SOVEREIGN CREDIT RATINGS AND THE FUNDAMENTALS OF THE GREEK ECONOMY

Dimitris Malliaropulos
Economic Analysis and Research Department
and University of Piraeus, Department of Banking and Financial Management

Petros Migiakis
Economic Analysis and Research Department

ABSTRACT

We discuss the factors behind sovereign credit ratings and reproduce their quantitative component, focusing on the case of Greece. The sovereign credit rating of Greece is still lower than the investment grade threshold. However, some of the fundamentals of the Greek economy are shown to be better than the average of the rating category it belongs to at present (BB) and better even than higher rating categories. Based on the reproduction of the score component of sovereign credit ratings of the three major Credit Rating Agencies, we show that an improvement in the institutional factors of the Greek economy to the level of the early 2000s can lead to a significant increase in Greece's score, thus contributing to an upgrade to the investment grade category.

Keywords: credit ratings; sovereign risk; Greek economy; institutions; governance indicators

JEL classification: E44; G24; H63

ΟΙ ΠΙΣΤΟΛΗΠΤΙΚΕΣ ΑΞΙΟΛΟΓΗΣΕΙΣ ΚΑΙ ΤΑ ΘΕΜΕΛΙΩΔΗ ΜΕΓΕΘΗ ΤΗΣ ΕΛΛΗΝΙΚΗΣ ΟΙΚΟΝΟΜΙΑΣ

Δημήτρης Μαλλιαρόπουλος
Διεύθυνση Οικονομικής Ανάλυσης και Μελετών
και Πανεπιστήμιο Πειραιώς, Τμήμα Χρηματοοικονομικής και Τραπεζικής Διοικητικής

Πέτρος Μηγιάκης
Διεύθυνση Οικονομικής Ανάλυσης και Μελετών

ΠΕΡΙΛΗΨΗ

Το παρόν άρθρο περιγράφει τις παραμέτρους των κρατικών πιστοληπτικών αξιολογήσεων και αναπαράγει την ποσοτική συνιστώσα τους, εστιάζοντας στην περίπτωση της ελληνικής οικονομίας. Η πιστοληπτική διαβάθμιση της ελληνικής οικονομίας βρίσκεται χαμηλότερα από το όριο της επενδυτικής κατηγορίας, όμως ορισμένα από τα θεμελιώδη μεγέθη της είναι καλύτερα από τα μέσα επίπεδα της κατηγορίας στην οποία ανήκει (ΒΒ) ή ακόμη και ανώτερων κατηγοριών. Με βάση την αναπαραγωγή του ποσοτικού σκέλους των κρατικών πιστοληπτικών διαβαθμίσεων των τριών μεγάλων οίκων πιστοληπτικής αξιολόγησης, υποδεικνύεται ότι η βελτίωση της θέσης της ελληνικής οικονομίας στους δείκτες του θεσμικού περιβάλλοντος, σε επίπεδα παρόμοια εκείνων που είχαν καταγραφεί στις αρχές της δεκαετίας του 2000, θα συμβάλει σε ενδεχόμενη αναβάθμισή της στην επενδυτική κατηγορία.

SOVEREIGN CREDIT RATINGS AND THE FUNDAMENTALS OF THE GREEK ECONOMY[1]

Dimitris Malliaropulos
Economic Analysis and Research Department
and University of Piraeus, Department of Banking and Financial Management

Petros Migiakis
Economic Analysis and Research Department

1 INTRODUCTION

Credit ratings are important inputs to portfolio allocation decisions, as they are widely used by investors as measures of default risk.[2] Previous research has shown that both sovereign and corporate credit ratings are closely associated with the level of risk premia in the underlying bonds.[3] Understanding credit ratings and disentangling their information is a crucial task both for investors and borrowers, thereby facilitating in an economically efficient way their decisions.

According to the methodologies of Credit Rating Agencies (CRAs), credit ratings are assessments of the *ability* and the *willingness* of a debt issuer to pay back the debt in full. In the process of this assessment for sovereigns, CRAs analyse several categories of fundamentals of the domestic economies, while the final ratings also incorporate judgment about the prospects of the economy and potential developments that pose upside or downside risks to the initial assessment.[4] Sovereign credit ratings have a wider importance for the national economy; they are linked to country risk assessments and the so-called "country ceiling", i.e. the maximum rating that can be assigned to any entity of the public or the private sector originating from the same economy.

In this paper, we estimate a model of sovereign credit ratings based on the methodologies of the three major CRAs using data from 93 countries over a long time span and then apply it to the data for Greece. This allows us to decompose Greece's sovereign credit ratings into their main determinants and quantify the contribution of each determinant to the overall rating. Finally, we assess the importance of institutional factors such as the quality of governance for the prospects of an upgrade of the Greek sovereign rating to the investment grade category credit rating.[5,6]

The paper is organised as follows: The next section discusses the methodologies followed by the three large CRAs (i.e. Fitch, Moody's and Standard and Poor's) for rating sovereign entities. Section 3 compares the fundamentals of Greece with those of sovereigns belonging to the same and other rating categories. In Section 4 we present the econometric model and the estimation results of credit scores, discuss the driving factors of the Greek sovereign rating for the period 2006-2018 and report the results of an impact analysis around the prospect of an upgrade of the Greek sovereign rating to the investment grade category. Finally, Section 5 concludes.

2 SOVEREIGN CREDIT RATING METHODOLOGIES

The process of assigning credit ratings to sovereign entities followed by CRAs[7] entails two

2 For example, Morahan and Mulder (2013) find that four out of five investment managers use credit ratings in their portfolio allocation process.
3 For sovereign risk premia and ratings, see, among others, Livingston et al. (2010), Aizenmann et al. (2013), de Santis (2012), El-Shagi and von Schweinitz (2018) and Malliaropulos and Migiakis (2018); for corporate bonds, see Fons (1994), Longstaff et al. (2005), Heinke (2006) and Grothe (2013).
4 A number of studies criticise CRAs for providing inflated ratings, e.g. White (2010), Fulghieri et al. (2013) and Boermans and van der Kroft (2020). The issue of comparing credit ratings to "true measures of credit risk" is beyond the scope of this paper.
5 The investment grade category includes ratings equal to or better than BBB-/Baa3; ratings below this threshold (i.e. BB+/Ba1 or worse) are classified as sub-investment grade.
6 Since January 2020, Fitch's sovereign credit rating for Greece stands at BB, Moody's assigns a rating two notches lower than Fitch (i.e. B1) and Standard and Poor's one notch lower (i.e. BB-).
7 In the present paper, we examine the three large, by international standards, CRAs (in alphabetical order): Fitch, Moody's and Standard and Poor's (S&P).

Table 1 Variables used as input to the quantitative models of CRAs

Fitch	Moody's	Standard and Poor's
Structural factors	**Institutions and governance strength**	**Political score**
· Governance	· Quality of legislative and executive institutions	· Effectiveness, stability and predictability of policymaking, political institutions and civil society
· GDP per capita	· Strength of civil society and the judiciary	· Transparency and accountability of institutions, data and processes
· GDP as % of world GDP	· Fiscal policy effectiveness	· Debt payment culture
· Time since last default	· Monetary and macroeconomic policy effectiveness	· External security risks
· Broad money		
Macroeconomic factors	**Economic strength**	**Economic score**
· Real GDP growth	· Real GDP growth	· GDP per capita
· Volatility of real GDP	· Volatility of real GDP	· Real GDP p/c trend growth
· Inflation rate	· Nominal GDP	· Economic concentration and volatility
	· GDP per capita	
Public finances	**Fiscal strength**	**Fiscal score**
· General government debt as % of GDP	· General government debt as % of GDP	· General government debt as % of GDP
· General government interest payments as % of revenues	· General government debt as % of revenues	· Change in net general government debt as % of GDP
· General government budget balance as % of GDP	· General government interest payments as % of revenues	· General government interest payments as % of revenues
· Foreign currency public debt as % of general government debt	· General government interest payments as % GDP	· Contingent liabilities (financial institutions, public sector enterprises, off-budget contingent liabilities)
External finances	**Event risk**	**External score**
· Reserve currency status	· Domestic political risk	· Reserve currency status
· Sovereign net foreign assets	· Ease of access to funding	· External liquidity (ratio of gross external financing to current account receipts (CAR) plus foreign exchange reserves)
· Commodity dependence	· Risk of banking sector credit event	
· Reserves	· Total domestic bank assets to GDP	· External indebtedness (ratio of net external debt to CAR)
· External interest service	· External vulnerability risk	
· Current account balance plus FDI		
		Monetary score
		· Exchange rate regime
		· Monetary policy credibility

stages: the quantitative or objective and the qualitative or subjective one. In the first (quantitative) stage, each sovereign is assigned a score or is ranked in relation to other sovereigns, based on the country's economic and political fundamentals. In the second (qualitative) stage, the quantitative score is adjusted using experts' opinions on the challenges or opportunities[8] that the economy is expected to face in the near future. Usually, the qualitative adjustment does not change the score assigned in the initial stage by more than one to three notches.

During the first stage, CRAs incorporate into their quantitative analytical tools a distinct list of variables representing the fundamentals of each economy. For example, Fitch uses sixteen variables as inputs to its sovereign rating model. These are classified in four categories: structural features, macroeconomic performance policies and prospects, public finances, and external finances (Fitch 2018). Similarly, Moody's uses seventeen variables, which

---

8 Political and geopolitical developments, nonlinearities in the public debt features and upcoming economic challenges are some of the issues considered at this stage.

belong to four categories: economic strength, institutions and governance strength, fiscal strength, and susceptibility to event risk (Moody's 2019). Finally, Standard and Poor's incorporates sixteen factors in its model that belong to the following categories: political score, economic score, external score, fiscal score, and monetary score (Standard and Poor's 2017).

While the terminology and the number of categories imply that there is some deviation between the various quantitative models used by CRAs, when we look closer into the individual variables that are included in each category, we find a remarkable similarity of the factors taken into consideration for assigning sovereign credit ratings. Table 1 outlines the individual variables used by each CRA in their quantitative models.

The details of each category of variables used in the process of the quantitative assessment reveal the similarity of the factors assessed across the three large CRAs. For example, real GDP growth, volatility of real GDP, GDP per capita, general government debt as a percentage of GDP and general government interest payments are used by all three CRAs. Institutional factors also play a prominent role in the quantitative assessment of all three CRAs. These factors reflect: (a) transparency and accountability; (b) effectiveness of the administration and political institutions; (c) the sovereign's debt payment culture (Standard and Poor's), the time since the last default (Fitch) or the government default history (Moody's); (d) the quality of the legislation and the rule of law; and (e) the perceived level of corruption. In order to measure institutional factors, Fitch and Moody's use the World Bank's Worldwide Governance Indicators (WGIs); Fitch uses the average score of the six individual indicators, while Moody's makes use of the indicators for regulatory quality and government effectiveness.[9]

Overall, the factors taken into account in the stage of quantitative assessment of the credit

profile of each sovereign are very similar across credit rating agencies. Also, the weights assigned to the broad categories are similar across the three CRAs: the most important ones are the institutional factors, followed by economic and fiscal factors, while external, monetary and event-risk factors are mostly used for adjustment/calibration purposes.

Nevertheless, the three CRAS' methodological frameworks bear some differences with respect to the structure of their scorecards. In particular, the relative importance of the individual variables may differ due to differences in their weighting schemes for individual variables, while other variables, such as market-based indicators, are also taken into account by Standard and Poor's and Moody's. In practice, however, these differences do not result in systematic divergences of more than two or three notches in the final credit ratings assigned to the same sovereign by the three CRAs.

3 HOW DOES THE GREEK ECONOMY COMPARE TO OTHER ECONOMIES IN TERMS OF CREDIT FUNDAMENTALS?

All CRAs rely on rankings of the values of the fundamentals vis-à-vis those of other sovereigns of the same or other categories. Hence, it could be useful to compare the fundamental variables of the Greek economy with the median of the rating categories in order to identify both the strengths and the weaknesses of the Greek economy from the point of view of rating agencies.

In order to do this, we analyse annual data of the individual variables used by CRAs for a sample of 110 countries over the period 2006-2018.[10] We only take into account categories and not notch-deviations within categories, e.g.

9 However, in the qualitative stage Moody's also makes use of three additional indicators: voice and accountability; rule of law; and control of corruption.

10 The data set for 17 countries does not cover the entire period. So, while we use the data available for these countries in order to construct the rating buckets they belong to in each year, depending on data availability, we exclude them from our econometric estimation (see Section 4).

sovereigns rated AA+ and AA- are included in the AA category, sovereigns rated A+ and A- are included in the A category, and so on. The categories are dynamic, i.e. sovereigns migrate to higher or lower categories at the end of each year if they are upgraded or downgraded by at least two CRAs. This ensures that the statistical properties of the fundamentals in each category are representative of the rating category and not of specific groups of sovereigns.

In order to compare Greece's fundamentals with those of other sovereigns in the same or neighbouring rating categories, we compute the median and the 10% and 90% quantiles of each rating category. We then compare Greece's fundamentals with the median and the interquantile range of each rating category. In this way, we construct a statistical criterion similar to the one used by CRAs for classifying sovereigns into rating categories before ranking their fundamentals according to the weighting scheme or taxonomy of their scorecard.

The way this statistical criterion works can be easily understood: consider, for example, the case where the value of a given fundamental variable for Greece, in a specific year, is better (worse)[11] than the 90% (10%) quantile of the rating category where the country belongs. This would suggest that the country's credit rating is likely to be upgraded (downgraded) based on this fundamental. The Appendix reports detailed charts of the median and the interquantile range of a wide array of variables used by CRAs for each rating class (AAA to B) based on the data of 110 countries in our sample. The Appendix charts (A1-A15) also report the data for Greece and how they compare with the data of other countries in each rating class. We briefly discuss the main observations from these charts in the following paragraphs.

Institutional factors

One of the most important factors across CRAs is the quality of institutions and the political landscape; this factor is measured either by individual or by aggregate indicators of the quality of governance, such as the ones provided by the World Bank's Worldwide Governance Indicators (WGIs). Based on the average of the six individual indicators provided by the World Bank (see Chart A1 in the Appendix), Greece constantly ranks above the median of its present rating category and even better than the BBB category. However, there is room for improvement, as Greece still lies below the median of sovereigns above single-A, which include other developed economies and most euro area countries.

Chart 1 plots Greece's ranking in each of the six governance indicators reported by the World Bank for the years 2001, 2008, 2012 and 2018.[12] The chart shows that the position of Greece vis-à-vis the rest of the countries in the World Bank's governance indicators has deteriorated in the years following the global financial crisis. The greatest fall has been observed in the political stability indicator, which includes the absence of violence, where Greece fell by almost two deciles in the overall ranking, from the 55th percentile in 2008 to the 39th percentile in 2012. Since then it has improved by 11% in the percentile ranking, according to the World Bank's 2018 WGI report.[13] However, Greece remains lower than its ranking in 2001-2002,[14] when it ranked at the 75th percentile, i.e. among the top 25% countries of the distribution. Also, in the rule of law, Greece ranked at the 59th percentile in 2018, which was even lower than its ranking in 2012 (64th percentile), having fallen by about 15 percentiles since 2008. Similar, though smaller, falls have been recorded in the rest of the governance indicators, such as government efficiency, control of corruption, regulatory quality, and voice and
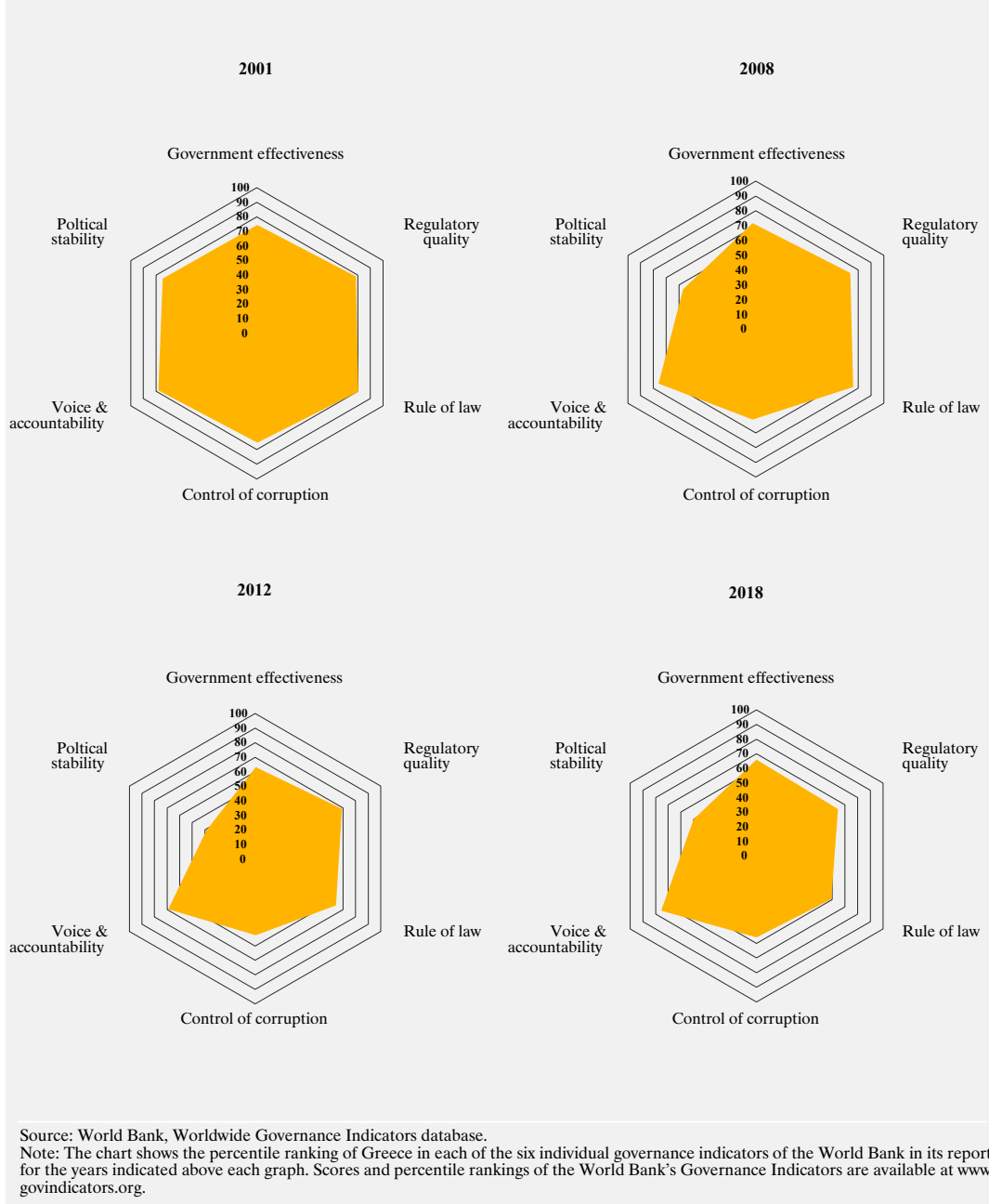
---

11 We use the terms "better" and "worse", instead of "larger" and "smaller", as the direction of the effect of each variable on the rating depends on the sign the variable has in the scorecard of the CRAs. For example, the debt-to-GDP ratio worsens the rating, whereas real GDP growth improves the rating.

12 Note that the rating agencies introduce the levels of the governance indicators with a one-year lag, i.e. the ratings assigned in 2019 take into account the figures reported by the World Bank for 2018.

13 This report was released in September 2019 and is the most recent one.

14 Until 2002 the World Bank's governance indicators were published every two years. Greece's historically highest ranking in the "political stability and absence of violence/terrorism" indicator was recorded in the 2001-2002 report.

2001

Government effectiveness

Poltical stability

Regulatory quality

Voice & accountability

Rule of law

Control of corruption

2008

Government effectiveness

Poltical stability

Regulatory quality

Voice & accountability

Rule of law

Control of corruption

2012

Government effectiveness

Poltical stability

Regulatory quality

Voice & accountability

Rule of law

Control of corruption

2018

Government effectiveness

Poltical stability

Regulatory quality

Voice & accountability

Rule of law

Control of corruption

Source: World Bank, Worldwide Governance Indicators database.
Note: The chart shows the percentile ranking of Greece in each of the six individual governance indicators of the World Bank in its reports for the years indicated above each graph. Scores and percentile rankings of the World Bank's Governance Indicators are available at www. govindicators.org.

accountability. Thus, a possible policy objective for Greece could be to regain the position that the country had in the World Bank's governance indicators before the eruption of the crisis.

Broad money is used by rating agencies to measure the level of financial intermediation in

the economies (Fitch 2018). As shown in Chart A2, Greece seems to be in an advantageous position, relative to its current rating category (BB, including BB+ and BB-) on the basis of the broad money rating factor, as its level, which also bears a positive sign in the CRAs' scorecards, is higher than that of the top 10% of the

sovereign entities belonging to the same category. Moreover, on the basis of the same factor, Greece compares favourably even vis-à-vis the upper class of BBB-rated countries, with the value of the variable being close to the median of the A category. This finding, combined with fact that Greece, as a member of the euro area, is assigned the highest score under the criterion of "reserve currency", indicates the strong advantages for its rating, stemming from its monetary and financial structure.

The institutional factors taken into account by CRAs also include GDP per capita as a measure of the income level of an economy (see Chart A3). According to this criterion, Greece fares better than its current rating category (in fact, above the BBB median). GDP as a percentage of world GDP (as shown in Chart A4), another measure used by rating agencies to capture the shock-absorption capacity of the economy, provides a similar picture. However, the restructuring of public debt, which bears a heavy weight among the criteria used in CRAs' scorecards, poses a disadvantage for the Greek economy in the category of institutional factors.

Macroeconomic factors

The only advantage of the Greek economy in the macroeconomic factors' category is that of lower inflation, compared with the economies included in almost all rating categories (see Chart A5); given the negative sign of this factor, the low level of inflation in Greece increases its relative position. However, low real GDP growth (as shown in Chart A6) compared with other BB-rated sovereigns reduces the probability of a rating upgrade. Finally, higher volatility of Greek GDP (see Chart A7) as a result of the deep recession of 2009-2013 will continue to weigh on the probability of an upgrade, due to the fact that real GDP volatility is measured over a 10-year period.

Fiscal factors

Fiscal consolidation has improved the picture of Greek public finances. The positive primary budget balance, achieved for the first time in 2014, led Greece above the BB category ever since, despite the fact that the overall rating of the country was much lower at that time. The continued effort has enabled Greece to exceed the median and interquantile range of its rating category as well as that of sovereigns rated at the BBB category (as shown in Chart A8). Moreover, it brings Greece's figure above the medians of even upper rating classes, such as single-A and double-A rating categories.

By contrast, Greece's high general government debt-to-GDP ratio (as shown in Chart A9) exceeds the medians of all rating categories. Thus, as this factor carries a weight much heavier than that of the budget balance, it lowers the total contribution of fiscal factors. This is partially counterbalanced by the fact that the share of public debt denominated in foreign currency is lower than both the BB and the BBB rating range, being close to the A-rated median (see Chart A10). Finally, the high public debt ratio is also offset by reduced interest expenses, due both to the lower coupon rates of the more recent bond issues and to the low cost of funding of the loans taken by Greece from the official sector (see Chart A11).

External factors

Last but not least, the external factors of the Greek economy reduce the prospects of rating upgrades. In particular, the Greek State has very low net foreign assets (see Chart A12); the interest service to foreign creditors is higher than the BB-category median; the current account balance, including FDI, as a ratio of GDP is close to the BB median (see Chart A13); and the reliance of the Greek economy on one sector (tourism), reflected in the so-called "commodity dependence" factor, is strong (see Chart A14). That said, it should be noted that the sovereign net foreign assets factor does not account for the fact that part of foreign borrowing has been used by the Greek State to build a sizeable cash buffer (nearly 10% of GDP at the end of 2019).

4 THE GREEK SOVEREIGN CREDIT RATING

4.1 REPRODUCING THE QUANTITATIVE COMPONENT OF RATINGS

The aim of this section is to replicate the quantitative component of ratings for Greece.[15] To that end, we estimate an ordered probit model for 93 sovereigns worldwide using annual data for the period from 2006 to 2018.[16] In particular, we estimated the following setup, equation (1), which is based on the structure of Fitch's scorecard, as already presented in Table 1:

$$c_{it}=a_1+\sum_{i=1}^{k}c^s(x_{it})\cdot s_{it}+\sum_{i=1}^{k}c^m(x_{it})\cdot m_{it}$$
$$+\sum_{i=1}^{k}c^f(x_{it})\cdot f_{it}+\sum_{i=1}^{k}c^x(x_{it})\cdot x_{it}+e_{it} \qquad (1)$$

where c_{it} is the credit rating assigned to sovereign $i=1,2...N$ for each year $t=1,2,...T$, a_1 is

[15] Previous studies aimed at quantifying the effect of factors on sovereign ratings include *inter alia* Afonso et al. (2009), D'Agostino and Lennkh (2016), Brůha et al. (2017) and Lennkh and Moshammer (2018).
[16] The source of the data is Fitch Ratings.

Table 2 Ordered probit estimation results

Category K={$x_1,x_2,...x_i$}	Variable x_{it}	Estimated coefficient C(x_{it})	Transformation F(x_{it})
Global a_1	Intercept	5.042** (0.455)	None
Institutional i_{it}	WB governance	0.094** (0.003)	Rank
	GDP per capita	0.026** (0.002)	Rank
	Share in world GDP	0.643** (0.030)	Nat. log.
	Default	-1.667** (0.226)	Time since event
	Broad money	0.097 (0.084)	Nat. log.
Macroeconomic m_{it}	Real GDP volatility	-0.556** (0.069)	Nat. log. (10y std.dev.)
	Real GDP growth	0.015 (0.015)	3y ave.
	Inflation	-0.104** (0.014)	3y ave.
Fiscal f_{it}	Gen.Gvt debt (%GDP)	0.027** (0.002)	3y ave.
	Gen.Gvt interest expenses (%rvn)	-0.019** (0.007)	3y ave.
	Gen.Gvt budget balance (%GDP)	0.081** (0.009)	3y ave.
	Foreign currency public debt	-0.015** (0.002)	3y ave.
External x_{it}	Reserve currency status	0.587** (0.042)	Eval.
	Sovereign net foreign assets	0.011** (0.001)	%CXR
	Commodity dependence	-0.003 (0.003)	3y ave.
	Reserves	0.047** (0.011)	%CXP
	External interest service	-0.004 (0.001)	3y ave.

Notes: The table presents the estimated coefficients of the individual variables of the ordered probit model described in equation (1), with the credit ratings of 93 sovereigns as the dependent variable. The sample is 2006-2018. The final column to the right describes the way the variable is transformed in order to be incorporated into the reproduced scorecard. CXR: current account receipts. CXP: current external payments. Asterisks (** and *) denote significance (at the 1% and 5% level, respectively).

the global intercept, s_{it} is the vector of the institutional/structural variables, m_{it} is the vector of macroeconomic variables, f_{it} is the vector of fiscal variables and x_{it} is the vector of external variables, with k being the number of variables in each category.[17] Finally, e_{it} is the panel data residual from the estimation. Table 2 presents the estimated coefficients for each variable and the transformation of each variable, as described by Fitch in its sovereign ratings methodology.

Based on the estimation of the coefficients, as shown in Table 2, we can reproduce the scorecard of Fitch by taking into account the coefficient $c(x_{it})$ and the transformation $F(x_{it})$ of each variable. In particular, the score of each variable is calculated as follows:

$$Score(x_{it})=c(x_{it}) \cdot F(x_{it}) \qquad (2)$$

Similarly, the score for each category of variables is the sum of its individual variables:

$$Score(K_t)=\sum_{i=1}^{k} c(x_{it}) \cdot F(x_{it}) \qquad (3)$$

Finally, the aggregate score of each country is the sum of the scores of the categories and the global intercept:

$$Score=\alpha+\sum_{j=1}^{4} Score(K_j) \qquad (4)$$

We use the aggregate score to rank each country and produce its initial rating. To do so, we use a rule that associates each score with a rating category, as shown in Table 3.

The replication of the scores of the fundamentals of the Greek economy, based on the above setup, facilitates both the monitoring of developments in the sovereign credit rating of Greece and the quantification of the impact of past and expected or assumed developments in Greece's fundamentals. Also, it enables the estimation of the contribution of each individual variable to the quantitative component of the final rating.

Chart 2 plots Greece's estimated score along with the actual rating (computed as the aver-
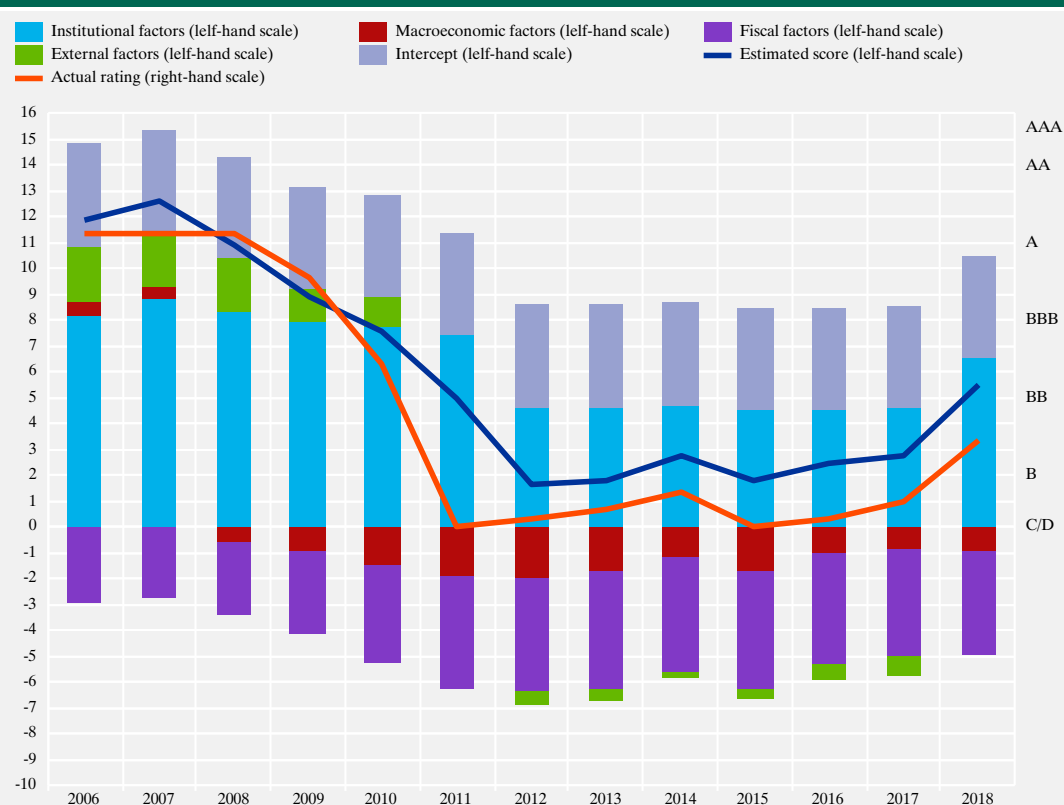
Table 3 Translating scores into ratings

AAA>15.5	AAA>15.5
15.5>AA>12.5	15.5>AA+>14.5
	14.5>AA>14
	13.5>AA+>12.5
12.5>A>9.5	12.5>A+>11.5
	11.5>A>11
	10.5>A->9.5
9.5>BBB>6.5	9.5>BBB+>8.5
	8.5>BBB>8
	7.5>BBB->6.5
6.5>BB>3.5	6.5>BB+>5.5
	5.5>BB>5
	4.5>BB->3.5
3.5>B>0.5	3.5>B+>2.5
	2.5>B>2
	1.5>B->0.5
0.5>C/D	0.5>C or D

age rating assigned by the three CRAs; for the ratings of individual CRAs, see Chart A15 in the Appendix) as well as the individual contribution of each variable over the 2006-2018 period. The chart shows that the estimated score for Greece follows closely the average sovereign credit rating assigned to the country by the three large CRAs. The two lines follow each other in close connection until 2009,[18] indicating that the rating assigned to Greece until the outbreak of the crisis was largely in line with the economy's fundamentals, as measured by the quantitative component (score) of

[17] The category of institutional factors includes the following variables: the average of the World Bank's Worldwide Governance Indicators, GDP per capita, GDP as % of world GDP, broad money, and time since last default. The economic activity/macroeconomic factor includes: real GDP growth, real GDP volatility and the annual rate of change in CPI. The fiscal factor includes: general government debt as % of GDP, general government interest payments as % of revenues, general government budget balance as % of GDP and foreign currency public debt as % of general government debt. Finally, the external factor includes: the status of reserve currency, sovereign net foreign assets as % of GDP, the degree of commodity dependence, the level of foreign exchange reserves, the external interest service and the current account balance plus FDI.

[18] Greece was rated at A+ on average by the three CRAs during 2009; by the end of that year a downgrade cycle had begun, which escalated with the restructuring of the Greek public debt in 2012. Ever since, with a short interruption in 2015, CRAs have continuously upgraded Greece's sovereign credit rating.

Institutional factors (lelf-hand scale)   Macroeconomic factors (lelf-hand scale)   Fiscal factors (lelf-hand scale)
External factors (lelf-hand scale)   Intercept (lelf-hand scale)   Estimated score (lelf-hand scale)
Actual rating (right-hand scale)

Note: The chart presents the score (blue line) for Greece, calculated as the sum of the contributions of the individual variables included in each category (institutional, macroeconomic, fiscal and external), with the addition of the intercept. The orange line is the average of the sovereign rating assigned to Greece by Fitch, Moody's and Standard and Poor's.

CRAs' ratings.[19] After 2010, the actual rating of Greece drops two to three notches below the estimated score, which measures the effect of fundamentals on the rating. This divergence is due to the judgmental component, which largely captures the effect of the Greek debt restructuring in March 2012.[20] An alternative interpretation of the divergence between actual ratings and estimated scores after 2010 is that CRAs overreacted to the deterioration of economic fundamentals after the sovereign debt crisis erupted. Distinguishing between these two explanations is difficult and certainly beyond the scope of this paper. Nevertheless, the fact that this divergence persists after 2010 suggests that it is driven by the debt restructuring rather than by an overreaction of CRAs to the deterioration of economic fundamentals after the eruption of the sovereign debt crisis.

4.2 THE DRIVERS OF SOVEREIGN RATING CHANGES FOR GREECE, 2006-2018

The Greek sovereign credit rating stood firmly within the investment grade category from the late 1990s, i.e. before the country's accession to the European Monetary Union, until the global financial crisis, when a downgrade cycle began for several euro area members.[21] This downward revision of the credit profiles of euro area countries impaired the conditions of refinancing their debt in the

19 Our findings are in line with those reported in Lennkh and Moshammer (2018) for Greece.

20 In March 2012, Greece restructured EUR 205 billion of public debt (165% of Greek GDP). Private investors suffered a 53% haircut on the face value of their Greek bond holdings.

21 Brůha et al. (2017) attribute this wave of downgrades following the global financial crisis to a structural break that led to greater importance of the quantitative stage and less optimism in the judgmental stage.

Chart 3 Changes in the Greek sovereign rating parameters

■ Institutional ■ Macroeconomic ■ Fiscal ■ External

Note: The chart shows the changes in the contribution of each parameter of the quantitative component of Greece's sovereign credit rating. Contributions are computed as the product of the change of the variables and their estimated coefficients.
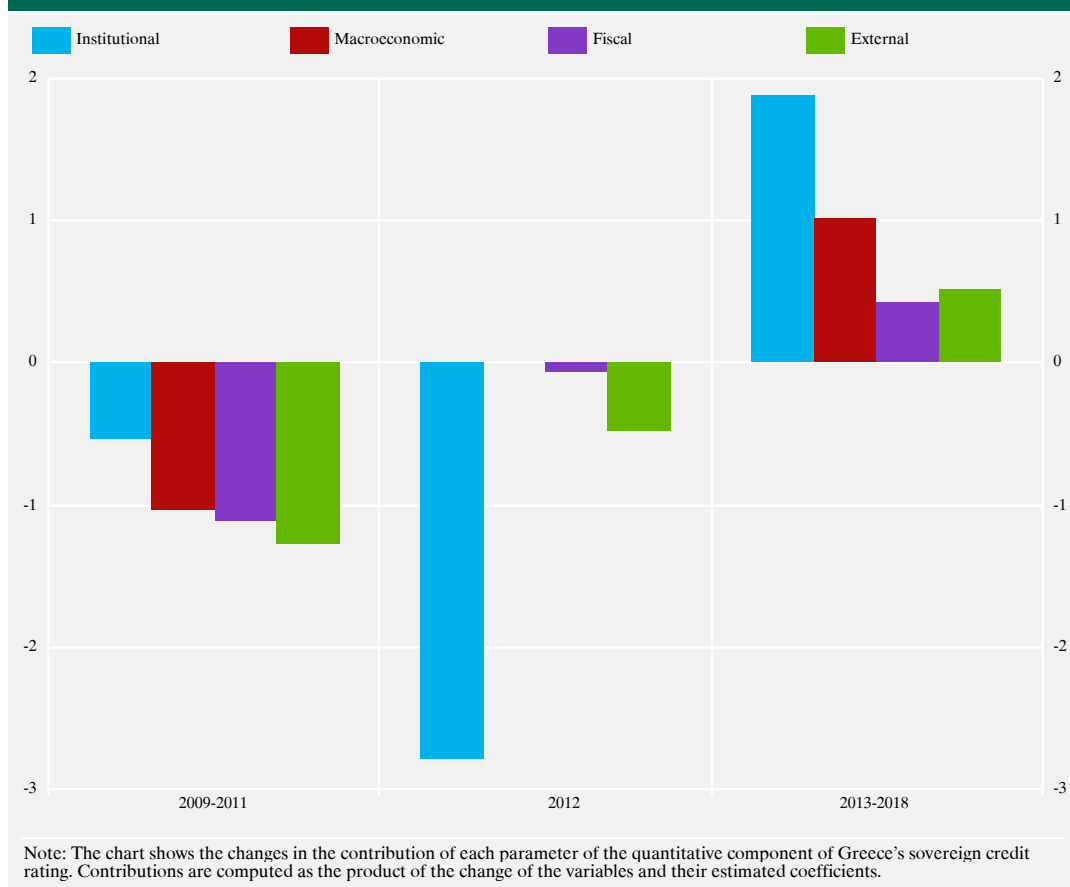
bond market and marked the beginning of the euro area debt crisis.

The downgrades of the Greek sovereign credit rating had a prominent role in this regard. This is because the Greek State was the first among euro area countries to lose its investment grade status. As shown by El-Shagi and von Schweinitz (2018), such downgrades to the sub-investment grade status can lead to a persistent increase in the cost of funding that could jeopardise public debt sustainability. This rise in the cost of funding, as well as the resulting reduction of financial flows (e.g. those reflected in the portfolio holdings of the international investment position) may result in an accentuation of the downturn of the economic cycle, thus creating adverse feedback loops between credit ratings and economic fundamentals.[22]

In the case of Greece, as shown in Chart 2, the initial downgrades during and immediately after the global financial crisis were largely related to the deterioration of the economy's fundamentals. In particular, the deterioration of the estimated score between end-2008 and end-2010 largely explains the loss of the investment grade status for Greece; over this period, the estimated score declines by 3.5 points, which is equivalent to a downgrade of four notches. Still, this figure, though informative, does not provide an answer to the question which one of the many adverse developments in the period from 2008 and up to 2010 had a greater contribution to the loss of the investment grade status.

In order to get a better understanding of the underlying drivers of ratings downgrades and

[22] See among others Gibson et al. (2017) and Amato and Furfine (2004).
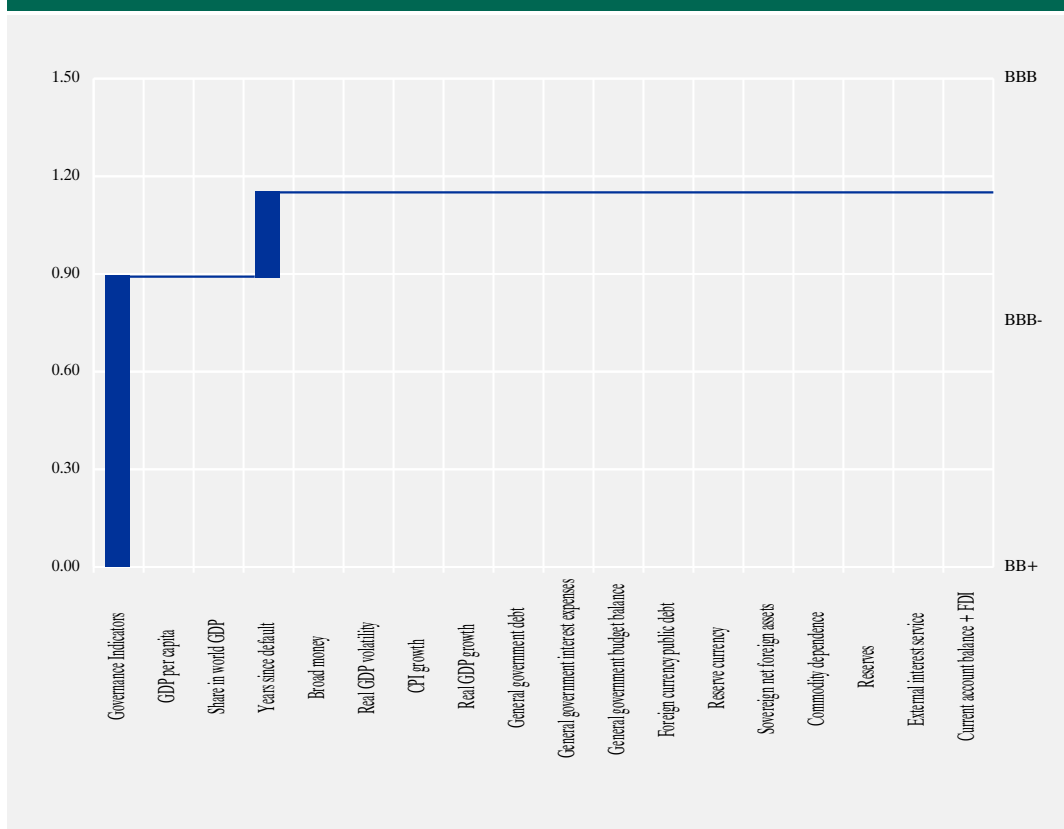
Source: Authors' calculations based on the estimated scorecard.
Note: The impact is measured in score units, which are associated to ratings based on the mapping provided in Table 3; in particular, one score unit represents a rating change of one notch, while a positive sign in the score units indicates upgrades and a negative sign downgrades.

upgrades, we calculate the contributions of the underlying variables across specific sub-periods of the sample. We separate the sample in three sub-periods: from 2009 to 2011, 2012, and from 2013 to 2018. Separating the sample in three sub-samples rather than two (e.g. 2009 to 2012 and 2012 to 2018) allows to isolate the effect of the debt restructuring of 2012 on the rating from the effect of fundamentals. Chart 3 illustrates the contributions to Greece's sovereign rating score of each group of fundamentals.

The chart shows that the factors contributing to the downgrades over the 2009-2011 period are different from the ones driving the upgrades during the 2013-2018 period. More specifically, the external and fiscal imbalances combined have contributed to a reduction in Greece's sovereign rating score by around -2.4

(which is equivalent to a downgrade of three notches) vis-à-vis -1.5 score units, due to the deterioration of macroeconomic (mainly) and institutional (secondarily) factors. The development of the scores in the institutional factors category in 2012 mainly reflects the debt restructuring, as this category includes the variable "time since default". Finally, the upgrades observed over the 2013-2018 period are primarily attributed to the improvement of the institutional factors, which have added 1.82 score unit and, secondarily, to the improvement in the macroeconomic environment (+1.02 score unit), with the external and fiscal factors adding 0.52 and 0.42 unit, respectively.

The improvement of the score of institutional factors after 2012 reflects to some extent the increasing distance from the time of debt

restructuring. More importantly though, it reflects improved governance, as suggested by the rise of Greece's ranking on the "political stability and absence of violence" sub-index of the World Bank's governance indicators. Nevertheless, there is room for further improvement, if we compare Greece's ranking in 2018 on all individual governance indicators with its position before the crisis.

4.3 HOW CAN GREECE BE UPGRADED TO THE INVESTMENT GRADE?

In the present section, we report the results of a simulation analysis of potential developments, with the aim to inform how the Greek sovereign credit rating can be upgraded to the investment grade.[23] The simulations assume (a) that Greece's institutional score improves, which positions the country on the basis of the World Bank's governance indicators to its historical high observed in the early 2000s, and (b) that one more year passes without any credit event. All other variables remain at the levels assumed by the CRAs in their most recent updates.[24]

Chart 4 presents the results of this simulation exercise. The results indicate that, all else equal, the improvement in governance to 2001 levels along with one more year passing without a credit event would improve Greece's score enough to contribute to an upgrade of its rating to investment grade (i.e. equal to or above BBB-), provided that the adjustment at the second stage remains at the present level. This highlights the importance of the institutional environment for the sovereign credit rating of the Greek economy and, as a consequence, for entities of both the public and the private sector, whose cost and opportunities of funding are associated with country risk.

5 CONCLUDING REMARKS

We estimate the quantitative component of sovereign credit ratings following methodologies of the three major Credit Rating Agencies. We then use the model to replicate Greece's sovereign credit ratings over the 2006-2018 period. We show that Greek sovereign ratings over this period have largely followed the economy's fundamentals. However, we find that, after 2010, Greece's actual rating drops two to three notches below the estimated score, which measures the effect of fundamentals on the rating. This divergence is due to the judgmental component of ratings, which, according to our interpretation, largely captures the effect of the Greek debt restructuring in March 2012.

At present, the Greek economy has several advantages and few disadvantages, compared with economies belonging to the same category (BB). On the positive side, Greece outperforms its BB peers due to the strength of its institutions, the developed status of its economy, the strength of the monetary regime and its high income per capita. On the negative side, Greece lags behind its past performance in terms of quality of governance, which constitutes one of the most important rating factors for sovereign entities. In fact, our simulations suggest that improving the quality of governance to pre-crisis levels is a necessary condition for an upgrade of the Greek sovereign credit rating to investment grade.

---

[23] In order to regain the investment grade status, Greece has to be upgraded by two notches by Fitch, three notches by Standard and Poor's and four notches by Moody's.
[24] See the rating action reports by Fitch (24 July 2020), Moody's (10 July 2020) and S&P (24 April 2020).

REFERENCES

Afonso, A., P. Gomes and P. Rother, (2009), "Ordered response models for sovereign debt ratings", *Applied Economics Letters*, 16(8), 769-773.

Aizenmann, J., M. Binici and M. Hutchinson (2013), "Credit ratings and the pricing of sovereign debt during the euro crisis", *Oxford Review of Economic Policy*, 29, 582-609.

Amato, J.D. and C.H. Furfine (2004), "Are credit ratings procyclical?", *Journal of Banking and Finance*, 28(11), 2641-2677.

Boermans, M.A. and B. van der Kroft (2020), "Inflated credit ratings, regulatory arbitrage and capital requirements: Do investors strategically allocate bond portfolios?", De Nederlandsche Bank Working Paper No. 673.

Brůha, J., M. Karber, B. Pierluigi and R. Setzer (2017), "Understanding sovereign rating movements in euro area countries", European Central Bank Working Paper No. 2011.

D' Agostino, A. and R.A. Lennkh (2016), "Euro area sovereign ratings: an analysis of fundamental criteria and subjective judgment", European Stability Mechanism Working Paper No. 14.

De Santis, R. (2012), "The euro area sovereign debt crisis: safe haven, credit rating agencies and the spread of the fever from Greece, Ireland and Portugal", European Central Bank Working Paper No. 1419.

El-Shagi, M. and G. von Schweinitz (2018), "The joint dynamics of sovereign rating and government bond yields", *Journal of Banking and Finances*, 97, 198-218.

Fitch (2018), *Sovereign rating criteria* (publication date: 19 July 2018).

Fons, J.S. (1994), "Using default rates to model the term structure of credit risk", *Financial Analysts Journal*, 50(5), 25-33.

Fulghieri, P., G. Strobl and H. Xia (2013), "The economics of solicited and unsolicited credit ratings", *Review of Financial Studies*, 27(2), 484-518.

Gibson, H., S. Hall and G. Tavlas (2017), "Self-fulfilling dynamics: the interactions of sovereign spreads, sovereign ratings and bank ratings during the euro financial crisis", *Journal of International Money and Finance*, 73B, 371-385.

Grothe, M. (2013), "Market pricing of credit rating signals", European Central Bank Working Paper No. 1623.

Heinke, V.G. (2006), "Credit spread volatility, bond ratings and the risk reduction effect of watch-listings", *International Journal of Finance and Economics*, 11(4), 293-303.

Lennkh, R.A. and E. Moshammer (2018), "An analysis of the degree, changes and source of Moody's judgment", European Stability Mechanism Working Paper No. 27.

Livingston, M., J. Wei and L. Zhou (2010), "Moody's and S&P ratings: are they equivalent? Conservative ratings and split rated bond yields", *Journal of Money, Credit and Banking*, 42(7), 1267-1293.

Longstaff, F.A., M. Sanjay and E. Neis E. (2005), "Corporate yield spreads: default risk or liquidity? New evidence from the credit default swap market", *Journal of Finance*, 60(5), 2213-2253.

Malliaropulos, D. and P. Migiakis (2018), "The re-pricing of sovereign risks following the Global Financial Crisis", *Journal of Empirical Finance*, 49, 39-56.

Moody's (2019), *Sovereign ratings methodology* (publication date: 25 November 2019).

Morahan, A. and C. Mulder (2013), "Survey of reserve managers: lessons from the crisis", International Monetary Fund Working Paper No. 13/99.

Standard and Poor's (2017), *Sovereign rating methodology* (publication date: 18 December 2017).

White, L.J. (2010), "Markets: The credit rating agencies", *Journal of Economic Perspectives*, 24(2), 211-226.

# APPENDIX

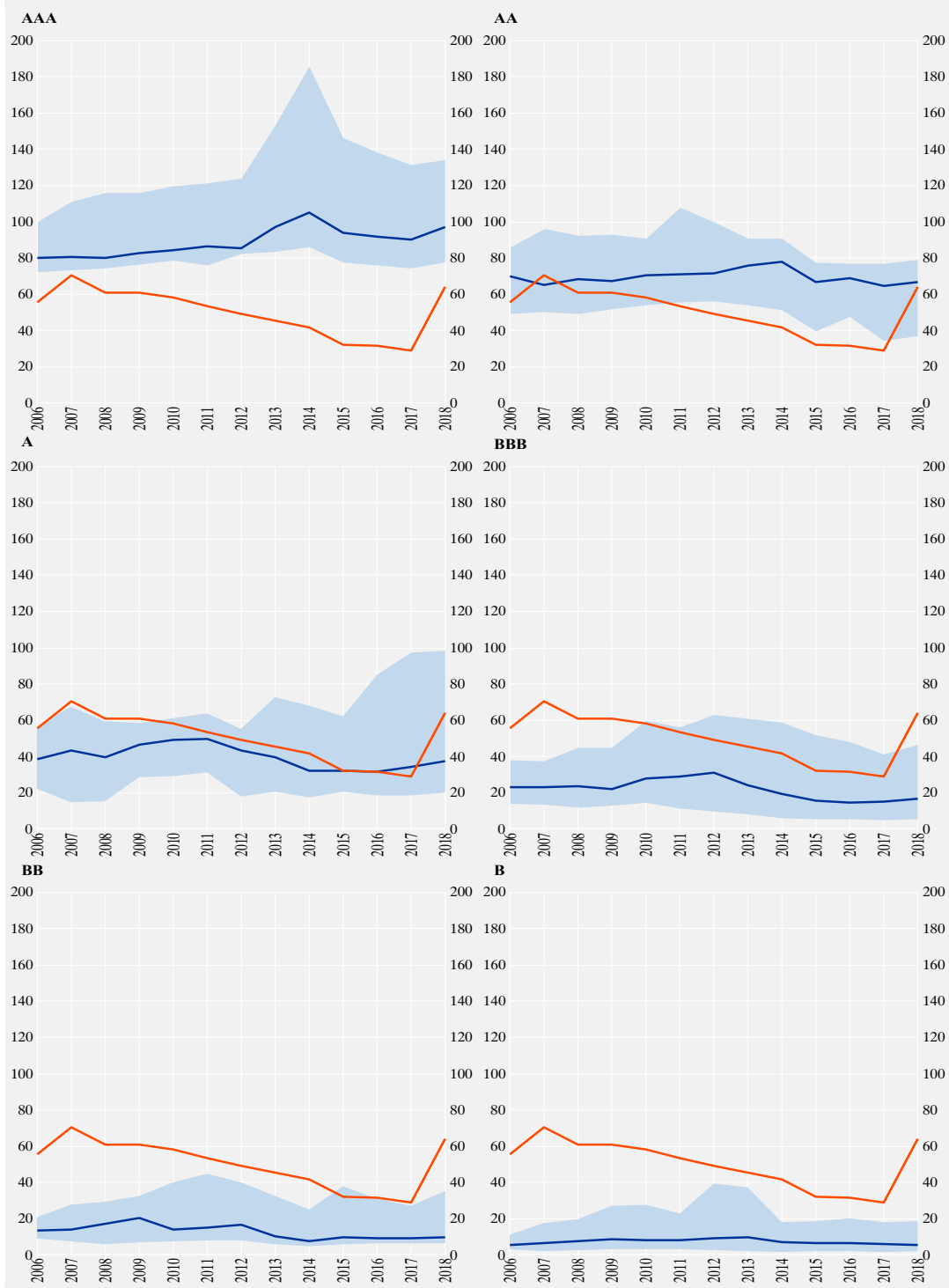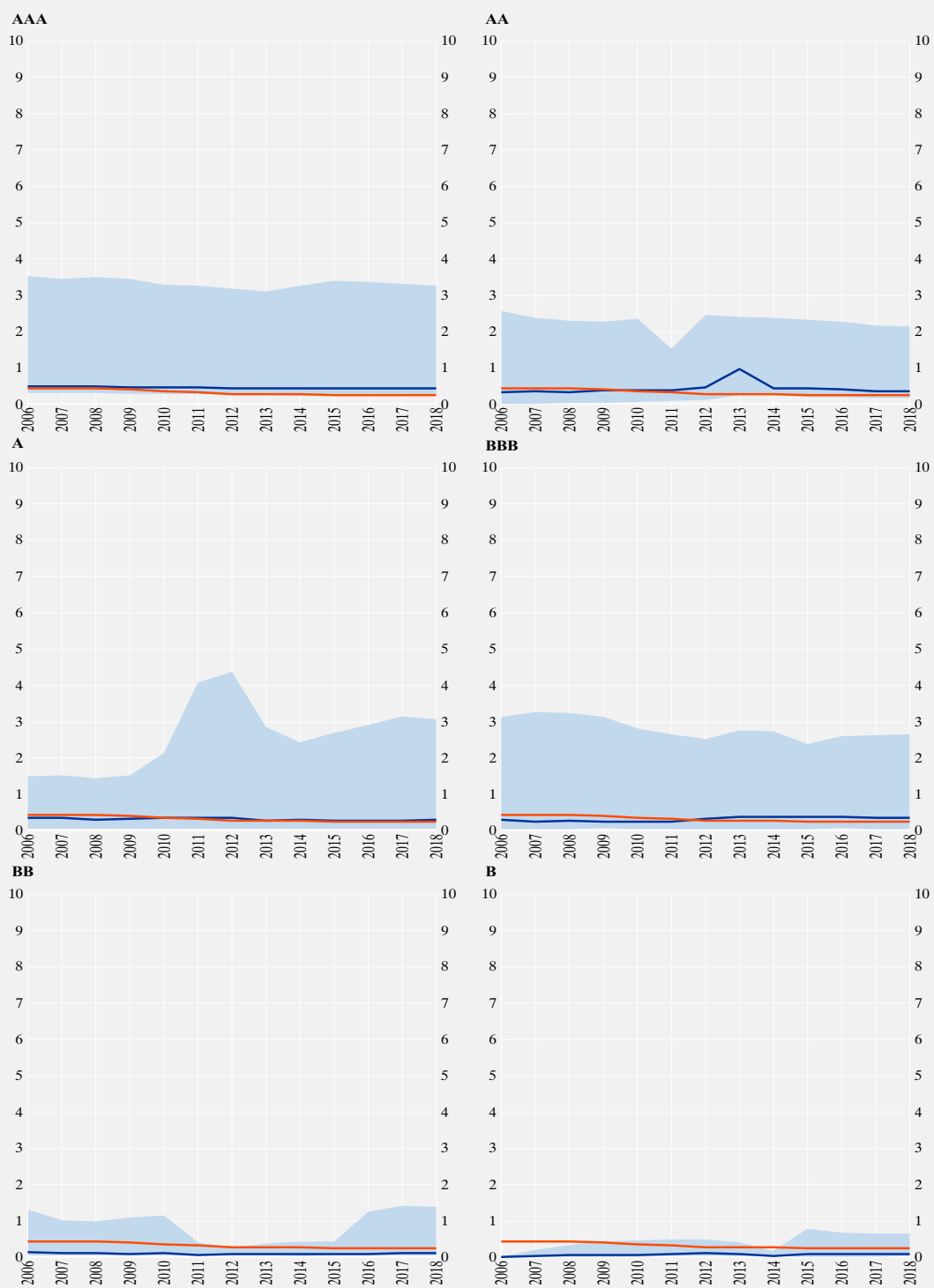**Chart AI Governance indicators**

(percentile rank)
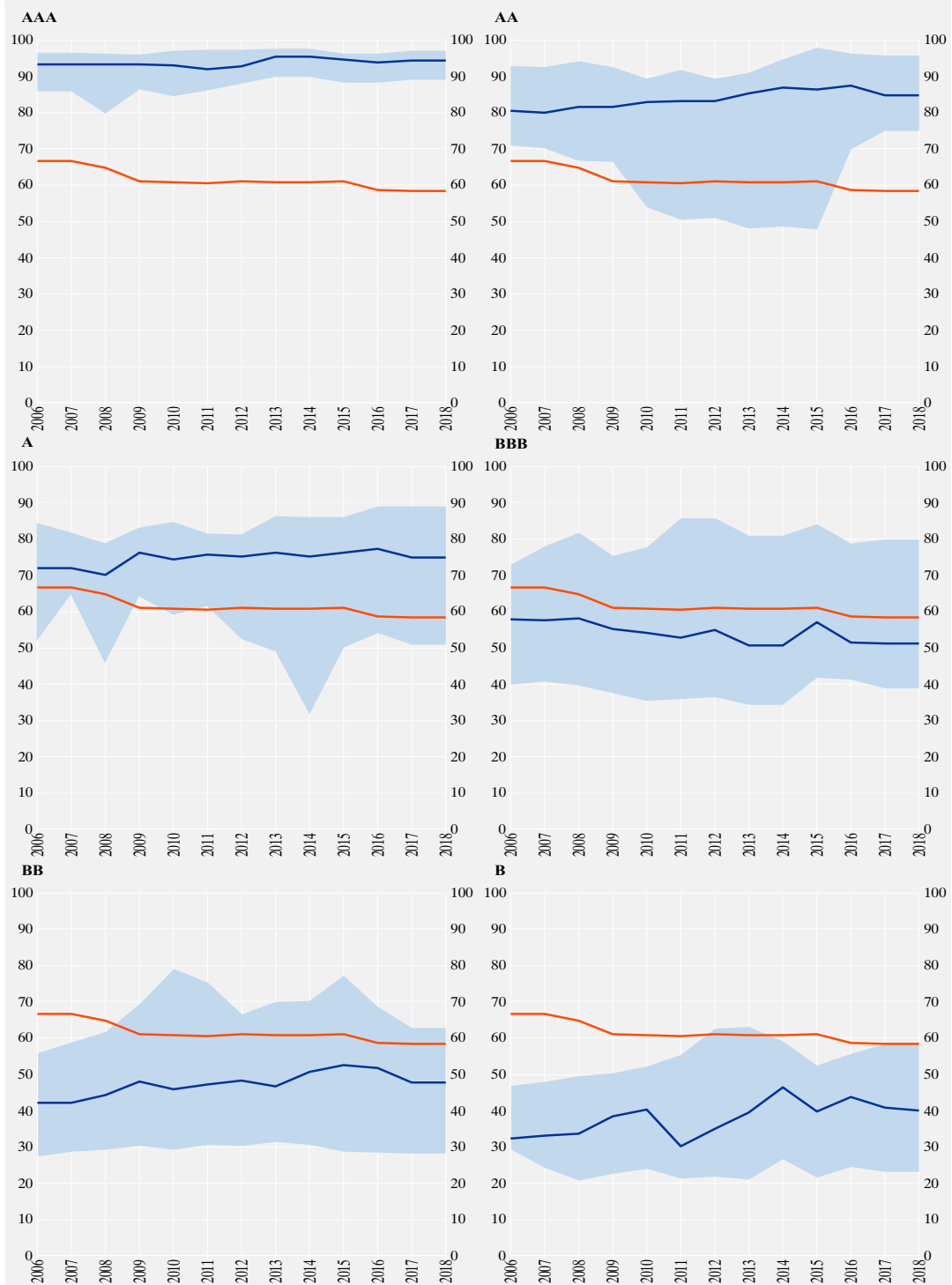
Note: The panels illustrate the value of the factor "governance indicators" for Greece (orange line), as well as the median (blue line) and the interquantile range (10% and 90%: light blue area) of each rating category. Rating categories are shown in the headings of individual panels; thus, apart from the value of this factor for Greece, the top left panel shows the median and the interquantile range for AAA-rated sovereigns, the top right panel for AA-rated sovereigns, the second-row left panel for A-rated sovereigns, and so on.
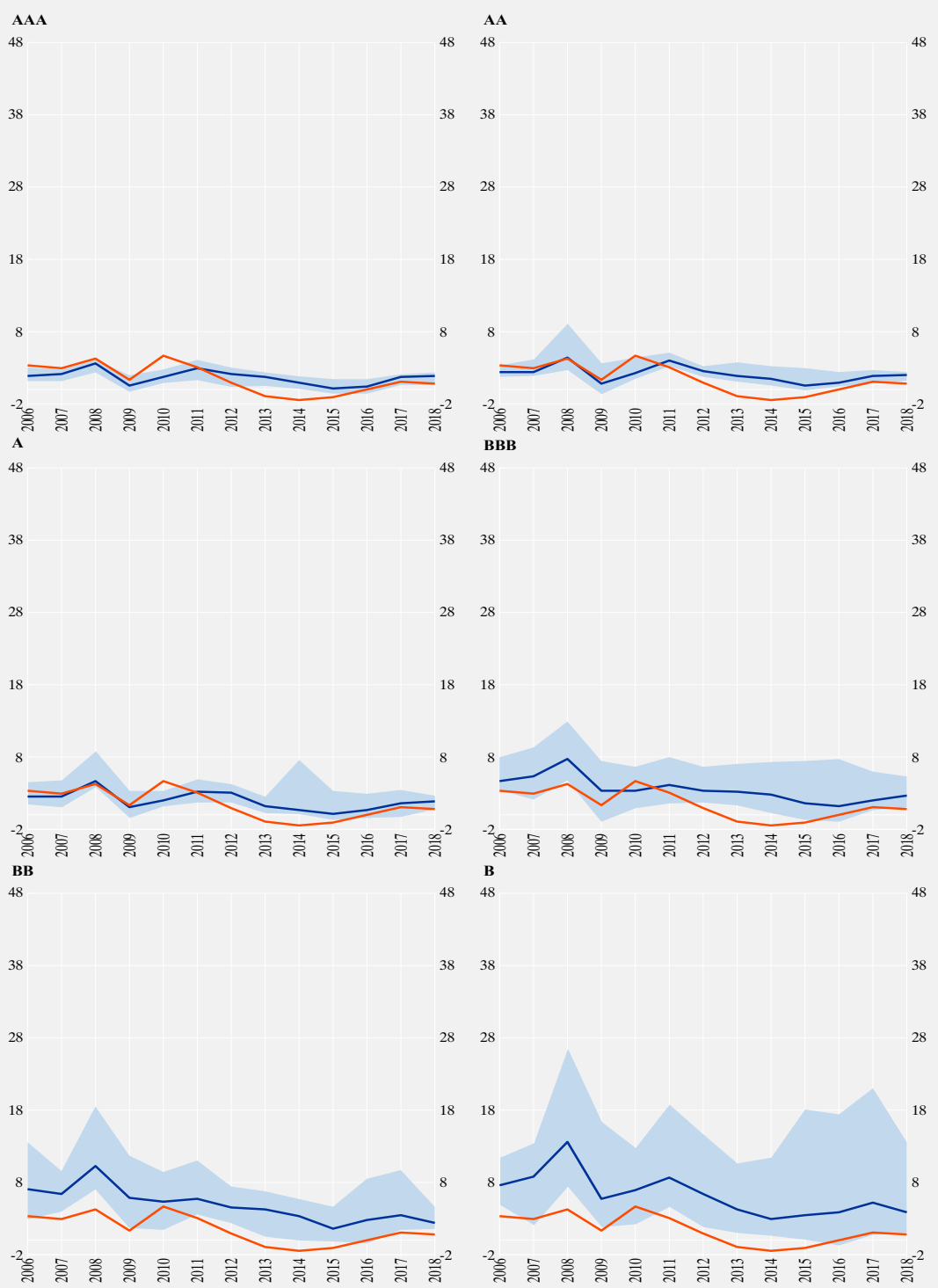
Chart A2 Broad money

(% of GDP)
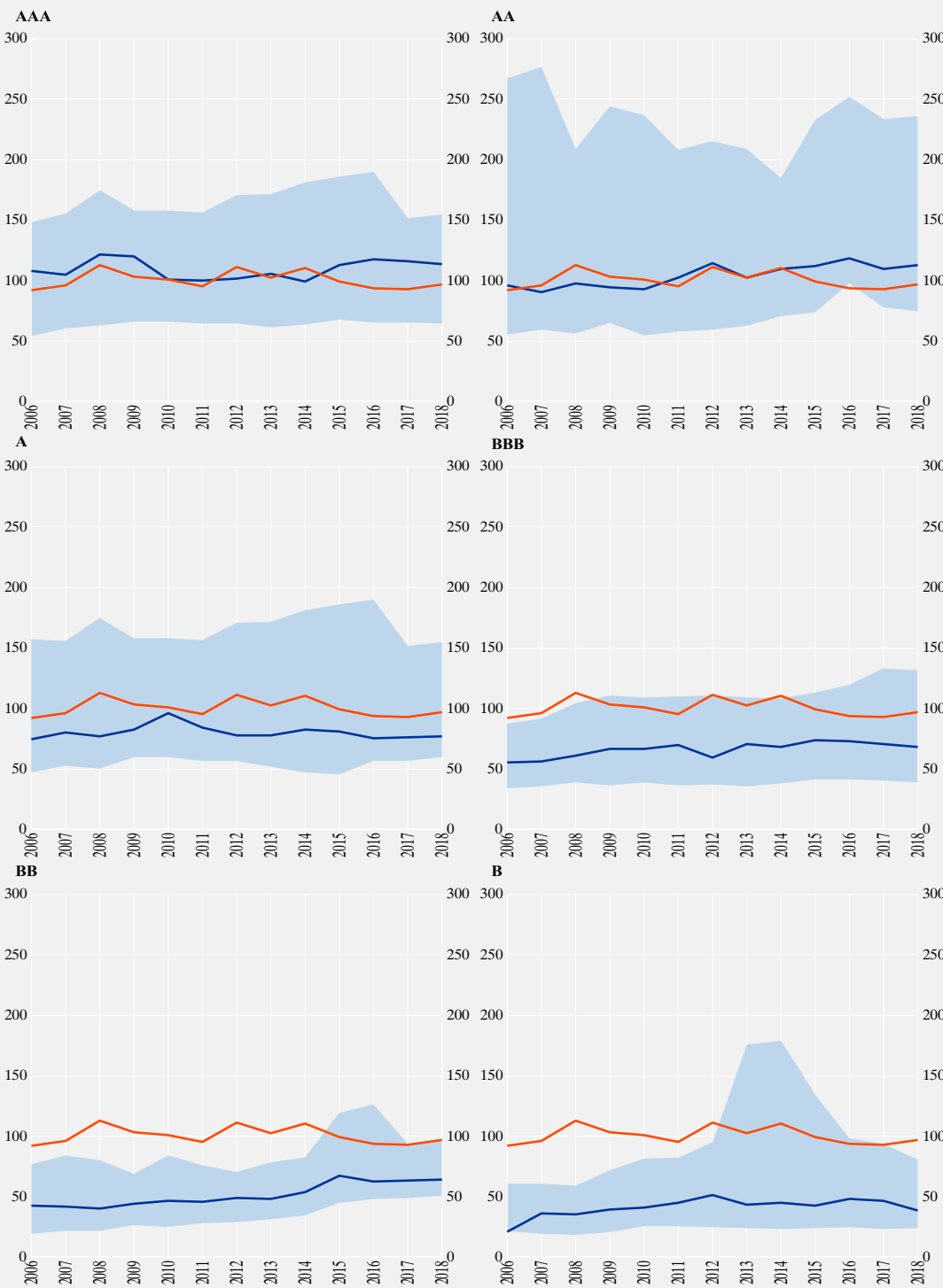
Note: The panels illustrate the value of the factor "broad money" for Greece (orange line), as well as the median (blue line) and the interquantile range (10% and 90%: light blue area) of each rating category. Rating categories are shown in the headings of individual panels; thus, apart from the value of this factor for Greece, the top left panel shows the median and the interquantile range for AAA-rated sovereigns, the top right panel for AA-rated sovereigns, the second-row left panel for A-rated sovereigns, and so on.

Chart A3 GDP per capita
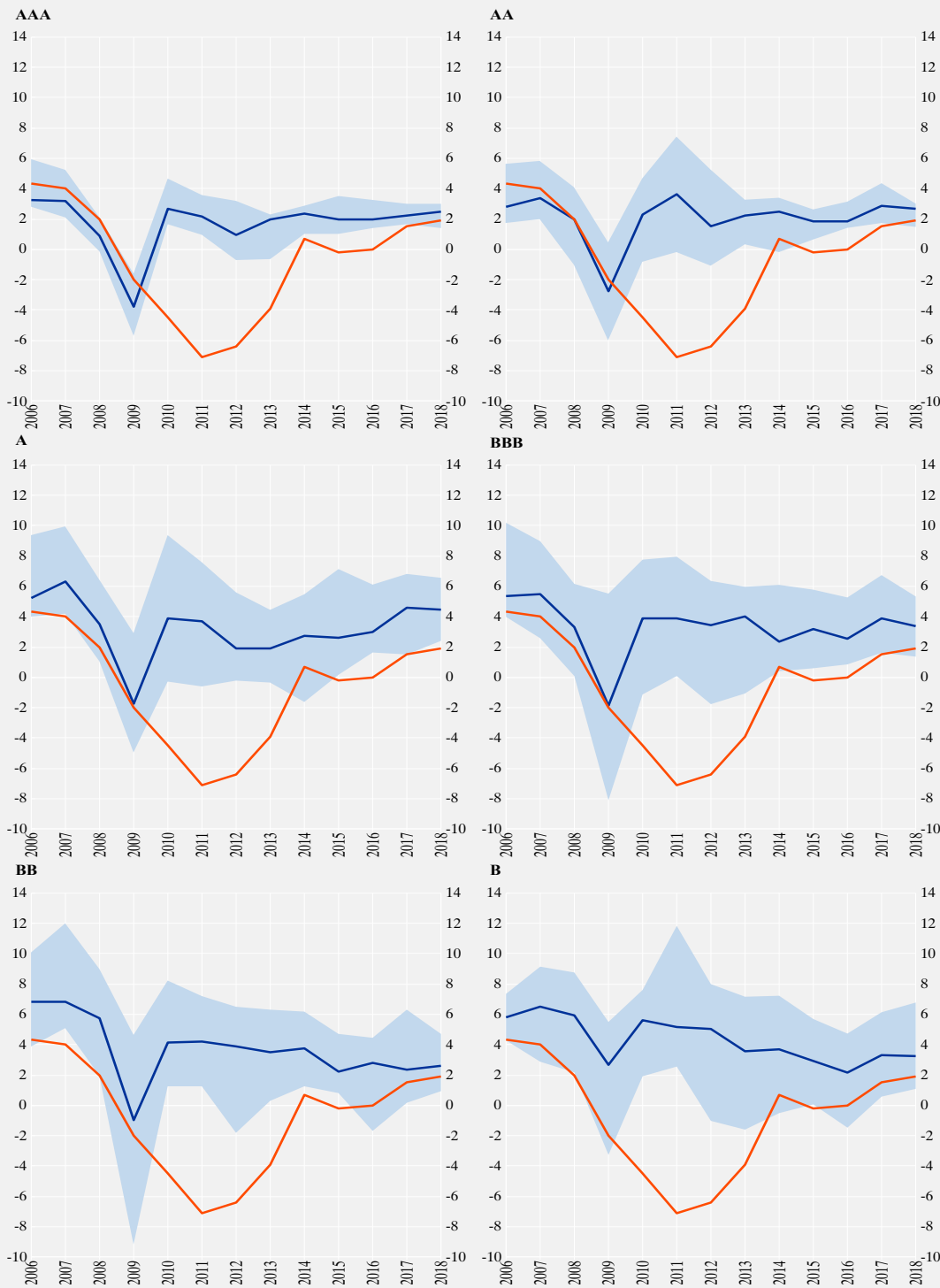
(% of US GDP per capita)

Note: The panels illustrate the value of the factor "GDP per capita" for Greece (orange line), as well as the median (blue line) and the interquantile range (10% and 90%: light blue area) of each rating category. Rating categories are shown in the headings of individual panels; thus, apart from the value of this factor for Greece, the top left panel shows the median and the interquantile range for AAA-rated sovereigns, the top right panel for AA-rated sovereigns, the second-row left panel for A-rated sovereigns, and so on.
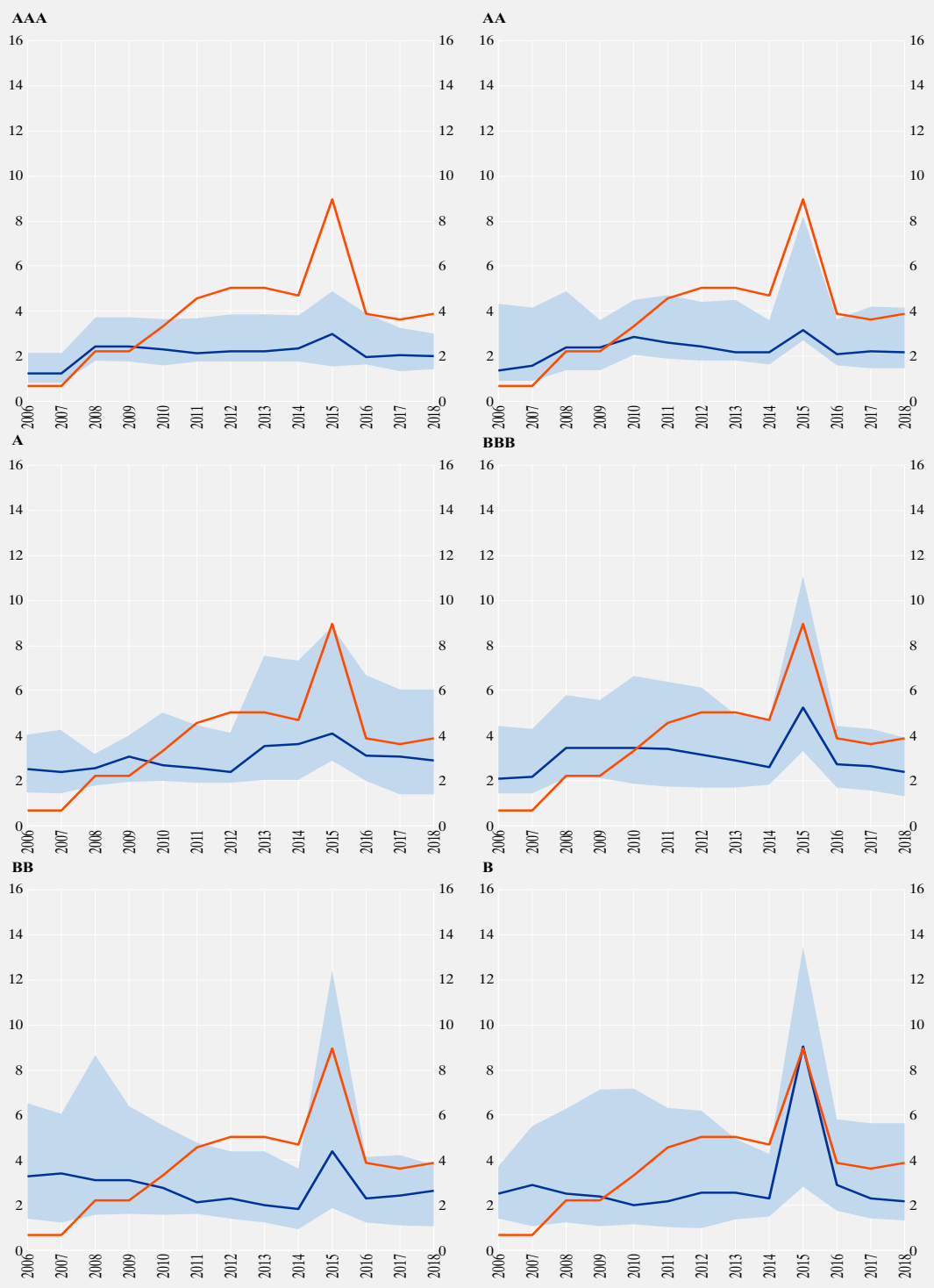
Chart A4 Share in world GDP

(% of world GDP)

Note: The panels illustrate the value of the factor "share in world GDP" for Greece (orange line), as well as the median (blue line) and the interquantile range (10% and 90%: light blue area) of each rating category. Rating categories are shown in the headings of individual panels; thus, apart from the value of this factor for Greece, the top left panel shows the median and the interquantile range for AAA-rated sovereigns, the top right panel for AA-rated sovereigns, the second-row left panel for A-rated sovereigns, and so on.

(annual rate of change in CPI)

Note: The panels illustrate the value of the factor "inflation rate" for Greece (orange line), as well as the median (blue line) and the interquantile range (10% and 90%: light blue area) of each rating category. Rating categories are shown in the headings of individual panels; thus, apart from the value of this factor for Greece, the top left panel shows the median and the interquantile range for AAA-rated sovereigns, the top right panel for AA-rated sovereigns, the second-row left panel for A-rated sovereigns, and so on.

Chart A6 Real GDP growth

(year-on-year percentage change in real GDP)

AAA

AA

A

BBB

BB

B

Note: The panels illustrate the value of the factor "real GDP growth" for Greece (orange line), as well as the median (blue line) and the interquantile range (10% and 90%: light blue area) of each rating category. Rating categories are shown in the headings of individual panels; thus, apart from the value of this factor for Greece, the top left panel shows the median and the interquantile range for AAA-rated sovereigns, the top right panel AA-rated sovereigns, the second-row left panel for A-rated sovereigns, and so on.

Chart A7 GDP volatility

(10-year standard deviation in real GDP growth rates)

Note: The panels illustrate the value of the factor "GDP volatility" for Greece (orange line), as well as the median (blue line) and the interquantile range (10% and 90%: light blue area) of each rating category. Rating categories are shown in the headings of individual panels; thus, apart from the value of this factor for Greece, the top left panel shows the median and the interquantile range for AAA-rated sovereigns, the top right panel for AA-rated sovereigns, the second-row left panel for A-rated sovereigns, and so on.
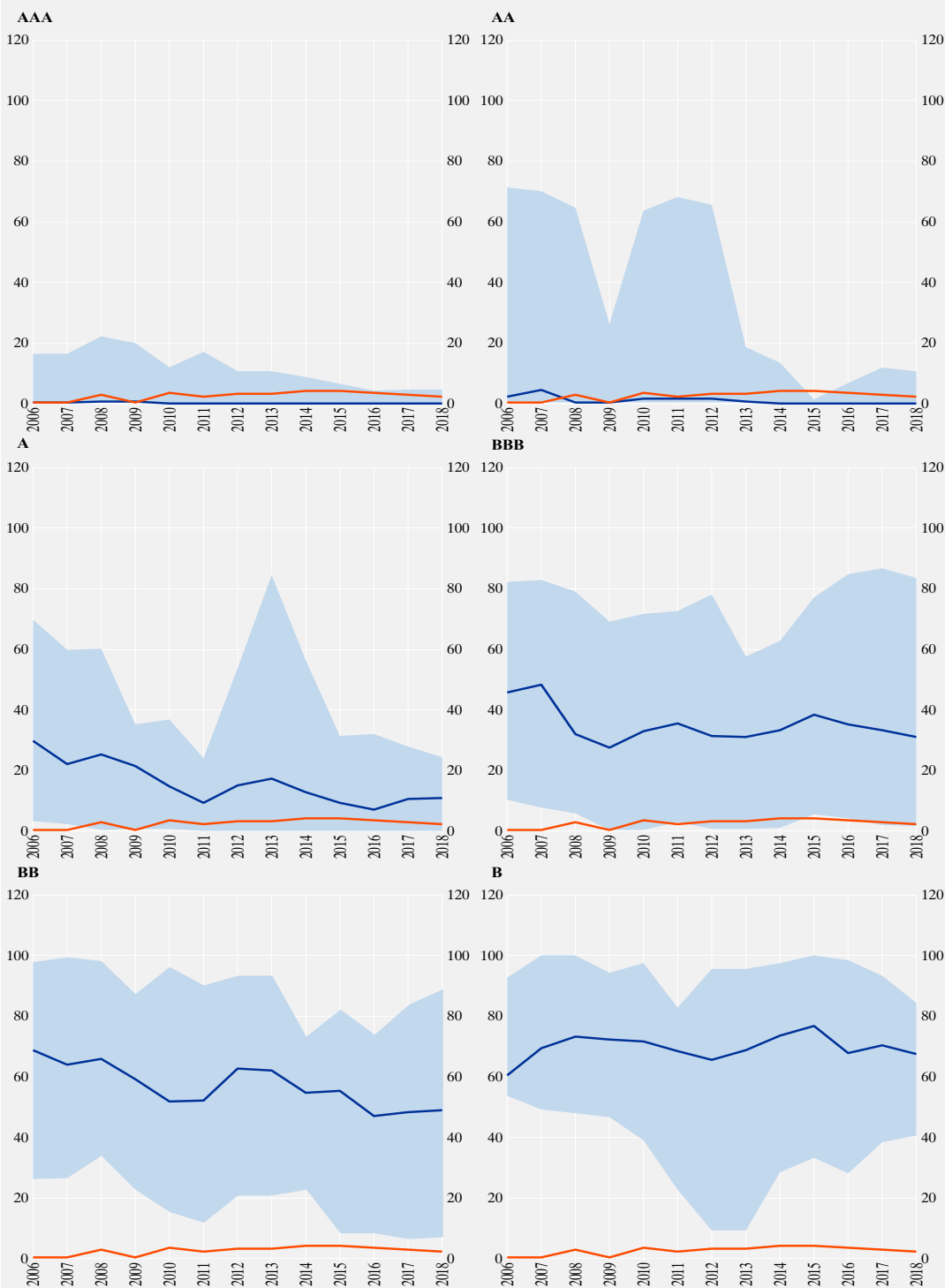
Chart A8 General government budget balance

(% of GDP, + surplus / - deficit)
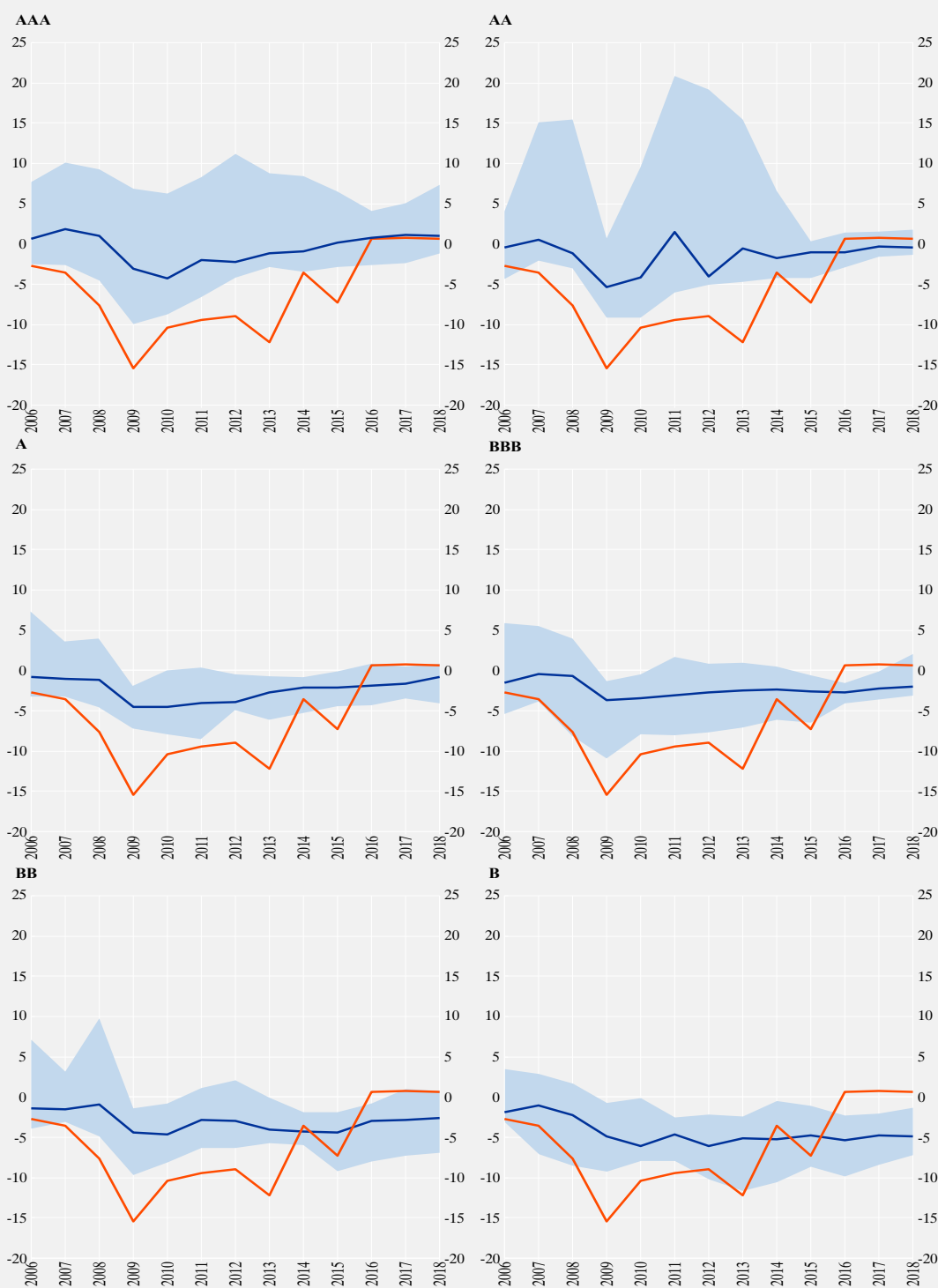
Note: The panels illustrate the value of the factor "general government budget balance" for Greece (orange line), as well as the median (blue line) and the interquantile range (10% and 90%: light blue area) of each rating category. Rating categories are shown in the headings of individual panels; thus, apart from the value of this factor for Greece, the top left panel shows the median and the interquantile range for AAA-rated sovereigns, the top right panel for AA-rated sovereigns, the second-row left panel for A-rated sovereigns, and so on.

Chart A9 General government debt

(% of GDP)
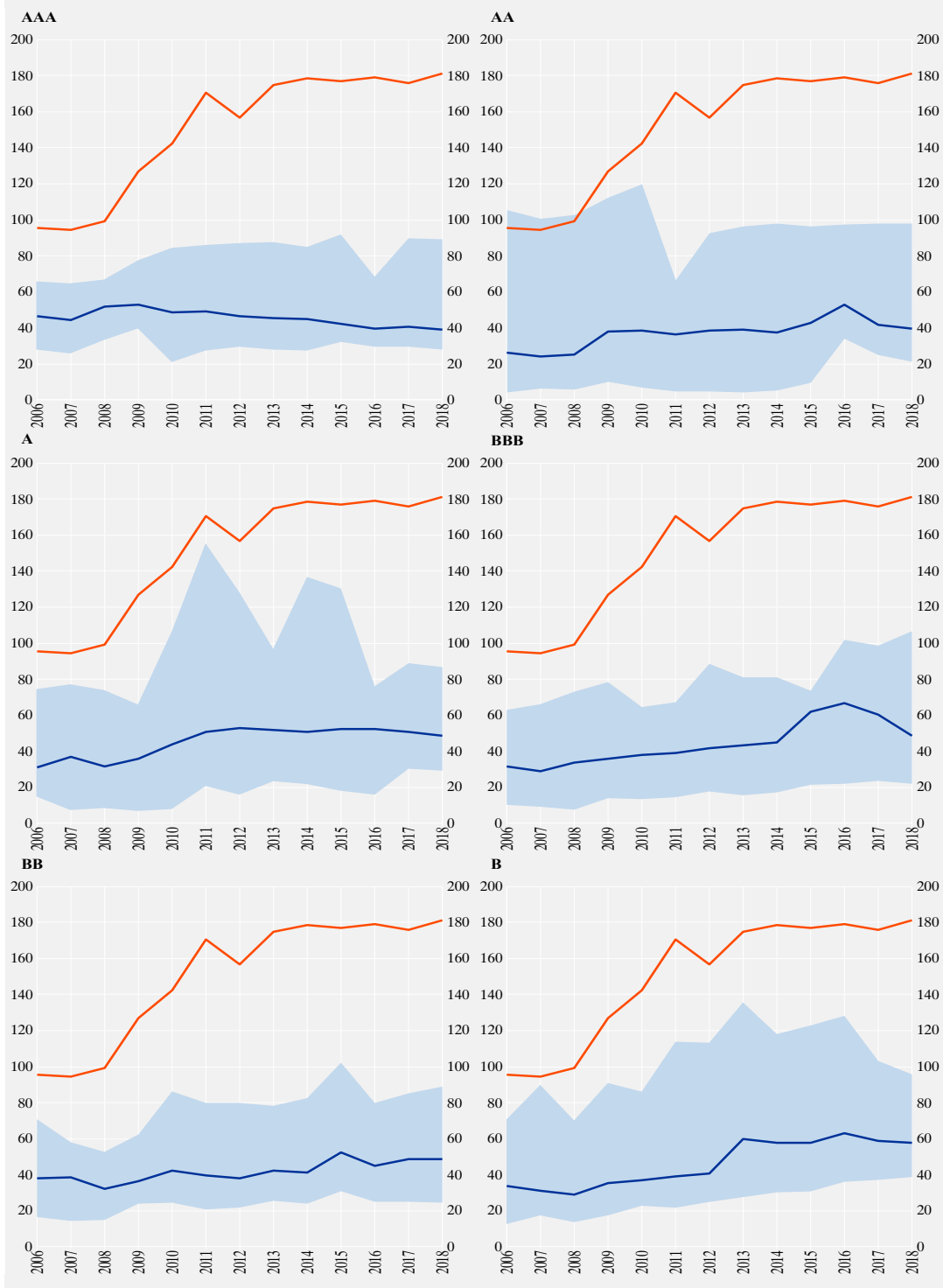
Note: The panels illustrate the value of the factor "general government debt" for Greece (orange line), as well as the median (blue line) and the interquantile range (10% and 90%: light blue area) of each rating category. Rating categories are shown in the headings of individual panels; thus, apart from the value of this factor for Greece, the top left panel shows the median and the interquantile range for AAA-rated sovereigns, the top right panel for AA-rated sovereigns, the second-row left panel for A-rated sovereigns, and so on.

Chart A10 Public debt denominated in foreign currency

(% of gross general government debt)

Note: The panels illustrate the value of the factor "public debt denominated in foreign currency" for Greece (orange line), the median (blue line) and the interquantile range (10% and 90%: light blue area) of each rating category. Rating categories are shown in the headings of individual panels; thus, apart from the value of this factor for Greece, the top left panel shows the median and the interquantile range for AAA-rated sovereigns, the top right panel for AA-rated sovereigns, the second-row left panel for A-rated sovereigns, and so on.

## Chart A11 General government interest expenses

(% of revenues)
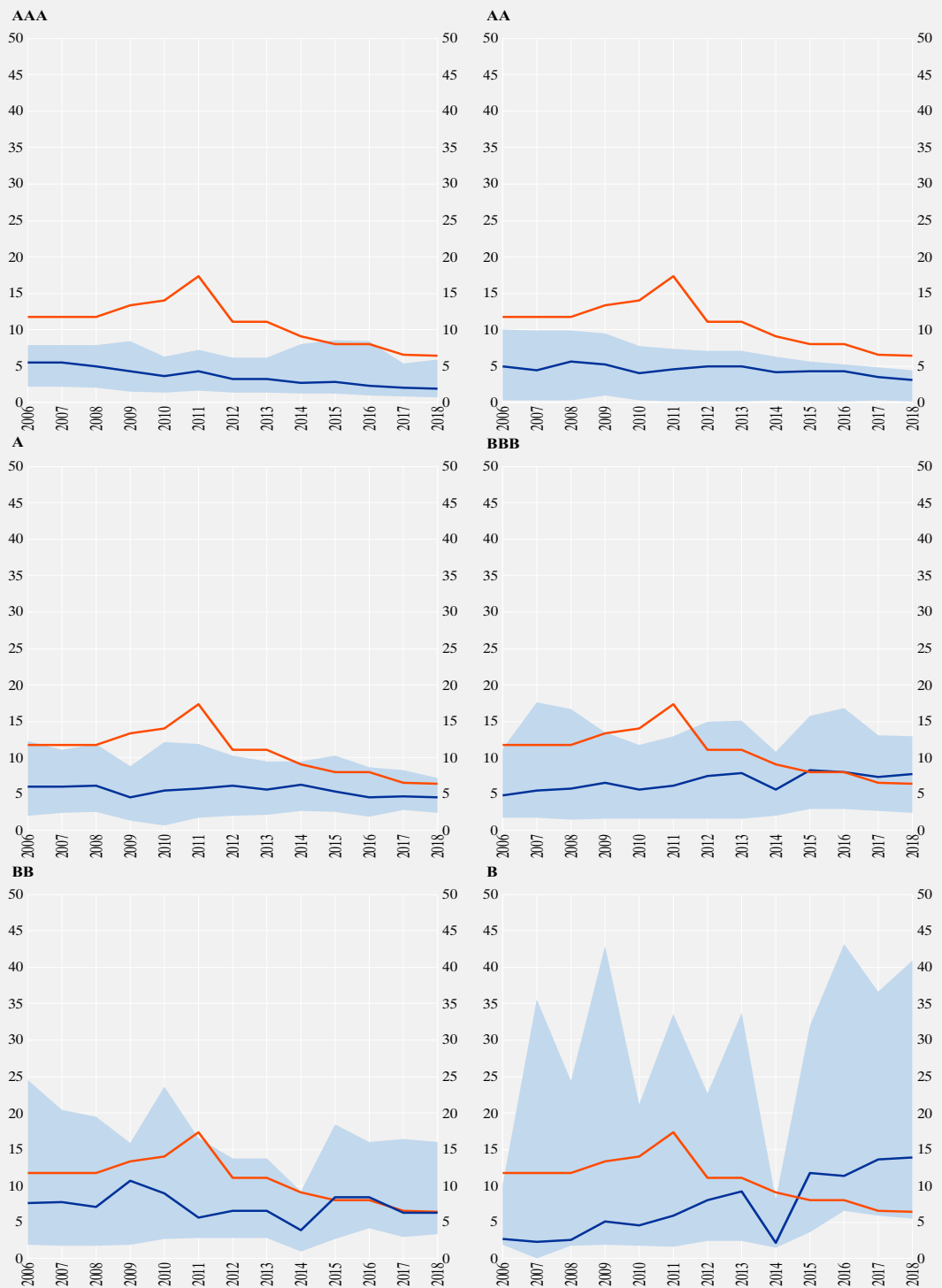
Note: The panels illustrate the value of the factor "general government interest expenses" for Greece (orange line), as well as the median (blue line) and the interquantile range (10% and 90%: light blue area) of each rating category. Rating categories are shown in the headings of individual panels; thus, apart from the value of this factor for Greece, the top left panel shows the median and the interquantile range for AAA-rated sovereigns, the top right panel for AA-rated sovereigns, the second-row left panel for A-rated sovereigns, and so on.
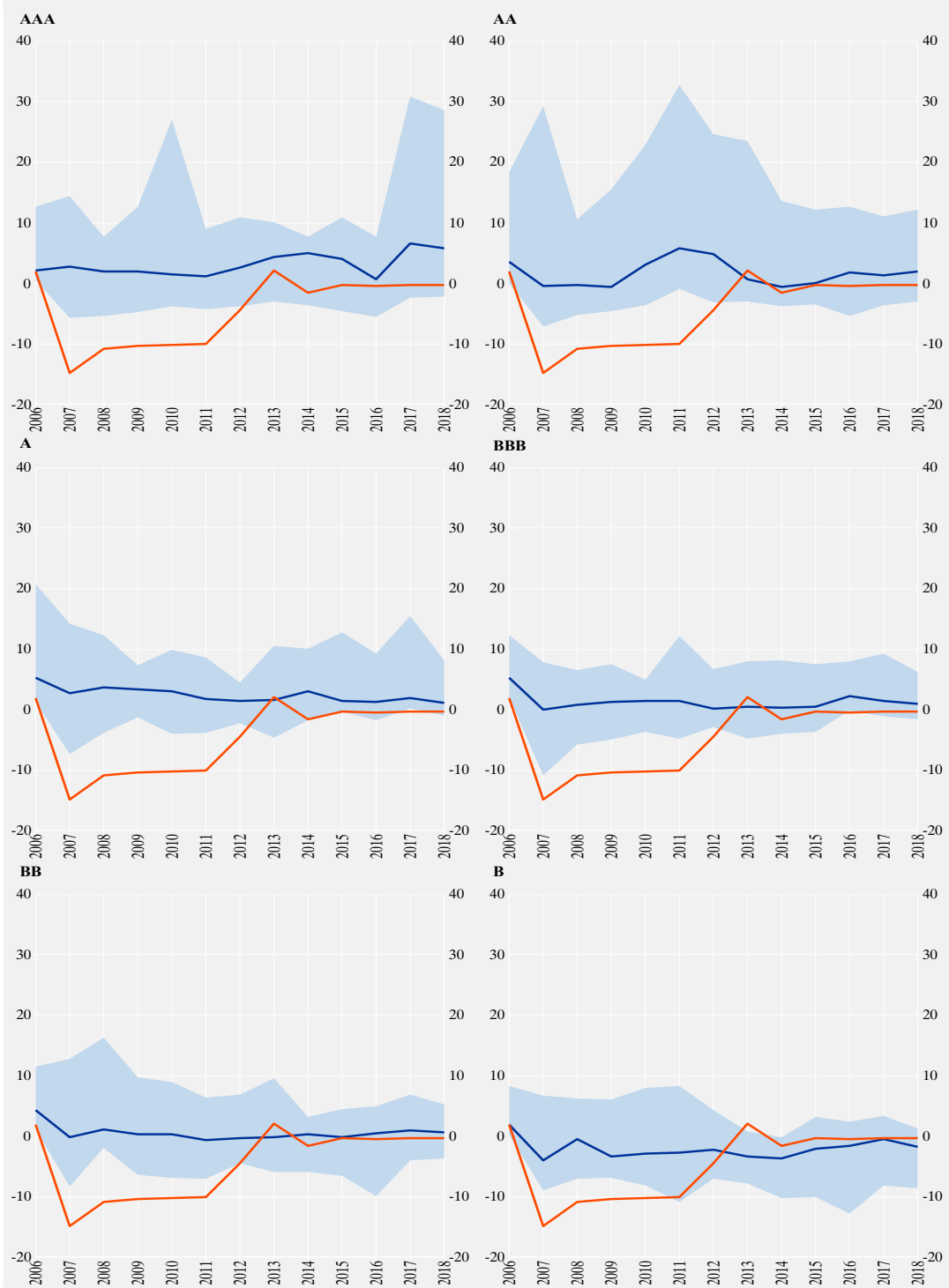
Chart A12 Sovereign net foreign assets

(% of GDP)
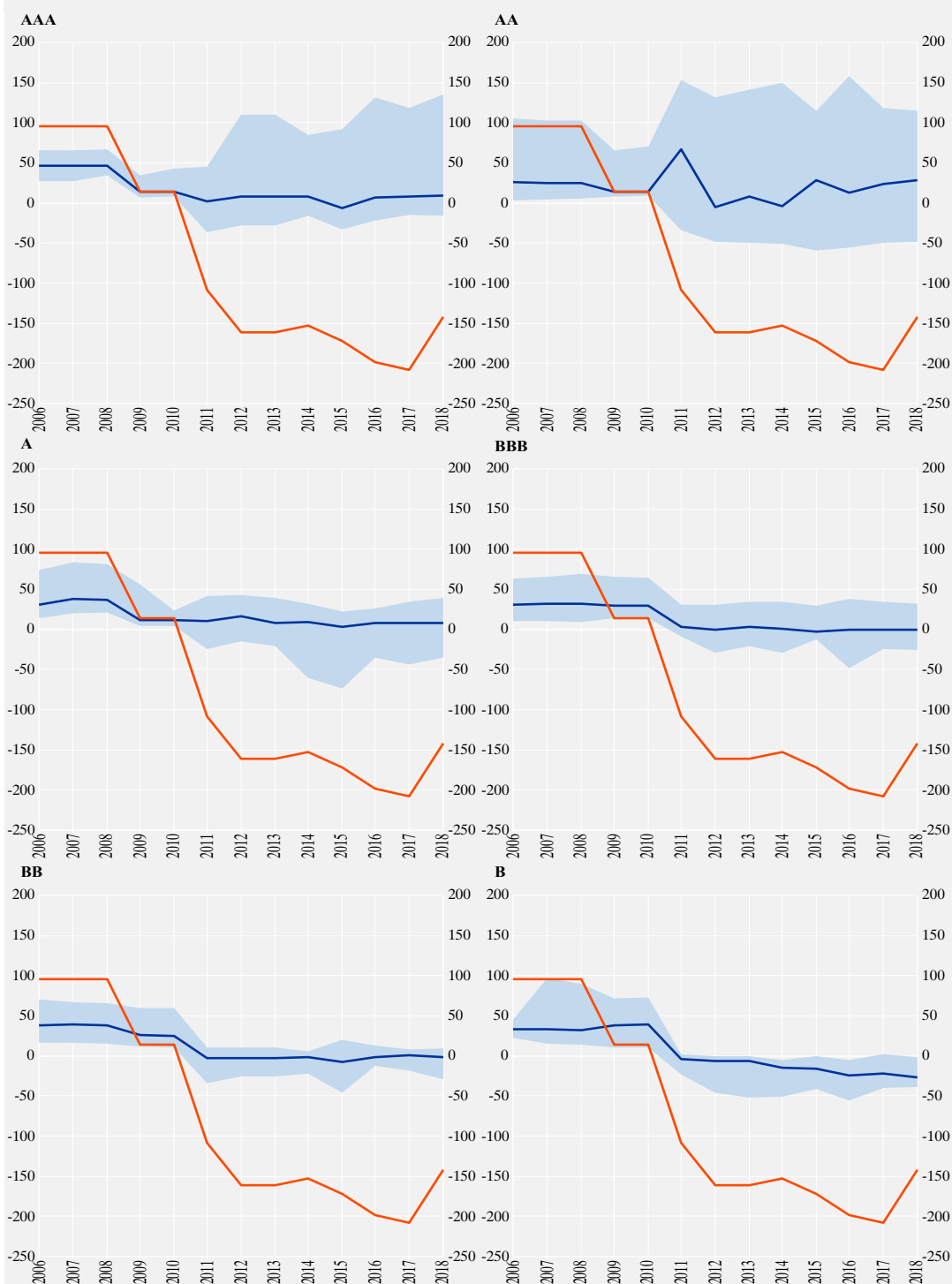
Note: The panels illustrate the value of the factor "sovereign net foreign assets" for Greece (orange line), as well as the median (blue line) and the interquantile range (10% and 90%: light blue area) of each rating category. Rating categories are shown in the headings of individual panels; thus, apart from the value of this factor for Greece, the top left panel shows the median and the interquantile range for AAA-rated sovereigns, the top right panel for AA-rated sovereigns, the second-row left panel for A-rated sovereigns, and so on.

## Chart AI3 Current account balance and foreign direct investment

(% of GDP)

Note: The panels illustrate the value of the factor "current account balance and FDI" for Greece (orange line), as well as the median (blue line) and the interquantile range (10% and 90%: light blue area) of each rating category. Rating categories are shown in the headings of individual panels; thus, apart from the value of this factor for Greece, the top left panel shows the median and the interquantile range for AAA-rated sovereigns, the top right panel for AA-rated sovereigns, the second-row left panel for A-rated sovereigns, and so on.

Chart A14 Commodity dependence

(% of GDP)
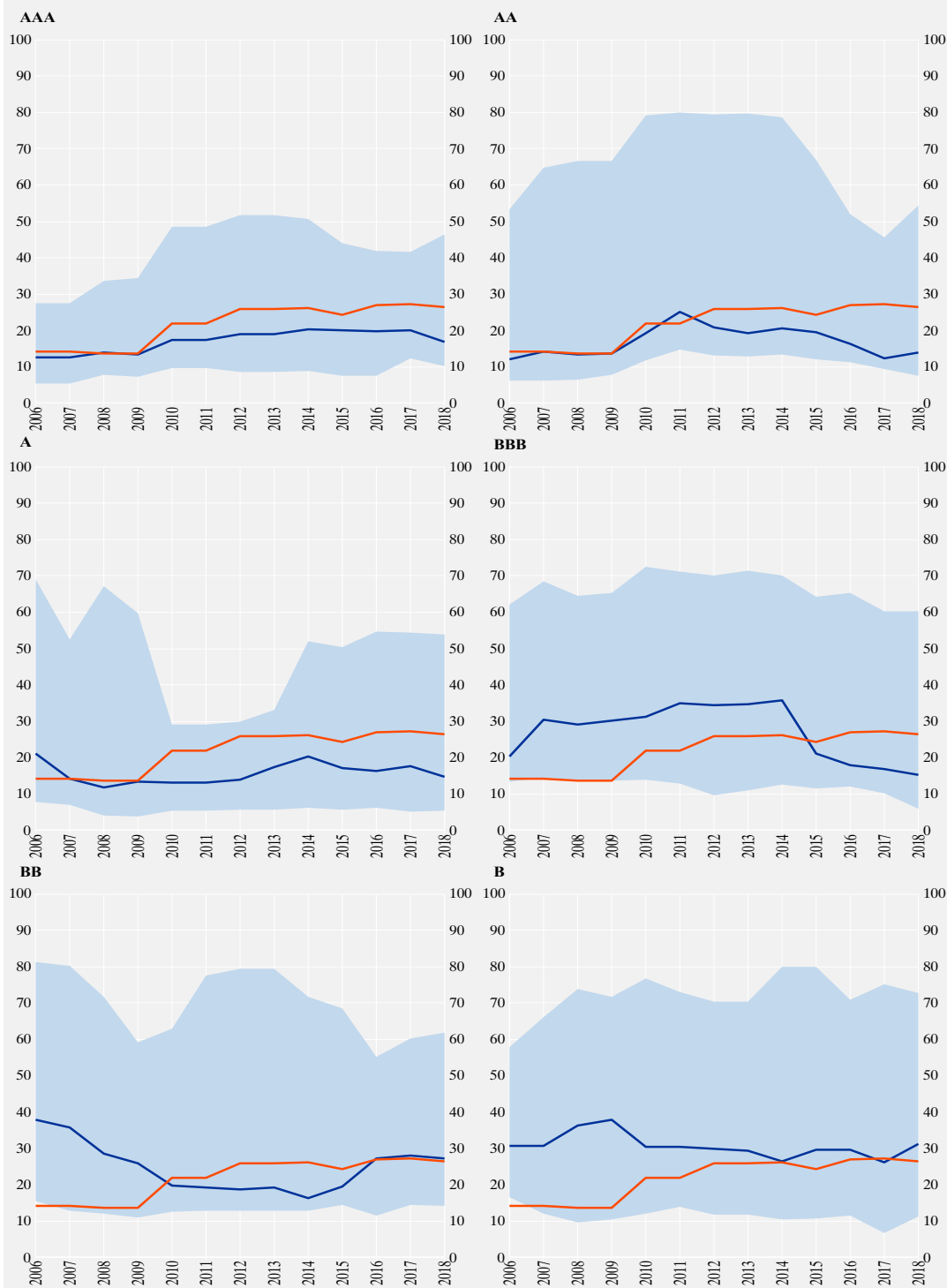
Note: The panels illustrate the value of the factor "commodity dependence" for Greece (orange line), as well as the median (blue line) and the interquantile range (10% and 90%: light blue area) of each rating category. Rating categories are shown in the headings of individual panels; thus, apart from the value of this factor for Greece, the top left panel shows the median and the interquantile range for AAA-rated sovereigns, the top right panel for AA-rated sovereigns, the second-row left panel for A-rated sovereigns, and so on.

Chart A15 Greece's sovereign credit rating from individual CRAs
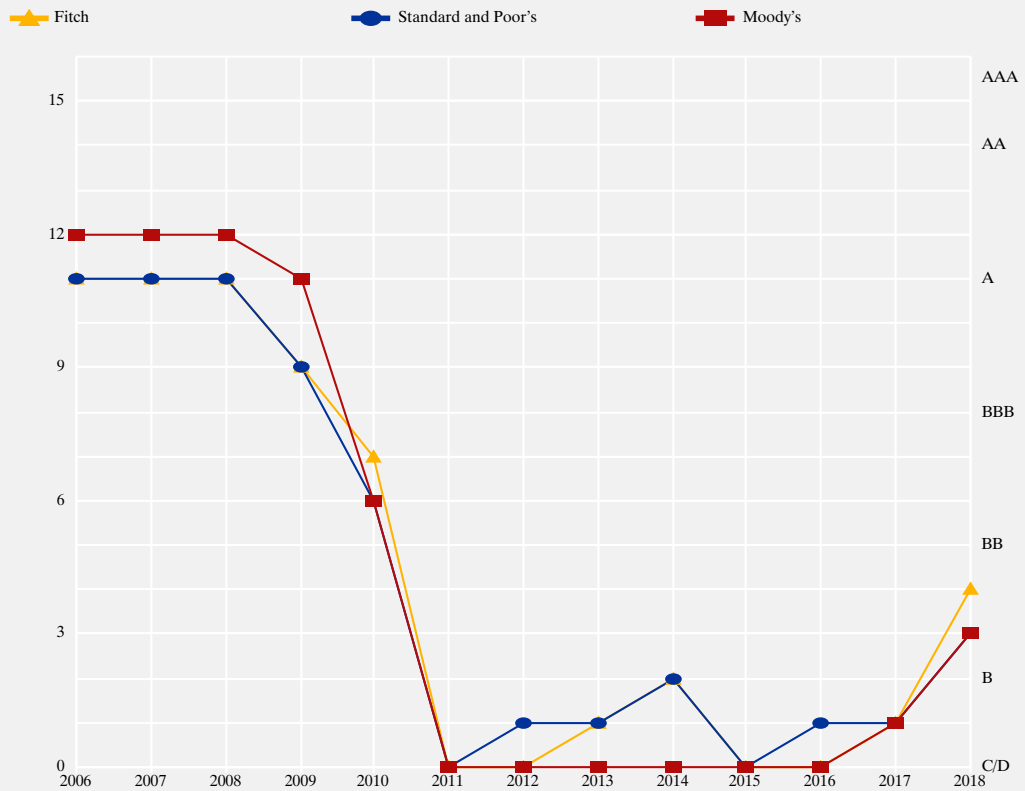
Note: The chart shows the sovereign credit rating assigned to Greece by Fitch (marked by orange triangles), Moody's (marked by brown squares) and Standard and Poor's (marked by blue circles) for the period 2006-2018. Each mark is the rating assigned by each of the three CRAs at the end of the respective year; ratings are noted in notches and shown on the left-hand scale in numerical and on the right-hand scale in alphanumeric form.