PIRAEUS BANK

Greek Bonds: On the Verge of Regaining Investment Grade Status by... 2020.

ECONOMIC RESEARCH & INVESTMENT STRATEGY

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CONTENTS

The **i m p o r t a n c e   o f   s o v e r e i g n   r a t i n g s** cannot be overstated enough as they define the cost of funding not only for the public sector but also for the vast majority of domestic corporate and financial institutions via their impact on sovereign rating ceiling.

Furthermore, **r a p i d   d o w n g r a d e s** of the sovereign credit quality can –as we know all too well in Greece- lead to the exclusion of the sovereign from the global funding markets.

For all these reasons, understanding the **m e c h a n i c s   a n d   t h e   f a c t o r s** affecting sovereign ratings assigned by major rating agencies is of particular interest for both macroeconomic analysis and investment allocation purposes.

Responding to that need we developed last year and we update now our **G l o b a l   S o v e r e i g n   R a t i n g s   M o d e l**. The Global Ratings Model was developed in order to allow us to identify cases of substantial sovereign ratings dislocation i.e. instances where actual ratings assigned by rating agencies deviated substantially from our own model-implied rating assessment. Based on our results out of a total sample of 124 countries we rate, 78 have the "correct" rating (in the sense that our model implied rating matches that of Moody's), 13 are given a rating "premium" by Moody's vs our fundamental rating and 33 are rated more conservative that what their fundamentals imply.

Furthermore, given our **s p e c i a l   i n t e r e s t   i n   t h e   G r e e k   e c o n o m y**, we are able to identify a wide gap between our model-implied rating for Greece vis-à-vis Moody's. In particular, Moody's currently rates Greece in the Caa category while according to our model Greece has a 40% chance of being in the Ba range and a 37% chance of being a B rated credit. This "massive" distance between model-implied and Moody's ratings serves only to highlight how much qualitative factors are holding back Greece's official ratings.

This degree of overconservatism is likely to continue into the future as **o u r   m o d e l   p o i n t s   t o   a   c o n t i n u o u s   i m p r o v e m e n t   i n   G r e e c e ' s   i m p l i e d   r a t i n g**. In order to be able to assess the future evolution of Greece's sovereign rating we map our baseline macroeconomic scenario for the Greek economy into future rating projections. Provided that our macroeconomic scenario pans out, then Greece should be on the verge of regaining investment grade status by 2020.

CONTENTS

Our analysis of the **Greek sovereign rating outlook** takes place in **two distinct stages**:

One that assesses our current model-implied rating vs. the actual Moody's rating and

a **Second** that relates to using our ratings-model to forecast the evolution of Greek sovereign ratings

In the **First Stage** we utilize as inputs either actual data for 2017 or data that we can deduce with a high level of conviction and compare the model outcome with the actual Moody's rating.

Based on that comparison (reported on page 9) Moody's assigns an extremely conservative rating for Greece (Caa) vis-a-vis the "theoretical" ratings that Greece should have based purely on the values of its fundamentals (Ba).

In the **Second Stage** we assume that the global ratings distribution remains constant and use our baseline macro-forecasts for Greece to project our baseline macro-scenario on future ratings. Based on that analysis (and contingent upon the realization of our forecasts) Greece should be on the verge of investment grade status by 2020.

FORECASTS

Gross domestic product, constant prices (% YoY)
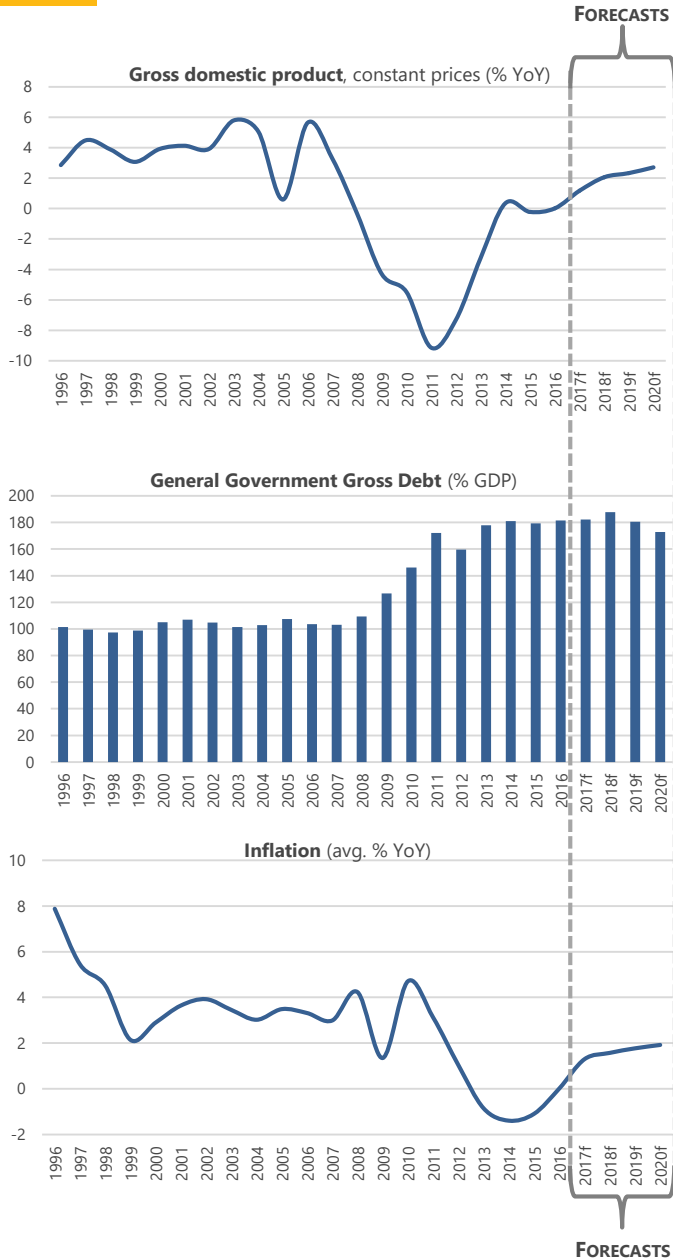
	Real GDP (% YoY)	Inflation (avg. %YoY)	GDP, current prices bn $	GDP per capita, constant prices PPP $	General Government Gross Debt (% GDP)
2017	1.16	1.30	202.09	25,151	182.14
2018	2.06	1.57	217.61	25,695	187.84
2019	2.32	1.77	226.66	26,316	180.46
2020	2.70	1.92	236.60	27,054	172.77

Source: Piraeus Bank Research, IMF, Moody's

General Government Gross Debt (% GDP)

Inflation (avg. % YoY)

FORECASTS

o The four rating factors reflect the central tendency of our macroeconomic projections.

o Going forward, the successful implementation of the remaining programme reviews as well as the preservation of economic stability and credibility are of paramount importance so that the Greek economy will be able to capitalize on the growing positive momentum.

o Greece is projected to continue the positive trajectory of economic activity in the future three year window. Real GDP will continue to grow by more than 2% per annum over the next three years.

o After a period of deflation, we expect inflation to remain positive allowing Nominal GDP to recover from the crisis-lows.

o On the fiscal front, Greece is expected to achieve the primary balance target of 3.5% of GDP in 2018 - 2019.

o The recovery of a number of economic activity indicators ranging from tourist arrivals, to employment, retail sales and industrial production creates significant upside potential to our 2017-2020 outlook.

Economic Strength remains firm but progresses at a slower rate relative to other economies. Greece currently marginally surpasses the lower 15% range of the factor distribution.
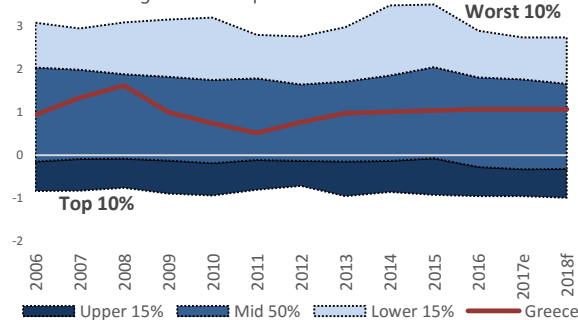

Top 10%

Worst 10%

Lower 15%   Mid 50%   Upper 15%   Greece
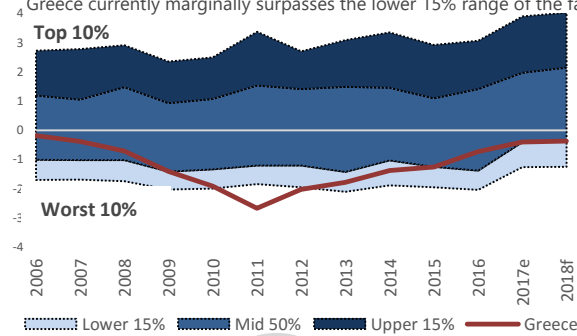
Fiscal Strength recovered from a trough in 2011 through a six-year adjustment process, returning back to the lower 15% range of the factor distribution across countries in our sample.
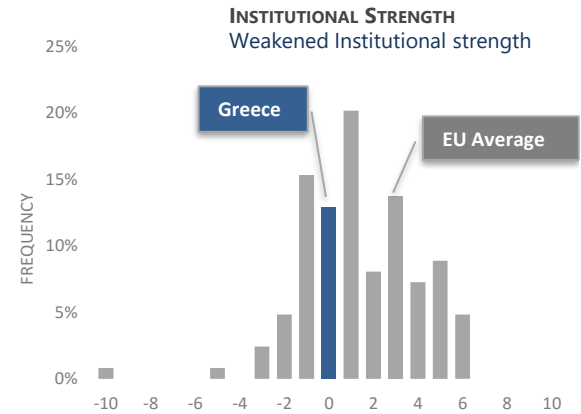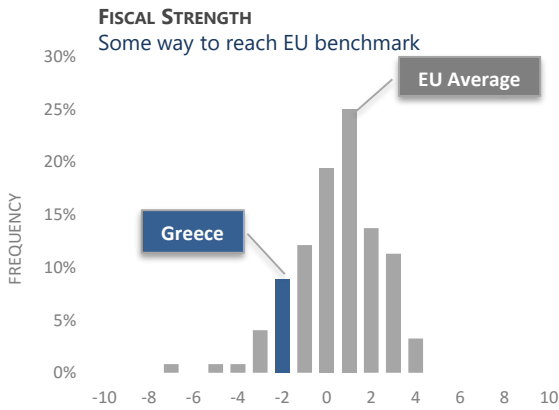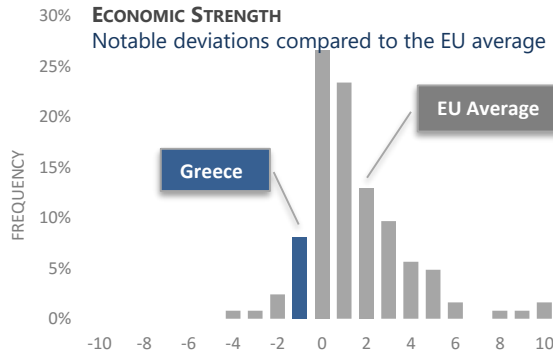

Top 10%

Worst 10%

Lower 15%   Mid 50%   Upper 15%   Greece
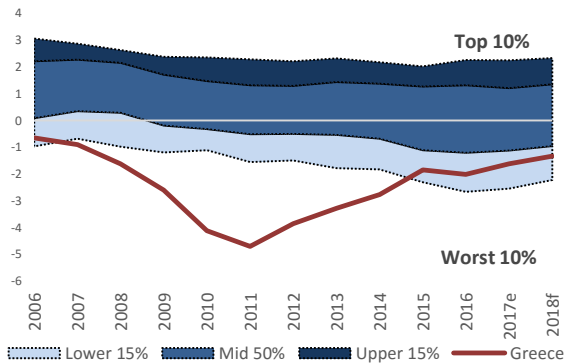
Institutional Strength stabilized over the past 2 years remaining in the mid 50% range of the total sample.

Top 10%

Worst 10%

Lower 15%   Mid 50%   Upper 15%   Greece

Economic Strength

Fiscal Strength

Greece Rating

Institutional Strength
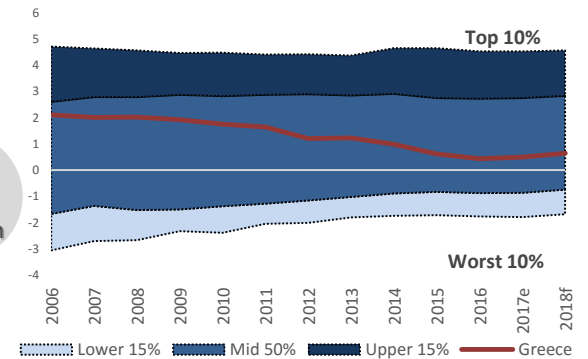
Event Risk

Event Risk lies at normal levels commonly found in the middle range of the sample's distribution.

Worst 10%

Top 10%

Upper 15%   Mid 50%   Lower 15%   Greece

ECONOMIC STRENGTH
Notable deviations compared to the EU average

Greece

EU Average

FISCAL STRENGTH
Some way to reach EU benchmark

EU Average

Greece

INSTITUTIONAL STRENGTH
Weakened Institutional strength

Greece

EU Average

EVENT RISK
Higher Event Risk

Greece

EU Average

Economic Strength

Fiscal Strength

Greece 2017 Rating

Institutional Strength

Event Risk

GREECE: OUR CREDIT RATING PROJECTIONS

Year	Estimated Rating Probabilities									Actual
	C	Ca	Caa3-Caa1	B3-B1	Ba3-Ba1	Baa3-Baa1	A3-A1	Aa3-Aa1	Aaa	
2016	-	-	10%	43%	38%	8%	-	-	-	**Caa3**
2017	-	-	8%	37%	40%	15%	-	-	-	**Caa2**
2018f	-	-	7%	32%	39%	22%	-	-	-	
2019f	-	-	6%	27%	37%	29%	1%	-	-	
2020f	-	-	4%	21%	33%	40%	2%	-	-	

Greece Rating Probabilities
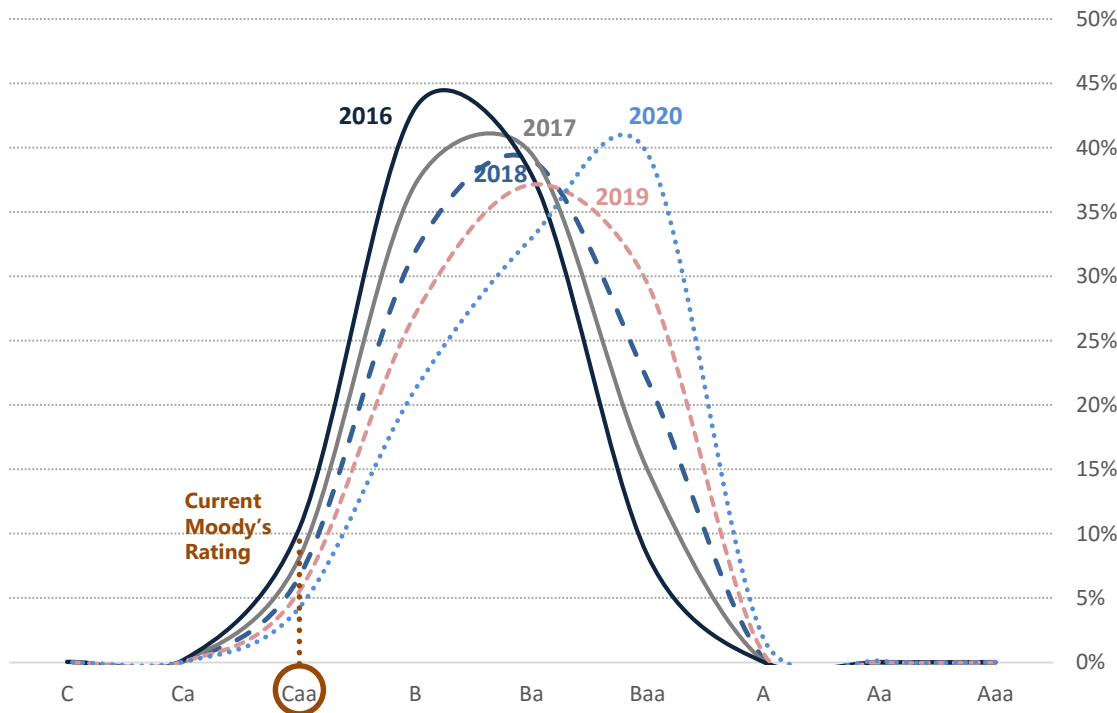
o   Greece is projected to **reach the investment grade rating score** (Baa band), though downside risks are still notable. This is evident from the left skew in the estimated rating distribution.

o   Caa2 rating in 2017 reflects primarily the "economic programme" status of the country and the associated uncertainty related to the transition to a "post-programme" era.

o   In contrast, **fundamental indicators cannot justify such a low rating** score relative to the rest of the countries in our sample.

o   The country's exit from the economic program and a smooth transition towards international funding markets should **moderate the gap between fundamentals and actual rating** decisions thus increasing the credit status of sovereign debt.

CONTENTS

Growth Dynamics	Average Real GDP Growth, Volatility of Real GDP Growth, WEF Competitiveness Index
Scale of Economy	Nominal GDP ($bn)
National Income	GDP/Capita (PPP,$)
Adjustment Factor	Credit Boom (Credit Growth/NGDP Growth)(t-2-->t) >2

Economic Strength

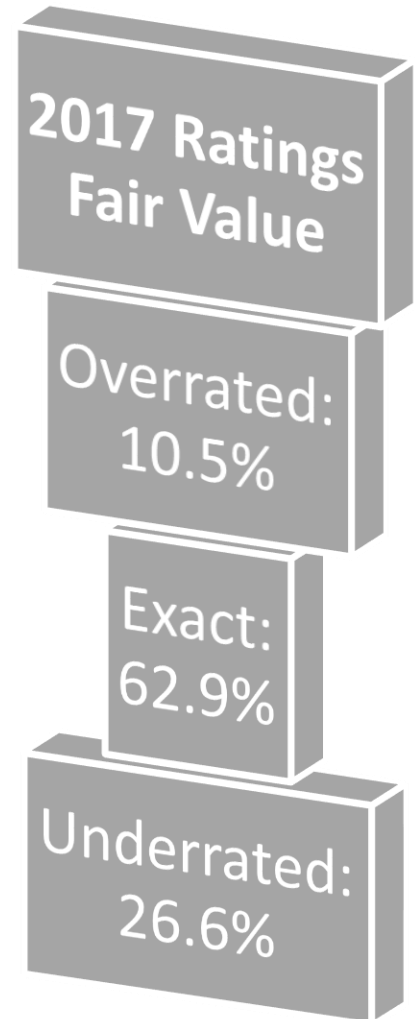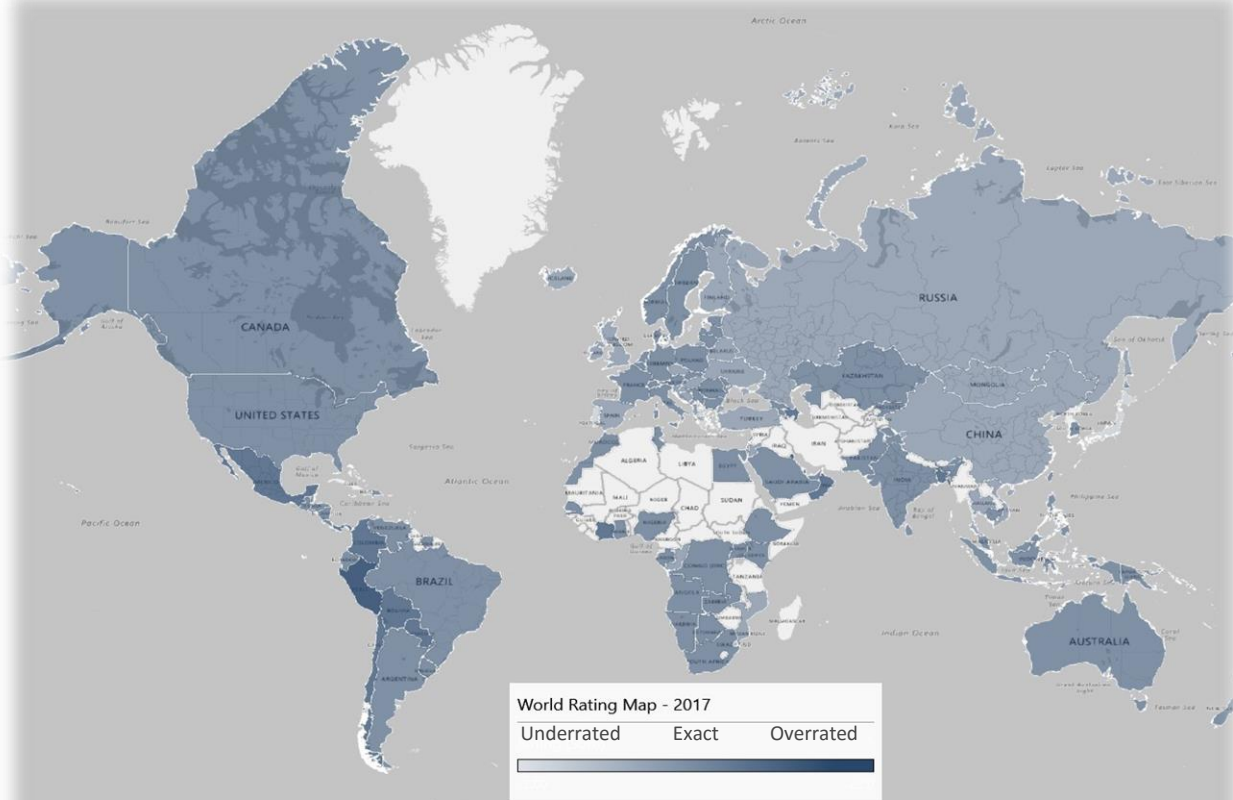| Debt Burden	General Govt. Debt to GDP, General Govt. Debt to Revenues
Debt Affordability	General Govt. Interest Payments to Revenues, General Govt. Interest Payments to GDP
Adjustment Factor	Debt to GDP Trend (t-4-->t+1), General Govt. Foreign Currency Debt to General Govt. Debt

Fiscal Strength

Rating

Institutional Strength

Institutional Framework & Effectiveness	Government Effectiveness, Rule of Law, Control of Corruption
Policy & Credibility	Inflation Level, Inflation volatility

Event Risk
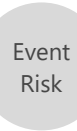
Political Risk	Domestic Political Risk (Voice & Accountability, GDP per capita)
Government Liquidity Risk	Fundamental Metrics (Government External Debt to Government Debt)
External Vulnerability Risk	(Current Account Balance & FDI) to GDP, External Vulnerability Indicator t+2, Net International Investment Position to GDP

o   Our model signals that the majority **62.9%** of the country ratings –that is 78 countries out of the total 124 countries- assigned by Moody's are in full accordance with our model-implied ratings. Just **10.5%** of the sample (13 countries of 124) is assigned a **higher-than deserved** rating. Another **26.6%** (that is 33 countries out of 124) is **rated lower** than deserved based purely on the fundamentals.

o   The uncertainty due to the global financial Crisis tilted sovereign ratings toward a larger percentage of underrated countries. In particular, **more than ¼** of the total sample is assigned a lower rating relative to that which is consistent with fundamentals.

o   In contrast, only 13 countries mainly located in Latin America, Africa and the Middle East were rated more favorably when compared with our model-implied rating scores.

o   Almost 2/3 of the countries in our sample are assigned a rating score that lies in the "fair" rating band implied by our model and the underlying fundamental factors.

2017 Ratings Fair Value

Overrated: 10.5%

Exact: 62.9%

Underrated: 26.6%

World Rating Map - 2017

| Underrated | Exact | Overrated |

Countries	Actual Rating Band	Implied Rating Probabilities									Implied Action	Confidence
		Aaa	Aa	A	Baa	Ba	B	Caa	Ca	C		
Albania	B	0.0%	0.1%	1.4%	39.6%	33.9%	20.6%	4.4%	0.1%	0.0%	▲	
Angola	B	0.0%	0.0%	0.0%	0.0%	7.8%	56.4%	34.7%	1.0%	0.0%	▬	
Argentina	B	0.0%	0.0%	0.0%	6.4%	34.7%	46.0%	12.7%	0.2%	0.0%	▬	
Armenia	B	0.0%	0.0%	0.0%	3.8%	29.4%	49.8%	16.7%	0.2%	0.1%	▬	
Australia	Aaa	86.4%	12.3%	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
Austria	Aa	49.3%	36.9%	13.8%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
Azerbaijan	Ba	0.0%	0.0%	0.0%	9.1%	26.6%	47.2%	17.1%	0.1%	0.0%	▼	
Bahamas	Baa	0.0%	1.0%	9.7%	54.6%	23.4%	9.8%	1.5%	0.0%	0.0%	▬	
Bahrain	B	0.0%	0.0%	0.0%	10.2%	21.5%	59.5%	8.8%	0.0%	0.0%	▬	
Bangladesh	Ba	0.0%	0.0%	0.0%	12.7%	32.1%	44.4%	10.7%	0.1%	0.0%	▼	
Barbados	Caa	0.0%	0.0%	0.9%	30.6%	45.1%	20.3%	2.7%	0.1%	0.3%	▲	
Belarus	Caa	0.0%	0.0%	0.0%	0.1%	4.1%	56.3%	39.6%	0.1%	0.0%	▲	
Belgium	Aa	11.5%	53.3%	34.3%	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
Belize	B	0.0%	0.0%	0.0%	1.5%	26.8%	54.6%	16.6%	0.4%	0.0%	▬	
Bolivia	Ba	0.0%	0.0%	0.0%	3.7%	25.4%	46.3%	24.2%	0.4%	0.0%	▼	
Bosnia and Herzegovina	B	0.0%	0.0%	0.8%	29.9%	31.8%	28.9%	8.5%	0.1%	0.0%	▲	
Botswana	A	0.0%	8.0%	46.3%	37.5%	5.6%	2.1%	0.4%	0.0%	0.0%	▬	
Brazil	Ba	0.0%	0.0%	0.1%	26.0%	39.8%	29.3%	4.7%	0.1%	0.0%	▬	
Bulgaria	Baa	0.0%	0.5%	6.2%	56.9%	22.6%	11.4%	2.4%	0.0%	0.0%	▬	
Cambodia	B	0.0%	0.0%	0.0%	5.3%	26.5%	50.3%	17.7%	0.2%	0.0%	▬	
Canada	Aaa	96.3%	3.2%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
Chile	Aa	0.3%	40.7%	55.5%	3.4%	0.1%	0.0%	0.0%	0.0%	0.0%	▼	
China	A	0.0%	91.8%	7.8%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	▲	
Colombia	Baa	0.0%	0.0%	0.3%	27.5%	36.3%	29.9%	5.9%	0.1%	0.0%	▼	
Costa Rica	Ba	0.0%	0.1%	2.2%	47.6%	32.6%	15.1%	2.3%	0.0%	0.0%	▬	
Cote d'Ivoire	Ba	0.0%	0.0%	0.0%	1.4%	21.3%	50.2%	26.3%	0.5%	0.3%	▼	
Croatia	Ba	0.0%	1.5%	15.1%	56.5%	17.8%	7.6%	1.5%	0.0%	0.0%	▲	
Cyprus	Ba	0.0%	5.6%	30.5%	49.8%	9.4%	4.0%	0.6%	0.0%	0.0%	▲	
Czech Republic	A	0.1%	53.5%	45.6%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	▲	
Democratic Republic of the Co	B	0.0%	0.0%	0.0%	0.1%	5.2%	51.6%	42.9%	0.3%	0.0%	▬	
Denmark	Aaa	95.0%	4.4%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
Dominican Republic	Ba	0.0%	0.0%	0.0%	12.8%	37.8%	40.0%	9.2%	0.1%	0.0%	▬	
Ecuador	B	0.0%	0.0%	0.0%	2.3%	25.2%	54.8%	17.5%	0.2%	0.0%	▬	
Egypt	B	0.0%	0.0%	0.0%	0.2%	15.9%	65.2%	18.4%	0.4%	0.0%	▬	
El Salvador	Caa	0.0%	0.0%	0.0%	4.2%	34.9%	47.6%	13.0%	0.3%	0.0%	▲	
Estonia	A	0.3%	46.6%	52.6%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
Ethiopia	B	0.0%	0.0%	0.0%	2.6%	17.4%	59.4%	20.5%	0.1%	0.0%	▬	
Fiji	Ba	0.0%	0.1%	2.5%	44.0%	30.9%	18.0%	4.3%	0.1%	0.0%	▬	
Finland	Aa	95.8%	3.3%	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	▲	
France	Aa	27.6%	64.8%	7.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
Gabon	B	0.0%	0.0%	0.0%	2.3%	28.3%	54.0%	15.1%	0.3%	0.0%	▬	
Georgia	Ba	0.0%	0.5%	5.6%	49.8%	25.9%	15.7%	3.0%	0.0%	0.0%	▬	
Germany	Aaa	92.0%	7.8%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
Ghana	B	0.0%	0.0%	0.0%	1.2%	30.3%	53.9%	14.0%	0.6%	0.0%	▬	
Greece	Caa	0.0%	0.0%	0.1%	14.5%	39.1%	37.7%	8.5%	0.1%	0.0%	▲	
Guatemala	Ba	0.0%	0.0%	0.1%	17.7%	32.7%	38.4%	11.0%	0.1%	0.0%	▬	

A downward arrow (in red ▼) indicates that according to the model estimate the country is over-rated and should be adjusted downwards. Similarly, an upward arrow (in green ▲) indicates that the country is under-rated according to the model and its rating score should be adjusted upwards. The dash sign (in yellow ▬) indicates that the country is fairly rated. The confidence level ( ) indicates the degree of certainty in the model-implied rating scores. One blue bar in the confidence scale graph indicates less than 50% confidence, two blue bars correspond to between 50 % - 60% confidence, three bars to 60% - 70% confidence and finally four bars to more than 70% confidence.

Countries	Actual Rating Band	Implied Rating Probabilities									Implied Action	Confidence
		Aaa	Aa	A	Baa	Ba	B	Caa	Ca	C		
Honduras	B	0.0%	0.0%	0.0%	7.9%	30.6%	46.0%	15.3%	0.2%	0.0%	▬	
Hong Kong	Aa	81.0%	17.4%	1.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	▲	
Hungary	Ba	0.0%	3.9%	26.1%	55.6%	10.3%	3.4%	0.6%	0.0%	0.0%	▲	
Iceland	A	9.3%	63.5%	27.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	▲	
India	Baa	0.0%	4.7%	13.1%	74.7%	5.7%	1.7%	0.2%	0.0%	0.0%	▬	
Indonesia	Baa	0.0%	2.5%	12.8%	70.9%	9.6%	3.7%	0.5%	0.0%	0.0%	▬	
Ireland	A	22.5%	55.5%	21.9%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	▲	
Israel	A	1.1%	55.6%	41.5%	1.8%	0.0%	0.0%	0.0%	0.0%	0.0%	▲	
Italy	Baa	0.0%	5.6%	19.7%	66.6%	6.5%	1.5%	0.1%	0.0%	0.0%	▬	
Jamaica	B	0.0%	0.0%	0.0%	4.7%	40.2%	44.7%	10.1%	0.4%	0.0%	▬	
Japan	A	78.8%	20.5%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	▲	
Jordan	B	0.0%	0.0%	0.6%	28.5%	35.9%	29.1%	5.9%	0.1%	0.0%	▲	
Kazakhstan	Baa	0.0%	1.3%	10.1%	59.7%	13.8%	12.0%	3.1%	0.0%	0.0%	▬	
Kenya	B	0.0%	0.0%	0.0%	5.4%	30.4%	50.3%	13.8%	0.2%	0.0%	▬	
Korea	Aa	0.5%	74.1%	25.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
Kuwait	Aa	0.0%	2.8%	17.1%	63.4%	10.9%	4.9%	0.9%	0.0%	0.0%	▼	
Kyrgyz Republic	B	0.0%	0.0%	0.0%	0.5%	14.8%	58.7%	25.7%	0.3%	0.0%	▬	
Latvia	A	0.0%	18.8%	68.1%	12.1%	0.8%	0.2%	0.0%	0.0%	0.0%	▬	
Lebanon	B	0.0%	0.0%	0.0%	0.0%	8.8%	68.4%	21.1%	1.5%	0.1%	▬	
Lithuania	A	0.0%	27.1%	66.6%	6.0%	0.2%	0.0%	0.0%	0.0%	0.0%	▬	
Luxembourg	Aaa	86.2%	13.0%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
Macao	Aa	0.1%	50.9%	48.5%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
Malaysia	A	0.0%	25.5%	52.0%	21.3%	0.9%	0.2%	0.0%	0.0%	0.0%	▬	
Malta	A	0.1%	45.5%	52.1%	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
Mauritius	Baa	0.0%	12.0%	45.3%	38.4%	3.5%	0.7%	0.1%	0.0%	0.0%	▲	
Mexico	A	0.0%	0.6%	5.0%	62.7%	19.3%	10.6%	1.8%	0.0%	0.0%	▼	
Moldova	B	0.0%	0.0%	0.0%	6.6%	30.3%	45.5%	17.3%	0.2%	0.0%	▬	
Mongolia	Caa	0.0%	0.0%	0.0%	5.4%	25.8%	50.0%	18.6%	0.1%	0.0%	▲	
Montenegro	B	0.0%	0.3%	5.0%	48.4%	26.8%	15.8%	3.7%	0.0%	0.0%	▲	
Morocco	Ba	0.0%	0.4%	4.9%	53.5%	23.9%	14.4%	2.9%	0.0%	0.0%	▬	
Mozambique	Caa	0.0%	0.0%	0.0%	0.3%	16.0%	60.6%	22.7%	0.4%	0.0%	▲	
Namibia	Ba	0.0%	0.4%	5.3%	50.4%	27.1%	14.0%	2.8%	0.0%	0.0%	▬	
Netherlands	Aaa	92.0%	7.2%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
New Zealand	Aaa	97.5%	2.2%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
Nicaragua	B	0.0%	0.0%	0.0%	3.3%	18.9%	56.3%	21.5%	0.1%	0.0%	▬	
Nigeria	B	0.0%	0.0%	0.0%	1.4%	17.9%	54.6%	25.8%	0.2%	0.0%	▬	
Norway	Aaa	98.2%	1.7%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
Oman	Baa	0.0%	0.4%	4.1%	55.1%	25.3%	13.0%	2.1%	0.0%	0.0%	▼	
Pakistan	B	0.0%	0.0%	0.0%	0.8%	17.8%	60.9%	20.3%	0.2%	0.0%	▬	
Panama	Baa	0.0%	0.1%	1.2%	44.1%	34.2%	17.5%	3.0%	0.0%	0.0%	▼	
Papua New Guinea	B	0.0%	0.0%	0.0%	5.9%	29.8%	46.1%	17.9%	0.3%	0.0%	▬	
Paraguay	Ba	0.0%	0.0%	0.0%	5.1%	27.2%	48.6%	19.0%	0.2%	0.0%	▼	
Peru	A	0.0%	0.3%	4.8%	53.8%	24.2%	13.7%	3.1%	0.0%	0.0%	▼	
Philippines	Baa	0.0%	1.2%	9.8%	63.7%	15.3%	8.4%	1.6%	0.0%	0.0%	▬	
Poland	A	0.0%	34.4%	55.6%	9.7%	0.3%	0.0%	0.0%	0.0%	0.0%	▬	
Portugal	Ba	0.4%	15.3%	50.4%	30.1%	3.0%	0.7%	0.1%	0.0%	0.0%	▲	

A downward arrow (in red ▼) indicates that according to the model estimate the country is over-rated and should be adjusted downwards. Similarly, an upward arrow (in green ▲) indicates that the country is under-rated according to the model and its rating score should be adjusted upwards. The dash sign (in yellow ▬) indicates that the country is fairly rated. The confidence level (▦) indicates the degree of certainty in the model-implied rating scores. One blue bar in the confidence scale graph indicates less than 50% confidence, two blue bars correspond to between 50% - 60% confidence, three bars to 60% - 70% confidence and finally four bars to more than 70% confidence.

Countries	Actual Rating Band	Implied Rating Probabilities									Implied Action	Confidence
		Aaa	Aa	A	Baa	Ba	B	Caa	Ca	C		
Qatar	Aa	0.0%	35.2%	39.4%	24.4%	0.8%	0.2%	0.0%	0.0%	0.0%	▼	
Republic of the Congo	Caa	0.0%	0.0%	0.0%	0.0%	8.4%	63.0%	26.9%	1.6%	0.1%	▲	
Romania	Baa	0.0%	0.7%	8.2%	58.0%	21.2%	9.8%	2.1%	0.0%	0.0%	▬	
Russia	Ba	0.0%	1.8%	11.2%	66.4%	10.6%	8.1%	1.9%	0.0%	0.0%	▲	
Saudi Arabia	A	0.0%	39.3%	50.3%	9.6%	0.2%	0.1%	0.0%	0.0%	0.0%	▬	
Senegal	Ba	0.0%	0.0%	0.2%	21.7%	38.3%	32.4%	7.4%	0.1%	0.0%	▬	
Serbia	Ba	0.0%	0.0%	0.1%	17.6%	39.9%	34.2%	8.0%	0.1%	0.0%	▬	
Singapore	Aaa	96.9%	2.5%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
Slovakia	A	0.0%	27.2%	62.4%	9.9%	0.4%	0.1%	0.0%	0.0%	0.0%	▬	
Slovenia	Baa	0.1%	23.8%	63.5%	11.9%	0.7%	0.1%	0.0%	0.0%	0.0%	▲	
Solomon Islands	B	0.0%	0.0%	0.1%	9.4%	26.4%	44.3%	19.7%	0.1%	0.0%	▬	
South Africa	Baa	0.0%	1.1%	10.7%	60.2%	18.6%	7.9%	1.5%	0.0%	0.0%	▬	
Spain	Baa	0.2%	37.4%	50.4%	11.6%	0.3%	0.1%	0.0%	0.0%	0.0%	▲	
Sri Lanka	B	0.0%	0.0%	0.0%	2.9%	34.0%	51.2%	11.6%	0.3%	0.0%	▬	
. Vincent and the Grenadin	B	0.0%	0.0%	0.9%	32.4%	39.8%	22.3%	4.4%	0.1%	0.0%	▲	
Suriname	B	0.0%	0.0%	0.0%	0.1%	11.7%	56.5%	30.4%	1.3%	0.0%	▬	
Sweden	Aaa	96.8%	2.9%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
Switzerland	Aaa	86.3%	12.8%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
Taiwan	Aa	1.7%	65.1%	32.8%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
Thailand	Baa	0.0%	12.6%	45.5%	37.3%	3.1%	1.3%	0.2%	0.0%	0.0%	▲	
Trinidad & Tobago	Ba	0.0%	0.1%	1.4%	36.7%	35.3%	21.5%	5.0%	0.1%	0.0%	▬	
Tunisia	B	0.0%	0.0%	0.0%	10.0%	38.8%	41.7%	9.3%	0.1%	0.0%	▬	
Turkey	Ba	0.0%	2.1%	12.8%	63.5%	12.4%	7.7%	1.5%	0.0%	0.0%	▲	
Uganda	B	0.0%	0.0%	0.0%	3.7%	26.9%	51.9%	17.3%	0.2%	0.0%	▬	
Ukraine	Caa	0.0%	0.0%	0.0%	0.0%	6.9%	56.1%	35.9%	1.1%	0.0%	▲	
United Arab Emirates	Aa	3.4%	75.8%	20.6%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
United Kingdom	Aa	85.3%	13.4%	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	▲	
Uruguay	Baa	0.0%	3.3%	22.6%	55.6%	13.2%	4.6%	0.7%	0.0%	0.0%	▬	
US	Aaa	81.1%	18.5%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	▬	
Venezuela	Caa	0.0%	0.0%	0.0%	0.0%	0.1%	19.7%	80.1%	0.2%	0.0%	▬	
Vietnam	B	0.0%	0.0%	0.6%	37.2%	31.1%	25.9%	5.2%	0.0%	0.0%	▲	
Zambia	B	0.0%	0.0%	0.0%	0.7%	24.3%	56.8%	17.6%	0.6%	0.0%	▬	

A downward arrow (in red ▼) indicates that according to the model estimate the country is over-rated and should be adjusted downwards. Similarly, an upward arrow (in green ▲) indicates that the country is under-rated according to the model and its rating score should be adjusted upwards. The dash sign (in yellow ▬) indicates that the country is fairly rated. The confidence level ( ) indicates the degree of certainty in the model-implied rating scores. One blue bar in the confidence scale graph indicates less than 50% confidence, two blue bars correspond to between 50 % - 60% confidence, three bars to 60% - 70% confidence and finally four bars to more than 70% confidence.

Contents

# of Countries	124
# of Years	12 years
Time Span	2006-2017
Outliers	To facilitate the statistical properties of our scoring model we truncate outliers in each of the four factor variables. As a result, we avoid extreme values that distort the statistical analysis. The maximum and minimum values used for truncation purposes are decided on a factor by factor case and are affected by qualitative and judgmental criteria.
Standardisations	We standardise each variable with a mean and standard deviation that are consistent with the rating system of Moody's. In particular for the mean we take the average for Moody's middle (or 'M') rating band. Similarly for the standard deviation we get the average range of the 15 notch rating system and divide it by 0.4 which is the value (in std's) of each notch value change
Data Sources	Moody's Rating Agency, International Monetary Fund, World Bank.

CONTENTS

Analytical Rating	Grouped Rating Band	Indicates
Aaa	Aaa	Highest quality with minimal risk.
Aa1	Aa	High quality, subject to very low default risk.
Aa2		
Aa3		
A1	A	Upper-medium grade, subject to low credit risk.
A2		
A3		
Baa1	Baa	Medium-grade, moderate credit risk, may have speculative characteristics.
Baa2		
Baa3		
Ba1	Ba	Substantial credit risk, have speculative characteristics.
Ba2		
Ba3		
B1	B	High credit risk, considered speculative.
B2		
B3		
Caa1	Caa	Very high credit risk, poor standing.
Caa2		
Caa3		
Ca	Ca	Highly speculative. Likely in or very near default with some prospect of recovery of principal or interest.
C	C	Lowest rated class of bonds. Typically in default with little prospect for recovery of principal or interest.

Contents

- Rating agency decisions fit naturally with ordered choice models where an individual, i.e. the rating agency in our case, must choose among an ordered set of discrete scores that characterise the capacity of a country to pay off its debt obligations. By ordered set, we mean that the scores follow a natural ordering from low ability (C) to high ability of debt repayment (Aaa). Ordered choice models can be thought of as an indirect regression of the observed rating decisions (y) to a set of instrument variables (x) that define several economic and qualitative characteristics of the country's debt repayment ability.

- The difference with the standard linear regression framework is that it is not possible to relate discrete rating scores in a linear way with the continuum of values observed in x. In order to overcome this problem we assume that the underlying process of choosing a country's discrete rating score is driven by a continuous preference strength random variable (z) that relates indirectly the rating decision y with the economic characteristics of each country x. In particular we relate the observed rating decisions y with the unobserved preference strength z which in turn is related with the observed characteristics in x.

- Perhaps the notion of ordered choice models can be better understood in the context of two country-two-rating scores example (binary choice model). For the sake of simplicity lets say that the rating agency must choose between two scores for Greece and Italy, C and Aaa, where the first rating indicates low ability of debt repayment and the second a high ability of debt repayment. For each country the rating agency observes a single characteristic that indicates the country's GDP growth x_G for Greece and x_I for Italy. We further assume that the rating agency assigns an Aaa rating to Italy and an C rating to Greece based on the GDP growth and on some other unobserved factors that we cannot measure accurately or are not available publicly.

- Our goal is to estimate how the rating score outcome is related to the observed characteristic. For this reason we assume that the rating agency makes decisions according to a preference index z that is positively related to the observed characteristic (GDP growth) and the unobserved factors. In other words we assume that as GDP growth increases, the tendency (or preference) of the rating agency to assign an Aaa rating is greater. Additionally, preferences are also affected (positively or negatively) by some other unknown factor ε, ($z_i = \beta_0 + \beta_1 * x_i + \varepsilon_i$).

Ordered Choice Models
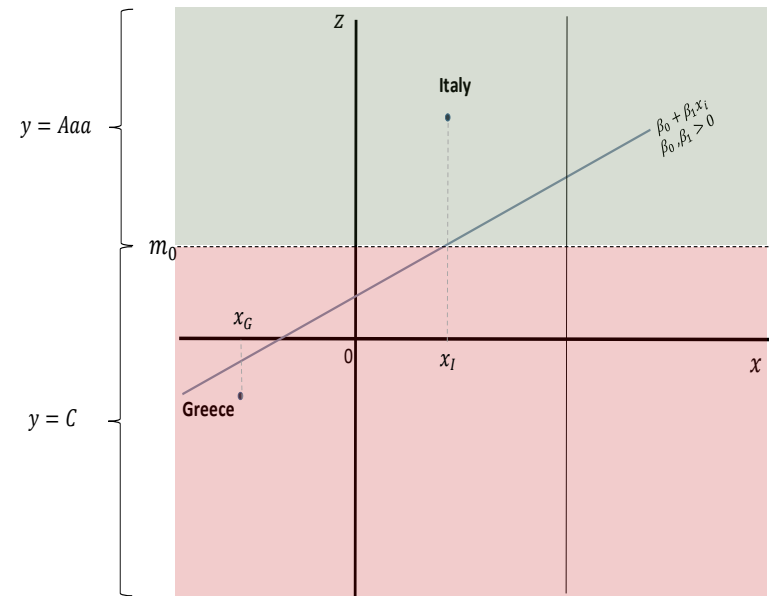
- Now assume that the values of z can be partitioned into two areas representing the two observed rating score choices, those that lie above a specific threshold m_0 and those that lie below. For example, since $z_G < m_0$ then $y_G = C$ while for Italy $z_I > m_0$ so $y_I = $ Aaa.

- Up to now we managed to relate the rating decisions for the two countries with their GDP growth indirectly through the preference strength variable z. Since z depends also on the unobserved term ε which is random, the next step is to make assumptions on the distribution of this unobserved term.

Logit Transformation and Error Distribution
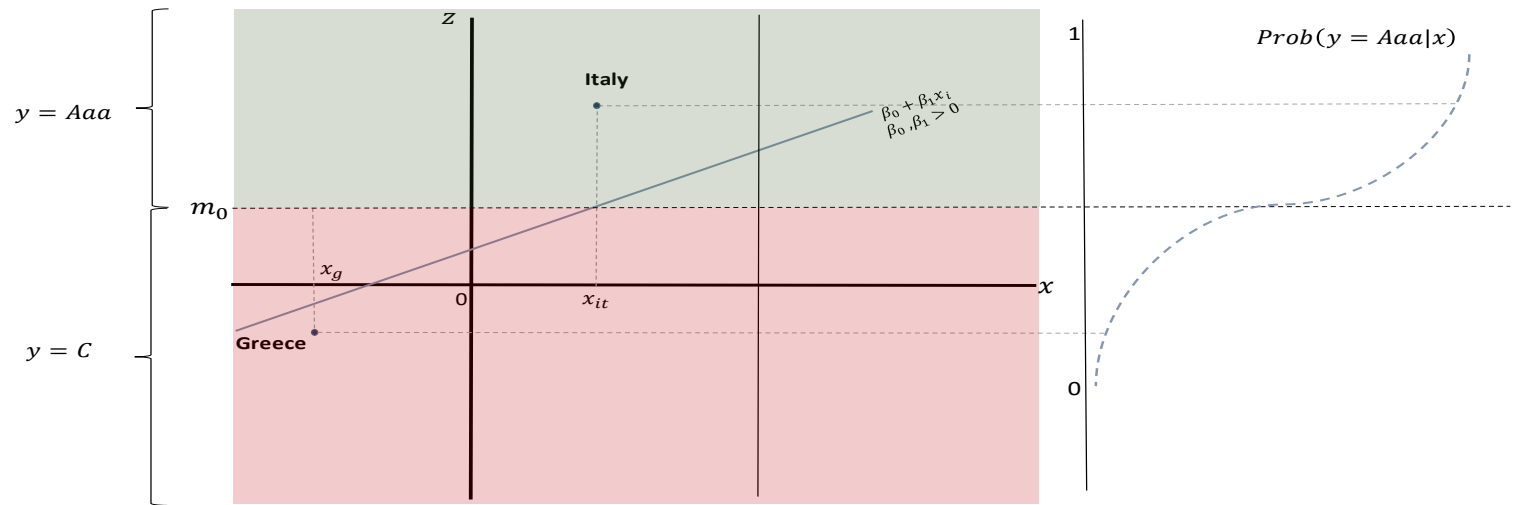
o The model suggested provides a crude description of the mechanism underlying an observed rating decision. The next crucial assumption is that of the distribution of the random error component ε, i.e. the country's unobserved or unmeasured features.

o The standard assumption here is that errors are randomly drawn from some theoretical distribution allowing us to attach probabilities to each rating decision. In other words, by specifying the error distribution in the model we transform the rating score preferences z to a probability function of the rating score outcome conditional on x, β_0, β_1 and m_0. Intuitively, the conditional probability function works as the preference strength variable transformed in such a way so that it takes values between zero and one and changes analogously with the economic characteristics of the country. That is, if x_G increases, then the probability of assigning a higher rating to Greece increases as well.

o For each choice of error distribution we should apply an appropriate transformation. Usually these transformations are non-linear function and the most common are the probit function (for normally distributed errors) and the logit function (for errors drawn from a logistic distribution). In our study we prefer to work with the latter S-shaped function as shown in the figure above.

o Multinomial logit or probit models are extensions of this simple binary choice example to a setting where the rating agency has to choose among more than two rating scores. The parameters that we estimate in the multinomial logit model are the β from the linear equation as well as the $n-1$ threshold parameters m that correspond to the n rating scores.