Sovereign Ratings Model: Global Downgrades but a Greek Upgrade

November 2022

Economics & Investment Strategy

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INTRODUCTION

- The importance of sovereign ratings cannot be overstated enough as they define the cost of funding not only for the public sector but also for the vast majority of corporate and financial institutions, given the link between those ratings and their sovereign rating ceiling. Furthermore, the recent Global Financial Crisis has taught us that the smooth functioning of substantial segments of the financial markets (fixed income, securitizations) can be affected by sudden downgrades of a sovereign's rating especially when a sovereign's rating crosses the Non-Investment Grade threshold, creating serious risks to financial and economic stability of the entire economy.

- For all these reasons, understanding the mechanics of the factors 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 have updated our Global Sovereign Ratings Model.

  The Global Sovereign Ratings Model was developed to satisfy the following needs:

  a. To allow us to form our own independent opinion regarding the creditworthiness of the global sovereign fixed income market.
  b. To allow us to identify cases of substantial sovereign ratings dislocations i.e. instances where actual ratings assigned by rating agencies deviate substantially from our own assessment creating the opportunity for future upgrades or the danger of imminent downgrades.
  c. Last but not least, we use our model as a forecasting tool. Using our forecasts for the key macro variables and assuming that the ratings distribution does not vary significantly from year to year we are able to provide probabilistic forecasts for sovereign ratings in the near future.

GLOBAL RATINGS

- Based on our results out of a total sample of 123 countries we rate, 33 have the "correct" rating (in the sense that our model implied rating matches that of Moody's), 36 are given a rating "premium" by Moody's vs our fundamental rating and 54 are rated more conservative than what their fundamentals imply.
- Our implied ratings signal a shift towards the lower Non-Investment Grade of our ratings spectrum for 2023 compared to 2019, before the global pandemic outbreak and the current geopolitical instability.

GREECE

- Our implied ratings for Greece exhibit a sharp bias towards investment grade after 2021 despite its current rating of Ba3, i.e. three notches below its factor-implied fair value.
- Clearly, the institutional factor that is based on world governance indicators recorded the best performance, while the fiscal factor presents the highest risk despite its recent improvement.
- Greece: Historic Factor Evolution
    - *Economic Strength* remains firm and improving after 2012 but lies above the median across all other economies.
    - *Fiscal Strength* recovered from a peak in 2011 through an eight-year fiscal consolidation process, returning back to the best performing range of the factor distribution across countries in our sample.
    - *Institutional Strength* substantially better than the other three factors fairing much better than the sample median.
    - *Event Risk* lies at normal levels commonly found in the middle range of the sample's distribution.

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The Four-Factor Model

Growth Dynamics	*Average Real GDP Growth, Volatility of Real GDP Growth*
Scale of Economy	*Nominal GDP ($bn)*
National Income	*GDP/Capita (PPP,$)*

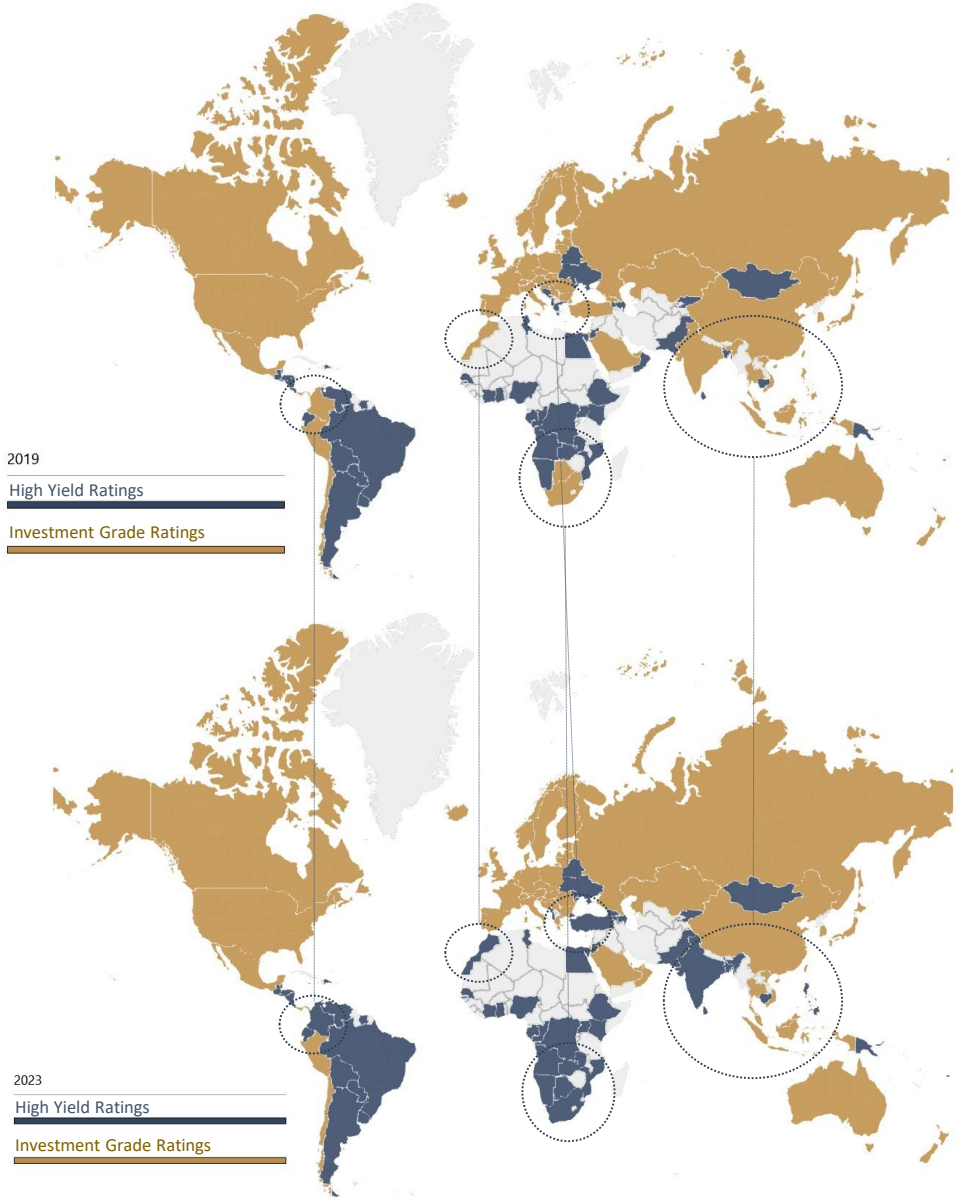
Debt Burden	*General Govt. Debt to GDP, General Govt. Debt to Revenues*
Debt Affordability	*General Govt. Interest Payments to Revenues, General Govt. Interest Payments to GDP*
Adjustment Factor	*Increase in General Government Debt/GDP ppts, General Govt. Foreign Currency Debt/General Govt. Debt*

Quality of Institutions	*Government Effectiveness, Rule of Law, Control of Corruption*
Policy Effectiveness	*Fiscal Policy Effectiveness, Monetary & Macroeconomic Policy Effectiveness*

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, Net International Investment Position to GDP*

Source: Moody's, Economics & Investment Strategy

THE GLOBAL BIRD'S-EYE VIEW I Is there a mismatch between realized ratings and implied ratings model?



2022	Same Rating	Underrated	Overrated
# countries	33	54	36
% of total	26.8	43.9	29.3

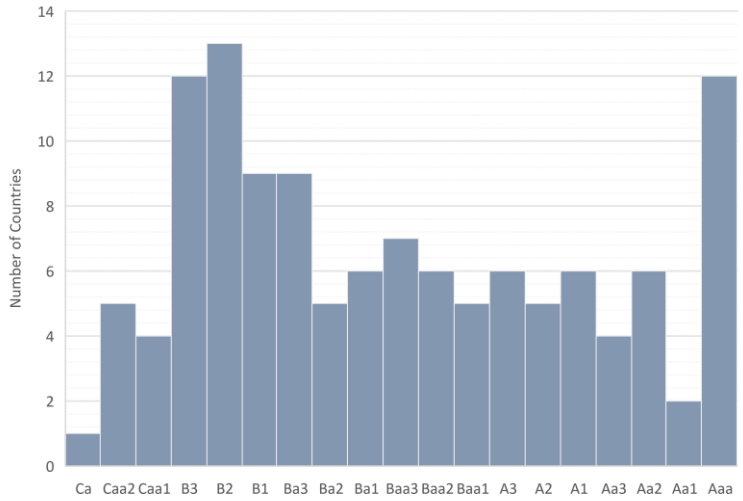
Based on our results out of a total sample of 123 countries we rate, 33 have the "correct" rating (in the sense that our model implied rating matches that of Moody's), 36 are given a rating "premium" by Moody's vs our fundamental rating and 54 are rated more conservative that what their fundamentals imply.

Our 2023 implied ratings forecast signal a shift of the global sovereign ratings distribution towards lower (Non-Investment Grade) ratings versus the actual 2019 levels, due to the "hangover" effects of the global pandemic crisis and the current geopolitical stability.

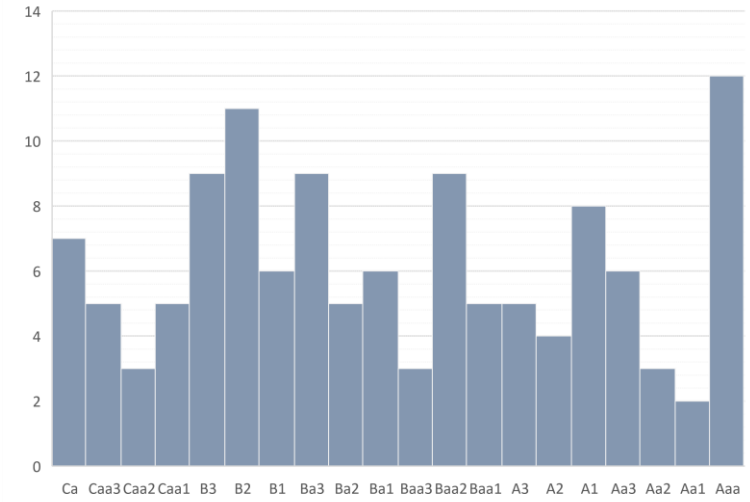
Source: Moody's, Economic Research & Investment Strategy

Rating Distributions

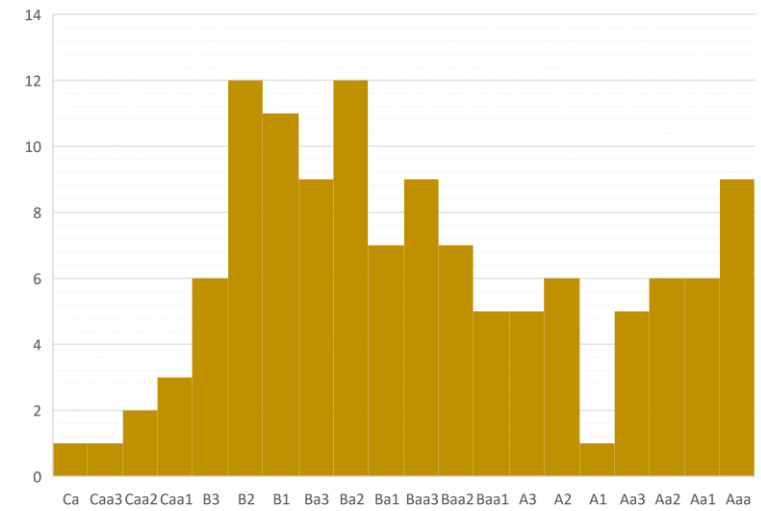
2019 Actual Rating Distribution



2022 Actual Rating Distribution



2023 Implied Rating Distribution



Source: Moody's, Economics & Investment Strategy

Factor-Implied Rating Decisions versus Actual Ratings I Full Sample 1/3

Countries	Implied Rating	Rating	Implied Rating	Non-Investment Grade Probability	Investment Grade Probability	Confidence	Economic Risk	Institutional Risk	Fiscal Risk	Event Risk
	2023	2022								
ALBANIA	Ba2	B1	Ba2	72.7	27.4	19.8	11.4	9.9	13.8	8.5
ANGOLA	Caa2	B3	Caa2	99.8	0.1	26.6	20.0	14.2	18.6	13.0
ARGENTINA	Ba3	Ca	Ba3	83.9	16.0	27.1	9.0	14.6	14.8	10.8
ARMENIA	B1	Ba3	B1	90.8	9.4	30.9	12.0	11.8	16.0	10.8
AUSTRALIA	Aa1	Aaa	Aa1	0.1	99.9	42.6	4.1	5.5	5.4	4.1
AUSTRIA	Aa1	Aa1	Aa1	0.0	99.9	69.1	5.5	4.7	5.9	3.2
AZERBAIJAN	Ba3	Ba2	Ba3	82.3	17.6	25.9	11.7	12.7	8.0	16.7
BAHAMAS	B1	Ba3	B1	90.7	9.3	30.9	11.7	10.2	21.9	5.5
BAHRAIN	B1	B2	B1	94.3	5.6	30.2	8.4	12.4	23.7	15.2
BANGLADESH	Ba3	Ba3	Ba3	87.0	13.1	29.0	7.6	16.3	14.9	14.1
BARBADOS	Ba3	Caa1	B1	90.3	9.7	30.8	14.8	8.3	17.0	7.5
BELARUS	B1	Ca	B1	93.9	6.1	30.5	12.2	15.0	11.3	15.6
BELGIUM	Aa2	Aa3	Aa1	0.0	99.8	45.4	6.4	6.1	7.4	3.7
BELIZE	B2	Caa3	B2	96.3	3.7	26.8	17.0	9.6	17.3	5.9
BOLIVIA	B2	B2	B2	97.7	2.4	29.0	13.8	13.0	19.0	10.6
BOSNIA HERZEGOVINA	Baa3	B3	Baa3	45.7	54.3	19.6	11.0	8.5	8.7	11.5
BOTSWANA	Ba1	A3	Ba1	52.8	47.1	18.6	12.3	11.8	6.5	4.4
BRAZIL	Ba1	Ba2	Ba1	60.4	39.6	17.0	8.4	15.3	15.6	9.5
BULGARIA	Baa2	Baa1	Baa2	22.6	77.6	18.1	8.3	10.1	8.2	6.9
CAMBODIA	B1	B2	Ba3	89.1	10.6	30.3	13.7	11.3	10.8	13.8
CANADA	Aa2	Aaa	Aa1	0.1	100.0	42.9	4.3	4.8	6.5	2.9
CHILE	Baa2	A1	Baa2	18.5	81.6	17.7	8.2	8.9	7.0	10.4
CHINA	A3	A1	A3	6.8	93.2	17.6	4.1	10.7	10.9	15.4
COLOMBIA	Ba1	Baa2	Ba1	60.3	39.6	17.0	8.5	11.8	13.0	10.6
CONGO	B3	Caa1	B3	98.8	1.2	33.5	19.1	9.5	14.5	15.6
COSTA RICA	Ba2	B2	Ba2	75.8	24.3	21.5	9.2	8.2	20.7	11.0
COTE D'IVOIRE	Ba3	Ba3	Ba3	84.9	15.2	27.7	10.2	11.4	16.0	13.4
CROATIA	Baa2	Ba1	Baa2	17.8	82.1	17.5	7.8	6.8	12.7	6.3
CYPRUS	Baa1	Ba1	Baa1	16.8	83.1	17.3	10.0	4.8	8.4	5.4
CZECH REPUBLIC	A2	Aa3	A2	3.5	96.6	25.2	5.5	8.5	4.4	7.2
DEMOCRATIC REP. OF CONGO	B3	Caa2	B3	99.0	1.1	33.6	16.0	17.6	8.2	18.3
DENMARK	Aaa	Aaa	Aaa	0.0	99.9	88.0	5.5	2.7	2.4	2.2
DOMINICAN REP.	Ba2	Ba3	Ba2	64.7	35.2	17.9	7.0	11.6	18.9	7.8
ECUADOR	Ba2	Caa3	Ba2	73.2	26.9	19.9	11.8	9.3	13.3	10.0
EGYPT	B1	B2	B1	95.2	4.9	29.3	5.7	18.0	20.8	17.1
EL SALVADOR	B2	Caa3	B2	97.8	2.0	30.3	14.3	10.0	21.2	14.5
ESTONIA	A2	A1	A2	4.1	96.0	23.5	8.2	7.8	2.5	3.5
ETHIOPIA	B3	Caa2	B3	99.3	0.7	32.9	14.0	15.5	17.9	17.6
FIJI	B2	B1	B2	96.8	3.2	25.5	14.9	10.0	20.1	9.1
FINLAND	Aaa	Aa1	Aaa	0.0	100.0	77.7	5.6	3.6	4.5	3.7
FRANCE	Aa1	Aa2	Aa1	0.0	100.0	57.5	6.2	5.4	5.2	5.3

Confidence: Our confidence estimate for each country in a specific year is defined as the maximum of probability estimates across the implied rating distribution. For instance, assuming that for country {A} the highest probability estimate for Aaa implied rating is 60% and for country {B} is 30% for the same rating, we conclude that the underlying fundamental factors imply a high confidence for country {A} having a Aaa rating relative to country {B}. The intuition behind the confidence estimate is that a high gauge (e.g. greater than 50%) for the maximum probability estimate results in a less spread-out implied rating distribution and thus a lower uncertainty on the "fair" value of the implied rating score.

Source: Moody's, Economics & Investment Strategy

Factor-Implied Rating Decisions versus Actual Ratings I Full Sample 2/3

Countries	Implied Rating	Rating	Implied Rating	Non-Investment Grade Probability	Investment Grade Probability	Confidence	Economic Risk	Institutional Risk	Fiscal Risk	Event Risk
	2023	2022								
GABON	Ba2	Caa1	Ba2	75.1	25.1	21.1	11.0	9.1	14.6	12.2
GEORGIA	Ba2	Ba2	Ba2	76.7	23.2	22.1	11.6	10.7	11.3	12.7
GERMANY	Aaa	Aaa	Aaa	0.0	99.9	91.1	3.7	3.8	2.3	3.2
GHANA	B2	B3	B2	97.7	2.4	28.9	10.7	16.3	22.8	6.9
GREECE	Baa3	Ba3	Baa3	34.5	65.6	19.6	9.8	5.7	11.7	8.0
GUATEMALA	Ba2	Ba1	Ba2	78.4	21.6	23.2	10.3	12.8	12.2	11.5
HONDURAS	B1	B1	B1	94.3	5.9	30.4	13.6	13.1	12.9	12.4
HONG KONG	Aa1	Aa3	Aa1	0.0	100.0	66.9	3.7	3.7	0.7	8.6
HUNGARY	Baa3	Baa2	Baa3	35.4	64.9	19.7	6.5	12.5	7.6	10.1
ICELAND	A2	A2	A2	3.6	96.4	24.7	8.3	8.4	9.7	9.2
INDIA	Ba1	Baa3	Ba1	62.5	37.7	17.2	7.9	14.9	16.9	11.1
INDONESIA	Baa2	Baa2	Baa2	25.9	73.8	18.0	6.1	8.7	14.2	10.2
IRELAND	Aa3	A1	Aa3	0.6	99.2	24.2	2.7	3.1	5.8	5.4
ISRAEL	Aa2	A1	Aa3	0.3	99.7	22.0	4.5	6.3	6.6	9.5
ITALY	Baa1	Baa3	Baa1	16.7	83.3	17.3	6.1	7.0	13.7	4.6
JAMAICA	B2	B2	B2	97.2	2.9	27.0	14.7	10.9	20.3	8.6
JAPAN	Aa2	A1	Aa2	0.1	99.9	38.7	2.4	7.8	7.1	3.0
JORDAN	Ba2	B1	Ba3	82.0	18.0	25.6	10.5	8.7	18.4	12.6
KAZAKHSTAN	Baa3	Baa2	Baa3	39.0	61.1	19.9	7.0	13.5	6.8	14.1
KENYA	B2	B2	B2	98.1	1.8	31.0	10.1	16.6	21.4	13.0
KOREA	Aa1	Aa2	Aa1	0.0	100.0	61.1	1.7	3.8	6.3	8.3
KUWAIT	A1	A1	A1	1.6	98.4	29.3	10.1	6.3	7.3	10.3
KYRGYZ REPUBLIC	B2	B3	B3	98.2	1.6	32.0	16.9	14.6	11.7	12.1
LATVIA	A3	A3	A3	7.7	92.2	16.4	8.6	8.6	3.6	5.0
LEBANON	Caa3	Ca	Caa3	100.0	0.0	36.3	16.4	21.3	18.4	17.8
LITHUANIA	A2	A2	A2	2.9	97.2	26.6	6.5	8.8	2.8	3.4
LUXEMBOURG	Aaa	Aaa	Aaa	0.0	99.8	91.8	4.7	2.9	1.8	1.8
MALAYSIA	Baa1	A3	Baa1	13.9	85.9	16.8	6.1	6.7	13.2	9.1
MALTA	Baa1	A3	Baa1	9.6	90.5	16.3	8.9	6.2	6.1	2.9
MAURITIUS	Ba2	Baa2	Ba2	77.6	22.5	22.6	12.1	10.5	15.4	4.1
MEXICO	A3	Baa1	A3	5.4	94.6	20.3	7.4	12.3	10.5	11.7
MONGOLIA	B1	B3	B1	94.9	5.1	29.6	12.7	12.9	15.3	13.4
MONTENEGRO	Ba3	B1	Ba3	82.3	17.8	25.7	12.4	9.4	12.9	13.7
MOROCCO	Ba1	Ba1	Ba1	53.8	46.0	18.4	11.5	10.0	12.1	11.8
MOZAMBIQUE	Caa1	Caa2	Caa1	99.5	0.3	27.2	15.5	15.1	20.9	14.5
NAMIBIA	B1	B1	B2	97.0	3.1	25.7	15.5	12.2	15.5	9.5
NETHERLANDS	Aaa	Aaa	Aaa	0.0	100.0	92.7	2.1	4.3	4.1	2.5
NEW ZEALAND	Aa2	Aaa	Aa2	0.3	99.7	22.3	5.8	5.8	6.1	6.2
NICARAGUA	B2	B3	B3	98.8	1.2	33.4	16.3	15.0	12.7	14.3
NIGERIA	B3	B2	B3	99.0	0.9	33.5	13.9	17.5	14.7	16.3
NORWAY	Aaa	Aaa	Aaa	0.0	100.0	79.8	3.8	7.4	3.2	1.5

Confidence: Our confidence estimate for each country in a specific year is defined as the maximum of probability estimates across the implied rating distribution. For instance, assuming that for country {A} the highest probability estimate for Aaa implied rating is 60% and for country {B} is 30% for the same rating, we conclude that the underlying fundamental factors imply a high confidence for country {A} having a Aaa rating relative to country {B}. The intuition behind the confidence estimate is that a high gauge (e.g. greater than 50%) for the maximum probability estimate results in a less spread-out implied rating distribution and thus a lower uncertainty on the "fair" value of the implied rating score.

Source: Moody's, Economics & Investment Strategy

FACTOR-IMPLIED RATING DECISIONS VERSUS ACTUAL RATINGS I FULL SAMPLE 3/3

Countries	Implied Rating	Rating	Implied Rating	Non-Investment Grade Probability	Investment Grade Probability	Confidence	Economic Risk	Institutional Risk	Fiscal Risk	Event Risk
	2023	2022								
OMAN	Baa3	Ba3	Baa3	41.2	58.9	19.9	9.5	8.0	11.6	11.3
PAKISTAN	B2	B3	B2	97.8	2.0	30.2	9.3	17.2	19.7	17.1
PANAMA	Baa3	Baa2	Baa3	45.6	54.4	19.6	8.2	8.5	17.1	6.6
PAPUA NEW GUINEA	B3	B2	B3	99.0	0.9	33.6	16.4	14.9	15.6	11.1
PARAGUAY	Ba3	Ba1	Ba3	84.2	15.9	27.2	11.2	13.6	12.8	8.7
PERU	Baa3	Baa1	Baa3	40.2	59.8	19.9	9.8	10.2	8.6	9.2
PHILIPPINES	Ba2	Baa2	Ba2	70.4	29.4	19.4	8.9	11.0	15.4	11.7
POLAND	A3	A2	A3	6.8	93.0	17.5	3.7	11.1	5.4	7.3
PORTUGAL	A3	Baa2	A3	6.3	93.8	18.8	6.9	3.8	9.6	5.7
QATAR	Aa3	Aa3	Aa3	0.6	99.5	23.6	7.9	3.8	9.1	10.9
REPUBLIC OF MOLDOVA	Ba3	B3	Ba3	82.3	17.9	25.7	11.8	14.7	8.1	10.4
ROMANIA	Baa3	Baa3	Baa3	40.1	60.0	19.9	5.5	12.7	12.5	12.0
RUSSIAN FEDERATION	Baa2	Ca	Baa2	20.7	79.3	18.0	8.9	14.5	3.1	14.4
SAUDI ARABIA	Aa3	A1	Aa3	0.6	99.4	24.5	4.9	8.2	6.5	16.5
SENEGAL	Ba3	Ba3	Ba3	88.8	11.1	30.1	12.2	9.3	19.5	8.3
SERBIA	Baa3	Ba2	Baa3	45.1	54.8	19.7	8.3	11.1	11.3	9.6
SINGAPORE	Aa1	Aaa	Aa2	0.1	99.9	35.5	2.4	4.1	11.8	5.7
SLOVAKIA	A2	A2	A3	4.9	95.1	21.6	6.3	8.8	5.1	5.5
SLOVENIA	A2	A3	A2	2.3	97.8	28.5	7.6	3.8	5.8	4.1
SOLOMON ISLANDS	B1	Caa1	B1	90.0	9.9	30.7	18.5	9.1	9.0	5.4
SOUTH AFRICA	Ba1	Ba2	Ba1	47.2	52.7	19.5	10.3	11.6	15.2	7.6
SPAIN	Baa1	Baa1	Baa1	10.2	89.7	16.5	6.5	6.1	10.6	5.6
SRI LANKA	B3	Ca	B3	99.3	0.7	32.6	10.3	16.7	25.1	15.8
ST. VINCENT	B1	B3	Ba3	88.2	11.9	29.8	14.7	7.7	17.8	5.6
SURINAME	Caa1	Caa3	Caa2	99.9	0.1	25.8	16.1	16.8	25.7	6.5
SWEDEN	Aaa	Aaa	Aaa	0.0	100.0	94.0	3.2	3.1	2.4	2.2
SWITZERLAND	Aaa	Aaa	Aa1	0.0	99.9	76.6	-0.1	4.3	1.7	1.6
TAIWAN	Aaa	Aa3	Aaa	0.0	100.0	77.6	2.3	3.7	3.2	3.5
THAILAND	Baa2	Baa1	Baa2	19.8	80.1	17.9	7.8	7.5	8.8	13.3
TRINIDAD & TOBAGO	Ba2	Ba1	Ba2	75.5	24.6	21.3	12.4	9.8	14.0	6.5
TUNISIA	Caa1	Caa1	Caa1	99.3	0.7	31.9	15.5	14.5	18.4	15.4
TURKEY	Ba2	B2	Ba1	61.7	38.4	17.0	4.2	15.1	14.7	15.8
UGANDA	B2	B2	B2	97.0	3.0	26.2	12.5	13.3	18.3	13.5
UKRAINE	B2	Caa3	B2	96.0	3.8	27.3	13.9	14.3	13.2	12.2
UNITED ARAB EMIRATES	Aa2	Aa2	Aa2	0.3	99.6	22.3	5.5	6.1	7.4	10.7
UNITED KINGDOM	Aa3	Aa3	Aa3	0.8	99.1	26.7	6.3	6.2	10.2	5.3
UNITED STATES	Aa3	Aaa	Aa2	0.3	99.6	22.5	2.3	9.0	8.1	6.5
URUGUAY	Ba1	Baa2	Ba1	58.7	41.1	17.3	10.2	9.8	12.9	8.6
VENEZUELA	Ca	Ca	Ca	99.9	0.0	76.5	19.7	21.4	20.3	20.0
VIETNAM	Baa2	Ba3	Baa2	17.9	82.1	17.6	5.2	10.5	9.0	13.4
ZAMBIA	Caa2	Ca	Caa3	100.0	0.0	32.4	17.2	18.2	22.3	13.9

Confidence: Our confidence estimate for each country in a specific year is defined as the maximum of probability estimates across the implied rating distribution. For instance, assuming that for country {A} the highest probability estimate for Aaa implied rating is 60% and for country {B} is 30% for the same rating, we conclude that the underlying fundamental factors imply a high confidence for country {A} having a Aaa rating relative to country {B}. The intuition behind the confidence estimate is that a high gauge (e.g. greater than 50%) for the maximum probability estimate results in a less spread-out implied rating distribution and thus a lower uncertainty on the "fair" value of the implied rating score.

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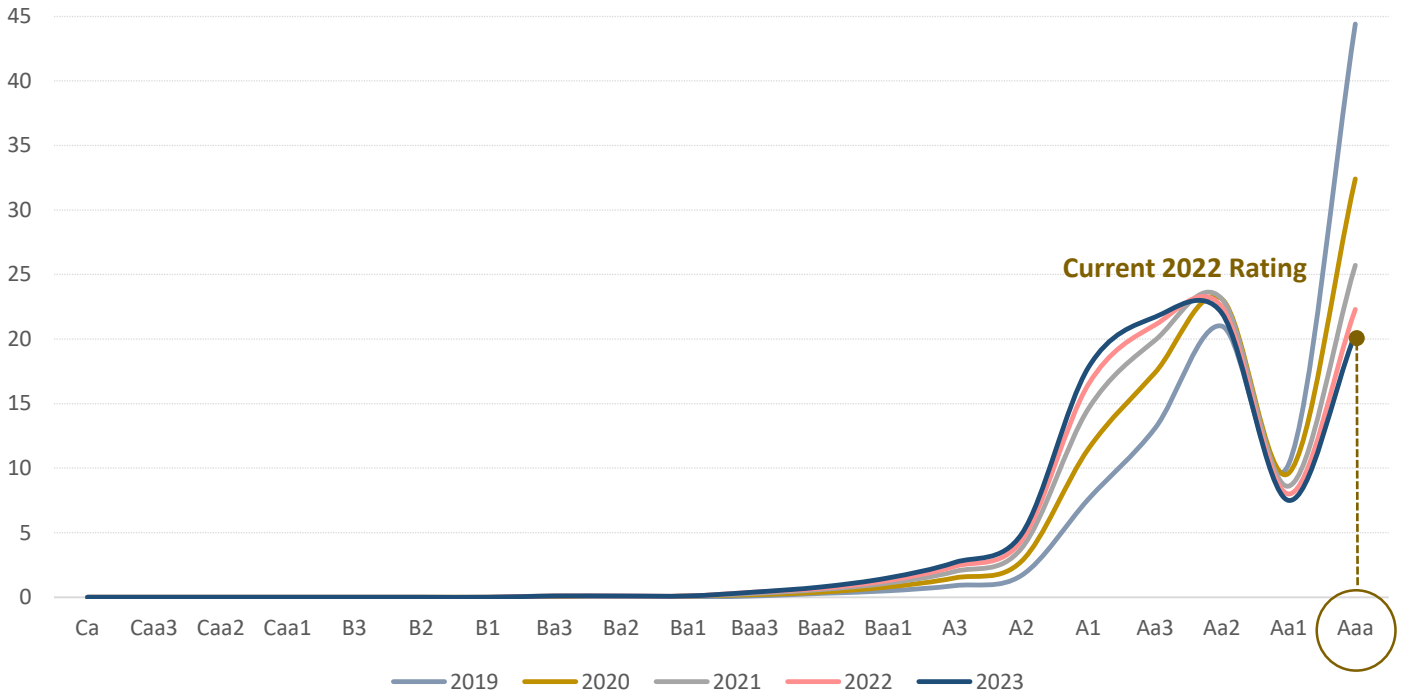
FOCUS I USA

Piraeus Bank Implied Rating Probability



- Our implied ratings point to a lower rating for the USA, notably at least two notches lower than the current Aaa rating. The confidence indicator points to a lower probability of the implied rating since 2020, signaling that based on the fundamentals USA should have a lower rating compared to 2019.

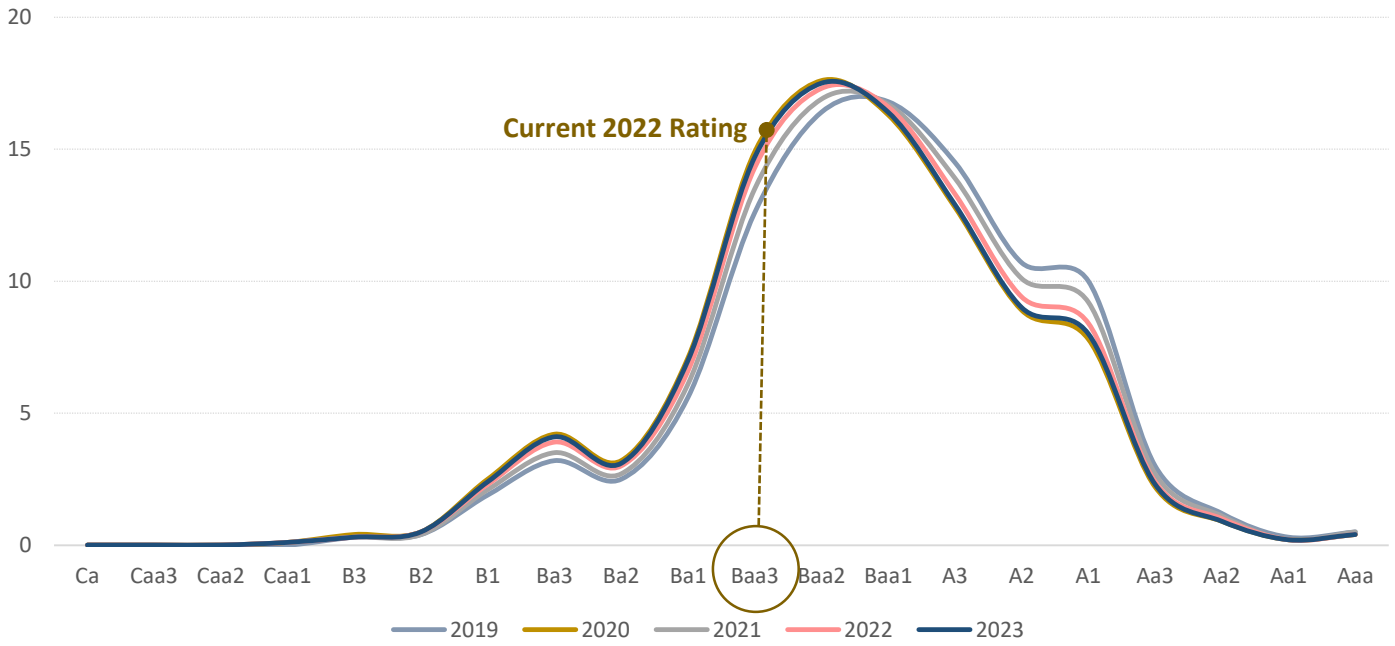
- The Economic Strength Factor is the only one among the four factors that remains stable, whereas the Institutional, Fiscal and Event Risk Factors have all deteriorated signaling more stress.

	Economic Factor	Institutional Factor	Fiscal Factor	Event Risk Factor
2019	1.44	5.76	9.11	5.91
2020	2.10	6.71	8.99	6.45
2021	2.32	8.84	7.31	6.45
2022	2.33	9.03	8.06	6.45
2023	2.43	9.14	8.36	6.45

** The higher value the riskier*

Source: Moody's, Economics & Investment Strategy

Piraeus Bank Implied Rating Probability



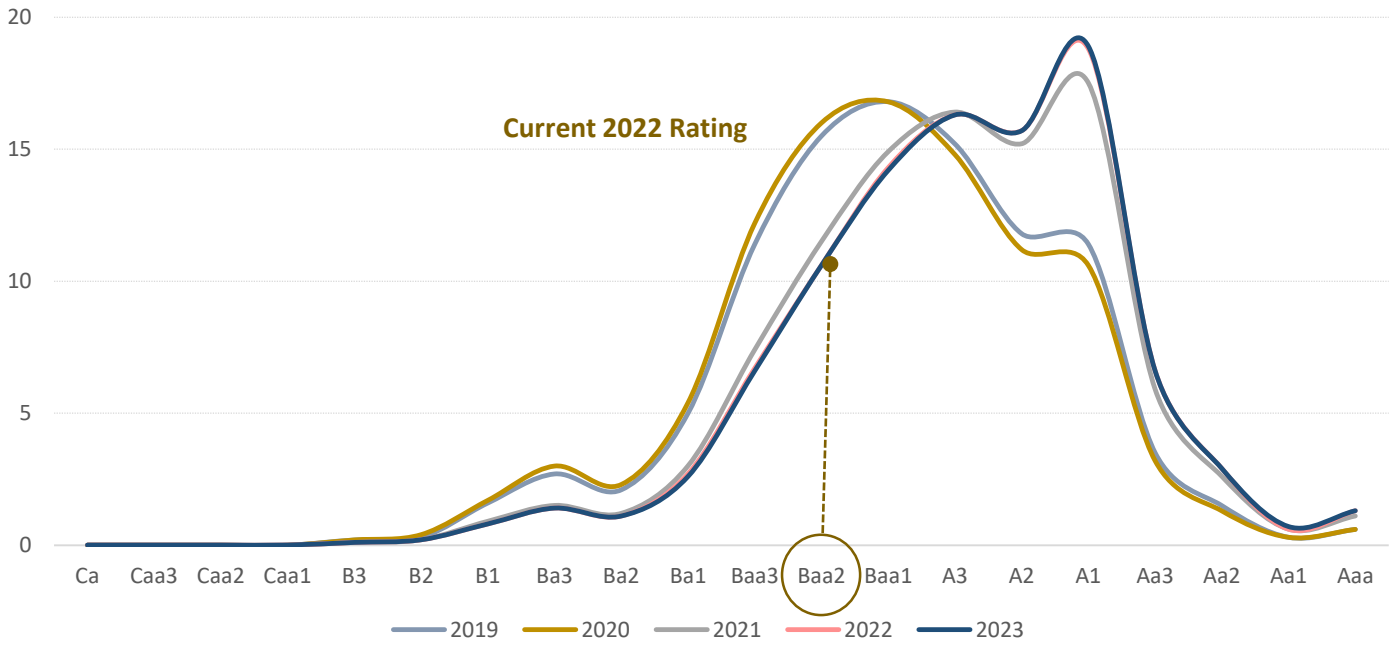
- Our implied ratings point to a higher rating for Italy, notably at least one notch higher than the current Baa3 rating. Our confidence indicator points to a cumulatively higher probability of a better implied rating versus actual.
- The Fiscal Strength Factor is the riskier one among the four, whereas Event Risk Factor provides more stability to the implied rating.

	Economic Factor	Institutional Factor	Fiscal Factor	Event Risk Factor
2019	4.76	7.76	13.82	5.07
2020	6.02	7.48	13.59	4.56
2021	6.07	6.69	13.54	4.56
2022	6.07	7.01	13.68	4.56
2023	6.06	7.30	13.63	4.56

** The higher value the riskier*

Source: Moody's, Economics & Investment Strategy

Piraeus Bank Implied Rating Probability



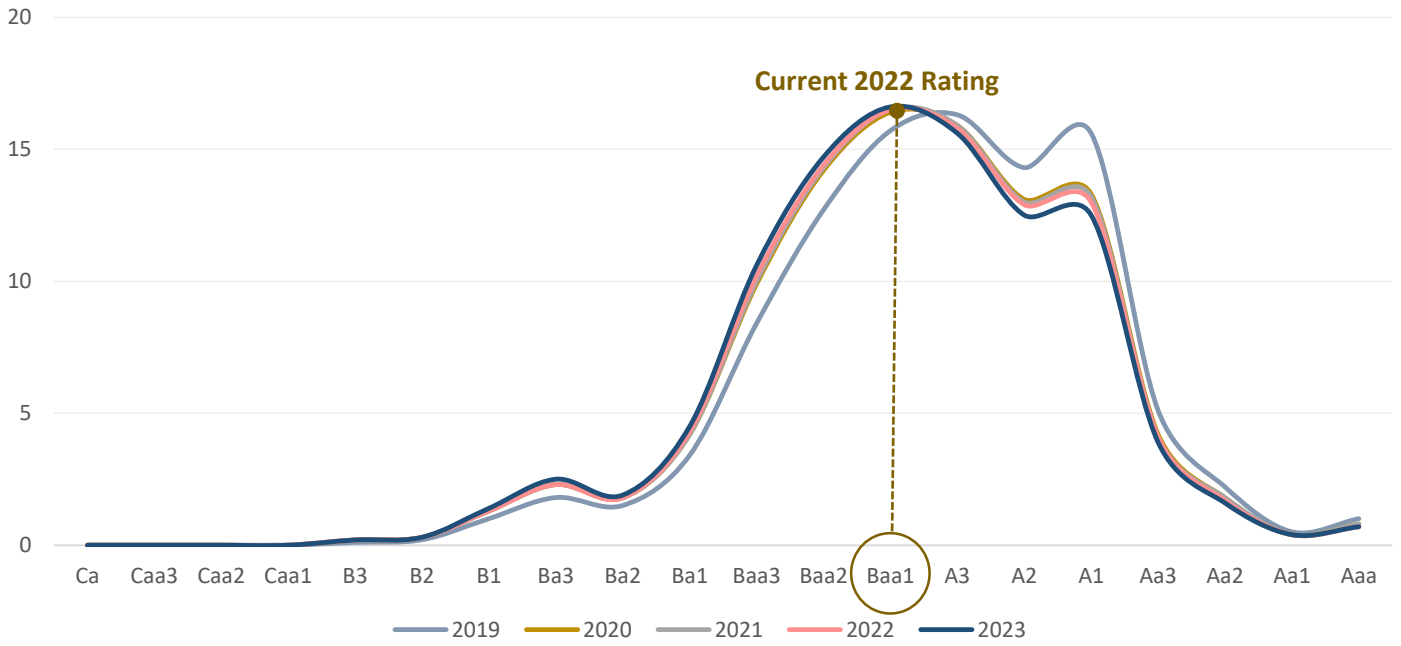
- Portugal is one of the sovereigns with the biggest improvement in its rating distributions between 2019-20 and 2021-23.
- Portugal's actual rating of Baa2 reflects its fundamentals of the 2019-20 period, while its recent and projected macro performance would justify a very aggressive upgrade process that would result in Portugal's rating reaching the A3-A1 rating range.
- The Fiscal Strength and Economic Risk Factors are the riskier ones, while the Institutional Factor is the more stable one.

	Economic Factor	Institutional Factor	Fiscal Factor	Event Risk Factor
2019	7.44	5.46	10.55	5.22
2020	7.28	5.52	11.16	5.62
2021	7.07	3.74	10.09	5.67
2022	6.91	3.80	9.64	5.71
2023	6.81	3.93	9.52	5.85

** The higher value the riskier*

Source: Moody's, Economics & Investment Strategy

Piraeus Bank Implied Rating Probability



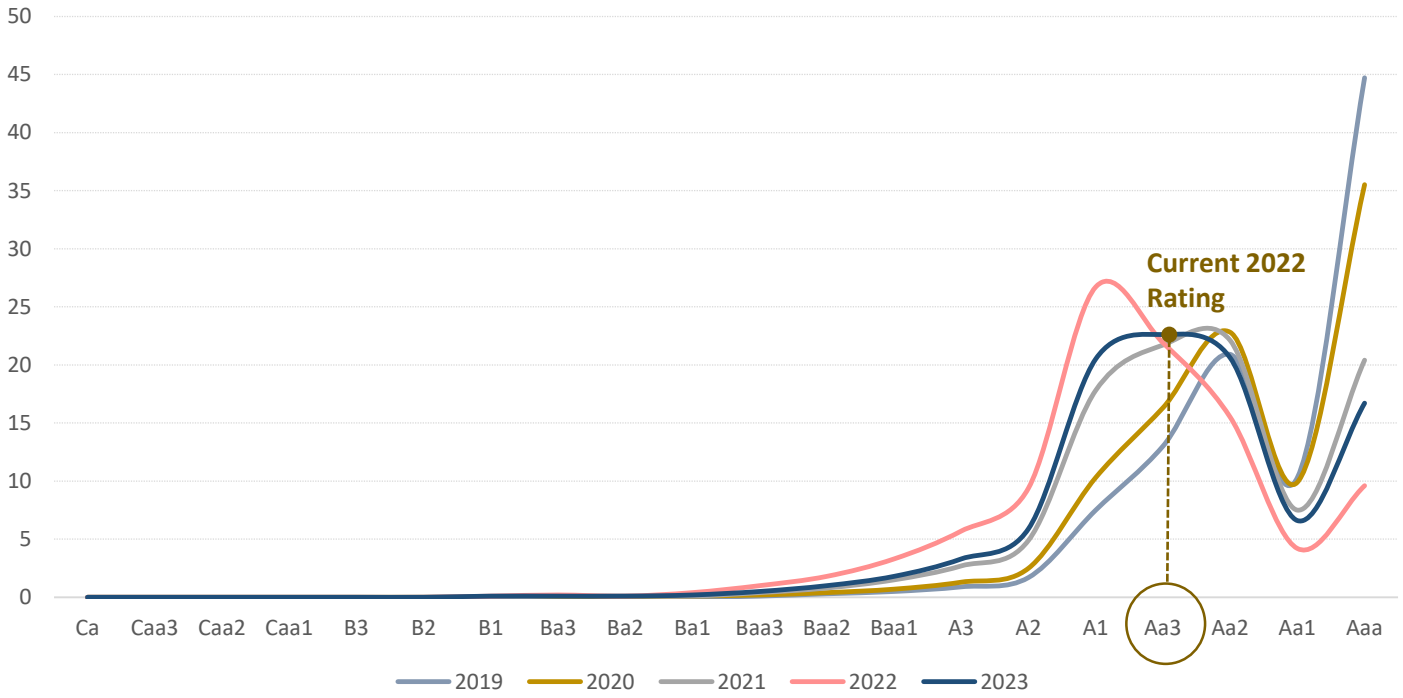
- Our implied rating is in line with the actual rating of Baa1, with symmetrical probabilities for a possible one notch upgrade or downgrade.
- As in the rest of the periphery, the Fiscal Factor is the one imposing more pressure to the rating. The Economic and Institutional Factors also signal risks to the upside.

	Economic Factor	Institutional Factor	Fiscal Factor	Event Risk Factor
2019	5.12	6.82	10.94	5.20
2020	6.62	5.49	10.74	5.75
2021	6.58	5.92	10.48	5.32
2022	6.45	6.06	10.56	5.55
2023	6.42	6.29	10.60	5.59

** The higher value the riskier*

Source: Moody's, Economics & Investment Strategy

Piraeus Bank Implied Rating Probability



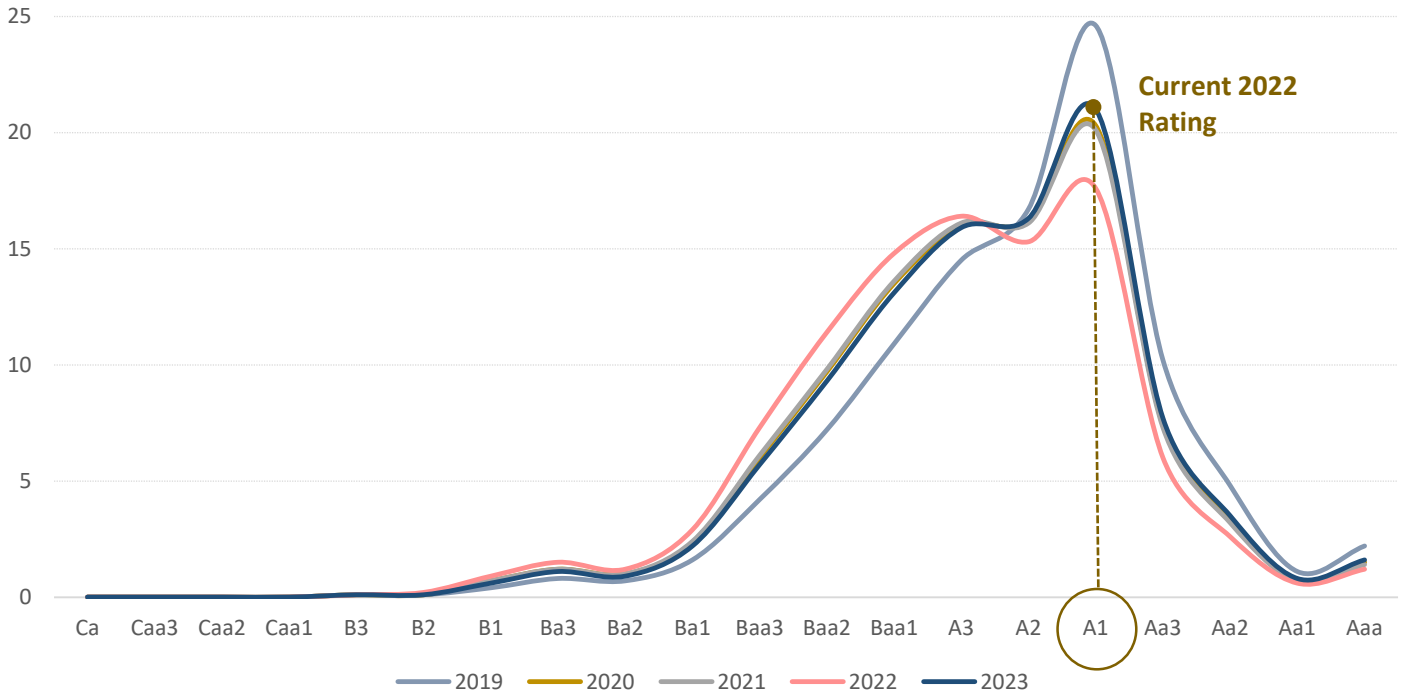
- UK is fairly rated with both actual and implied ratings converging to the Aa3 level. Furthermore, the probabilities are perfectly balanced around the Aa3 rating, with an equal chance of either a one notch upgrade or one notch downgrade.
- All four Factors are pointing towards a riskier 2023 for the UK.

	Economic Factor	Institutional Factor	Fiscal Factor	Event Risk Factor
2019	4.49	3.75	6.11	4.93
2020	6.21	3.97	4.78	4.22
2021	6.28	5.21	6.42	5.74
2022	6.32	6.19	10.19	5.32
2023	6.33	6.37	6.18	5.44

** The higher value the riskier*

Source: Moody's, Economics & Investment Strategy

Piraeus Bank Implied Rating Probability



- China is fairly rated, having identical implied and realized ratings.
- The Event Risk Factor is the one that is more volatile imposing a higher risk for the rating.

	Economic Factor	Institutional Factor	Fiscal Factor	Event Risk Factor
2019	4.07	10.40	7.62	15.28
2020	4.57	10.11	9.35	15.37
2021	4.22	10.45	9.67	15.37
2022	4.07	10.73	10.89	15.37
2023	2.94	10.90	11.24	15.37

** The higher value the riskier*

Source: Moody's, Economics & Investment Strategy

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GREECE SOVEREIGN RATING PROJECTIONS

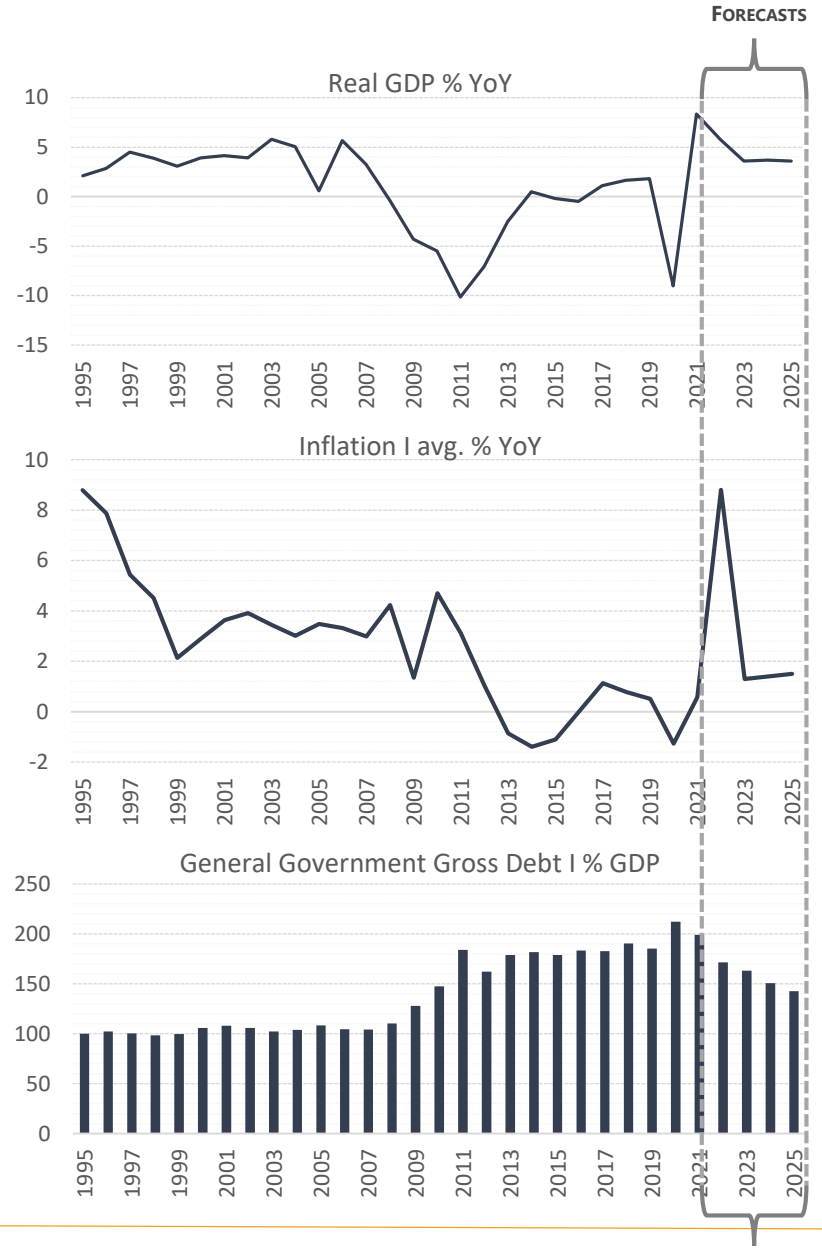
- Our analysis of the Greek sovereign rating outlook takes place in two distinct stages:

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

  Second using our ratings-model to forecast the evolution of Greek sovereign ratings

- In the **First Stage,** we utilize as inputs either actual data for the period of interest 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 Moody's assigns an extremely conservative rating for Greece (Ba3) vis-a-vis the "theoretical" ratings that Greece should have, based purely on the values of its fundamentals (Baa3).
- In the **Second Stage** we assume that the global ratings distribution remains constant and use macro-forecasts for Greece to project the baseline macro-scenario on future ratings. Based on this analysis (and contingent upon the realization of our forecasts) Greece's sovereign debt should achieve **investment grade status by 2023**.

GREECE SOVEREIGN RATING PROJECTIONS I THE MACRO-FORECAST INPUTS

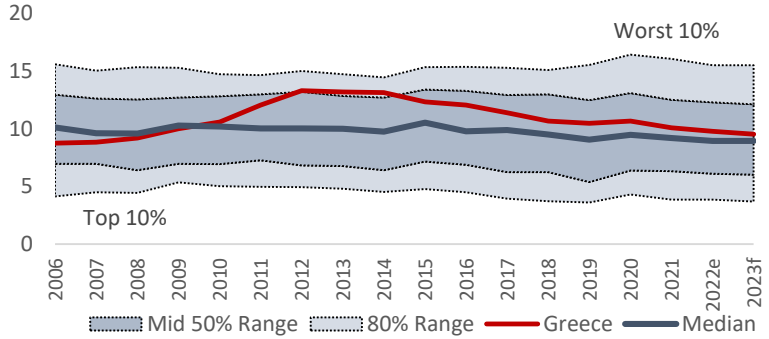


	Real GDP (% YoY)	Inflation (avg. %YoY)	General Government Gross Debt (% GDP)
2022	5.8	8.8	171.4
2023	3.6	1.3	163.1
2024	3.7	1.4	150.7
2025	3.6	1.5	142.5

Source: Piraeus Bank Research, IMF, Moody's

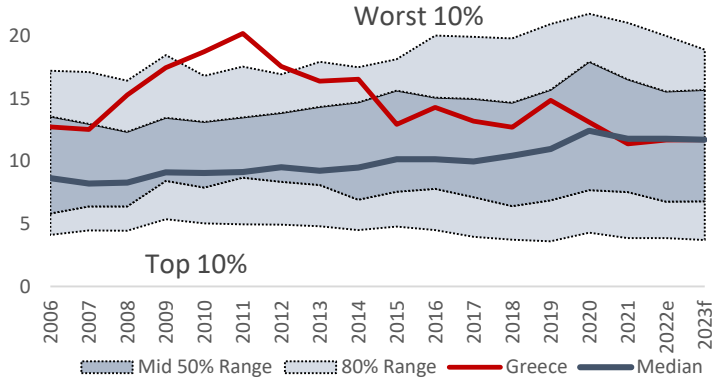
- Even though real GDP in 2021 returned back close to 2019 levels Greek economic activity is projected to slow down over the next three years starting in 2023 from very high current growth rate. In particular real GDP is expected to grow by more than 3% per annum over the next three years .
- Persistent inflation dynamics indicate a high reading for 2022 at 8.8% driven by high energy prices, geopolitical risks and supply bottlenecks abroad. We expect a rapid improvement as ECB hikes rates over the next year.
- High inflation and robust economic activity push nominal GDP significantly higher. As a result, a more prudent fiscal policy and higher interest rates as well as a sizable cash buffer are expected to push debt levels down to 140% of GDP by 2025.

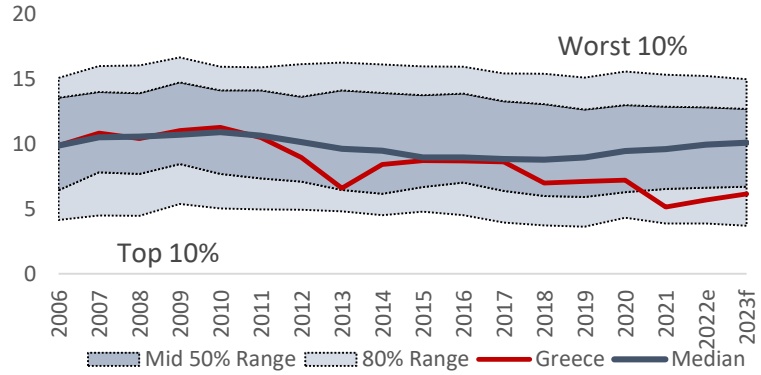
Greece Historic Factor Evolution



Economic Strength remains firm and improving after 2012 but lies above the median across all other economies.

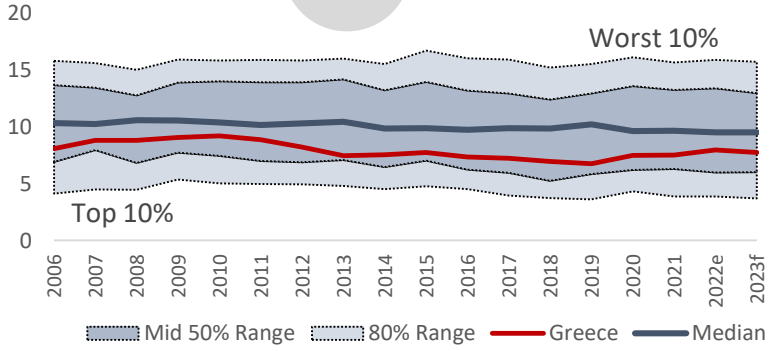
Fiscal Strength recovered from a peak in 2011 through an eight-year fiscal consolidation process, returning back to the best performing range of the factor distribution across countries in our sample.



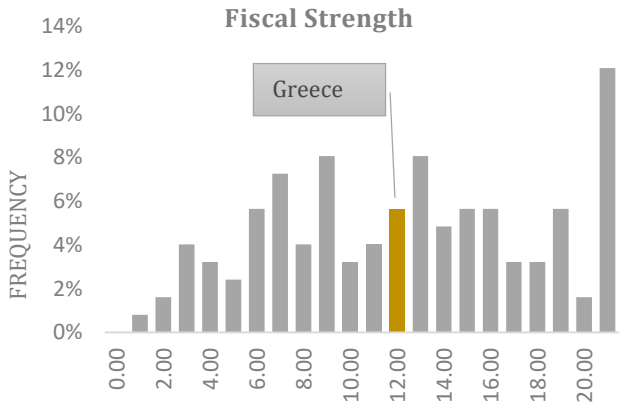


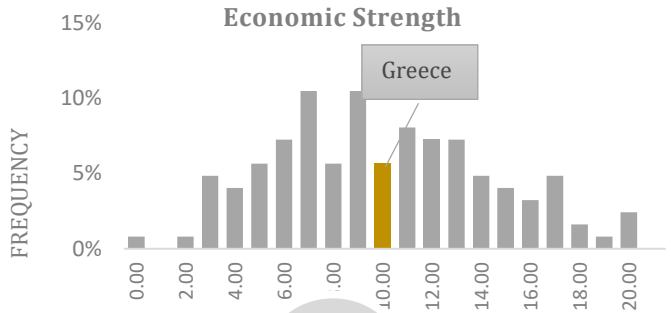
Institutional Strength substantially better than the other three factors fairing much better than the sample median.

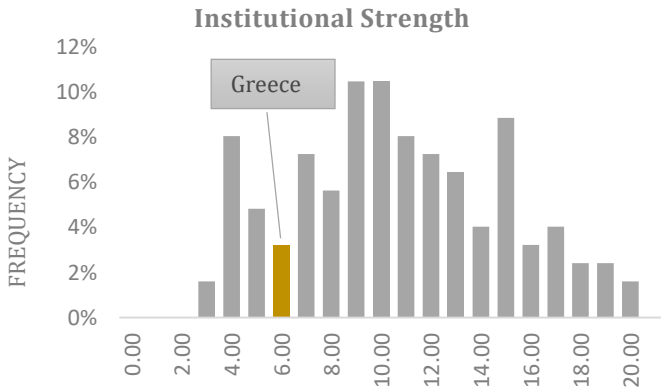
Event Risk lies at normal levels commonly found in the middle range of the sample's distribution.



MACRO FACTORS I GREECE'S RELATIVE POSITION VS 123 SOVEREIGNS

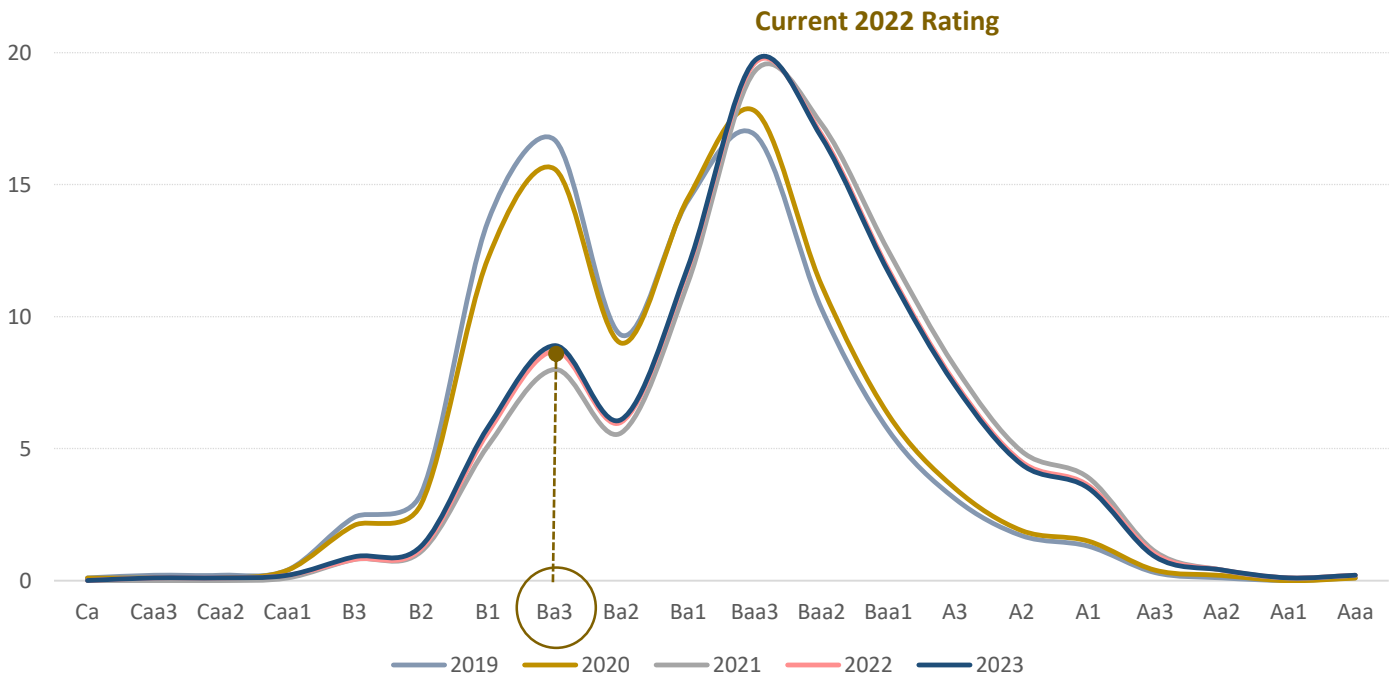






Focus I Greece: Stuck in a Suboptimal Level

Piraeus Bank Implied Rating Probability



- Our implied ratings for Greece exhibit a sharp bias towards investment grade after 2021 despite its current rating of Ba3, i.e. three notches below its factor-implied fair value.
- Clearly, the institutional factor that is based on world governance indicators recorded the best performance, while the fiscal factor presents the highest risk despite its recent improvement.

	Economic Factor	Institutional Factor	Fiscal Factor	Event Risk Factor
2019	10.48	7.10	14.88	6.76
2020	10.68	7.20	13.13	7.50
2021	10.09	5.14	11.41	7.53
2022	9.77	5.67	11.70	7.97
2023	9.54	6.16	11.72	7.75

** The higher value the riskier*

Source: Moody's, Economics & Investment Strategy

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Data Description

# of Countries	123
# of Years	18 years
Time Span	2006-2022
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 follow the qualitative and judgmental criteria described in Moody's methodology (Updated Version November 25, 2019).
Standardisations	In order to construct the factors on which implied rating scores are based we follow Moodys standardization process in which the numeric representation of each sub-factor is based on a 20-level scoring scale that matches sub-factor gauges to numeric scores. As a final step, sub-factors are weighted appropriately under the weighting scheme provided by Moody's to end up at the four main factors utilized in the scorecard framework.
Data Sources	Moody's Rating Agency, International Monetary Fund, World Bank, Bloomberg, Datastream

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Sovereign Ratings I Description

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

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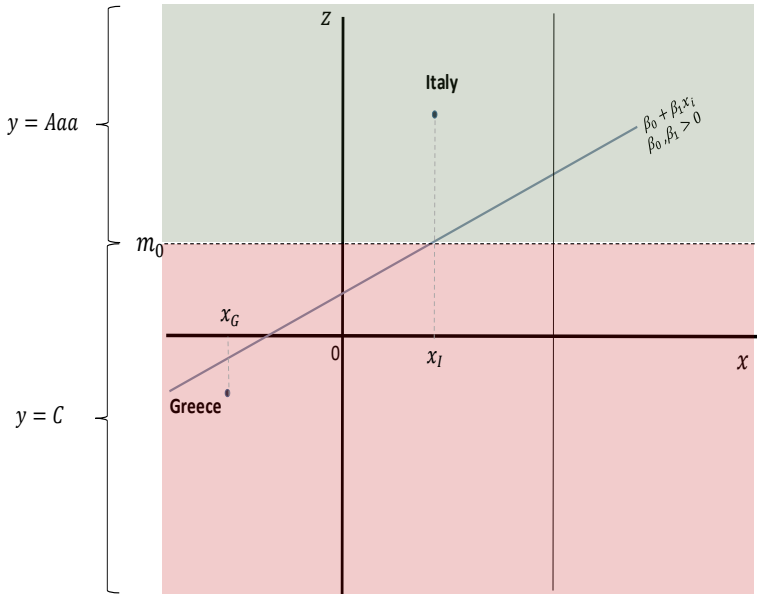
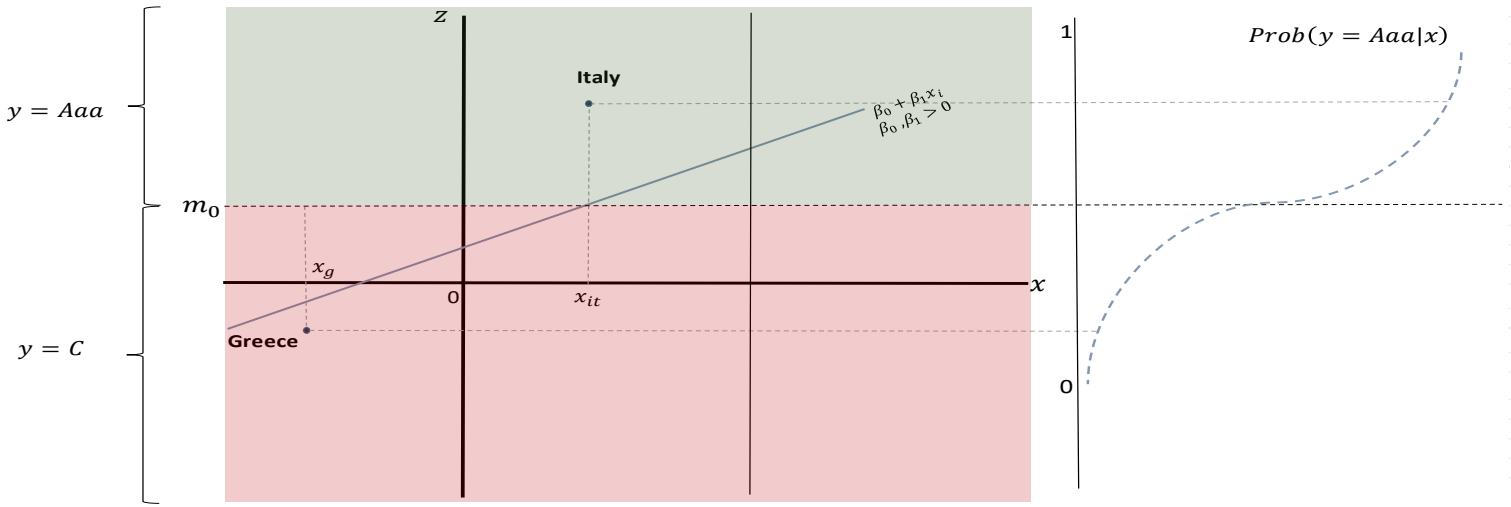
From Data to Ratings I Ordered Choice Models

- 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, $(z_i = \beta_0 + \beta_1 * x_i + \varepsilon_i)$.
- 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 $z_{\mathrm{G}} < m_0$ then $y_{\mathrm{G}} = \mathrm{C}$ while for Italy $z_{\mathrm{I}} > m_0$ so $y_{\mathrm{I}} = \mathrm{Aaa}$.
- 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.

Ordered Choice Models



Logit Transformation and Error Distribution



- 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.
- 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.
- 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.
- Ordered 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 ordered 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.

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