579***	-1.477***	-2.386***	-1.739***	-3.283***	-1.984***	-1.042**	-2.971***	-1.759***	-2.514***	-1.377**
	(.514)	(.483)	(.533)	(.508)	(.449)	(.313)	(.325)	(.495)	(.413)	(.559)	(.601)	(.621)
Constant	-7.041***	-8.490***	-12.085***	4.179*	1.651	-4.159**	12.524***	10.753***	3.343	-11.705***	-9.488***	-13.342***
	(1.161)	(1.082)	(1.05)	(2.158)	(2.333)	(1.903)	(2.189)	(2.754)	(3.326)	(1.449)	(.948)	(1.182)
N	528	483	435	528	483	435	528	483	435	528	483	435
F/Wald	308.654	348.205	358.659	328.639	731.905	452.085	11.445	17.081	11.342	788.043	1457.078	1031.537
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
R^2	.831	.849	.86	.828	.829	.821	.371	.384	.366	.955	.977	.961
RMSE	1.889	1.761	1.83	.834	.806	.816	.689	.676	.709	.735	.726	.797
BIC	2217.815	1964.114	1797.881				1141.674	1026.49	968.541			
Log-Likelihood	-1080.696	-954.247	-871.601				-548.895	-491.617	-463.007			
Breusch-Pagan LM	RE rather than POLS											
	825.41	782.22	427.36									
	(0.0000)	(0.0000)	(0.0000)									
Hausman							FE rather than RE					
							170.40	76.12	65.07			
							(.000)	(.000)	(.000)			

Notes: $*p < 0.10$; $**p < 0.05$; $***p < 0.01$. Standard Errors are given in parentheses.

Table 5 presents an overview of the results when the variables are organized in different groups. As previously mentioned, the examined period is divided in two sub-groups - one previous to the Asian crisis and another one presents the period afterwards. Another division in sub-groups is made on the basis of the development level, so the first group includes developed countries, while the second one the developing ones, using the OECD classification. As the sovereign ratings present an overview of the country's capability of repaying its debt, it may be of interest to divide groups by their level of indebtedness and check whether the agencies assign different weights to some indicators if the countries belong to different groups. It can be noticed that the results here are quite similar to those presented in the previous table. Indeed, *per capita* GNI, inflation, government debt and default history result significant everywhere, for all periods and levels of development and indebtedness. The results for the basic model estimated over the period $1975-2010$ underline that only GNI growth does not affect average ratings. In fact, the remaining explanatory variables are statistically significant, showing the expected sign. Using two sub-periods, $1975-1996$ and $1997-2010$, the only difference in the estimates is represented by the irrelevance of current account balance in the more recent years. Adding real interest rate and reserves to the model, we can notice that they influence the rating (negative and positively, respectively). Again, current account (as unemployment) has not statistical relevance in the years $1997-2010$. Interestingly, no relevant difference exists between developed countries and less developed ones, except that in the latter real interest rate influence negatively the rating. Moreover, EU membership increases rating, while having an average public debt/GDP ratio $> 60\%$ negatively affects the dependent variable. Furthermore, unemployment is statistically significant only for highly indebted countries, while fiscal balance for the less indebted ones. Finally, some nonlinear effects emerge, since both fiscal balance and government debt square are strongly significant. It is important to mention that the R^2 increased to at least 93% in all regressions, except the regression including only developing countries. Following a suggestion of Haugh *et al.* (2009), we included squared terms of fiscal variables to test for nonlinearities in ratings' assessment. The results show that the squared terms are statistically significant, but at least for government debt, the nonlinear term mainly reduces the coefficient on the linear one. Moreover, they do add to the explanatory power of the model as indicated by the adjusted R-squares. When two dummy variables are taken into account - the EMU membership and the degree of indebtedness - the goodness-of-fit improves and these variables are statistically significant.

Table 5: Static panel estimates (PCSE estimates, dependent variable: Average Rating)

Variable	**Full period 1975-2010**	**1975-1996**	**1997-2010**	**Full period**	**1975-1996**	**1997-2010**	**Full period DC**	**Full period LDC**	**Full period**	**Full period HIC**	**Full period LIC**	**Full period Nonlinearities**
GNI growth	.271	3.219	.383	0.309	5.549***	.555	3.728	.886	.779	3.672**	.742	.939
	(.529)	(3.018)	(.543)	(1.219)	(.116)	(1.250)	(2.851)	(1.342)	(.546)	(1.653)	(1.428)	(1.195)
Per capita GNI	3.004***	2.372***	3.076***	1.008***	.280***	1.447***	.757*	1.442***	1.795***	.783***	2.021***	1.278***
	(.105)	(.277)	(.100)	(.218)	(.009)	(.244)	(.423)	(.233)	-.044	(.133)	(.276)	(.214)
Current account balance	.028*	.2552***	.020	.001	.483***	.001	.068*	.064***	.039**	.063***	.039*	-.003
	(.015)	(.061)	(.019)	(.017)	(.009)	(.018)	(.037)	(.021)	(.015)	(.020)	(.020)	(.019)
Inflation	-.027**	-.0981***	-.0270**	-.048***	-.062***	-.0581***	-.036**	-.060***	-.051***	-.032*	-.038**	-.049***
	(.012)	(.014)	(.012)	(.015)	(.003)	(.016)	(.017)	(.018)	(.013)	(.019)	(.018)	(.014)
Unemployment	-.081**	-.098*	-.0643*	-.006	-.067***	-.004	.014	-.057	-.110***	-.157***	.051	.010
	(.036)	(.050)	(.038)	(.038)	(.017)	(.042)	(.099)	(.047)	(.034)	(.037)	(.033)	(.032)
Fiscal balance	.067***	.115***	.076***	-.045	.063*	.110***	.012	.046	.059***	.054	.141***	.209***
	(.016)	(.033)	(.018)	(.037)	(.033)	(.040)	(.118)	(.044)	(.017)	(.065)	(.048)	(.043)
Government debt	-.009*	-.029***	-.008*	-.037***	-.258***	-.026***	-.077***	-.012*	-.035***	-.039***	-.021*	-.005
	(.005)	(.009)	(.004)	(.004)	(.021)	(.005)	(.009)	(.007)	(.004)	(.007)	(.012)	(.010)
Default history	-2.399***	-1.599***	-2.076***	-3.837***	-1.304***	-3.057***	-1.588***	-2.915***	-3.097***	-1.558***	-2.706***	-3.660***
	(.582)	(.437)	(.554)	(1.163)	(.299)	(.728)	(.406)	(.756)	(.666)	(.609)	(.685)	(.671)
Real interest rate				-.018**	-.069***	-.024**	-.000	-.038**		-.026***	-.027***	-.023**
				(.008)	(.002)	(.010)	(.009)	(.017)		(.010)	(.009)	(.009)
Reserves				.816***	.535***	1.009***	.728**	.593***		.560**	.468**	.856
				(.190)	(.018)	(.249)	(.347)	(.191)		(.226)	(.212)	(.181)
EMU									3.266***			
									(.346)			
Highly Indebted Countries									-1.476***			
									(.387)			
Fiscal balance squared												.017***
												(.005)
Government debt squared												.519***
												(.242)
Constant	-10.921***	-2.229	-11.915***	2.175	17.013***	-2.408	5.551	-.902	9.875***	7.386***	-6.199***	2.324***
	(1.029)	(2.515)	(.951)	(1.782)	(.093)	(.785)	(5.086)	(2.049)	(1.283)	(.975)	(2.296)	(2.725)
Wald χ^2	1014.726	1291.809	1180.33	313.097	2229424	330.951	207.224	17.081	22421.223	991.983	260.569	747.599
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
R^2	.944	.991	.945	.937	.999	.931	.972	.384	.976	.977	.931	.978
RMSE	.713	.884	.704	.769	.042	.753	.801	.676	.735	.492	.793	.779

Notes: $*p < 0.10$; $**p < 0.05$; $***p < 0.01$. Standard Errors are given in parentheses.

Table 6: Granger causality tests: GMM Estimator

Variable	Rating_{avg}	$\text{Rating}_{S\&P}$	Rating_{M}	Rating_{F}
$\text{Rating}_{i,t-1}$	.8436*** (.0811)	.6697*** (.0695)	.6421*** (.0501)	.7677*** (.0429)
$\text{Rating}_{i,t-2}$	.0904 (.0897)	.2397* (.0984)	.1920*** (.0396)	.1724*** (.0431)
GDP $\text{growth}_{i,t-1}$	.0149 (.0133)	.0197 (.0132)	.0424* (.0242)	.0334** (.0156)
GDP $\text{growth}_{i,t-2}$	.0156 (.0176)	.0061 (.0162)	.0392** (.0176)	.0135 (.0193)
Per capita $\text{GDP}_{i,t-1}$	.2190 (.1888)	.2357 (.2650)	.8414*** (.2916)	.0878 (.1525)
$\text{Inflation}_{i,t-1}$	-.0081 (.0117)	-.0061 (.0157)	-.0276*** (.0087)	-.0255** (.0113)
$\text{CAB}_{i,t-1}$	.0214*** (.0068)	.0273*** (.0080)	.0055 (.0082)	.0217** (.0089)
Fiscal $\text{balance}_{i,t-1}$	.0009 (.0173)	.0124 (.0148)	.0079 (.0118)	.0176 (.0229)
Government $\text{debt}_{i,t-1}$	-.0011 (.0027)	-.0000 (.0037)	-.0312*** (.0031)	-.0026 (.0033)
$\text{Unemployment}_{i,t-1}$	-.0445** (.0187)	-.0343* (.0184)	-.0272 (.0274)	-.0352 (.0227)
N	450	518	376	465
Wald statistics	25039.34 (.0000)	13893.04 (.0000)	16350.34 (.0000)	13174.20 (.0000)
Arellano-Bond AR(2)	(0.542)	(0.910)	(0.553)	(0.059)
Sargan statistics	(0.060)	(0.079)	(0.198)	(0.050)
	GDP growth (Rating_{avg})	GDP growth ($\text{Rating}_{S\&P}$)	GDP growth (Rat_{M})	GDP growth (Rating_{F})
$\text{Rating}_{i,t-1}$	1.0268** (.4001)	.8414*** (.2617)	.9766** (.4704)	.4907* (.2775)
$\text{Rating}_{i,t-2}$	.5138 (.3507)	.1752 (.2223)	.8128* (.4208)	.0072 (.1944)
GDP $\text{growth}_{i,t-1}$	.1982*** (.0621)	.1614** (.0639)	.0168 (.0688)	.1585** (.0750)
GDP $\text{growth}_{i,t-2}$	.1889** (.0690)	.2298*** (.0691)	.0179 (.0587)	.2287** (.1008)
Per capita $\text{GDP}_{i,t-1}$	3.4670*** (.7956)	3.8143*** (.9672)	1.2818** (.5159)	4.0426*** (.9496)
$\text{Inflation}_{i,t-1}$	-.0914 (.0882)	-.0402 (.0858)	-.0189 (.0483)	-.2458*** (.0770)
$\text{CAB}_{i,t-1}$	.1279** (.0538)	.1361** (.0568)	.0721* (.0421)	.1316** (.0597)
Fiscal $\text{balance}_{i,t-1}$	.0624 (.0845)	.0681 (.0733)	.1393*** (.0476)	.0125 (.0785)
Government $\text{debt}_{i,t-1}$	-.0050 (.0151)	-.0080 (.0147)	-.0010 (.0117)	-.0126 (.0141)
$\text{Unemployment}_{i,t-1}$	-.2974*** (.1056)	-.3722*** (.1216)	-.1939** (.0914)	-.1919** (.0979)
N	541	517	424	465
Wald statistics	387.36 (.0000)	476.39 (.0000)	287.82 (.0000)	439.36 (.0000)
Arellano-Bond AR(2)	(0.673)	(0.624)	(0.100)	(0.669)
Sargan statistics	(0.106)	(0.629)	(.073)	(0.917)

Notes: Estimated by GMM estimator in simultaneous equation system, with instruments for endogeneous variables and up to two lags for the rating and *per capita* GNI variable. Wald-test is applied in order to test for zero-coefficients in the equation system. $*p < 0.10$; $**p < 0.05$; $***p < 0.01$. Standard Errors are given in parentheses.

Generally speaking, the model determines the aggregate income changes well, while rating changes seem to be partly explained by variables outside the model (reserves, real exchange rate, terms of trade, etc.). In fact, we do find a strongly significant unidirectional impact of changing S&P ratings on GDP growth, while GDP growth does not Granger causes ratings. On the contrary,

ratings by Moody's and Fitch are significantly Granger caused by the lagged economic growth, and *vice versa*, so that in these cases a feedback mechanism exists with a bidirectional causality flow. Furthermore, our results are in line with those of Reisen and von Maltzan (1999). For the sample comprising the rating average of all three agencies, the results show a one-way causality running from ratings to economic growth.

VII Concluding Remarks

This paper aims to shed a light on the the economic variables used in the assessment of sovereign ratings, comparing different econometric methodologies in order to test the significance of a set of macroeconomic variables. We selected some variables, which the economic literature indicated as those influencing ratings. The analyse considered the determinants of rating provided by three main Credit Rating Agencies (Standard and Poor's, Moody's and Fitch), but also an average rating. Moreover, we added several alternative explanatory variables, to test their statistical significance. Some non-linear effects have been discussed, too.

The examined literature has been divided in two mainstreams: one that revises the determinants and behaviour of ratings and the other one that examines the causality of ratings. The research focused on both of those issues and provides important results. In the economic analysis it has been argued that the CRAs are publishing "opinions" in the form of ratings about the creditworthiness of the entity/country and the published ratings might be influenced by informational duties, conflicts of interests and reputational issues.

Our analysis is undertaken on an unbalanced panel, consisting of 5143 observations. The dependent variable consists of long-term foreign currency ratings on a yearly basis. According to the literature, the following set of regressors has been used: GNI growth, *per capita* GNI, inflation, unemployment, fiscal surplus/deficit, current account balance, government debt, default history, real interest rate and reserves. Notwithstanding, the effects of EMU membership and level of indebtedness as well as the non linearities due to the public finance variables are not negligible.

Furthermore, Granger causality results show a strongly significant unidirectional impact of changing S&P ratings on GDP growth, while ratings by Moody's and FItch are significantly Granger caused by the lagged economic growth, and *vice versa* (feedback effect).

Appendix

Table 7: *Linear Transformation of Ratings*

Standard and Poor's	Moody's	Fitch	Linear transformation
AAA	Aaa	AAA	21
AA+	Aa1	AA+	20
AA	Aa2	AA	19
AA-	Aa3	AA-	18
A+	A1	A+	17
A	A2	A	16
A-	A3	A-	15
BBB+	Baa1	BBB+	14
BBB	Baa2	BBB	13
BBB-	Baa3	BBB-	12
BB+	Ba1	BB+	11
BB	Ba2	BB	10
BB-	Ba3	BB-	9
B+	B1	B+	8
B	B2	B	7
B-	B3	B-	6
CCC+	Caa1	CCC+	5
CCC	Caa2	CCC	4
CCC-	Caa3	CCC-	3
CC		CC	2
C		C	2
SD	Ca	DDD	1
D	C	DD	1
		D	1

Table 8: Between and within components in Standard and Poor's rating data

	Overall Freq.	Overall Perc.	Between Freq.	Beetwen Perc.	Within Perc.
1	10	0.51	7	5.79	13.31
2	2	0.1	2	1.65	6.11
3	1	0.05	1	0.83	8.33
4	5	0.25	4	3.31	10.62
5	13	0.66	5	4.13	18.7
6	64	3.25	18	14.88	27.89
7	119	6.05	33	27.27	36.51
8	134	6.81	39	32.23	42.58
9	98	4.98	28	23.14	30.63
10	128	6.51	30	24.79	29.15
11	96	4.88	24	19.83	28.56
12	119	6.05	30	24.79	22.51
13	98	4.98	26	21.49	21.9
14	61	3.1	21	17.36	17.5
15	104	5.29	24	19.83	31.96
16	121	6.15	22	18.18	32.21
17	62	3.15	17	14.05	18.79
18	54	2.75	15	12.4	19.49
19	99	5.03	16	13.22	28.24
20	112	5.69	12	9.92	31.31
21	467	23.74	22	18.18	69.93
Total	1967	100	396	327.27	30.56

Table 9: Between and within components in Fitch rating data

	Overall Freq.	Overall Perc.	Between Freq.	Beetwen Perc.	Within Perc.
1	11	0.8	3	2.83	25.71
2	1	0.07	1	0.94	7.14
3	11	0.8	1	0.94	78.57
4	10	0.73	6	5.66	21.4
5	5	0.36	3	2.83	21.48
6	54	3.93	16	15.09	39.86
7	71	5.17	24	22.64	32.97
8	90	6.55	25	23.58	43.58
9	86	6.26	21	19.81	46.83
10	69	5.02	21	19.81	23.15
11	97	7.06	27	25.47	28.03
12	108	7.86	28	26.42	29.82
13	87	6.33	22	20.75	25.29
14	40	2.91	14	13.21	21.64
15	74	5.39	14	13.21	33.8
16	58	4.22	13	12.26	30.01
17	41	2.98	16	15.09	18.51
18	71	5.17	14	13.21	35.43
19	80	5.82	12	11.32	41.15
20	60	4.37	12	11.32	29.13
21	250	18.2	18	16.98	72.59
Total	1374	100	311	293.4	34.08

Table 10: Between and within components in Moody's rating data

	Overall Freq.	Overall Perc.	Between Freq.	Beetwen Perc.	Within Perc.
1	3	0.2	2	1.89	9.09
3	2	0.13	1	0.94	22.22
4	6	0.4	1	0.94	54.55
5	42	2.77	10	9.43	36.62
6	34	2.24	13	12.26	22.94
7	66	4.35	18	16.98	39.01
8	74	4.88	20	18.87	52.24
9	59	3.89	16	15.09	28.78
10	71	4.68	20	18.87	34.2
11	89	5.87	20	18.87	41.98
12	87	5.74	23	21.7	31.25
13	63	4.16	15	14.15	37.34
14	65	4.29	17	16.04	28.01
15	75	4.95	14	13.21	37.15
16	95	6.27	22	20.75	34.7
17	53	3.5	15	14.15	27.85
18	53	3.5	14	13.21	23.79
19	67	4.42	14	13.21	21.65
20	96	6.33	13	12.26	36.44
21	416	27.44	22	20.75	70.15
Total	1516	100	290	273.58	36.55

Table 11: Standard and Poor's Transition Matrix

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	
1	33	0	0	0	11.11	44.44	11.11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
2	0	0	0	0	0	50	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
3	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
4	0	20	0	20	20	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
5	0	0	0	0	46.15	38.46	7.69	7.69	0	0	0	0	0	0	0	0	0	0	0	0	0	100
6	3.45	0	1.72	1.72	1.72	70.69	15.52	5.17	0	0	0	0	0	0	0	0	0	0	0	0	0	100
7	0.93	0	0	1.87	1.87	3.74	72.9	16.82	0	0.93	0	0.93	0	0	0	0	0	0	0	0	0	100
8	0	0.85	0	0	0.85	2.56	12.82	70.09	11.11	1.71	0	0	0	0	0	0	0	0	0	0	0	100
9	3.26	0	0	1.09	0	1.09	2.17	7.61	69.57	14.13	1.09	0	0	0	0	0	0	0	0	0	0	100
10	0	0	0	0	0	0	0	1.69	5.93	76.27	14.41	1.69	0	0	0	0	0	0	0	0	0	100
11	0	0	0	0	1.09	0	1.09	0	0	9.78	70.65	16.3	1.09	0	0	0	0	0	0	0	0	100
12	0	0	0	0	0	0.95	0	0	0	0.95	3.81	78.1	15.24	0.95	0	0	0	0	0	0	0	100
13	0	0	0	0	0	0	0	1.08	0	0	2.15	8.6	67.74	17.2	3.23	0	0	0	0	0	0	100
14	0	0	0	0	0	0	0	0	0	0	0	1.75	12.28	64.91	19.3	1.75	0	0	0	0	0	100
15	0	0	0	0	0	0	0	0	0	1.01	0	1.01	1.01	4.04	78.79	13.13	1.01	0	0	0	0	100
16	0	0	0	0	0	0	0	0	0	0	0.88	0	0.88	1.75	3.51	81.58	11.4	0	0	0	0	100
17	0	0	0	0	0	0	0	0	0	0	0	3.39	0	0	1.69	11.86	67.8	15.25	0	0	0	100
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	72	17.5	0	0	100
19	0	0	0	0	0	0	0	0	0	1.05	0	0	0	0	0	1.05	0	5.26	84.21	8.42	0	100
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.82	3.64	86.36	8.18	100
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.67	1.56	97.78	100
	0.54	*0.11*	*0.05*	*0.27*	*0.7*	*3.36*	*5.85*	*6.18*	*4.55*	*6.39*	*4.88*	*6.07*	*4.82*	*3.25*	*5.25*	*6.23*	*3.2*	*2.82*	*5.2*	*5.96*	*24.32*	*100*

Table 12: Fitch Transition Matrix

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	
1	72.73	0	0	9.09	0	9.09	9.09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
2	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
3	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
4	12.5	0	0	37.5	0	37.5	12.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
5	0	0	0	20	40	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
6	0	2.04	2.04	4.08	0	71.43	16.33	4.08	0	0	0	0	0	0	0	0	0	0	0	0	0	100
7	0	0	0	1.64	0	8.2	72.13	14.75	3.28	0	0	0	0	0	0	0	0	0	0	0	0	100
8	0	0	0	0	1.27	1.27	6.33	74.68	15.19	1.27	0	0	0	0	0	0	0	0	0	0	0	100
9	0	0	0	0	0	0	3.85	8.97	74.36	11.54	1.28	0	0	0	0	0	0	0	0	0	0	100
10	1.52	0	0	0	0	0	0	0	6.06	68.18	19.7	3.03	1.52	0	0	0	0	0	0	0	0	100
11	0	0	0	1.1	0	0	0	0	0	5.49	72.53	19.78	1.1	0	0	0	0	0	0	0	0	100
12	0	0	0	1.05	0	1.05	1.05	0	0	0	7.37	71.58	17.89	0	0	0	0	0	0	0	0	100
13	0	0	0	0	0	0	0	0	0	0	0	7.79	75.32	11.69	5.19	0	0	0	0	0	0	100
14	0	0	0	0	0	0	2.63	0	0	0	0	5.26	13.16	57.89	18.42	2.63	0	0	0	0	0	100
15	0	0	0	0	0	0	0	0	0	0	0	0	0	5.56	80.56	12.5	1.39	0	0	0	0	100
16	0	0	0	0	0	0	0	0	0	0	0	0	1.75	3.51	1.75	75.44	17.54	0	0	0	1.04	101
17	0	0	0	0	0	0	0	0	0	0	2.94	2.94	0	0	0	2.94	73.53	17.65	0	0	0	100
18	0	0	0	0	0	0	0	0	0	0	0	0	1.52	1.52	0	0	4.55	83.33	9.09	0	0	100
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.28	2.56	85.9	10.26	0	100
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.51	1.75	80.7	14.04	100
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.43	0	0.85	98.72	100
	0.87	*0.08*	*0.87*	*0.79*	*0.24*	*3.79*	*5.05*	*6.07*	*5.99*	*4.73*	*6.94*	*7.65*	*6.62*	*3*	*5.52*	*4.26*	*3.15*	*5.21*	*5.84*	*4.42*	*18.93*	*100*

Table 13: Moody's Transition Matrix

	1	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	
1	33.33	0	0	66.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
3	0	50	0	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
4	0	0	80	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
5	2.78	0	2.78	86.11	2.79	2.78	0	2.78	0	0	0	0	0	0	0	0	0	0	0	0	100
6	0	0	0	9.09	63.64	18.18	6.06	3.03	0	0	0	0	0	0	0	0	0	0	0	0	100
7	0	1.64	0	4.92	8.2	73.77	9.84	1.64	0	0	0	0	0	0	0	0	0	0	0	0	100
8	1.61	0	0	0	0	6.45	80.65	4.84	4.84	0	1.61	0	0	0	0	0	0	0	0	0	100
9	0	0	1.79	0	1.79	1.79	5.36	75	12.5	1.79	0	0	0	0	0	0	0	0	0	0	100
10	0	0	0	0	1.54	4.62	1.45	1.54	75.38	12.31	3.08	0	0	0	0	0	0	0	0	0	100
11	0	0	0	0	0	0	0	0	2.41	83.13	10.84	1.2	2.41	0	0	0	0	0	0	0	100
12	0	0	0	0	2.44	1.22	1.22	0	1.22	0	76.83	12.2	3.66	1.22	0	0	0	0	0	0	100
13	0	0	0	0	0	0	0	0	0	0	0	84.21	10.53	3.51	1.75	0	0	0	0	0	100
14	0	0	0	0	0	0	0	0	0	0	0	0	77.05	11.48	8.2	3.28	0	0	0	0	100
15	0	0	0	0	0	0	0	0	0	0	0	0	1.37	80.82	13.7	4.11	0	0	0	0	100
16	0	0	0	0	0	0	0	0	0	1.19	1.19	0	0	2.38	84.52	8.33	2.38	0	0	0	100
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.26	80.85	14.89	0	0	0	100
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.96	74.51	21.57	0	1.96	100
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.67	85	8.33	5	100
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.08	4.3	87.1	7.53	100
21	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0.25	0	1.77	97.73	100
	0.21	0.14	0.43	2.91	2.2	4.33	4.47	3.55	4.4	5.6	5.39	4.18	4.18	5.04	6.31	3.62	3.55	4.68	6.6	28.23	100

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