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Assessing the Debt Sustainability Analysis Methodology in the EU's New Economic Governance Framework

Economic Governance and EMU Scrutiny Unit (EGOV)
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Abstract

This paper argues that the debt sustainability methodology in the EU new economic governance framework, while analytically sound, faces major implementation challenges. Primary among these is the reliance on a non-observable variable (the volatility of future debt-to-GDP ratios) that must be estimated based on ad hoc procedures that may affect significantly the required decline in the debt ratio after the end of the adjustment period and, hence, the primary surplus that a Member State needs to achieve during the adjustment period.

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LIST OF ABBREVIATIONS

DSA	Debt Sustainability Analysis
EU	European Union
ECB	European Central Bank
GDP	Gross Domestic Product
IMF	International Monetary Fund
SVAR	Structural Vector Auto-Correlation model

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EXECUTIVE SUMMARY

The new EU Economic Governance Framework requires that the projected general government debt-to-GDP ratio of member States, if not already below 60% of GDP, is put or remains on a plausibly downward path over the medium term. One of the conditions to evaluate whether this requirement is met is that "the risk of the general government debt ratio not decreasing in the five years following the adjustment period of the national medium-term fiscal-structural plan is sufficiently low, the assessment of which shall be based on the Commission's Debt Sustainability Analysis (DSA). Thus, this methodology plays a critical role in the new economic governance framework.

Against this background, this paper reviews the Commission's DSA methodology, in terms of its transparency, replicability and differences with respect to the approach followed by other organizations implementing DSA, such as the International Monetary Fund (IMF).

The main conclusions are:

- **Most features of the DSA methodology are appropriate and in line with state-of-the art practice**. However, the methodology reflects ad hoc procedures that may affect in a critical way the results that are obtained in terms of fiscal adjustment that Member States have to implement.
- This is not a critique of the methodology itself or of the methodological choices made by the Commission. Rather it is an **inevitable consequence of having opted for an economic governance framework based on a non-observable and difficult to estimate variable**, namely the volatility of the path of the debt-to-GDP ratio following the end of the four-to-seven year adjustment period. This decision was contrary to one of the stated goals of the economic governance reform, namely to reduce the reliance on non-observable variables.
- In these circumstances, as a minimum, **it would be useful to work further in assessing the implications of the specific features of the DSA methodology** in determining the required reduction of the debt ratio in the post-adjustment period and hence on the required level of the primary surplus to be reached at the end of that period.
- The paper also highlights the **radical change of the new governance framework with respect to the past**, especially in terms of the relationship between the required reduction of the debt ratio in the post adjustment period and the initial level of the debt ratio.
- Indeed, the pre-reform framework required an annual decline in the debt-to-GDP ratio that was proportional to the initial debt level. Instead, the new framework requires that, under certain reasonable assumptions, the debt ratio falls annually by one tenth of the estimated standard deviation of the debt ratio distribution five years after the end of the adjustment period (a measure of the volatility of the debt ratio). **The initial debt level is (almost) irrelevant in determining the magnitude of the required debt decline**.
- **This feature of the new governance framework was not highlighted in the Commission's documents leading to the reform** and one wonders whether it was fully understood by all policy makers and stakeholders when the new framework was adopted.

INTRODUCTION[1]

The new EU economic governance framework, which entered into force in April 2024, is centered on some requirements outlined in article 6 and article 10 of the Regulation on the "Effective coordination of economic policies and multilateral budgetary surveillance" (henceforth "the 2024 Regulation").[2] More specifically:

- Article 6 requires that the "reference trajectory" transmitted by the Commission to Member States and, ultimately, the "national medium-term fiscal-structural plan" submitted by Member States (see article 11 of the 2024 Regulation) ensure that the "projected general government debt [to GDP] ratio is put or remains on a plausibly downward path, or stays at prudent levels below 60% of GDP over the medium term".
- Article 10 clarifies that to assess the plausibility of the above-indicated downward path the Commission "shall apply a replicable, predictable and transparent methodology" based on two conditions. The first is that the public debt ratio "declines or stays at prudent levels, under the deterministic scenarios of the Commission's medium-term government debt projection framework". The second is that "the risk of the general government debt ratio not decreasing in the five years following the adjustment period of the national medium-term fiscal-structural plan is sufficiently low, the assessment of which shall be based on the Commission's Debt Sustainability Analysis".

Thus, the new framework assigns a critical role to the Debt Sustainability Analysis (DSA) implemented by the Commission: the DSA is one of the tools to assess whether the public debt trajectory of a Member State is on a plausibly downward path and thus complies with the requirement under Article 6. Against this background, this paper evaluates the Commission's DSA framework in terms of its strengths and remaining challenges including by comparing it with similar DSAs used by other international organizations and by evaluating its replicability, predictability and transparency.

The outline of the paper is the following. Section 1 provides an overall discussion of what DSAs try to evaluate, as a necessary discussion of the desirable features of an effective DSA. Section 2 highlights the key aspects of the methodology used by the Commission, discussing whether it can be regarded as "state of the art" in terms of its effectiveness compared with those used by other international organisations. Section 3 assesses the overall quality of the DSA methodology as well as its replicability, predictability and transparency. Section 4 concludes by providing an overall assessment of the methodology.

[1] I thank Giampaolo Galli, Daniel Gros and Lucio Pench for very helpful comments and Alessio Capacci and Leoluca Virgadamo for excellent research assistance. A first draft of this paper also benefitted from helpful comments from DGECFIN of the European Commission. I also thank Mark Flanagan for very helpful comments regarding the IMF DSA methodology.

[2] The new economic governance framework has come into effect with the approval of the "Regulation of the European Parliament and of the Council on the effective coordination of economic policies and multilateral budgetary surveillance and repealing Council Regulation (EC) No 1466/97" (European Union, 2024a) and of the "Regulation amending Regulation (EC) No 1467/97 on speeding up and clarifying the implementation of the excessive deficit procedure" (European Union, 2024b).

1. THE ROLE OF DSA IN THE CONTEXT OF THE OVERALL SURVEILLANCE OF FISCAL RISKS

The DSA has been used by the European Commission to describe a methodology, focused on especially on the behavior of the public debt-to-GDP ratio, to evaluate the risk that fiscal stress would arise over the medium term for a member State (see Box 1). To fully understand the meaning of the term a brief discussion of its origin is useful.

Box 1 - What is Debt Sustainability Analysis (DSA)?

The term Debt Sustainability Analysis is used by the European Commission to describe a set of tools to evaluate whether a certain fiscal policy plan is likely to lead to stress in the government paper market over the medium-term. Typically this involves projecting the path of key fiscal variables (the overall balance, the primary balance, the public debt-to-GDP ratio, the gross borrowing requirement) and evaluate whether the public debt-to-GDP ratio, the focus of the analysis, rises, declines or remains stable, when it starts declining and how high, with respect to the past, the primary balance is assumed to be during the projection period (to evaluate the space for possible further fiscal corrections). The behaviour of the debt ratio is considered:

- in a projection based on baseline assumptions for the key drivers of the debt ratio (growth rate of GDP, interest rate on public debt and the primary balance), the so-called baseline scenario;
- in scenarios in which the key drivers of the debt ratio suffer from unfavorable shocks (e.g. lower growth) of pre-defined magnitude;
- in stochastic simulations in which the debt path is projected a very large number of times (for example 10,000) to calculate the percentages of cases in which at the end of the projection period the debt ratio exceeds (typically) the initial level.

The specific features of these projections are described in the European Commission's 2023 Debt Sustainability Monitor (see in particular Annex A1 and Section I.2, especially Box I.2.1). This methodology was, however, simplified significantly in applying it as a component of the new EU Economic Governance Framework. The necessary adaptations are described in Part II.1 of the 2023 Debt Sustainability Monitor0r (pages 109-115) and discussed in section 2 of this paper.

DSAs for sovereign countries were first introduced as a standard methodology to be applied to "market access countries", that is to countries that could borrow from financial markets, by the International Monetary Fund (IMF) in the yearly 2000s following the Asian crisis of the second half of the previous decade.[3] That crisis had revived an old issue: how the burden of restoring fiscal solvency had to be shared between a country in trouble and its creditors. Debt was regarded as sustainable when it could continue to be serviced without an unrealistically large future fiscal correction. DSAs were meant, in principle, to assess whether this condition would hold. Given this definition, DSA should have focused on: (i) the extent of the fiscal adjustment required to restore fiscal solvency (the latter meaning the ability to service debt in an orderly manner) and (ii) on whether such adjustment was realistic. The concept of "realism" had to be understood in relative terms: it was a matter of comparing the fiscal adjustment in the absence of debt restructuring (that is an adjustment that involved burden sharing with creditors) with an adjustment that would fall uniquely on debtors, i.e. achieved by a fiscal

[3] See International Monetary Fund (2002).

correction involving raising taxes or cutting public spending.[4] Thus, strictly speaking, a DSA should focus on the relative cost of restoring fiscal solvency with or without debt restructuring, something that would require evaluating the primary deficit adjustment in the two alternative paths (with and without debt restructuring), the loss of credibility relating to restructuring public debt, the consequences of the wealth loss falling on residents in case the restructured public debt were held domestically, etcetera.[5]

However, in practice the tools introduced by the IMF to assess "debt sustainability", rather than being aimed at assessing whether restoring more normal conditions could be achieved without debt restructuring, focused on whether, given a current or planned fiscal policy stance, a country was likely to face a situation of fiscal distress (higher interest rates, difficulties in servicing debt and, ultimately, loss of market access). The European Commission in its analysis of fiscal risks followed the same approach.

However, the IMF has recently recognised that the set of tools used for evaluating the risk of fiscal distress do not strictly relate to the sustainability of public debt: the term now adopted to describe their use is "sovereign risk assessment". In contrast, the term "debt sustainability assessment" is now used as referring to the evaluation of whether restoring fiscal solvency would require or not debt restructuring.[6]

In contrast, the term DSA is still used by the Commission as referring to an assessment of whether, given a current or planned fiscal stance, a Member State will face medium-term fiscal sustainability risks, i.e. whether it is likely, with a certain degree of probability, to run into a fiscal distressed situation over the medium term. In other terms, the Commission's DSA is, in terms of its goals, similar to the IMF's new "sovereign risk assessment". The toolkits used by both the Commission and the IMF for this common purpose include baseline projections, shocked scenarios and stochastic tests aimed at evaluating whether a fiscal correction is necessary to avoid the risk of falling into a distressed situation over the medium term. Thus, the term DSA is, strictly speaking, inappropriate but will continued to be used in the rest of this paper as it is the one used by the Commission.

The Commission's DSA assessment is indeed a component of a broader "fiscal sustainability risk" framework involving an assessment of short-term risk (focusing on liquidity aspects), medium-term risks (through the DSA toolkit) and long-term risks (focusing on measures that, in light of aging trends, are needed to stabilise the public debt ratio over the long term). Member States are classified in three risk groups (low, medium and high risk) along these three time dimensions. The classification of a Member State in one of these three risk categories is based on specific rules described in detail by Annex A1 of the 2023 Debt Sustainability Monitor (henceforth the 2023 Monitor) prepared by the Commission.[7]

While the new economic governance framework included in the 2024 Regulation refers to the DSA methodology, the specific formulation of article 6 of the 2024 Regulation require reaching a pass/fail conclusion on whether "projected general government debt ratio is put or remains on a plausibly downward path, or stays at prudent levels below 60% of GDP over the medium term". The DSA methodology, therefore, originally used to assess whether medium-term risks were low, medium or high was adapted to produce a pass/fail assessment (the risk is or is not sufficiently low). However, the

[4] Realism must be assessed in relative terms because a very large (and potentially unprecedented adjustment) may be unavoidable even cancelling completely public debt. If a government is running, for example, a 10 per cent of GDP primary deficit, such deficit must be brought to zero regardless of whether debt is restructured or not.

[5] See International Monetary Fund (2011), especially Box 1,

[6] See International Monetary Fund (2022), particularly pages 5-7 and 96-97.

[7] See European Commission (2023).

adaptation does not simply imply the shift from a three-grade assessment to a pass/fail assessment. It also involves:

- changes in the way the conclusions are reached (with a simpler methodology followed in the assessment of the compliance with articles 6 and 10 than the one used to evaluate fiscal risks in the 2023 Monitor and somewhat different stress tests)
- a different time horizon considered to evaluate the behaviour of the debt ratio (in some respects, longer for the assessment of the compliance with articles 6 and 10)
- a quantitative interpretation of what could be regarded as a "sufficiently low" probability that the debt ratio is not declining in the five years following the end of the adjustment period.

These adaptations and, in general, the methodology used to assess whether a Member State's fiscal plan are complying with articles 6 and 10 are described in Part II.1 of the 2023 Monitor (pages 109-115) are analysed and discussed in section 2 of this paper.

Before proceeding, two considerations are in order.

First, given these differences, in principle a Member State may comply with articles 6 and 10 even when fiscal risks continue to be regarded as high, although this is unlikely to be a frequent situation.

Second, the question arises of whether passing the simplified test of article 6 and 10 is adequate at reducing fiscal risks. The goal of a fiscal framework such as the one arising from articles 6 and 10 should be to reduce the risk that a Member State, as a result of the poor state of its public finances, faces a period of distress with negative spill overs for the other members of the European Union. In this respect, evaluating the fiscal risks does require looking at a range of variables (as it is done both in the IMF's "sovereign risk assessment" and in the Commission's "fiscal sustainability risk framework", including its DSA component, used in the 2023 Monitor). The approach of articles 6 and 10, focused just on the decline in the debt ratio (in the baseline and shocked scenarios), is therefore rather limited. This said, one merit of that approach is that it recognises one key aspect of fiscal stress, namely that the probability of a fiscal crisis, for a given level of the debt ratio, is significantly reduced if the debt ratio is on a declining path.[8] Of course, being on a declining path in which the pace of the decline is very modest does not help much in reducing fiscal risks. This said, in order to meet the conditions that (i) debt declines in the "deterministic scenarios" (involving less favorable conditions that the baseline), and (ii) the probability of debt not declining in the following five years is sufficiently low, debt needs to fall in the baseline at a sufficiently fast pace: with the caveats discussed, in particular, in section 2.6, a small decline would not be sufficient. Of course this conclusion holds as long as the deterministic scenarios and the stochastic simulations used by the Commission are properly designed, something that is also discussed in the next section.

[8] See, for example, the econometric analysis in Bassanetti, Cottarelli and Presbitero (2019).

2. THE DSA METHODOLOGY IN THE NEW ECONOMIC GOVERNANCE FRAMEWORK

The Commission's DSA methodology described in Part II.1 of the 2023 Monitor has three components: the analysis of the baseline in the absence of shocks, the determinist stress tests and the stochastic analysis. This methodology has to be applied first to evaluate the "reference trajectory" that, as required by article 6, the Commission has to send to Member States at the beginning of the planning period as the starting point of negotiations of the fiscal structural plans; and, second, to the fiscal structural plans themselves put forward by Member States. Let us consider how these three components are built and the process that is followed by the Commission to come to assess whether the requirements of articles 6 and 10 are met.

2.1. The baseline (adjustment scenario)

Article 10 requires that "the general government debt ratio of a Member State declines or stays at prudent levels, under the deterministic scenarios of the Commission's medium-term public debt projection framework". The first deterministic scenario is the baseline (or the "adjustment scenario" in the Commission's terminology). In the design of this scenario, four points, relating to the Commission's methodology, are worth raising.

The first point relates to **the length of the planning period and the path of the structural primary balance**. As indicated in Part II.1 of the 2023 Monitor, the scenario covers the full "adjustment period" (which can last from four to seven years), in which the structural primary balance follows the chosen fiscal adjustment path, followed by a ten year no-policy-change scenario in which the structural primary balance remains constant except for changes in the cost of aging. The Commission does not explain why a ten-year period is selected as the chosen interpretation of the "medium term" mentioned in article 10. Given the total length of the period covered by the projection (up to seventeen years, adding to the adjustment period the ten years post-adjustment scenario), the impact of demographic trends can be potentially huge. While Part II.1 does not say this explicitly, the wording in article 6 and 10 suggests that, in order to comply with the new fiscal framework, the debt ratio should be continuously declining (see below). It would not be enough that the debt ratio at the end of the period is below its level at the beginning of the planning horizon, or even at the end of the adjustment period. If this is the right interpretation, then, by the end of the adjustment period, the structural primary balance should be raised to a level that is sufficient to bring down the debt ratio steadily in the following ten years in spite of its possible shrinking due to demographic trends. Of course, the effects of these trends on the public accounts can be altered through pension reforms. One way or another, this approach would force Member States to plan ahead policies for the coming (up to) seventeen years. This long term planning, in principle, is a desirable feature but it may be quite hard to explain to the public opinion why it is necessary to take corrective measures in the immediate future to avoid an increase in the debt ratio ten-to-fifteen years down the road when the debt ratio is declining over a shorter time horizon.

More generally, it is hard to argue that a seventeen-year period can be considered as a standard interpretation of the expression "medium term" used in article 6 and 10. Indeed, DSAs implemented by other organisations have typically shorter horizon (5-10 years). This problem could have been alleviated if the Commission had interpreted the expression "medium term" as referring just to the five years following the adjustment period. Limiting the analysis to five years would have also to be consistent with the explicit reference to the five years following the adjustment period included in article 10 relating to the stochastic simulations (see below). Moreover, the standard DSA used by the

Commission for the assessment of medium-term fiscal risks has a total ten-year horizon, as underscored by the Commission's itself (see Part II.1, p. 110).

The second point relates to the **GDP growth and output gap assumptions**. The Commission's documents could have been clearer on this issue but it seems that the GDP projections are based on three principles: first, potential growth is based on the standard methodology agreed within the Output Gap Working Group. Second, the output gap is supposed to be closing "over three years after the end of adjustment". Third, actual growth is reduced with respect to what would result from the first two principles as a result of fiscal adjustment using a (presumably instant) multiplier of 0.75.[9] The latter is a fairly reasonable figure, although perhaps on the lower side of the available empirical estimates. However:

- the assumption that GDP growth is affected only in the year when the fiscal tightening takes place is rather unusual: lagged responses to a fiscal tightening are usually to be expected.
- The multiplier seems to be zero following the adjustment period even if the structural primary balance changes as a result of demographic forces, as noted by Darvas, Welslau and Zettelmeter (2023, p. 57).
- It is not clear why, leaving aside the impact of fiscal adjustment (which could have been explicitly considered), the output gap would close only over the three years following the (four to seven year) adjustment period. In the Commission's standard DSA the assumption is that the output gap would close within three years, in the absence (by hypothesis) of further fiscal adjustment. The same hypothesis could have been made, adding on top the impact of the fiscal adjustment based on a 0.75 multiplier. In Member States where the required fiscal adjustment is small the output gap may be close well before the three years following the adjustment period.
- The Commission does not explicitly discuss the uncertainty arising from estimates of the potential growth. This said, one of the stress tests to the baseline discussed below does consider the effect of lower long-term output growth. This at least recognises that the estimates of long-term output growth are subject to a high degree of uncertainty, although this uncertainty seems to be one-sided.

The third point relates to the **assumptions used for interest rates and inflation**. These assumptions are explained in detailed terms (and are broadly in line with standard practice), but some aspects remain somewhat unclear. Market interest rates and inflation are "assumed to converge over a 10-year horizon to country-specific values reflecting financial markets' expectations", beyond which they converge to common values in line with the latest Aging Report for interest rates and with the 2% inflation target. Regarding interest rates, more specific information is reported in the 2023 Monitor on pages 133-135 as part of the information on the "standard DSA", from which the DSA prepared as part of the new fiscal governance framework is derived. The process is very complex and the details provided are probably not sufficient to allow outsiders to replicate the results, particularly for long-term interest rates.[10]

[9] The term "instant multiplier" refers to the change in GDP caused by a change in the fiscal deficit occurring in the same year. Commission staff has indicated that Member States can use a different fiscal multiplier if they provide sufficient proof that the composition of their consolidation efforts justify a different multiplier.

[10] The approach requires distinguishing between short term (below one year) and long term (all the rest) interest rates, with specific rules on how these rates converge to certain forward values for the first 10 years, with additional assumptions regarding the convergence after ten years.

The fourth point relates to the **hypotheses on the stock-flow adjustment**, namely the statistical difference between the change in the debt stock in a certain period and the deficit in the same period (due, for example, to discrepancies between accrual and cash accounting, the accumulation of financial assets by the government or privatisation revenues). These are simple and standard: for the first two years, the stock-flow adjustment is in line with the Commission's forecast (presumably built based on specific information on the various items that are part of the stock-flow residual) and are set to zero afterwards, with the exception of some specific Member States (in 2023 these included Luxemburg, Finland and Greece). This approach of including any specific information, usually referring to the short term, while setting the stock-flow adjustment to zero thereafter is common practice in other international organisations like the IMF.

2.2. Deterministic stress-tests

As it is customary in traditional exercises aimed at assessing fiscal risks and, generally, in stress test analysis, the projected path of the debt ratio is evaluated under less favorable circumstances than those underlying the baseline. The Commission considers three scenarios: one in which the structural primary balance is permanently weaker, one in which the interest rate-growth differential is permanently higher and one in which nominal market rates are temporarily higher. Focusing on shocks to these variables is common to what is done by other organisations.[11] However, one non-standard feature is that the shock starts not from the first projection year, that is the first year of the adjustment period, but from the first year after the adjustment period. There is no clear reason why the Commission follows this approach, rather than the more customary one of starting from the first projection year. The choice may be perhaps justified for the shock on the primary balance, which is the focus of the monitoring of the Commission during the adjustment period, but it is not clear why it is assumed that things may go wrong in the behavior of other variables only after the adjustment period.

Another aspect that is not clear relates to the interaction among the key variables under the shocked scenario. It is standard practice to include these interactions, as they are important in actual economic developments. For example, if GDP growth is lowered, this will have implications for government revenues and the primary balance. If interest rates increase, this will have an impact on growth, etcetera. Presumably, these interactions are taken into account, but Part II.1 does not state this explicitly, nor does it indicate the extent of the interactions considered in the scenarios.

Finally, the magnitude of the shocks is the same for all counties (with the partial exception of the interest rate shock). This is somewhat at odds with the standard practice of calibrating the magnitude of the shock to the past volatility of the shocked variables in a specific country. More specifically:

- The structural primary balance shock is a ½ of a percentage point of GDP weakening of the balance, with a ¼ percent reduction each in the first two years after the end of the adjustment period, after which the structural primary balance remains permanently weaker. Part II.1 (p. 111) argues that a shock of this magnitude "corresponds to half of the historical standard deviation of the structural primary balance over all EU countries". In other words, the shock for country A is calibrated by looking at the average past volatility of primary balances across all EU countries, and not at the volatility of the primary balance in that country. Footnote 101

[11] For example, before its most recent revision, the IMF methodology (see International Monetary Fund, 2013) was focusing on separate shocks on real growth, real interest rates, the primary balance, the exchange rate and contingent liabilities (i.e. a one off increase in the debt ratio). Currently, the IMF no longer requires its staff to present shocked scenarios, except in specific cases. However, the assumptions for the key baseline variables (including the real growth rate the fiscal adjustment) are assessed for "realism", based on defined rules, which may potentially lead to a revision in the baseline itself. The ECB (see Bouabdallah et al., 2017) implements country-tailored shocked scenarios including less favorable assumptions on long-term growth and fiscal policy outcomes, in addition to a scenario in which the key variables are set at their historical level.

argues that this approach is in line with the IMF's practice as described in IMF (2013). However, this is not the case as the IMF considered a shock equal to "half of the 10-year historical standard deviation" of the primary balance. The shock, therefore, would be larger for countries that had a more volatile their primary balance.

- The interest rate-growth differential in the shocked scenario is assumed to be permanently increased by 1 percentage point. Again, this is the same size for all countries regardless of the past volatility in the differential or of the past over-optimism by country authorities or the Commission in projecting ahead, for example, the long-term growth rate of the economy.
- In the "financial stress scenario" market interest rates are assumed to increase temporarily (for one year) by one percentage point "plus a risk premium for high-debt countries". There is no clear indication of how this higher risk premium is computed other than a generic reference in a footnote to Pamies, Carnot and Patarau (2021). We do not know, therefore, what is the increase in the spread that would be included for countries that underwent severe financial stress during, for example, the 2011-12 euro debt crisis. In any case, a one percentage point increase for one year constitutes a very mild interest rate shock. During the most recent surge, ECB interest rates increased by over 4 percentage points in one year and remained at higher levels for well over one year.[12]

2.3. Stochastic DSA: general aspects

The general idea behind stochastic analysis is to evaluate the probability of a certain event, in this case, as indicated in article 10, that the debt ratio will decline in the five years following the adjustment period. This probability is computed empirically by applying to the baseline of the structural fiscal plan a very large number of sets of shocks to the variables driving the debt accumulation. The shocks are applied in each year of the five-year post-adjustment period. Finally, the percentage of paths in which the debt ratio turns out to have and not to have declined at the end of the period with respect to its value at the beginning of the period is computed.

In implementing stochastic DSA different approaches can be followed regarding: (i) the time period over which the paths are computed; (ii) the variables that are shocked; (iii) the number of paths (sets of shocks) that are computed; (iv) the nature of the shocks; (v) the way the shocks are computed and the paths generated. We now consider these aspects in turn: the first four are relatively simple, while the last one requires a more thorough assessment and is discussed in section 2.4. The relevant information to illustrate the methodology used by the Commission is for this exercise included in Annex A4 of the 2023 Monitor (pages 139-145).

The **time period over which debt paths are computed** is set directly by article 10: five years after the end of the adjustment period. The Commission, therefore, has no flexibility in this respect, given the decision reflected in the 2024 Regulation.[13] It remains strange that the stochastic analysis does not cover the adjustment period as if, during that period, the adjustment path were not subject to random shocks.

[12] In may be argued that that this interest rate increase occurred in response to higher inflation which boosted government revenues and eroded the value of public debt in circulation, thus with an offsetting effect on the debt ratio. The fact remains that, when nominal rates increased, inflation started declining which implied a sizable increase in real rates. In any case, as already noted, the extent to which other macro variables co-move with the shocked variable in the various scenarios is not clarified by the Commission's documents.

[13] Of course, the Commission contributed in a primary and critical way to the drafting of the 2024 Regulation itself.

The **shocks involve five variables**:[14] the primary balance (as a ratio to GDP), the nominal GDP growth, the nominal short-term interest rate, the nominal long-term interest rate and (for non euro area countries) the exchange rate.[15] These are the key variables appearing in the debt accumulation equation and are those normally considered also by other organisations.[16] The only exception is the absence of shocks to the stock-flow adjustment, including, for example, the effect of one-off increases in the debt stock, but this kind of shocks, when they occur (e.g. as a result of a banking crisis), is of a different nature than those considered typically in stochastic DSA. If anything, it may have been the focus of the deterministic component of the DSA.

The Commission's stochastic DSA involves **10,000 sets of random shocks** covering for the above four/five variables each of the first five years after the end of the adjustment. The number of shocks has been increased with respect to previous Commission's DSA, which involved 2,000 shocks. There is some evidence 2,000 shocks may not be sufficient to ensure the stability of the empirical distribution of debt ratios at the end of the period and hence of the estimate of the probability of debt declining.[17] In any case, with the improvement over time in data processing speed it has become common to increase the number of shocks in stochastic DSA. In its latest methodology, the IMF has also moved to 10,000 shocks. The ECB methodology presented in Bouabdallah et al. (2017) involves 5,000 shocks.

As to **the nature of the shocks**, in the Commission's DSA they are symmetric, that is with an equal probability between a favorable shock reducing the debt ratio and an adverse shock raising it. The practice of asymmetric shocks (with a higher probability for an adverse shock, to be more "on the safe side") was used in the past by the IMF but has now been discontinued.

2.4. How the stochastic shocks and the stochastic paths are computed

Stochastic DSAs performed by various organizations differ significantly in the (usually fairly complex) way in which the random shocks are generated. The Commission's approach involves the following six steps (see Figure 1).

The first step is to compute the historical "shocks". The goal is to evaluate how volatile the key drivers of the debt accumulation equation were in the past as a guide to replicate these shocks in the future.

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[14] The sources of the information on these variables are listed in Annex A4 (pages 139-140 and Table A.4.1), with specific details on some countries for which the standard definitions had to be modified, adding some further complexity to the replicability of the analysis.

[15] Annex A4 (p. 139) indicates that the shocks affect "the primary balance" without indicating that this variable is taken as a ratio to GDP. However, a few lines earlier, in listing the drivers of the debt dynamics, it was explicitly mentioned that the primary balance entered the equation as a ratio to GDP.

[16] The debt accumulation equation used by the Commission is a more complex version of the standard debt accumulation equations according to which:

$$d_t = d_{t-1} - pb_t + \frac{(i_t - g_t)}{(1+g_t)} d_{t-1}$$

where d is the debt-to GDP ratio, pb is the primary balance, i is the average nominal interest rate on public debt and g is the nominal growth rate of GDP. This equation is modified to allow for the possibility that some debt is contracted in a currency different from the euro (or other national currency of non-euro EU members), to identify separately the effect of aging costs and to add the statistical residual (stock-flow imbalance, namely the difference between the change in the stock of debt in a certain period of and deficit in the same period):

$$d_t = \alpha^n d_{t-1} \frac{1+i_t}{1+g_t} + \alpha^f d_{t-1} \frac{1+i_t}{1+g_t} \frac{e_t}{e_{t-1}} - b_t + c_t + f_t$$

where the additional components of the equation are, the share of total debt denominated in national currency (α^n) and foreign currency (α^f), the nominal exchange rate expressed in national currency per unit of foreign currency (e_t), the primary balance over GDP (before ageing costs) (b_t), the change in age-related costs over GDP in year t relative to the starting year (c_t) and the stock-flow-adjustments (SFA) over GDP (f_t).

[17] Darvas, Welslau and Zettelmeyer (2023), Appendix IV find that with 2,000 shocks the estimates of the probabilities of debt declining may differ by some 3% from one set of 2,000 shocks to another. They therefore opt for one million shocks, arguing that this yields stable probabilities. It is not clear whether moving from 2,000 to 10,000 shocks removes completely the instability problem but it should at least reduce it.

For example, if in the past GDP growth was volatile, then GDP growth is assumed to be volatile also in the future. These past shocks are simply defined as the quarterly change in the five above mentioned variables computed over the period Q1 2000-Q3 2023. The implications of the choice of this period, over which the convergence process after the euro area creation was certainly not completed and the euro area had to undergo a major credibility crisis, are not explicitly assessed by the Commission. In any case, these quarterly changes are not de-trended, as the variables are not expected to have a trend.[18] On the positive side, in order to remove a component of the volatility of growth that is entirely predictable and self-reversing, the primary balance is adjusted for seasonality using the X-12-Arima package, a standard one in statistical analysis.

The second step is to eliminate from the historical shocks the "outliers", that is changes in the variables that are particularly large. This is done by replacing changes below the 5th percentile and the 95th percentile of the distribution of the historical shocks (in other words, both the very large increases and the very large declines) with the value of the variable corresponding to the closest percentile within the 5th to 95th percentile range.[19] This procedure reduces the volatility in the data and it does not have a clear justification: outliers do happen in real life. Why excluding them?

Third step: based on these historical "shocks", the Commission computes the so-called "variance-covariance matrix" a four-times-four (five-times-five for non euro area countries) matrix in which the numbers in main diagonal are the variance of the variable in a certain row/column and the other numbers are the covariances between the variables in corresponding rows and columns. Leaving aside the technicalities, the numbers in the rows and columns of the matrix describe both the volatility of each of the variables and the extent in which variables tend to move together when they are shocks: for example, when GDP growth is lower, revenues will tend to be lower and the primary balance will tend to be lower. Standard statistical packages compute a variance-covariance matrix once provided with a set of shocks computed over a certain period of time (notably, those derived in the first and second steps).

Fourth step: a specific algorithm (also normally included in any statistical analysis computer software) is then used to generate a set of "shocks" to the key variables, under the assumption that these shocks come, usually, from a joint normal distribution (the typical "bell curved" distribution for single variables) with zero mean and the variance-covariance matrix estimated under the third step. This fourth step is replicated 10,000 times yielding 10,000 sets of shocks at the quarterly level.

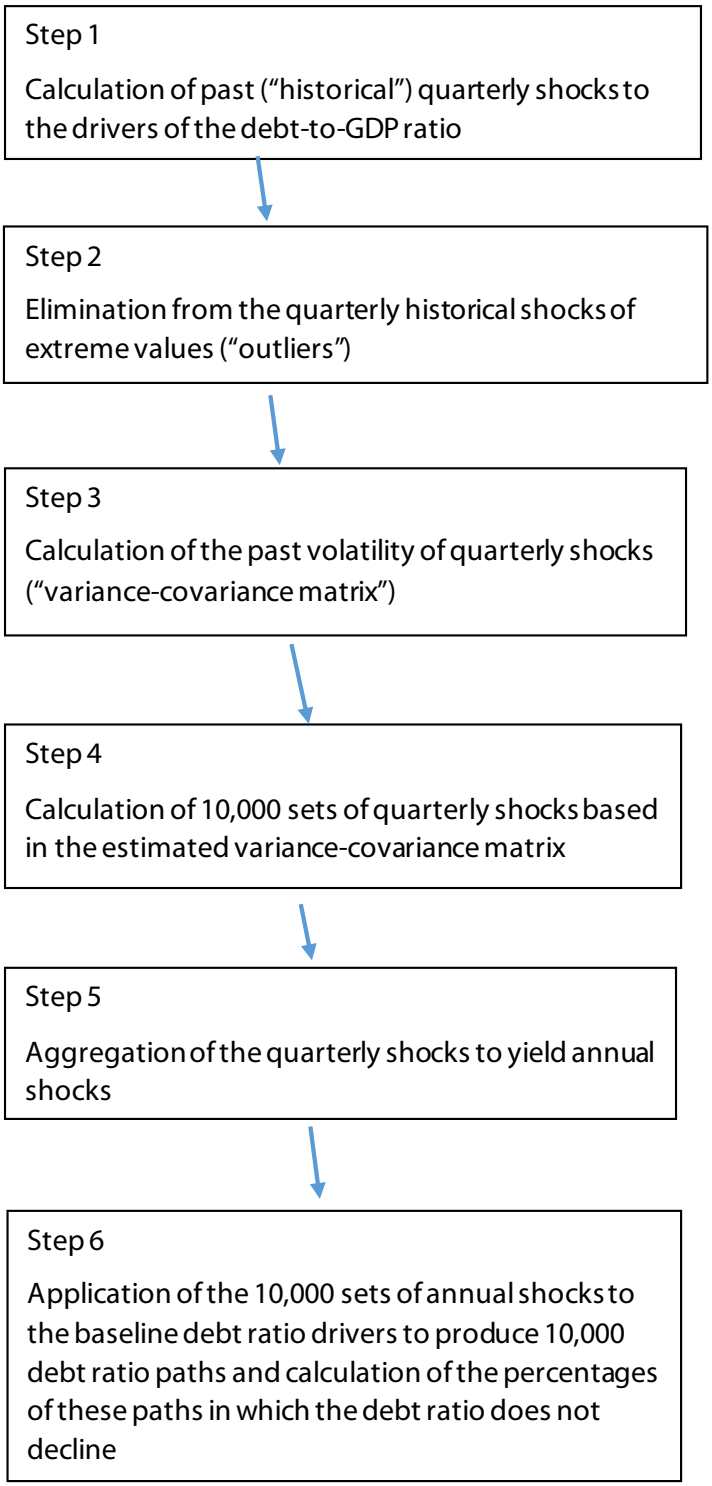
Fifth step: these quarterly shocks are then aggregated at the annual level by adding them. They are considered to be temporary shocks and are applied as such to the corresponding variables included in the baseline to yield, through the standard debt accumulation equation, 10,000 alternative debt paths. The only exception to the temporary nature of the shocks relates to long-term interest rates. However, this is not because the shocks on long-term interest rates are regarded as long lasting, but just because their impact on interest payments, and hence on the effective (that is average) interest rate entering the debt dynamics equation, is long lasting because of the long-term maturity of the securities to which these interest rates apply. The procedure for moving from shocks to short-term and long-term interest rates to shocks in the effective interest rates appearing in the debt accumulation equation is described

[18] For non euro area countries a trend may, in principle, be present also in the exchange rate, to reflect inflation differentials (short of an equilibrium real exchange rate appreciation or depreciation).

[19] Annex A4 (p. 140) actually refers to a replacement "by the closest percentile value", which is not clear, but, presumably, what is meant is that if an observation corresponds, for example, to the 99th percentile it is replaced by the value of the variable corresponding to the 95th percentile.

in Annex A4 of the 2023 Monitor (pages 140-142) and is rather complex, albeit it remains a simplified one with respect to the actual pass-through process of increases in interest rates.[20]

Figure 1: Stochastic DSA – A flow chart in six steps



Source: Author's own elaboration

[20] The main simplification is that, instead of computing the impact of the increase in interest rates by considering the actual composition of the stock of public bonds in circulation in a certain year in terms of debt term structure, the methodology simply splits debt into a short-term and a long-term component, with the impact on the effective interest rate reflecting the relative weight of the two components of the debt stock.

The sixth and final step involves the calculation of the 10,000 paths around the baseline by adding the vector of the shocks to the baseline variables and using the debt accumulation equation to get the debt-to-GDP levels for the five years following the adjustment period. The distribution of these 10,000 paths is summarized in a fan chart, usually reporting the paths of the 10th and the 90th percentile of the debt distributions (containing 80% of paths), although the calculation of the percentages of cases in which debt declines or not of course includes the full set of paths.

Is this approach appropriate? What are the alternatives in producing the random shocks and, hence, the path distribution? Stochastic simulations require applying shocks to the initial baselines and there are essentially three ways of producing those shocks. The first is the one followed by the Commission. The second one, used for example by the ECB and described in Bouabdallah et al. (2017), is similar. However, the variance-covariance matrix is not computed from the changes in the historical values, but from the residuals of an econometric model describing the past behavior of the economy (typically a structural vector auto-regression model, or SVAR). This is done because of the attempt to focus on the changes that are truly unexpected (and hence should not be already incorporated in the baseline). This, in principle, is preferable but only as long as the SVAR model is appropriately specified and estimated. In any case, both these approaches require assuming that the shocks come from a distribution with a specific shape, as noted, typically a joint normal distribution. Annex A4 of the 2023 Monitor justifies this choice on simplicity grounds and because the process "reduces the likelihood of drawing extreme outliers", which, again, raises the issue of why it is preferable to exclude outliers that are instead part of normal economic developments.

The third approach, currently used by the IMF, is much simpler and does not require any assumption on the shape (for example its normality) of the shock distribution and, hence, does not require the preliminary calculation of a variance covariance matrix. The approach requires selecting randomly a year T from a pre-determined time interval (for example the first two decades of this century) and taking the values of the relevant variables in year T and year T+1. The shocks are then computed as these values minus the mean of the variables in the historical period. So, for the typical 6 years period for which the IMF computes the paths, three random draws are made. This process is repeated 10,000 times. There are two advantages in this process. First, as noted, the process does not require the assumption of normality in the shock distribution and thus it can capture the actual shape of the real life distribution. This is particularly important for the countries whose, for example, growth rates are not normally distributed but with a fat tail (of extreme values) in one direction. Second, the fact that observation years are drawn in pairs allows to generate shocks that are potentially auto-correlated, an important feature of real life shocks: in real life shocks normally lasts more than one period. This is particularly relevant when, as in the case of the Commission's DSA, shocks are computed on a quarterly basis, as these in real life are almost certainly correlated.

It is not clear why the IMF approach has been ruled out by the Commission, nor it is clear what are the consequences of the Commission's choice in terms of the distributions of the 10,000 paths built through the stochastic DSA. However, one can conjecture that the absence of autocorrelation errors, the exclusion of outliers in the calculation of the variance-covariance matrix, and the choice of a joint normal distribution of the shocks implies that the likelihood of more extreme paths is reduced, leading to a narrower fan width and a reduction in the estimated uncertainty around the baseline. The only evaluation of the effects of the Commission's methodology is presented on page 143 of Annex A4. It just illustrates the effect on the fan shape of the limited changes introduced by the Commissions with respect to the old Commission's methodology, namely the shift from 2,000 to 10,000 random draws, the harmonisation of the sample length across countries and the exclusion of outliers. Just these changes reduce the amplitude of the 10th-90th percentile fan width, in the example shown, from about

24 percentage points of GDP to 18 percentage points, i.e. by one quarter. The fan width may have been further reduced by the adoption of the above mentioned other aspects of the selected approach with respect to the results that would have been obtained using, for example, the IMF approach.

2.5. The DSA-based criteria to evaluate compliance with the new fiscal rules

Part II.1 of the 2023 Monitor (page 111) lists three "DSA-based criteria" that Member States' plans must comply with to be in line with the new fiscal framework. The first is that the deficit should be brought and remain below 3% of GDP over the medium term. The second and third requirements are a more detailed version of Articles 6 and 10.

The second is that "By the end of the adjustment period at the latest, and over the 10 following years, debt declines or stays below 60% of GDP both in the adjustment scenario and under all three deterministic stress tests". This is the first requirement listed in art. 10 with the addition that the "medium term" needs to be understood as the 10 years following the end of the adjustment period. The Commission has thus added a specific timeframe, which is not included in articles 6 and 10. One could argue that the authority to do so has come from the reference in art.10 "to the Commission's medium-term public debt projection framework". However, in the standard DSA implemented by the Commission, as already noted, the time frame considered is 10 years starting with the first year after the last actual debt data. Instead, the 10-years period mentioned in the first requirement of Part II.1 starts with the end of the adjustment period for a total of up to seventeen years ahead, an unusually long period for a "medium term" perspective.

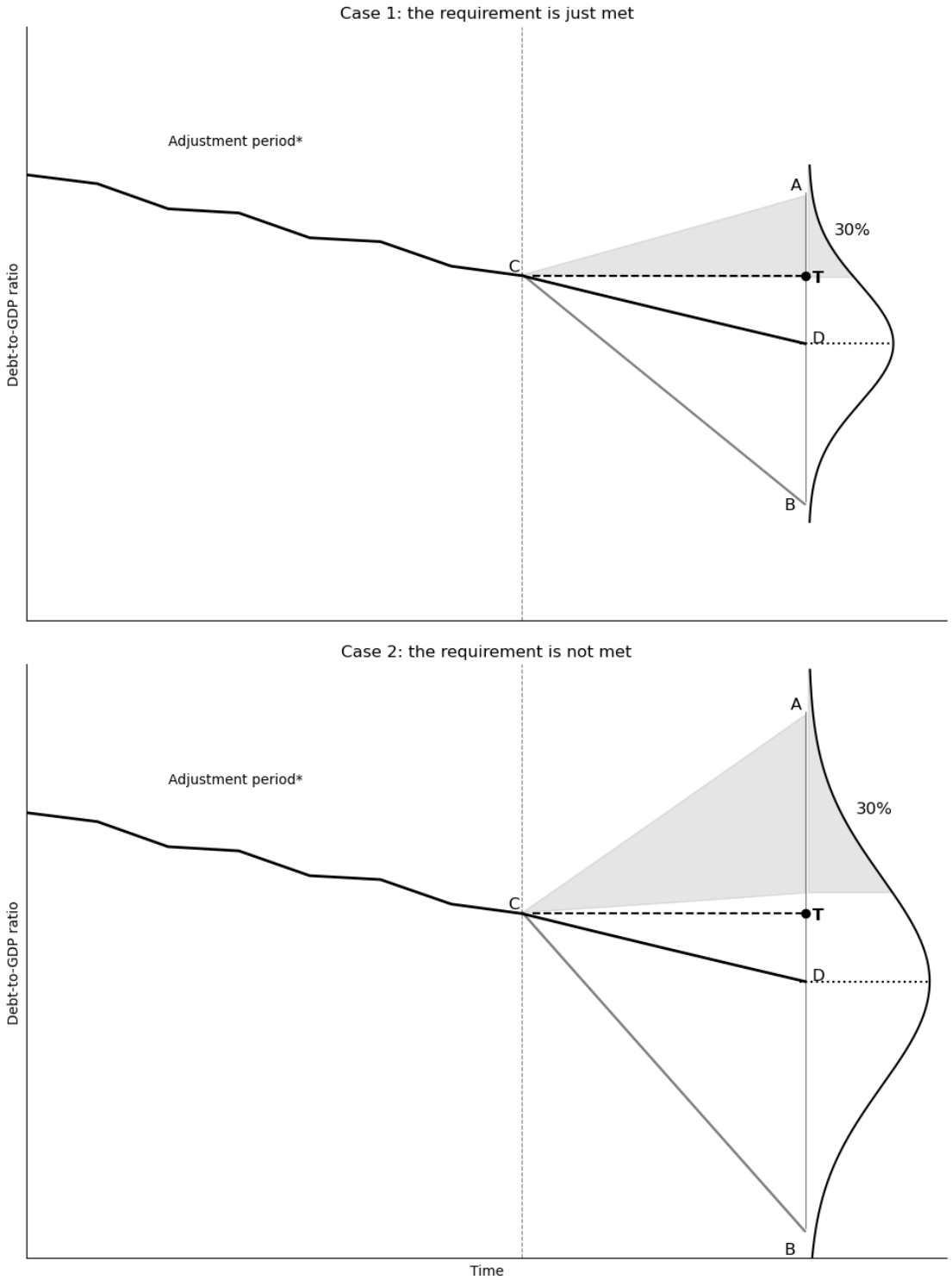
The second requirement is that "In the 5 years following the adjustment period, debt declines with a sufficiently high probability, i.e. at least 70% in line with the threshold used in the Commission's standard DSA". This repeats the second requirement in art. 10 with the addition that a "sufficiently high probability" means a probability of at least 70%, which the Commission argues is used in its standard DSA. The Commission's standard DSA, in its stochastic component, does indeed identify a probability of 70% of debt remaining lower than the initial level as the relevant threshold for not considering risk as "high" (Annex A1 of the 2023 Monitor, page 123). This, however, holds for countries with an initial debt ratio higher than 90%, while for countries with a debt ratio between 60% and 90% the relevant probability threshold for risk not being high is just 40%. Thus, it is not clear why the Commission decided to use a probability of 70% also for this second group of countries.

2.6. How relevant are the specific features of the stochastic simulations in determining the required decline of the debt ratio in the baseline?

In order to better assess the Commission's DSA methodology, it is useful to evaluate how important the specific features of the stochastic DSA are in determining the degree of fiscal adjustment that a Member State is supposed to undertake. The short answer is that they are very important. Those features determine the distribution of the paths at the end of the projection period (i.e. five years ahead) and, in particular, how dispersed they are around the baseline debt ratio. This dispersion univocally determines how low the baseline debt ratio should be at the end of the five years and, hence, how much the planned decline in the debt ratio should be. The higher is the dispersion, the lower you need to aim at in the baseline to avoid that more than 30% of the paths imply values of the debt ratio above the level of the debt ratio at the beginning of the five-year period.

Figure 1 illustrates this in more detail. In the figure, the vertical dotted line through point C marks the end of the adjustment period and the beginning of the five-year stochastic analysis. Point C marks the level of the debt ratio. The solid line starting from that point represents the baseline path of the debt ratio ending in point D after five years. As noted, the fan (the area included between lines CA and CB), as usually depicted in the Commission's document, describes the distribution of the debt ratios in the 10,000 stochastic paths truncated between the 10^{th} and the 90^{th} percentile (see, for example, the country fiches in Annex A of the 2023 Debt Sustainability Monitor; p. 181 for Belgium, for example). Figure 1 adds to the usual representation of fan by the Commission the probability distribution of the debt ratio at the end of the five-year period, assuming (see discussion below) that this distribution is normal (the bell shaped curve at the right of the vertical line AB). Even if it is not normal, this distribution is likely to be symmetrical around the end-point of the debt ratio (point D), given the symmetric distribution of the shocks. About fifty percent of the paths are above that point, fifty percent below.

Figure 2: How the stochastic DSA affects the required decline in the debt ratio



(*) During the adjustment period (the period before point C) the debt ratio must decline by one percentage point of GDP per year, on average

Source: Author's own elaboration

For the stochastic DSA test to be passed at most 30% of the distribution of debt paths must lie above point T, where the debt ratio is at the same level of the starting point C (and thus has not increased). This is what is depicted in the top panel of Figure 1 in which the test is barely passed. Consider now the lower panel of Figure 1. The fan is wider and so is the probability distribution of debt ratios at the end

of the five-year period.[21] This implies that, for the same level of the debt ratio at the end of the five years, the percentage of the curve above point T exceeds 30%: the test is not passed. This shows how important is the shape of the distribution of the 10,000 debt paths in determining whether a Member States passes the test: a more spread out distribution (a wider fan) requires aiming lower in the baseline in order to pass the test.

What is the precise relationship between the amplitude of the fan (i.e. how spread out is the debt distribution) and required the decline in the baseline debt ratio? How much lower should one Member State aim at if the distribution is more spread out?

To answer this question, we just need to know how far point D must be from point T, so as to leave 30% of the distribution of debt ratios above point T. In the case the distribution is normal (as in Figure 2) the calculation is simple. The distance between the mean of a normal distribution and the point that leaves to the left 30% of the distribution is equal to 0.524 times the standard deviation of the distribution.[22] It follows that the projected baseline decline in the debt ratio (the distance between D and T) to ensure that the stochastic DSA test is passed must be at least equal to:

(1) Total required decline in the debt ratio = 0.524 x standard deviation

(2) Required annual decline = (0.524 x standard deviation)/5= 0,1048 x standard deviation

In other words, the current fiscal framework requires that at the end of the adjustment period the primary surplus is brought to a level that ensures that, from then on, the debt ratio declines by about one tenth of the standard deviation of the distribution of the 10,000 debt paths after five years.

What does this mean in practice for Member States? To answer this question we need to apply equation (2) above to various Member States, which requires information on the standard deviation of the distribution of the debt paths for each Member State. Fortunately, Annex A8 of the 2023 Monitor reports the fan charts for all Member States for the 10%-90% range of the distribution of debt paths at the end of the five-year period covered by the stochastic DSA (the precise fan widths at the fifth year are published in a related spreadsheet also publicly available). These ranges are reported in the first column of Table 1 (labelled as R10%90%) The formula for the standard error of a normal distribution where the distance between the 10th and the 90th percentile is R10%90% is:

Standard deviation = R10%90%/2.5632[23]

Using this formula the second column of Table 2 reports the calculated standard deviation of the distribution of the debt paths at the fifth year. By using equation (2), it calculates the required decline in the debt ratio in the post adjustment period necessary to just pass the stochastic DSA (third column) and, hence, in the level of the required primary balance at the end of the adjustment period, other things being equal (see below for the impact of the primary balance of the so called "snow ball effect").

[21] In what follows, I do not distinguish between the theoretical distribution of the debt ratios and the sample distributions. With 10,000 paths, the theoretical and sample distributions are likely to be similar.

[22] The figure 0.524 is derived from the usual statistical tables reporting for each point of the standard normal distribution (that is a normal distribution with mean zero and a unit standard deviation) the percentage of that distribution that lies to the left of that point and, hence, the probability of an outcome smaller than the one corresponding to that point.

[23] The figure 2.5623 is also derived based on the usual statistical tables describing the shape of the standard normal distribution.

Table 1: Required decline in the debt ratio for selects EU countries based on stochastic DSA

	R10%90%	Standard deviation	Required debt decline	Required debt decline (simplified)
Belgium	28,5%	11,1	1,16%	1,40%
France	19,5%	7,6	0.80%	1,00%
Greece	58,0%	22.6	2,37%	2,90%
Italy	33,3%	13.8	1,36%	1,65%
Spain	31,1%	12,1	1,27%	1.55%

Source: Author's calculations based on data from the 2023 Debt Sustainability Monitor

The differences across countries are not huge, but they are not trivial either: for example, Greece, on account of the volatility of its economy, would have to keep its primary balance higher than the level required from France by about 1,6 percentage points of GDP (almost 2,4 percentage points instead of 0.8 percentage point).

The figures in Table 1 are, of course, indicative. The actual required decline will depend on the actual distribution of the 10,000 debt ratios at the end of the five year period. This distribution will not necessarily be normal, even if the shocks come from a normal distribution, because they do not enter the debt accumulation equation in a linear way. In the first year, with the debt ratio being pre-determined, the relationship between the stochastic variables is almost linear (except for the GDP growth rate entering the equation in the denominator of the term relating to the interest rate-growth differential, which is unlikely to make much of a difference unless g is very large). However, from then on, the debt ratio is also a random variable as it depends on the previous year's shocks. The Commission has not provided any comments on the shape of the actual distribution of debt ratios, which is unfortunate. But one cannot rule out that that distribution is not too far away from normality, which would allow to regard equation (2) above as the new fiscal rule arising from the stochastic component of the new fiscal framework.[24] In any case, what really matters to determine the decline in the debt ratio is how spread out the distribution of debt ratio is after five years, whatever its precise shape might be.

It is thus worth underscoring the dramatic change in the EU fiscal framework with respect to the old (pre-Covid) one. In the old framework the annual required debt decline depended just on the debt level according to the following formula:

(3) Annual required decline= (1/20)x(debt ratio-60%)

Rule (2) and rule (3) are completely different. In rule (3) the only thing that matters in determining the required adjustment is the debt ratio. In rule (2) the debt ratio does not matter almost at all. A second important difference is that in rule (3) the adjustment depends on an easily observable variable (the debt ratio), while in rule (2) it depends on a variable (the standard deviation of the debt distribution) that needs to be estimated through a complex, and to some extent (as discussed above) arbitrary

[24] Preliminary results of a study conducted at the Institute for European Policy-Making of the Bocconi University suggest that the distribution of debt ratios at the end of the five-year period is indeed close to normal.

process. In their paper the authors did not underscore that, in practice, this would mean adopting a rule similar to the one in equation (2), which is entirely based on a variable that is not observable (the volatility of projected debt paths) and that is hard to estimate. This is not a minor difference as one of the main goals of the reform of the fiscal rules was the reduction on the reliance of non-observable variables.

The only reason why countries with a higher debt ratio might need to reduce their ratio faster is that, in the debt accumulation equation, a larger debt stock "magnifies" any shock on the interest rate and the growth rate, thus involving a broader distribution of debt ratios at the end of the five years. This is not a very transparent way through which the debt ratio may influence the required decline. In any case, this channel operates strongly only for Member States that experienced in the past high volatility in interest and growth rates, so we go back to the issue just mentioned: more than debt levels, what matters in determining the required adjustment is past volatility, and, as a reflection, the projected distribution of debt ratios around the baseline. This distribution had to be estimated though the complex approach described in the previous sections. Member States with a, potentially, very high debt ratio may not need to reduce that ratio much in the baseline, at least based on the stochastic component of the DSA, as long as they were in the past subject to moderate shocks so that their debt fan width is narrow.[25]

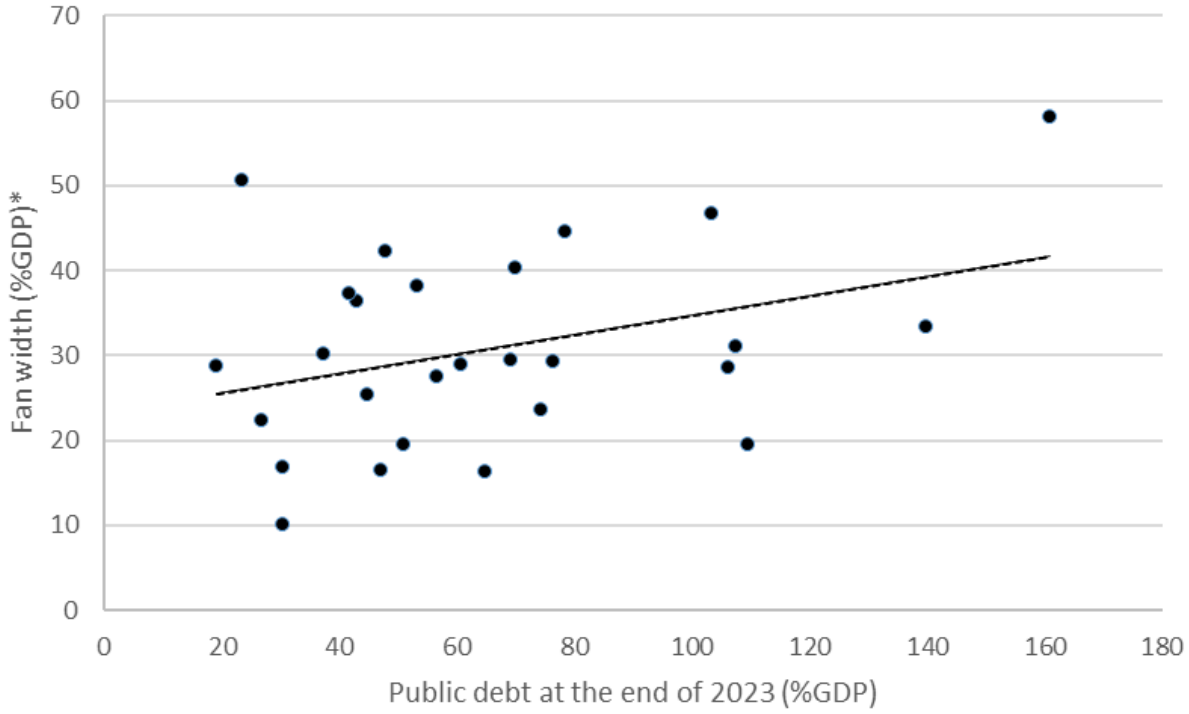
The primary balance to be achieved by the end of the adjustment period will of course be affected by the initial debt level. In order to achieve a certain decline in the debt ratio, the primary surplus will need to be higher if the debt ratio is higher because the so-called "snowballing effect" (i.e. the difference between the average interest rate on public debt and the GDP growth rate multiplied by the debt ratio) will be higher. However, the required decline in the debt ratio will not be much affected by the initial debt stock.

One could, however, argue that, empirically, Member States with a high debt ratio typically showed in the past higher volatility in the drivers of the debt ratio and, hence, will have a larger fan width. Figure 2 shows that this is indeed true: the correlation between fan width, as computed by the Commission, and the debt ratio in 2023 is positive. However, the correlation coefficient is not very large (0.36) and the dispersion around the regression line is sizeable. The old and the new rule are therefore quite different in the amount of decline in the debt ratio required by individual Member States.

It could of course be argued that the new rule is anyway better than the old one because it is the volatility of public debt, i.e. its susceptibility of being moved to a higher level as a result of shocks, that is relevant in assessing fiscal risks, rather than its level. However, past volatility (in any case something that is not observed, as noted) may be a poor indicator of future volatility. Moreover, a high public debt leaves a country more exposed to economic shocks through a number of channels (such as higher impact of interest rate increases, bad equilibria problems, absence of fiscal space to raise the primary balance beyond what is needed to just stabilise the debt ratio at high levels). **From this point of view a rule focused on the reduction of the debt level** (at a more moderate pace than the unrealistic one reflected in rule (3)) **may have been preferable and it would certainly have been simpler and transparent.**

[25] The intellectual stimulus in the shift from equation (3) to equation (2) may have come from Blanchard, Leandro and Zettelmeyer (2021). While the authors advocated a shift away from rigid rules in favor of "fiscal standards", they argued that "The primary tool for assessing whether the fiscal standard is satisfied would be stochastic debt sustainability analysis. Conceptually, this analysis would generate a distribution of paths of the debt ratio (sometimes called a "fan chart"), based on forecasts for the drivers of the debt dynamics, which are themselves stochastic …" (page 22)

Figure 3: Relationship between public debt ratios and fan widths for EU countries



(*) Difference between the 90th and 10th percentile of the stochastic projections

Source: Author's own elaboration. Fan widths are from the 2023 Debt Sustainability Monitor; debt ratios are from Eurostat.

One last remark. The above discussion is based on the normality of the fan, which may be a good approximation to the shape of this distribution. The formula of the required decline in the debt ratio becomes even simpler if we assume that the distribution of end of the period debt ratios is uniform (i.e. same probability abound the baseline for various debt level within a certain interval). In that case the annual required decline is described simply by the following equation

$$\text{annual required decline} = 0.05 \times R10\%90\%$$

This means that for each 10 percentage points of GDP increase in the fan width, the projected annual decline in the debt ratio in the baseline must be 0.5 percentage point of GDP larger.[26] This simplified approach yields results somewhat larger than to the ones based on the normality hypothesis (as shown by comparing the third and fourth columns of Table 1), and consistent with the fact that the normal distribution is more concentrated around its mean.

[26] As noted, the 10%-90% fan width is published in the 2023 Monitor. The conclusion that the annual required decline in the debt ratio must be at least equal to 0.05% of this fan width, under the hypothesis of uniform distribution, follows from two conditions. First, calling L the total fan width, i.e. the distance between point A and B in Figure 1 (under the hypothesis of uniform distribution between these two points), the distance between point T and the top of the fan width, when the stochastic DSA criterion is just met, must be equal to 0.3L (as 30% of debt paths must lie in that portion of the line). Second, the fan chart, by construction, is symmetrical around point D, so that below that point lies 50% of L. So if we call x the total required decline of the debt ratio over five years (the distance between D and T), we know that x = L - 0.3L – 0.5L, which implies x=0.2L. The annual required decline in the debt ratio is one fifth of this: annual required decline=x/5= 0.04L. The 10%-90% band published by the Commission in the 2023 Monitor includes 80% of the full band, L=R10%90%/0.8. It follows that the annual requited decline is: x/5=0.04L=(0.04/0.8)R10%90%=0.05R10%90% as reported in the text.

2.7. How sensitive are the stochastic simulations to the methodology used by the Commission?

The relevance of the stochastic DSA for the magnitude of the required adjustment brings to the fore the issue of the specificities of the DSA methodology adopted by the Commission vis-à-vis other methodologies. However, to what extent do these specificities matter? As a term of reference, Table 3 compares the widths of the DSA fan charts of the Commission (also used in Table 2) with those estimated by the IMF with the different methodology discussed above.[27] The last column, showing the differences between the two sets of estimates, highlights that in two cases (Belgium and France) the estimates are fairly close. In one case (Italy) the Commission's estimate is somewhat larger. In the remaining two cases (Greece and Spain), the estimates are much larger for the IMF.

Table 2: Estimates of the width of the DSA fan chart

	EU Commission	International Monetary Fund	Difference
Belgium	31%	28,25%	2,75%
France	22%	25,90%	-3,90%
Greece	64%	89,00%	-25,00%
Italy	37%	31,30%	5,70%
Spain	34%	70,60%	-36,60%

Altogether, the differences appear to be relevant in some cases and, on average, the IMF's width are larger. The two cases in which the IMF widths are particularly larger than the ones estimated by the Commission refer to two countries that since the early 2000s were hit by severe shocks. This suggests that the larger width of the IMF estimates may be explained by the fact that the Commission's estimates exclude by construction extreme outliers, thus reducing the width of the fan charts whenever those outliers were particularly relevant in the past.

[27] The IMF fan widths are derived from the annexes on Sovereign Risk Debt Sustainability Analysis included in the most recent IMF's Article IV Reports for the various countries. The widths reported by the IMF refer to the distance between the 5th and the 95th percentile of the debt ratio distribution and so they are not precisely comparable with those derived from the Commission's DSA, which refer to the distance between the 10th and the 90th percentile. Given the way the IMF computes the shocks, the distribution of debt ratio is unlikely to be normal and it is therefore impossible to re-size the IMF widths to cover the same distance covered by the Commission's widths. Another correction is, however, possible to facilitate the comparison. The IMF projection period is six years. Therefore, to make the widths comparable with those estimated by the Commission over five years, the IMF estimates were multiplied by five sixths.

3. OVERALL QUALITY OF THE COMMISSION'S DSA PROCEDURE AND THE ISSUE OF ITS REPLICABILITY, PREDICTABILITY AND TRANSPARENCY

How good is the Commission's DSA procedure? It is impossible to answer this question in abstract terms. Different methodologies are followed by different institutions to run DSAs and perhaps only time will allow identifying the one that was able to better identify fiscal risks. Therefore, what follows looks at two more specific questions. The first is whether there were aspects in the Commission's DSA methodology that were chosen without explaining well why it was decided to deviate from alternative solutions. In a way, this is an issue of "transparency" of the methodology. The second one is whether the results reached through the Commission's methodology are replicable and, therefore, predictable given sufficient information.

Regarding the issue of transparency (and leaving aside the question of the overall transparency of the DSA approach discussed in the next Section), Section 2 highlighted a number of aspects of the Commission's methodology for which it was not explained why certain options were followed and what are the consequences of the approach followed. More specifically:

- The "medium term" mentioned by Article 10 to evaluate debt declines under the Commission's deterministic scenarios is interpreted by the Commission as referring to ten years after the adjustment period. A ten year period is very long (as it is added to the four to seven year adjustment period, for a total of fourteen to seventeen years) compared to what other institutions do, what the Commission does in its debt risk assessment (ten years altogether) and what is done for the stochastic DSA (five year period after the adjustment period).
- The Commission assumes that the output gap will be closed "over 3 years after the end of adjustment" period (see 2023 Monitor, p. 110), while in the Commission's standard fiscal risk assessment the output gap is closed within three years from the latest data. Information provided by the Commission staff indicates that in the DSA methodology the output gap starts closing, ceteris paribus, already during the adjustment period, but it is kept open by the fiscal adjustment itself. However, if so, there would be no reason to assume that the output gap closes only during the three years following the adjustment: if the magnitude of the required adjustment is small, the output gap may be closed even before three years after the end of the adjustment period.
- The methodology implies a fiscal multipliers of 0.75 during the adjustment period, but, apparently, the multiplier is zero following the adjustment period even if the structural primary balance changes because of demographic forces.
- In the deterministic scenarios the primary balance, GDP growth and interest rate shocks start only at the end of the adjustment period. It is customary to run shocked scenarios in the first projection year, including in the period when an adjustment is envisaged. This may be justified by the fact that Member States are supposed, during the adjustment period, to stick to the agreed net expenditure growth path. However, in order to assess whether that path is adequate to reduce fiscal risks **it would have been preferable to evaluate whether that path guarantees a sufficient debt reduction even under less favourable circumstances than those underlying the baseline also during the adjustment period and not only subsequently**.

- Also in the deterministic scenarios, the magnitude of the shocks is the same for all countries; the alternative, more in line with what the IMF does, would be to consider larger shocks in Member States that, based on past experience, are more exposed to shocks.
- In the interest rate shock scenario a one percentage point shock seems quite low compared to the historical shocks suffered by the EU economy since the inception of the euro.
- The stochastic analysis covers only the post adjustment period even if random shocks are obviously possible also during the adjustment period, thus adding to the uncertainty about future debt developments. This feature follows directly from the wording of Article 10, but its inclusion in the legislation is unlikely to have happened without the support of the Commission.
- Random shocks are generated in a way that differs significantly from the one followed by the IMF and some feature (lack of autocorrelation of the shocks, elimination of outliers) are likely to lead to an underestimation of the fan width and, hence, of the required adjustment in the baseline.
- The choice of the period over which the variance-covariance matrix of the shocks was computed is not clearly justified.
- In the stochastic DSA the term "sufficiently high probability" is interpreted as a probability of 70%. While this is in line with the probability threshold used in the past by the Commission in the fiscal risk analysis included in past Debt Sustainability Monitors, it is not clear how the results would change for different thresholds. However, the main problem is that in the fiscal risk analysis the threshold is much lower (40%) for Member States with a debt ratio lower than 90%, while in the stochastic DSA the 70% threshold is used for all Member States that need to undergo this assessment.

The fact that the features of the Commission's DSA differ from those used by other institutions (like the IMF) does not necessarily mean that are inappropriate. However, in general, it would have been preferable to clarify why certain options were followed and to publish an analysis of the sensitivity of the DSA results with respect to certain methodological options. It would also have been useful to publish information on the shape of the distribution of debt ratios at the end of the five years period covered by the stochastic DSA, given its importance in determining the required decline in the debt ratio.

Regarding the issue of replicability and, hence, predictability of the results, one premise is in order. The Commission's DSA require a huge input in terms of human resources. While institutions, like central banks and ministries of finance, as well as large think tanks, would have the resources needed to replicate the exercise, at least in principle, hardly any other observers would be in the same position. From this point of view, the approach is definitely less replicable and predictable in his results (and ultimately less transparent) than the previous approach, which was complicated in some details but easy to understand and replicate. To alleviate this problem (and even so only very partially) the Commission should make available to anybody interested the Python program used to run the DSA as well as some intermediate inputs such that the historical shocks and the country-specific variance-covariance matrix.

This said, the Commission's documents are in many aspects very clear, for example on the data sources and many methodological aspects, including the calculation of the variance-covariance matrix. However, some aspects could have been better clarified in the published material on the methodology. In particular:

- It would have been preferable to clarify, although it is the standard assumption by most observers and as it has been confirmed privately by Commission staff, that in the deterministic scenarios public debt needs to decline monotonically.
- It is not fully clear how some missing data were replaced.
- It is not fully clear whether the 0.75 multiplier is an instant multiplier and, if so, why a more realistic approach involving some delayed impact was not preferred.
- The lagged effect of interest rate shocks is hard to calculate and some "rule of thumb" could perhaps have been provided.
- It is not clear the extent to which various shocks interact in the simulations. It would be strange if they did not, but whether they do and the extent of any interaction is not clarified.
- It is not fully clear how the increase in the risk premium in the presence of interest rate shocks is calculated.

4. CONCLUDING REMARKS

DSA is definitely not a science. No methodology can be regarded as standard and various institution follow different paths. The Commission's DSA in most respects can be regarded as entirely acceptable, although some aspects could be improved, as detailed in Section 3. More attention could have been given to the autocorrelation that, in real life, random shocks to the key drivers of the public debt ratio typical show. The exclusion of outliers in the calculation of the variance-covariance matrix is also debatable. In both cases, the result is to reduce the volatility of debt ratios at the end of the five-year stochastic scenarios, in this way lowering the required decline in the debt ratio that Member States need to target in the baseline. Moreover, in many areas the Commission could have explained better the impact of alternative methodological choices and could have presented some sensitivity analysis to better illustrate the impact of those choices. This includes, for example, the interpretation of the reference to "medium term" as a period of time that would cover as long as seventeen years after the latest actual data. As to transparency, replicability and predictability (see also for this Section 3 for more detailed comments), the main hurdle is that the complexity of the methodology followed by the Commission makes reproducing the Commission's results virtually impossible in practice without a major input in terms of resources.

More generally, the paper has shown that the Commission's methodology reflects ad hoc procedures for which arbitrary decisions had to be made and that may affect in a critical way the results that are obtained in terms of required fiscal adjustment by Member States. This is not a critique of the methodology itself or of the methodological choices made by the Commission. Rather it is an inevitable consequence of having opted for an economic governance framework based on a non-observable and difficult to estimate variable, namely the volatility of the path of the debt-to-GDP ratio following the end of four-to-seven- year adjustment period. This decision was contrary to one of the stated goals of the economic governance reform, namely to reduce the reliance on non-observable variables.

In these circumstances, as a minimum, it would be useful to work further in assessing the implications of the specific features of the DSA methodology in determining the required reduction of the debt ratio in the post-adjustment period and hence on the required level of the primary surplus to be reached at the end of that period.

The paper also highlights the radical change of the new governance framework with respect to the past, especially in terms of the relationship between the required reduction of the debt ratio in the post-adjustment period and the initial level of the debt ratio. This change could have been better highlighted by the Commission to enhance the transparency of the new approach when it put forward the proposal of making the stochastic DSA a key pillar of the new fiscal framework in its November 2022 Communication (see European Commission, 2022, especially Box 1). In practice, the pre-reform framework required an annual decline in the debt-to-GDP ratio that was proportional to the initial debt level. Instead, the new framework requires that, assuming the normality of the distribution of debt ratios at the end of the five-year post adjustment period, the debt ratio declines annually by one tenth of the estimated standard deviation of the distribution of debt ratio derived from 10,000 stochastic simulations of the debt ratio path. The initial debt level is (almost) irrelevant in determining the magnitude of the required debt decline. Thus, Member States with an estimated low volatility of debt ratio may be required to target only a small reduction in their debt ratio, even if their debt level is high.

As to the deterministic components of the new DSA framework, the debt ratio is required to decline in the baseline, but Member States may comply with this requirement even with a small reduction in the debt ratio that would maintain its level very high. The only component of the DSA framework that would require a decline that is not minimal (for countries with an estimated low volatility of the debt

ratio) comes from the deterministic shocked scenarios. The requirement that debt declines not only in the baseline but also under the three deterministic shocked scenarios imply that a minimum decline in the debt ratio in the baseline would not be sufficient. However, as in the Commission's methodology the shocks to the baseline are (almost) the same for all Member States, even in the deterministic component of the DSA the initial debt ratio is not very relevant in determining the required decline in the ratio itself.

One can debate whether moving to a framework in which the initial level of the debt ratio is de-emphasised is preferable to the old rule in which debt was required to fall faster for Member States with a higher initial debt ratio. On the one hand, one may argue that maintaining for a long time a debt ratio at high level does not involve risks for a country with a stable debt ratio because meeting the government's intertemporal budget constraint just requires the stability of debt ratios, regardless of its level (see, for example, Bartolini and Cottarelli, 1994). On the other hand, one may argue that as long as the ratio remains high a country is exposed to shocks and that the absence of those shocks in the past does not mean that they will not occur in the future. Therefore, it would be appropriate to lower a high debt ratio regardless of past low volatility. Indeed, the urgency of lowering the ratio would be higher, the higher is the initially debt level as shocks would be amplified by a larger debt ratio. In any case, the fact that the initial level of the debt ratio was largely de-emphasised in determining the magnitude of the planned decline was not brought to the fore in the discussion leading to the reform.

Be this as it may, the stochastic DSA component of the new approach, in determining the targeted decline in the debt ratio, relies entirely on a variable that is not observable (the standard deviation of the debt distribution) and whose calculation is highly depended on a number of ad hoc assumptions relating to the stochastic DSA methodology. This is at odds with one of the stated goals of the reform, namely reducing the reliance on non-observable variables. Moreover, one can hardly expect that high-level policy makers fully understand the intricacies of stochastic DSA. Indeed, one can doubt whether even high-level officials are full aware of the implications of the Commission's stochastic DSA methodology and, specifically of the fact that (under the assumption of normality of the distribution) the required decline in the debt ratio is one tenth of the estimated standard deviation of the debt ratio distribution, as shown above.

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This paper argues that the debt sustainability methodology in the EU new economic governance framework, while analytically sound, faces major implementation challenges. Primary among these is the reliance on a non-observable variable (the volatility of future debt-to-GDP ratios) that must be estimated based on ad hoc procedures that may affect significantly the required decline in the debt ratio after the end of the adjustment period and, hence, the primary surplus that a Member State needs to achieve during the adjustment period.

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